The economic impact of the HIV/AIDS epidemic on health services and evaluation of potential response strategies: a case study of Hlabisa District, KwaZulu-Natal, South Africa

Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor of Philosophy by

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ABSTRACT

A large body of research concerned with HIV and AIDS has emerged in the last 2 decades, covering an enormous range of topics. However, one area that has received limited attention in South Africa – especially in rural areas - is the economic impact of the epidemic on health services, and identification of affordable and cost-effective ways in which health services can respond to this impact. This is despite the fact that through predominantly affecting young adults who would normally make comparatively low use of health services, the epidemic is likely to increase demand for care; and despite the fact that coping with the epidemic is likely to require more efficient approaches to care delivery, given the generally stagnating or decreasing resources available in the health sector.

The research reported in this thesis therefore had 2 main aims. First, to assess the economic impact of the HIV/AIDS epidemic on health services in rural South Africa. Second, to evaluate or appraise strategies to respond to this from an economic perspective. It is based on a detailed case study of Hlabisa District in KwaZulu-Natal, one of the worst affected parts of the country.

3 distinct but inter-related studies of the economic impact of HIV/AIDS were undertaken. The first focused on changes in demand for hospital care for the period 1991 (when the epidemic first began to emerge) to 1998 (when it had become well established), and an assessment of the extent to which these were related to HIV and AIDS. The second concerned a detailed analysis, based on retrospective data, of the costs of HIV-related morbidity between 1991 and 1998/9, an assessment of supply-side responses to the impact of HIV/AIDS, and trends in the cost-effectiveness of care. The third was a particularly comprehensive assessment of the impact of HIV and AIDS in 1998, being based on specially designed prospective data collection rather than retrospective data, and covering both hospital and clinic services. 2 studies of economically viable ways of responding to the epidemic were conducted. The first was an economic evaluation of the innovative "Hlabisa model" of community-based tuberculosis treatment. The second was an appraisal of alternative antiretroviral therapy interventions to prevent mother to child HIV transmission.

In terms of economic impact, the key results suggest that HIV-related tuberculosis is likely to be the single most important economic impact on health services; that tuberculosis and adult medical services will be seriously affected, and that the impact will be significant in the context of hospital services as a whole. In terms of response strategies, the results indicate that community-based approaches to tuberculosis care have the potential to substantially mitigate the impact of HIV-related tuberculosis on health services, reduce the costs incurred by patients in accessing care, and are comparatively cost-effective and feasible to implement within existing resource constraints. Some antiretroviral interventions for the prevention of mother-child HIV transmission appear affordable and cost-effective. More research is now required to confirm the truth of these conclusions and/or to give greater precision to their generalisabilty; and, more importantly, to further inform health systems' response to the epidemic.

PUBLICATIONS ARISING FROM THE RESEARCH INCLUDED IN THE THESIS

Peer-reviewed journals

1. Floyd K, Wilkinson D, Gilks CF "Comparison of cost-effectiveness of directly observed treatment (DOT) and conventionally delivered treatment for tuberculosis: experience from rural South Africa". 1997. BMJ. Vol. 315:1407-11

2. Floyd K, Reid RA, Wilkinson D and Gilks CF "Admission trends in a rural South African hospital during the early years of the HIV epidemic". 1999. JAMA. Vol. 282(11):1087-91

3. Wilkinson D, Floyd K and Gilks CF "Costs and cost-effectiveness of alternative tuberculosis management strategies in South Africa – implications for policy". 1997. South African Medical Journal. Vol. 87(4):451-5

4. Wilkinson D, Floyd K and Gilks CF "Antiretroviral drugs as a public health intervention for pregnant HIV-infected women in rural South Africa: an issue of cost-effectiveness and capacity". 1998. AIDS. Vol. 12:1675-82

5. Wilkinson D, Floyd K and Gilks CF "National and provincial estimates of the cost and cost-effectiveness of antiretroviral therapy for prevention of maternal to child HIV transmission". 2000. South African Medical Journal (in press)

Reports

Floyd K, Wilkinson D and Gilks CF "Community based, directly observed therapy for tuberculosis: an economic analysis". February 1997. South African Medical Research Council, Corporate Communications Division, Tygerberg, Cape Town

Wilkinson D, Floyd K and Gilks CF "A national programme to reduce mother-child transmission is potentially cost-saving in South Africa". April 1999. South African Medical Research Council, Corporate Communications Division, Tygerberg, Cape Town

Abstracts/presentations at international conferences

Floyd K, Reid RA, Wilkinson D and Gilks CF "The impact of the HIV/AIDS epidemic on demand for hospital care in rural South Africa". Abstract presented at XIIth International AIDS conference in Geneva, Switzerland, June 29th-July 3rd 1998

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CHAPTER 1: Introduction

The epidemic of Human Immuno-deficiency Virus (HIV) and Acquired Immuno-Deficiency Syndrome (AIDS) was first recognised in the United States in the early 1980s, where it was associated with the gay community in San Francisco and New York. Young male adults were presenting, and dying, at clinics and hospitals with health problems that were either previously rare or virtually non-existent in their age group. The most common initial presentation was pneumonia, but others included Kaposi's Sarcoma (a rare cancer), wasting, cytomegalovirus disease, tuberculosis, chronic diarrhoea, oral candida and neurological diseases. Initially, the underlying cause and mode of transmission was not known; but in 1983/4 HIV was discovered[1]; and it is now well-established that the virus is usually sexually transmitted. Other modes of transmission include transfusion with infected blood, and mother-child infection during pregnancy or in the first few months of life through breast-feeding. The mechanism through which HIV causes ill-health and later death is also now well-defined. The virus causes a progressive weakening of the immune system, eventually making individuals at highly increased risk of contracting diseases that they would normally resist. Without recently available and expensive combination anti-retroviral treatments, the natural history of infection consists of an asymptomatic phase that lasts several years, a period of symptomatic disease, and development of AIDS, which typically ends in death after between one and two years.

The epidemic is now a global phenomenon that dwarfs the initial USA epidemic among one particular risk group. Most cases are among heterosexual adults, and there are also a substantial number of children who have been infected by their mothers. At the end of 1999, UNAIDS estimated that, world-wide, the total number of people living with HIV or AIDS was 33.6 million (UNAIDS, 1999). Regional totals were 23.3 million in Sub-Saharan Africa, 6.0 million in South and South-East Asia, 1.3 million in Latin America, 920 000 in North America, 530 000 in East Asia and the Pacific, 520 000 in Western Europe, 360 000 in the Caribbean, 360 000 in Eastern Europe and Central Asia, 220 000 in North Africa and the Middle East, and 12 000 in Australia and New Zealand.

Though absolute figures are high everywhere, their importance in the context of total population levels varies considerably. The percentage of adults infected is lowest in Eastern Asia and the Pacific, and Eastern Europe and Central Asia, where figures range from almost negligible levels to 0.4%. In the Caribbean, figures range from 0.02% for Cuba to 5.2% in Haiti; and in Latin America, they vary from 0.07% for Bolivia to 2.1% in Guyana. In most countries of South and South East Asia, the proportion of the population infected is much less than 1%, though in Cambodia, Thailand and Myanmar the figure reaches 2.4%, 2.2% and 1.8% respectively. In Western Europe, North America, North Africa and the Middle East, and Australasia, the proportion of adults infected is less than

[1] Opinion on the year of discovery varies – the French view is 1983, the USA view 1984

0.5% in every country except Sudan (1%), the USA (0.8%), Portugal (0.7%) and Spain (0.6%).

Sub-Saharan Africa is the region most severely affected by the epidemic, by a substantial margin. The worst-affected countries are Zimbabwe (25.9%), Botswana (25.1%), Namibia (19.9%), Zambia (19.1%), Swaziland (18.5%), Malawi (14.9%), Mozambique (14.2%), South Africa (12.9%), Rwanda (12.8%), Kenya (11.6%), Côte D'Ivoire (10.1%), Uganda (9.5%) and Tanzania (9.4%). Only Comoros, Mauritania, Madagascar, Mauritius, Réunion and Somalia have a prevalence of less than 1%.

Though numbers are important for illustrating the scale of the epidemic, other diseases also affect large numbers of people. There are an estimated 110 million cases of malaria per year, for example (Ainsworth and Over, 1994); and the number of deaths from heart disease or cancer is far in excess of those from AIDS in developed countries. However, HIV/AIDS is unusual in four important ways. First, it primarily affects young adults who would normally be expected to be among the most healthy members of the population. This is in contrast to most major diseases that usually affect young children or the elderly. The number of healthy years of life lost per case is exceeded only by sickle cell anaemia, neonatal tetanus, birth injury and severe malnutrition (Over et al, 1988). Second, it is affecting a very large proportion – over 20% - of this young age group in some developing countries, thus causing an important addition to the existing burden of ill-health and death. In Sub-Saharan Africa, surveys have found that more than 50% of adult medical admissions, and as many as 80% of tuberculosis patients, may be HIV+. It has also been estimated that HIV/AIDS will account for 3% of disability-adjusted lost years (DALYs) in developing countries by 2020, up from 0.8% in 1990; and 13.6% of all deaths from infectious diseases (Murray and Lopez, 1996). In some parts of Africa it is reported to be the leading cause of adult deaths (Nunn et al, 1997; Borgdorff et al, 1995; De Cock et al, 1990). Third, there is as yet no known cure; almost everyone who is infected is likely to die from the infection. Although recent advances in treatment are prolonging life for those individuals who live in countries where combination antiretroviral drug therapies that cost up to US$20 000 per year are affordable, and for a limited number of people in poor countries who are able to pay for such treatments themselves, the vast majority of people in developing countries can be expected to die within 10-15 years of acquiring HIV infection. Fourth, those affected are typically the most economically productive age group that would be expected to support other members of their family, such as elderly parents and children. If the years of potential life lost due to a case of HIV/AIDS are weighted by the productivity of the years lost, HIV/AIDS ranks highest among all diseases in terms of the potential benefits of preventing a case (Over and Piot, 1993). These four factors mean that HIVAIDS is a disease with particularly serious social, cultural and economic ramifications.

Given the global scale of the epidemic, the rapidity with which it has spread, and its serious consequences for both individuals and their families,

it is not surprising that HIV/AIDS has been the subject of a substantial amount of research over the past two decades. A search on HIV in the Medline database in May 1999 generated 78 068 references (for comparison "malaria" resulted in 23 520). This research covers a range of disciplinary areas, including basic scientific research, clinical research, epidemiology, and the social, economic, political and cultural aspects of the epidemic. The variety of topics is vast: the first day of the most recent "World AIDS Conference" in Geneva in 1998 included presentations on the regulation of HIV replication; the role of chemokines and receptors in HIV infection; cytomegalovirus and Hepatitis C virus; issues in the clinical management of antiretroviral therapy; risks and community response among gay men; mother to child transmission; prevention programmes for youth; end of life issues; care in resource limited settings; opportunistic infections; access to STD diagnosis and treatment; socio-cultural and behavioural determinants of HIV transmission; immune reconstitution following antiretroviral therapy; early events in the HIV cycle; clinical trials; human rights and public health; counselling and testing; the politics behind AIDS policies; HIV and religion; and vaccine basics.

Despite the quantity of research already undertaken, several important issues have yet to be addressed, resolved, or have been given only limited attention. For example, basic research has yet to discover an effective vaccine; on-going clinical research is needed to determine the long-term consequences of anti-retroviral therapy, the optimum combinations and doses of anti-retroviral drugs, and when treatment should be initiated; there is still limited evidence concerning what are the most effective and cost-effective strategies for preventing new infections in the absence of a vaccine; the down-stream impact on health systems as growing numbers of people require care for HIV-related disease, and identification of viable ways to cope with this impact, has received little attention in developing countries; and studies are required to establish whether recent prevention successes such as the substantial reduction in mother-child transmission achieved by short-course drug treatments in clinical trials can be replicated in operational settings in developing countries.

The impact of the HIV/AIDS epidemic on health services in developing countries is one important area where knowledge is notably limited. This is despite the fact that HIV/AIDS is affecting large numbers of normally health adults, that this additional burden of disease is likely to have major ramifications for the health sector, and that studies of this impact could be used to inform the development and implementation of coping strategies. Moreover, with health sector resources severely constrained in many settings – budgets are stagnating or being cut in many places - there is a clear role for economic research to help identify affordable and cost-effective ways in which health services can deliver care.

This thesis is concerned with the economic impact of the HIV/AIDS epidemic on the health sector in rural South Africa, and with evaluation of possible strategies for responding to this impact. South Africa was chosen for two main reasons. First, it is experiencing one of the newest but also

most severe and rapidly emerging epidemics to date. A retrospective analysis of stored blood sera found no evidence of HIV infection among antenatal clinic attendees in KwaZulu-Natal province in 1985 (Abdool Karim, 1997): this is now one of the worst affected areas of the country, with approximately 30% of this same population group infected in 1998 (South African Department of Health, 1998). The country currently ranks second only to India in terms of number of cases, and already has the eighth highest adult HIV seroprevalence in Africa. Second, few studies have been done in the country on either the consequences of the HIV/AIDS epidemic for health systems, or on economically viable ways in which these can be managed in the context of a struggling economy, health services that are already operating at capacity in many places, and cutbacks in health service budgets.

The research was undertaken in the Hlabisa District of KwaZulu-Natal Province, a part of the country where the HIV/AIDS epidemic is already relatively advanced. It consisted of a series of separate but linked and complementary studies, three focused on the impact of HIV on the district health system and two on the evaluation of potential ways of responding to this impact. Taken together, they represent a case study of the impact of the HIV epidemic on a typical rural health district in South Africa, and of strategies that may help to at least mitigate this.

The thesis is structured in six major parts with ten major chapters, with each chapter designed to build on previous one(s) but also to be self-contained. They are:

- **overall background**, which provides an overview of the social, economic, demographic and political context of South Africa, explains the basic scientific, epidemiological and clinical aspects of the HIV/AIDS epidemic, and describes the HIV/AIDS epidemic and health service provision in South Africa (Chapter 2);
- **a literature review of economic research on the HIV/AIDS epidemic**, which explains the methods used to review existing literature, reviews this literature according to twenty main topic areas, and discusses where there are important gaps and/or limitations. It concludes by summarising how the research undertaken in Hlabisa addressed some of these gaps and limitations, and therefore why it represents an original contribution to knowledge (Chapter 3);
- **an overview of the research goal, objectives and methodology**, which defines and explains the overall goal and objectives, describes the study site of Hlabisa District and the province of which it is a part, and discusses over-arching methodological issues relevant to all studies or to at least two of them (Chapter 4). Particular attention is given to constraints that affected how objectives were defined, the extent to which Hlabisa is a representative district, reliability of retrospective data and the steps taken to ensure reliability in data recording, entry and analysis, and methods used in costing and cost-effectiveness analyses;
- **a series of three chapters concerning the studies of the impact of the HIV/AIDS epidemic on the district health system** (Chapters 5 through 7). The first two are longitudinal studies that relied heavily on

retrospective data. One concerns a general and relatively simple analysis of the impact of HIV/AIDS on demand for in-patient hospital care 1991-8. The second builds on this study by providing a detailed assessment of the economic impact of HIV-related disease on the district hospital between 1991 and 1998/9. As a longitudinal study, it focuses on the two HIV-related impacts that could be identified from available retrospective data: HIV-attributable tuberculosis admissions, and admissions of patients with AIDS-defining conditions other than tuberculosis. The costs associated with these types of HIV-related morbidity and their importance in the context of medical, tuberculosis and hospital services as a whole are quantified; trends in the efficiency with which care for these types of patient has been provided are documented and linked to supply-side responses; and their impact on quality of care, as measured by bed occupancy rates, is considered. The third study (Chapter 7) is largely concerned with a detailed assessment of the economic impact of HIV/AIDS on the district hospital's adult medical wards in 1998. Prospective data collection made it possible to assess not only the impact of HIV-attributable tuberculosis and AIDS, but also the role of other types of HIV-related morbidity – particularly early HIV-related morbidity which, in the absence of special data collection efforts, is not readily distinguishable from "normal" disease among the HIV-negative population. The study is therefore a particularly comprehensive one, enabling a fuller appreciation of the impact of HIV on health services. Methodologically, it also permits a discussion of the main limitations of retrospective studies. For comparison, Chapter 7 also includes an analysis of the impact of HIV at two government clinics and a private sector clinic in 1998;

- **two chapters concerning economic evaluations of affordable and cost-effective ways in which health systems can respond to the impact of the HIV/AIDS epidemic** (Chapters 8 and 9). The first covers an evaluation of community-based directly observed therapy (DOT) for tuberculosis, comparing this approach with the conventional approach to treatment in Sub-Saharan Africa and with other strategies that are currently widely used in South Africa. This evaluation is particularly relevant given that the World Health Organization is now advocating the "DOTS" strategy, and is increasingly interested in developing policy recommendations in relation to community-based care. The second study concerns an economic appraisal of the provision of antiretroviral treatment to prevent mother to child HIV transmission. In clinical trials, this has been shown to substantially reduce the risk of paediatric HIV infection. It is the major antiretroviral treatment strategy that is being seriously considered in the developing world, especially in middle-income countries such as South Africa. The affordability and cost-effectiveness of the intervention are assessed, and capacity to implement such an intervention within available human and infrastructural resource capacity is considered; and
- **an overall discussion of research results and implications**, including an assessment of where further research is required (Chapter 10).

CHAPTER 2: Overall Background

This chapter is designed to provide important background to the research undertaken in Hlabisa District, KwaZulu-Natal. It is divided into four major sections. The first sets the research in an overall context by describing demographic, socio-cultural, economic and political aspects of present-day South Africa. The second explains basic scientific, clinical and epidemiological aspects of HIV/AIDS. The third describes the HIV/AIDS epidemic in South Africa. The final section provides a general overview of health care provision in South Africa.

Unless otherwise stated, demographic and social data were taken from the "Census brief" of Statistics South Africa, 1998. Economic and health sector data were sourced from the South African Health Reviews of 1995 and 1998 (Health Systems Trust, 1995 and 1998), except for poverty and the geographic description of the country's economic regions. These statistics came from "Health Expenditure and Finance in South Africa" (Health Systems Trust and the World Bank, 1995), as did some of the background concerning politics in the country.

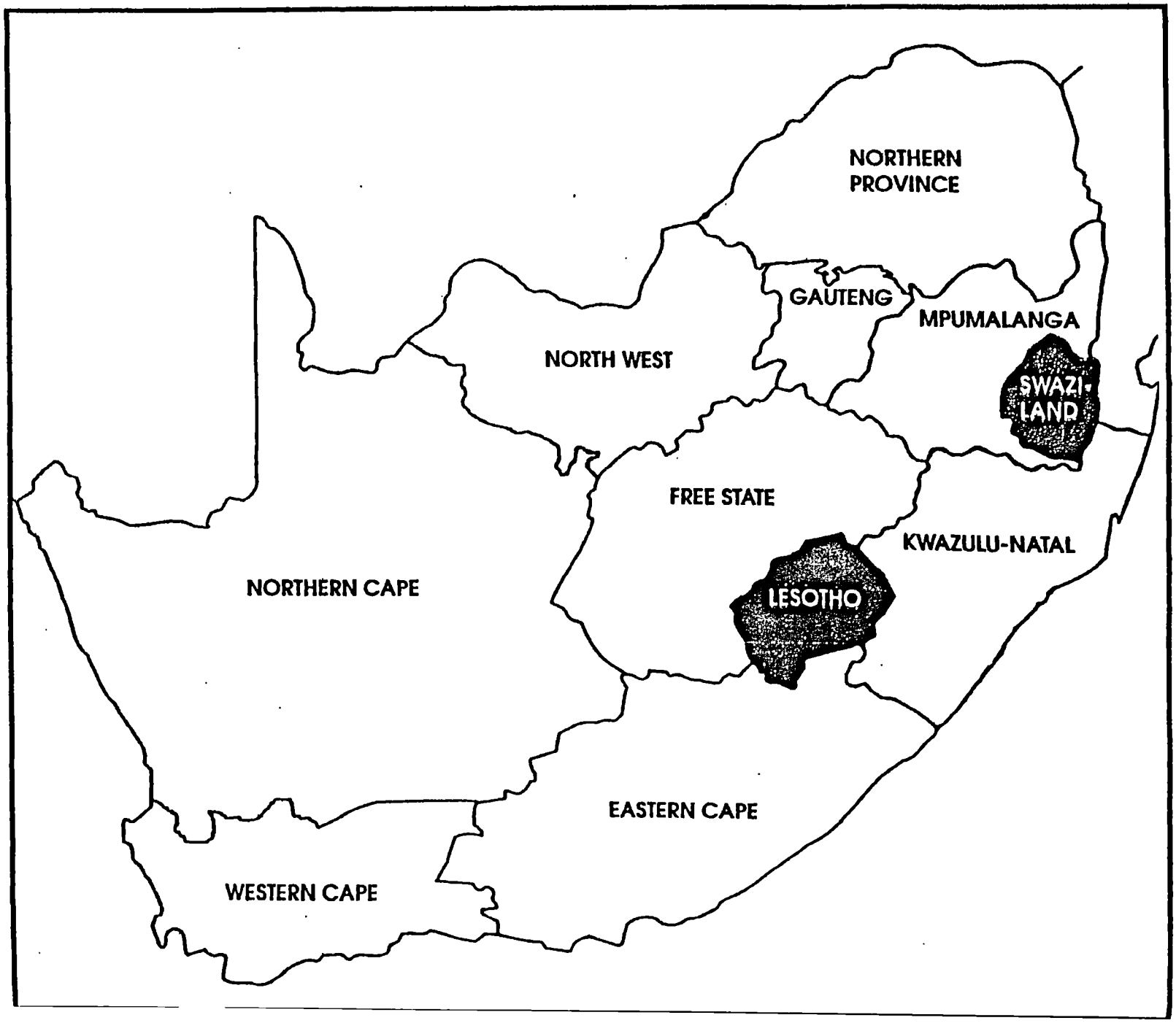
General epidemiological data were drawn from a 1998 UNAIDS report on the global status of the epidemic (UNAIDS, 1998), a 1996 UK Department for International Development (DFID) Occasional Paper (Nicoll et al, 1996), and a recent World Bank publication (Over and Ainsworth, 1997). The same publications, plus a 1998 DFID Occasional Paper (Gilks et al, 1998), were used for a description of the basic scientific and clinical aspects of the epidemic. The description of the HIV/AIDS epidemic in South Africa is based on a recent overview (Abdool-Karim et al, 1999) and the South African Health Review of 1995.

2.1 Overall demographic, social, economic and political context

2.1.1 Demography

South Africa is a large country with a population of 40.6 million people in 1996. It has a relatively low population density of 33 per square kilometre (compared with over 200 for the UK). The population growth rate averaged 2.1% 1960-94 (UNDP, 1997). The growth rate varies by racial group: 2.5% for Africans, 1.5% for the Coloured and Indian populations, and 0.7% for Whites. In 1996, 77% of the population was African, 9% Coloured, 3% Indian and 11% White.

The distribution of the population varies by race (Table 2.1; see map for the location of each province). The African population dominates in each province except the Western and Northern Cape, where the Coloured population is in the majority. Elsewhere, the Coloured population constitutes only a tiny fraction of the total population. The Indian population is also extremely concentrated, this time in KwaZulu-Natal. Here, it accounts for 9% of the population. In relative terms, the Indian


NORTHERN PROVINCE
GAUTENG
MPUMALANGA
NORTH WEST
SWAZI-LAND
FREE STATE
KWAZULU-NATAL
NORTHERN CAPE
LESOTHO
EASTERN CAPE
WESTERN CAPE

population is small compared to other groups in all parts of the country. The White population is in a minority throughout South Africa, but is comparatively large in both the Western Cape and Gauteng.

Table 2.1 Distribution of South Africa's population, by Racial Group

Province	% African	% Coloured	% Indian	% White
Western Cape	21	54	1	21
Eastern Cape	87	7	0.3	5
Northern Cape	33	52	0.3	13
Free State	84	3	0.1	12
KwaZulu-Natal	82	1	9	7
Northwest	91	1	0.3	7
Gauteng	70	4	2	23
Mpumalanga	89	0.5	0.5	9
Northern Province	97	0.1	0.1	2

Overall, almost 50% of the population is urbanised. Again, this varies by province (Table 2.2). Almost everyone lives in an urban area in Gauteng,

Table 2.2: Distribution, density and urbanization of population by Province, 1996

Province	% total population	Population density	% urbanised
Western Cape	9	28	89
Eastern Cape	16	38	37
Northern Cape	2	2	70
Free State	7	21	69
KwaZulu-Natal	21	92	43
Northwest	8	28	35
Gauteng	17	365	97
Mpumalanga	7	37	39
Northern Province	12	42	11
SOUTH AFRICA	100	33	54

and population density is very high. The Western Cape is also highly urbanised, although here population density is low. The provinces where most people still live in rural areas are KwaZulu-Natal (which also has the largest single share of total population), Eastern Cape, Northwest, Northern and Mpumalanga provinces. A large part of these areas were "homelands" – areas designated for Africans only - prior to 1994.

2.1.2 Socio-cultural aspects of life in South Africa

The social and cultural landscape of South Africa is diverse. There are twelve main languages, and a mix of Western, African and Indian culture. Overall, Zulu is the most widely spoken first language (23% of total population), followed by Xhosa (18%), Afrikaans (14%), Sepedi (9%) and English (9%). English is the language of government.

White population

The White population maintains a Western lifestyle and is the most materially privileged group in the country. The leading religion is Christianity, and the nuclear family is the main social unit. Afrikaans (a variant of Dutch) and English are the major languages. They are spoken by 59% and 39% of the population respectively, with English dominating only in KwaZulu-Natal. This is a legacy of the fact that the population of British origin became concentrated in the former White province of Natal.

Coloured population

Afrikaans is the first language of the vast majority (82%) of the Coloured population. Only 16% speak English as their first language. The population is otherwise difficult to characterise. A minority were relatively priveleged compared to the African population during the Apartheid years, with better access to education and well-paid employment. As a consequence, some people enjoy a lifestyle similar to that of Whites, at least in Cape Town; and the nuclear family may be the focus of social life. The dominant religion is also Christianity. A large proportion of the population is, however, very poor. Many people live in a low level of housing, and have unstable social networks and household units. At their worst, homes consist only of shacks on the Cape Flats outside Cape Town. Crime, alcoholism, poverty, drug abuse, migration, and high unemployment are important social issues in these areas.

Indian population

The Indian population retains some of the culture characteristic of the Indian sub-continent. For example, Hinduism is the main religion, the extended family network is important, and arranged marriages still occur. Nevertheless, the caste system appears to have broken down, and English is the first language of the vast majority – 94% - of the population. As for the Coloured population, this racial group was relatively favoured compared to Africans during the apartheid regime. There is strong participation in the business and industrial sectors, and income and education levels are comparatively high.

African population

Until recently, Africans suffered substantial discrimination. Educational provision was poor, access to good jobs virtually non-existent, and basic services such as water, electricity, sanitation and health care of much lower standard than for other South Africans. Restrictions on population movement – designed to preserve racial segregation as far as possible - also meant that many people were forced to work many hundreds and sometimes thousands of miles from their families. This was true for both men and women – with women typically working as domestic servants, and men in unskilled manual industrial jobs. This migrant labour system has been associated with multiple and often casual sexual partnerships, with

typically one or more wives (depending on wealth and status) in the rural home, and a second household (with a "town wife") or frequent use of commercial sex workers in towns and cities. Relationships were therefore higher in number and more unstable than those in other population groups. Although explicit and legislated–for discrimination no longer exists and affirmative action favouring Africans and women specifically has been introduced, it will take many years to substantially mitigate the legacy of the Apartheid years.

Zulu and Xhosa are the two most important languages (29% and 23% respectively of the total African population); others spoken by more than 10% of the population include Sepedi (12%), Setswana (11%) and Sesotho (10%). Depending on location, either English or Afrikaans are typically spoken as well.

General education levels

The general level of education varies by both Province and racial group (Tables 2.3 and 2.4). KwaZulu-Natal is broadly typical of South Africa,

Table 2.3: Educational attainment among those aged over 20 by province, 1996

Province	% with no education	% with primary education	% with secondary education	% with tertiary education
Western Cape	7	25	58	11
Eastern Cape	21	30	44	5
Northern Cape	22	30	43	6
Free State	16	31	47	5
KwaZulu-Natal	23	25	48	5
Mpumalanga	29	22	44	5
Northern Province	37	18	41	5
Gauteng	10	18	64	8
Northwest	23	58	16	4
SOUTH AFRICA	19	24	50	6

**numbers do not always sum to 100 due to rounding*

Table 2.4: Level of education among those aged over 20, by population group, 1996

Population group	% with no education	% with primary education	% with secondary education	% with tertiary education
African	24	28	45	3
Coloured	10	31	55	4
Indian	7	13	70	10
White	1	1	74	24

while Gauteng and the Western Cape have notably low rates of no education and high rates of tertiary education. The African population has

the lowest level of education. 24% of those over 20 have no education, compared with figures of 10%, 7% and 1% of the Coloured, Indian and White populations respectively. The White population is the most highly educated - 98% have secondary or tertiary education - followed by the Indian and Coloured population with figures of 80% and 59% respectively.

Other issues

Overall, there is one key social issue in South Africa that affects all population groups, and which is of concern to them all: crime. The country has one of the highest crime rates in the world, particularly for serious crimes such as homicides, car hijackings, and violent assaults including rape. Moreover, the situation is deteriorating in many areas, and is spreading to places that until recently were relatively unaffected.

2.1.3 The Economy

South Africa has the largest economy of any country in sub-Saharan Africa. It is perceived to be a key influence on economic development in Southern Africa as a whole – offering a source of technical expertise and goods and services not produced elsewhere, and a large market for imports. Services account for 54% of GDP, manufacturing and construction for 32%, and agriculture and mining for 14%. Per capita income was US$2 900 in 1998, which classifies South Africa as a middle-income country. Only Botswana and Gabon have higher average levels of wealth in Africa. However, relatively favourable indicators for average levels of wealth conceal important geographic variation, extreme income inequality, high levels of unemployment and poverty, social dislocation associated with employment-necessitated migration, the fact that economic growth lags behind population growth, and major weakening of the currency in the 1990s (see below).

Main economic regions

Geographically, the country has three key economic regions. These have been termed the "economic core", the "inner periphery", and the "outer periphery".

The economic core consists of Pretoria-Witwatersrand-Vereeninging, Durban-Inanda-Pinetown, the Cape Pensisula, Port Elizabeth-Uitenhage, and the metropolitan areas of East London, Pietermaritzburg, Bloemfontein and the Free State goldfields. 35% of the population live in these regions, including over 60% of the White population, over 50% of the Coloured population, and over 80% of the Asian population. Less than 25% of the total African population lives in this region – though since the abolition of influx-control legislation in 1986, numbers are increasing rapidly and over 50% of the "core" population is now accounted for by this group.

The inner periphery consists of areas previously allocated to the White, Asian and Coloured populations under the apartheid "Group Areas" policy.

It is organised into towns and commercial farms, and over 50% of people in these areas work as agricultural labourers. Provision of public services to the African population has historically been very poor.

The outer periphery is made up of the regions that used to be "homelands" – either independent (at least officially) states or self-governing territories. Until recently, these were inhabited exclusively by Africans, and in 1991 were where over 60% of the African population lived. The main economic activity in these areas is subsistence agriculture. Since many men migrate to other areas for paid employment, there are disproportionate numbers of women and children.

Income distribution

The 1996 census data show that the most favoured provinces in terms of average incomes, the proportion of people earning less than R500 per month (US$116 at the mid-1996 exchange rate of US$1=R4.3), and unemployment are the Western Cape and Gauteng (Table 2.5). Figures for other provinces were quite variable: between 28-42% earned less than R500/month, and the unemployment rate varied from 18 to 49%. KwaZulu-Natal was broadly typical of South Africa as a whole.

The census also revealed marked inequality among population groups and between men and women (Table 2.6). A substantial proportion of African men and almost 50% of African women earned less than R500 per month. Figures were smaller for other groups. Meanwhile, a large percentage (65%) of White men earned more than R 3 500 (US$814) per month, compared with approximately 25% of the Coloured and Indian population. Only 6% of African men and 5% African women earned this level of income.

Recent economic performance

Various indicators of economic performance in the 1990s are shown in Table 2.7.

Economic growth, measured in terms of real GDP per capita, has been less than the population growth rate of 2.1% p.a. in four of the last eight years. It has consistently been less than the 3.5% that some estimates suggest is required to reduce unemployment levels (Table 2.7), and during the period 1985-90 only seven new jobs were created for every 100 new entrants to the labour market. Prospects for increasing job opportunities appear poor at present: some traditionally important industries such as gold are declining globally, and foreign investor confidence in the country – partly at least due to the high and rising level of crime – is not high. In 1996, half of African women and one third of African men were unemployed in 1996 (Table 2.5). Figures were lower – though still high – among the Indian and Coloured populations. Low unemployment rates are only found among the White population, where they were 5% and 4% for men and women respectively in 1996. By 2005, the International Labour Organisation

Table 2.5: Income distribution and unemployment rates by province (ranking)

Province	Average income in 1994 (US$)*	% employed people earning <R500/month, 1996	Unemployment rate (% population aged 15-65)
Western Cape	4 188 (2)	18 (8)	18 (9)
Eastern Cape	1 358 (8)	32 (5)	49 (1)
Northern Cape	2 865 (3)	42 (1)	29 (7)
Free State	2 419 (4)	38 (3)	30 (5)
KwaZulu-Natal	1 910 (6)	28 (7)	39 (3)
Mpumalanga	2 164 (5)	36 (4)	33 (6)
Northern Province	725 (9)	41 (2)	46 (2)
Gauteng	4 992 (1)	15 (9)	28 (8)
Northwest	1 789 (7)	31 (6)	38 (4)
SOUTH AFRICA	2 566	26	34

*source: Development Bank of South Africa, 1994.

Table 2.6: Income among those employed and unemployment rates, by Population Group and Gender

Economic indicator	African		Coloured		Indian		White	
	Men	Women	Men	Women	Men	Women	Men	Women
Income < 500/month	26	47	19	30	5	9	4	8
Income 501-1 000/month	24	21	20	20	9	16	3	6
Income 1 001-1 500/month	23	13	21	22	18	26	6	10
Income 1 501-3 500/month	20	13	28	22	38	32	23	40
Income >3 500/month	6	5	28	22	30	17	65	35
Unemployment rate	34	52	18	24	11	14	4	5

Table 2.7: Key economic indicators for South Africa, 1991-8

Economic Indicator	1991	1992	1993	1994	1995	1996	1997	1998
GDP growth p.a. (%), at constant prices	-1	-2.2	1.3	2.7	3.4	3.2	1.7	0.5
Inflation p.a. (consumer price index)	15.3	13.9	9.7	9.0	8.6	7.4	8.5	6.9
US$: Rand exchange rate	2.7	3.1	3.4	3.5	3.6	4.7	4.9	5.5
UK£: Rand exchange rate	5.1	4.6	5.0	5.5	5.7	8.0	8.0	9.1
Interest rate paid on government treasury bills (%)	16.7	13.8	11.3	10.9	13.5	15.0	15.3	16.5
Discount rate (%)	17	14	12	13	15	17	16	19
Real interest rate, using treasury bill rate (%)[2]	1.4	-0.1	1.6	1.9	4.9	7.6	6.8	9.6
Real interest rate, using official discount rate (%)[3]	1.7	0.1	2.3	4	6.4	9.6	7.5	12.1

[1] 1991-1997 data from IMF International Financial Statistics Yearbook 1998; 1998 data from G. McCrystal (Reserve Bank of South Africa, written communication)

[2] Calculated as the difference between the interest rate paid on government treasury bills and the inflation rate

[3] Calculated as the difference between the official discount rate and the inflation rate

predicts that more than 50% of the economically active population will be out of work or working in the informal sector.

Internationally, economic difficulties are highlighted by the substantial weakening of the national currency – the Rand – in international markets. In relation to the UK£ and US$, this has approximately halved in value during the 1990s (Table 2.7).

Implications of income distribution and economic performance for poverty and public services

Reflecting income and economic performance indicators, absolute poverty is extensive. Approximately 17 million people (over 40% of the population) and 49% of households lived below the "minimal level of living" in 1994. The figures were 66%, 38%, 18% and 7% for African, Coloured, Indian and White households respectively. In rural areas, 75% of households were living below the poverty line compared with less than one third of urban households.

Regionally, poverty is worst in the Eastern Cape, Northern Province and KwaZulu-Natal. These account for 24%, 18% and 21% respectively of all people living below the poverty line. Northwest, Mpumalanga and Free State provinces account for 9% each, with the lowest figures for Gauteng (6%), Western Cape (4%) and Northern Cape (1%).

Slow economic growth also has important implications for provision of public services. Though government expenditure as a fraction of GDP has tended to rise in recent years, the government has stated that it intends to decrease the size of its deficit relative to GDP. This means that public spending is operating within tight limits – aggravated by currency devaluation that has increased the size of the external debt burden. There is tough competition among the many competing Ministries for funds. In this context, it appears unrealistic to expect much increase in the resources allocated to health services, especially as there is a large backlog of unmet need in many other sectors including education, housing, water and basic sanitation.

Possible impact of HIV/AIDS on the South African economy

It is not clear what impact the HIV epidemic will have on the South African economy. A 1991 modelling exercise for South Africa (Broomberg et al, 1991) suggested that HIV/AIDS would cost the equivalent of 0.3% of GNP in 2000 and 1.5% in 2005 (see also Chapter 3). Though not specifically concerned with South Africa, it has also been suggested that HIV/AIDS may have similar consequences to the Black Death in Europe in the Middle Ages, raising average wages for survivors (Bloom and Mahal, 1997).

The literature on this topic, for South Africa and more broadly, is reviewed in more detail in Chapter 3.

2.1.4 Politics

Until 1994, present-day South Africa was divided along racial lines into four "independent states", six "self-governing territories", and four provinces of "White" South Africa, under the regime of Apartheid (which means "separate development"). In the four White provinces, Africans were completely disenfranchised and their main political movement – the ANC – was banned. The Coloured and Indian population groups were more priveleged but still experienced discrimination. They were given some voting rights and a limited role in government.

Following years of campaigning and varying degrees of external pressure including economic and sporting sanctions, reform began in the late 1980s under President de Klerk. Major landmarks included the un-banning of the ANC, the release from prison of Nelson Mandela, and the promise of free and fair elections, which were held for the first time in 1994. This resulted in the ANC winning a substantial majority – though there were important exceptions (the majority of people in the Cape voted for the National Party of de Klerk). During the first two years of the new five year political term, there was a "Government of National Unity", with Cabinet ministers drawn from a range of parties including the ANC, the National Party and the Inkatha Freedom Party led by Buthelezi (whose stronghold is KwaZulu-Natal). Buthelezi was appointed Minister for Home Affairs and has remained in this role to date. However, the National Party withdrew from the government after two years; it is presently a weak opposition with a limited support base. The second general election in June 1999 returned the ANC to power with a substantial majority and Thabo Mbeki as President.

Since 1994, the national government has been decentralising a considerable amount of power to provincial administrations. These are now largely responsible for health services, education, agriculture, cultural affairs, environment, and housing. Funding remains controlled at national level – related to the fact that some provinces have weak taxation bases. All taxes accrue to the national government, which then transfers funds to provincial governments.

Below provincial level, hundreds of local authorities exist. These have traditionally been responsible for water, sanitation, transport, electricity, promotive and preventive primary health care services, housing and security. Financing came from national government grants and local revenue from property taxes, levies, fees and other taxes. In formerly White areas, these responsibilities were generally well discharged. In other areas provision was typically poor, with contributory factors including a small tax base and rent and tax boycotts against administrations lacking political legitimacy. These authorities have now been consolidated to form approximately 300 from the original total of over 800. Some will rely on locally generated funds; others will receive transfers from provincial and national level.

2.2 Basic scientific, epidemiological and clinical aspects of HIV/AIDS

2.2.1 What is HIV?

HIV is classified as a lentivirus, reflecting its ability to cause persistent infection and slowly progressive disease (Barre-Sinoussi, 1996). There are two main types of HIV: HIV-1 and HIV-2. HIV-1 is more virulent and more easily transmitted. Within each type, there are also several sub-types or "clades".

2.2.2 How HIV affects the immune system

Once introduced into the human body, HIV infects cells with CD4 molecules. CD4 cells play a key role in the immune system: they organise a person's overall immune response by secreting chemicals to help other immune cells work properly.

When first infected with HIV, an individual's CD4 count drops dramatically. This lasts until the body's immune system gains a degree of control over viral replication and the CD4 cell count rebounds – usually after about three weeks (though never to the pre-infection level). Also at this point, antibodies become detectable in the bloodstream. Since the most widely used HIV tests rely on detection of antibodies, it is only after approximately 3 weeks that it is possible to detect whether or not someone is infected.

After the initial phase of acute infection, HIV destroys large numbers of CD4 cells every day, most but not all of which are replaced as the bone marrow compensates by speeding up the production of new cells. As a result, the CD4 cell count, which is usually 800-1000 per cubic millimetre of blood in an uninfected person, gradually drops. This occurs at a rate of approximately 50-70 cells each year until the absolute level reaches 200, with individuals becoming progressively more prone to mild and then moderate disease. After the level of 200 is reached, people become extremely vulnerable to serious and life-threatening diseases.

CD4 counts, along with viral load measurements, are often used as a marker of immune status and disease stage, especially in developed countries where sophisticated laboratory facilities permit their regular measurement.

2.2.3 Disease progression following HIV infection

For those who are known to be HIV infected, WHO has developed 2 "staging systems" (Weekly Epidemiological Record, WHO, 1990). As the name suggests, these can be used to indicate what stage of HIV infection and disease an individual has reached, ranging from being infected but asymptomatic to having full-blown AIDS. The first, and simplest, defines four major disease stages between initial infection and

eventual death, using clinical and "performance" criteria only (Table 2.8). The second uses clinical, "performance", *and* laboratory criteria (Table 2.9).

Table 2.8: The WHO clinical staging system for HIV infection and disease among adults and adolescents, using clinical and performance criteria only

Stage	Clinical and Performance criteria
Stage 1	1. Asymptomatic 2. Persistent generalised lymphadenopathy (PGL) Performance scale 1: asymptomatic, normal activity
Stage 2	3. Weight loss < 10% of body weight 4. Minor mucocutaneous manifestations (seborrheic dermatitis, prurigo, fungal nail infections, recurrent oral ulcerations, angular cheilitis) 5. Herpes Zoster, within the last 5 years 6. Recurrent upper respiratory tract infections (i.e. bacterial sinusitis) And/or Performance scale 2: symptomatic, normal activity
Stage 3	7. Weight loss, > 10% body weight 8. Unexplained chronic diarrhoea, > 1month 9. Unexplained prolonged fever (intermittent or constant), > 1 month 10. Oral candidiasis (thrush) 11. Oral hairy leukoplakia 12. Pulmonary tuberculosis, within the past year 13. Severe bacterial infections (i.e. pneumonia, pyomyositis) And/or Performance Scale 3: bedridden < 50% of the day during the last month
Stage 4 **(defined within the staging system as "basically equivalent to AIDS")**	14. HIV wasting syndrome, as defined by CDC i.e. weight loss of > 10% body weight, plus either unexplained chronic diarrhoea (> 1 month), or chronic weakness and unexplained prolonged fever (> 1 month) 15. *Pneumocystis carinii* pneumonia 16. Toxoplasmosis of the brain 17. Cryptosporidiosis with diarrohea, > 1 month 18. Cryptococcosis, extrapulmonary 19. Cytomegalovirus disease of an organ other than liver, spleen or lymph nodes 20. Herpes simplex virus infection, mucocutaneous > 1 month, or visceral any duration 21. Progressive multifocal leukoencephalopathy 22. Any disseminated endemic mycosis (i.e., histoplasmosis, coccidioidomycosis) 23. Candidiasis of the oesophagus, trachea, bronchi or lungs 24. Atypical mycobacteriosis, disseminated 25. Non-typhoid *Salmonella* septicaemia 26. Extrapulmonary tuberculosis 27. Lymphoma 28. Kaposi's Sarcoma 29. HIV encephalopathy, as defined by CDC (Clinical findings of disabling cognitive and/or motor dysfunction interfering with activities of normal daily living, progressing over weeks to months, in the absence of a concurrent illness or condition other than HIV infection that could explain the findings) And/or Performance scale 4: bed-ridden, >50% of the day during the last month

In the first staging system (Table 2.8), people who are asymptomatic, or who have generalised lymphadenopathy but are classified as asymptomatic by general performance criteria, are categorised as Stage 1. Stage 2 is associated with early, mild disease; performance is symptomatic with normal activity. Stage 3 consists of intermediate, moderate disease, with general performance rated as bedridden for less than 50% of the day. Stage 4 is classified as late, severe disease with illnesses that are rare or virtually non-existent among HIV-negative individuals (and is "basically equivalent to AIDS", according to the WHO explanation of the staging system), with general performance characterised as bedridden for more than 50% of the day.

The more complicated staging system (Table 2.9) incorporates CD4 and lymphocyte cell counts to sub-divide each stage into three further categories, 1A through 4C. For example, 3B applies if an individual is in stage 3 according to clinical and performance criteria, and has either a lymphocyte count of 1000-2000 or a CD4 count of 200-500 according to laboratory criteria.

Table 2.9: WHO staging system for HIV infection and disease in adults and adolescents using clinical, performance and laboratory criteria

Lymphocyte or CD4 count		Staging by clinical and performance criteria			
Lymphocyte	CD4	Stage 1	Stage 2	Stage 3	Stage 4
>2000	>500	1A	2A	3A	4A
1000-2000	200-500	1B	2B	3B	4B
<1000	<200	1C	2C	3C	4C

2.2.4 Limitations of the WHO staging system

The WHO staging system is useful for characterising the progression of HIV-related disease for people known to be HIV infected. It also assists with individual prognosis, and is useful when analysing clinical trial results (e.g. to assess whether an intervention's efficacy varies according to disease stage). However, some stage 3 definitions are rather imprecise and may be more indicative of severe, end-stage disease (for example, weight loss of more than 10% of body weight). In addition, in many countries the vast majority of people with HIV infection have not been tested and therefore their HIV status has not been identified by health services. This means that the staging system is not particularly useful for monitoring the status and evolution of the HIV/AIDS epidemic at district, regional, national or international level. As a result, monitoring of the HIV/AIDS epidemic has focused on AIDS surveillance.

2.2.5 The AIDS case definitions for surveillance purposes

Both CDC (Centers for Disease Control) and WHO have developed AIDS case definitions for the purposes of surveillance (it is important to emphasise that they are *not* used for assessing prognosis, or for informing treatment). These have been separately defined for (a) adults and adolescents, classified as those over 12 years of age and (b) children.

The definitions have evolved over time. The first surveillance definition, developed in 1981 and codified by CDC in 1983 (CDC, 1983), was developed when HIV/AIDS was first emerging and not well understood. It focused on obvious features or hallmark diseases associated with AIDS that were highly indicative of underlying immunosuppression. It could not include HIV test results, since the test to detect HIV had not yet been developed. Since 1983, the definitions have become more precise, related to better understanding of HIV and development of more sophisticated laboratory tests (for WHO, see Weekly Epidemiological Records of March 7th 1986, 8th January 1988, and 16th September 1994; for CDC see MMWR May 23rd 1986, August 14th 1987, December 18th 1992). Recently, CDC (CDC, 1999) has suggested that the AIDS case definitions have little use for surveillance, at least in developed countries.

WHO surveillance definitions of AIDS in adults and adolescents

There are currently 2 WHO definitions for AIDS in adults and adolescents for use in resource-constrained settings (Box 1).

Box 1: WHO case definitions for AIDS surveillance for adults and adolescents (those >12 years of age)

1. WHO case definition for AIDS surveillance (recommended where HIV testing is not available)

At least two major signs and at least one minor sign, with:

- Major signs = weight loss > 10% body weight; chronic diarrhoea for more than one month; prolonged fever for more than one month
- Minor signs = persistent cough for > 1 month; generalised pruritic dermatitis; history of herpes zoster; oropharyngeal candidiasis; chronic progressive or disseminated herpes simplex infection; generalised lymphadenopathy

The presence of generalised Kaposi's sarcoma or cryptococcal meningitis is also sufficient for the diagnosis of AIDS

2. Expanded WHO case definition for AIDS surveillance (recommended where HIV testing is available)

A positive HIV test and one or more of:
Weight loss > 10% bodyweight, or cachexia, with diarrhoea or fever, or both, for at least one month, not known to be due to a condition unrelated to HIV infection; cryptococcal meningitis; tuberculosis; Kaposi's sarcoma; neurological impairment which prevents independent daily activities, not known to be due to a condition other than HIV infection; oesophageal candidiasis; life-threatening, or recurrent episodes of, pneumonia; invasive cervical cancer.

The first is a *clinical* case definition (i.e. one that relies on clinical symptoms alone and does not require specific laboratory tests to confirm HIV infection). It is currently known as the "WHO case definition for AIDS surveillance", and is designed for use where HIV testing is not available. It is a slight modification of a clinical case definition – known as the "Bangui definition" – that was developed in 1985 (see Weekly Epidemiological Record March 7th 1986).

The second, known as the "Expanded WHO case definition for AIDS surveillance", includes a broader range of clinical conditions – notably tuberculosis, invasive cervical cancer, pneumonia and neurological impairment – but requires a positive HIV test result.

The WHO surveillance definition of AIDS in children

The WHO surveillance definition for AIDS in children, in the absence of HIV testing, is shown in Box 2 below. The definition that applies when HIV testing is possible is complicated and not easily summarised (WHO, 1996), and none of the studies reported in this thesis were concerned with paediatric AIDS. Therefore, the definition is not included here: full details are available in "Weekly Epidemiological Record", WHO, 1988; 63, 1-8.

Box 2: WHO case definition for AIDS surveillance in children, in the absence of HIV testing (children defined as <12 years of age)

At least 2 major signs and at least 2 minor signs, in the absence of any other known causes of immunosuppression such as cancer, severe malnutrition or other recognised aetiologies

Major signs = weight loss or abnormally slow growth; chronic diarrhoea for more than 1 month; prolonged fever for more than 1 month.

Minor signs = generalised lymphadenopathy; oro-pharyngeal candidiasis; repeated common infections (otitis, pharyngitis etc.); persistent cough; generalised dermatitis; confirmed maternal HIV infection

The CDC surveillance definition for AIDS in adults and adolescents

The most recent CDC definition for AIDS in adults and adolescents is in most respects similar to the WHO Expanded Case Definition for AIDS surveillance. This is not surprising: the 1987 definition, used until the introduction of the most recent WHO definitions in 1994 and the most recent CDC definition in 1993, was a joint CDC/WHO definition.

Like the 1994 WHO revision, the "1993 Revised Classification System" (MMWR December 18th 1992) added pulmonary tuberculosis, invasive cervical cancer, and recurrent bacterial pneumonia within a year as clinical conditions that defined AIDS in the presence of a positive HIV test result. The major way in which it differs from the expanded WHO definition is that it emphasises the clinical importance of the CD4 T-lymphocyte count in the categorisation of AIDS cases. The justification given for this is that CD4 counts have been shown to correlate with HIV-related immune disfunction and disease progression, as well as being useful to guide

medical management. Any individual who is HIV+ and has a CD4 count of less than 200, or who is HIV+ and has a CD4 t-lymphocyte percentage of total lymphocytes of <14, is defined as an AIDS case. The definition is therefore based on clinical, laboratory *and* immunological criteria.

2.2.6 Main limitations of AIDS case definitions for surveillance purposes

The case definitions used for AIDS surveillance have some limitations. One general major problem, especially in Africa, is poor reporting.

The WHO definition for adults and adolescents that does not require a positive HIV test has relatively low sensitivity and specificity (Weekly Epidemiological Record, WHO, 1994). The expanded definition has higher specificity (ibid.). However, it includes HIV+ individuals with pulmonary tuberculosis, even though (a) this is common in developing countries and therefore is not necessarily the result of HIV infection (b) even though pulmonary tuberculosis is included in Stage 3 (rather than Stage 4) of the WHO staging system and (c) tuberculosis often occurs at an earlier stage in the natural history of HIV/AIDS than other AIDS-defining conditions.

The CDC definition inclusion of pulmonary tuberculosis (the previous joint CDC/WHO definition included only extra-pulmonary tuberculosis as an AIDS indicator disease) may be less problematical given that tuberculosis is much rarer in HIV-negative individuals in the USA compared to HIV-negative individuals in developing countries. However, the main reason for the inclusion of pulmonary tuberculosis was unrelated to whether or not it really represents the presence of AIDS – it was included because, under the Ryan White Care Act, tuberculosis care could be provided free of charge to HIV/AIDS patients if it was AIDS-defining.

The definition of paediatric AIDS has low specificity (partly because an HIV+ test result is not useful in young children, who may have maternal antibodies but not actually be infected).

CDC also specifically points out that the diagnosis of individual patients should not rely on the surveillance definitions. In good medical practice CDC states that supplemental tests are strongly endorsed (e.g. a confirmatory HIV test), that patients who do not meet the surveillance definition may be diagnosed with severe HIV disease on consideration of other clinical or laboratory evidence, and that while presumptive diagnoses are acceptable for surveillance, definitive diagnoses should be the standard of good medical practice (MMWR August 14th 1987).

Despite these limitations, the definitions do have value. They are useful standards for consistent global monitoring of the HIV epidemic. They are also useful when undertaking retrospective analyses of the impact of HIV/AIDS on health services (see also Chapters 4-6), provided good patient records are available (as in at least parts of South Africa – see also Chapters 4-6). This is because even though the number of cases identified

using the surveillance definition is unlikely to be the true number, they can be used to consistently identify cases. As such, they are useful for reliable monitoring of trends, particularly trends in the relative (rather than absolute) importance of HIV/AIDS disease.

2.2.7 Life expectancy after HIV infection

The period from initial infection to death varies among individuals and historically. Early natural history data among homosexual men in the USA indicated a median AIDS-free period of at least 11 years[2], but subsequent studies suggested that half of all infected people would develop AIDS within 9 years. AIDS survival time has gradually been extended. In the late 1980s the median was approximately 18 months in developed countries, but this was extended close to two years with better understanding of the disease and the use of effective prophylaxis for opportunistic infections – particularly pneumocystis carinii pneumonia. Combination anti-retroviral drug treatments are currently revolutionising the prognosis for people living with HIV, including those with AIDS.

There are few comparable natural history data from developing countries. The most extensive data are from a UK Medical Research Council study in Uganda. This shows that the median time from infection to death is at least eight years (data collection have been underway for eight years and the median point has not yet been reached). AIDS-free survival time therefore appears comparable to that found in developed countries prior to the advent of antiretroviral treatments and widespread use of prophylaxis for opportunistic infections. However, the median time between onset of AIDS and death was 9 months for those followed 1990-5 – much shorter than in developed countries (Morgan et al, 1997).

2.2.8 The global burden and geographical distribution of HIV infection

The global burden of HIV infection at the end of 1999 was 33.6 million cases, while at beginning of 1996[3] the number of AIDS cases was estimated as 1.1 million (Table 2.10, based on UNAIDS 1999 and Chapter 1 of Mann and Tarantola, 1996). HIV-1 is responsible for most cases, with HIV-2 common only in West Africa and India. In the USA, sub-type B of HIV-1 is dominant, but eight other sub-types have been defined and are well distributed geographically – with Africa having the greatest diversity.

[2] i.e. after eleven years of follow-up more than 50% of those being studied were still alive

[3] the most recent reports produced by UNAIDS concerning the HIV/AIDS epidemic quote figures for the number of people infected with HIV only: they do not quote estimates for the number of people living with AIDS. This is why the figures in Table 2.10 for AIDS cases are from 1996.

Table 2.10: Estimated global burden of HIV infection by region, December 1999, and estimated number of AIDS cases on January 1st 1996

Region	Estimated number of adults and children living with HIV or AIDS (millions)	Estimated number of adults and children living with AIDS	% of total adult population living with HIV or AIDS
Sub-Saharan Africa	23.3	803 000	Average of around 8, but figures very variable. Some countries extremely heavily affected and others not. Some <1, others >25; most >8
South and south-east Asia	6.0	112 000	Average 0.7. <1 except Cambodia (2.4), Thailand (2.2) and Myanmar (1.8)
Latin America	1.3	61 000	Average 0.6. Ranges from 0.07 (Bolivia) to 2.1 (Guyana)
North America	0.9	91 000	0.8 in USA; <0.5 in Canada
East Asia and Pacific	0.5	6 000	Average 0.07. <0.5 everywhere
Western Europe	0.5	52 000	Average 0.25. <0.5 except Portugal (0.7) and Spain (0.6)
Eastern Europe and Central Asia	0.4	2 000	Average 0.1. <0.5 everywhere
Caribbean	0.4	19 000	Average 2. 0.02 (Cuba) to 5.2 (Haiti)
North Africa and Middle East	0.2	4 000	Average 0.1. <0.5 except Sudan (1)
Australia and New Zealand	0.01	2 000	Average 0.1
TOTAL	33.4	1 152 000	1.1

Sub-Saharan Africa stands out as the region most severely affected by the epidemic. The worst-affected countries in terms of the proportion of the population that is infected are Zimbabwe (26%), Botswana (25%), Namibia (20%), Zambia (19%), Swaziland (19%), Malawi (15%), Mozambique (14%), South Africa (13%), Rwanda (13%), Kenya (12%), Côte D'Ivoire (10%), Uganda (10%) and Tanzania (9%). Only Comoros, Mauritania, Madagascar, Mauritius, Réunion and Somalia have a prevalence of less than 1%.

Parts of South-east Asia, Latin America and the Caribbean are seriously affected, but the numbers remain insignificant in comparison with those for countries in East, West, Central and Southern Africa. Elsewhere, the epidemic remains relatively small.

In all developing regions infection rates are still rising, while they appear to have stabilised in Western Europe and North America. The number of new infections is also rising exponentially in Eastern Europe and the former Soviet Union. Only in a few specific groups is there evidence that rates are

declining in developing countries. These include young adults in rural Uganda and Thai military recruits.

In all regions, the age group most affected is adults aged 25-44; women are consistently infected at a younger age than men.

2.2.9 Modes of transmission

The virus is usually sexually transmitted (approximately 75% of all world-wide transmission). Other transmission routes include maternal-child infection, shared use of equipment for injecting drugs, and blood transfusions. Most sexual transmission – an estimated 75% - is between men and women, with the figure close to 100% in Africa, Asia and the Caribbean. In Latin America, Europe, and the USA, sexual transmission between men is much more common.

Mother-to-child transmission, which globally ranks second as a mode of transmission, is especially important in developing countries. This reflects the fact that many young women are infected, while interventions that can prevent transmission (such as antiretroviral drug treatment and planned caesarian sections) are not widely available.

Injecting drug use is important in China, South-east Asia (with the notable exception of Thailand), the Russian Federation and other parts of the former Soviet Union. It now accounts for a substantial (close to 50%) share of HIV infections in the USA, and has caused localised but explosive epidemics in Edinburgh, UK; Thailand; and Myanmar.

Following the development of HIV tests that have facilitated blood screening, transmission through blood transfusion has become relatively insignificant.

2.2.10 Efficiency of transmission

The efficiency of transmission varies according to disease stage, mode of transmission, and the plasma viral load of the infectious source. It is higher from an individual who has been recently infected or has clinical AIDS. Blood transfusion is the most efficient mechanism (90-100 infections per 100 exposures), followed by maternal to child transmission (13-48 infections per 100 exposures). The risk of transmission by a needle-stick injury overall is 0.3 per 100 exposures, though this is volume–related. Homosexual intercourse is higher risk (0.5-3 infections per 100 exposures) than sex between men and women – with the risk of transmission per exposure lowest for female-male transmission (0.033-0.1 compared with 0.1-0.2 infections per 100 exposures for male-female transmission).

2.2.11 Factors affecting the spread of HIV infection

Several factors influence the rate and extent to which the HIV epidemic affects different areas and particular communities within them.

Biologically, the presence of other sexually transmitted diseases facilitates transmission. The rate of partner change and the extent of concurrent partnerships are also both highly influential – simulations demonstrate that HIV spreads most rapidly in populations where commercial, casual and marital sex are concurrent. This is most likely in places where the ratio of men to women is high (such as some urban areas in developing countries), since this encourages use of commercial sex workers; in cultures where it is the norm for men to have more than one wife; in countries where a migrant labour system operates, since in these settings men will often have one or more wives in a rural area in addition to either or both of a second household in the city and contact with commercial sex workers; and where many women have no other source of survival than to earn money through prostitution. All of these factors are present in sub-Saharan Africa and in Southern Africa in particular, largely explaining the particularly rapid emergence of the HIV epidemic there.

However, the extent to which behaviour is adapted to knowledge about HIV is also important. The risk of sexual transmission can be virtually eliminated through use of condoms, so the extent to which people are aware of and practise "safer sex" is also critical. Where governments have been slow to initiate preventive campaigns focused on information and education, populations are likely to be at higher risk. It is notable that in Uganda, where there has been a greater degree of openness about the epidemic and a strong commitment to addressing it at senior political level, rates of HIV infection appear to be falling. In the UK an extensive national campaign was launched as early as 1986, which may have helped limit the spread of the virus there.

2.3 The HIV/AIDS epidemic in South Africa

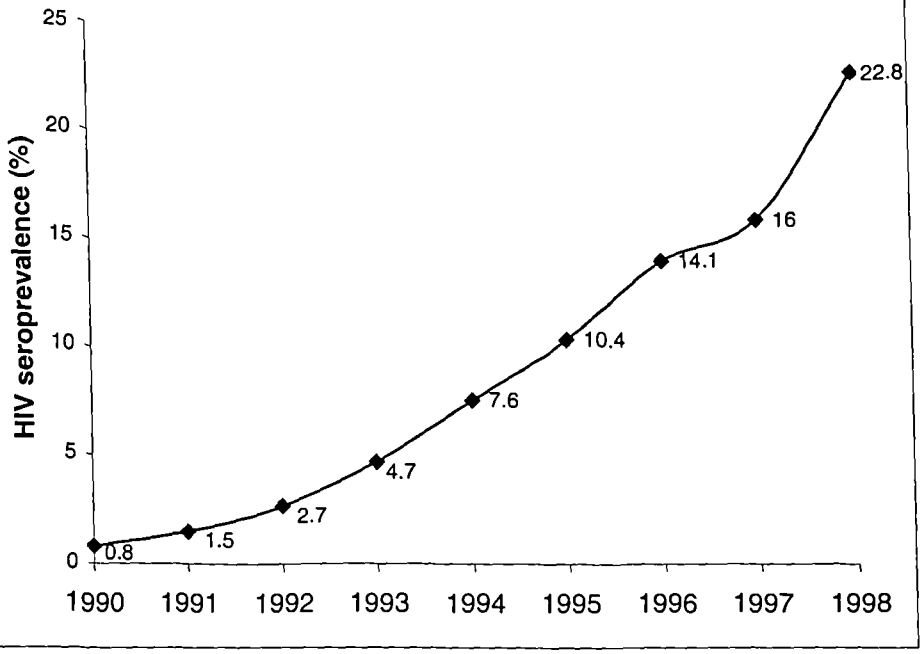
The first cases of AIDS in South Africa were reported among white homosexual men in 1982. Until the development of HIV antibody tests in 1985, which facilitated blood screening, there were also a small number of cases associated with transfusions of infected blood. However, in the mid-1980s the limited evidence available suggests that HIV prevalence was extremely low among the general population, and concentrated in the white homosexual population. In KwaZulu-Natal, for example, a retrospective analysis of stored sera found no evidence of HIV in the general population in 1985 (Abdool Karim, 1997).

In comparison with East and Central Africa, HIV appeared relatively late in South Africa – in common with other neighbouring countries such as Botswana and Namibia. Nonetheless, since the late 1980s, the HIV epidemic has spread rapidly and South Africa is now one of the most severely affected countries in the world. In 1998, adult prevalence was estimated as 16% (UNAIDS, 1998), the eighth highest prevalence in Africa, itself the worst-affected continent. The estimated number of people living with HIV or AIDS totals 2.8 million – the largest figure for any country except India. Most cases are heterosexual adults and, due to

transmission during pregnancy, young children. There are more infected women than men (Abdool Karim et al, 1992), and prevalence is highest among those aged 15-30. Overall, young black women are the population group with the highest recorded rates of infection.

Factors – often inter-related - that have been linked to the particularly quick and far-reaching emergence of HIV include a high background level of sexually transmitted diseases, which facilitate transmission of the virus; and the migrant labour system developed in the apartheid years, which has continued albeit in modified form since 1994. It is typical for men from the African and Coloured population groups – the vast majority of the population - to work for several months of the year in urban areas where they are separated from their families, encouraging casual and multiple sexual partnerships.

Figure 1: HIV seroprevalence among antenatal clinical attendees in South Africa 1990-1998



The evolution of the epidemic since national HIV seroprevalence surveys began in 1990 is illustrated in Figure 1. This shows a very dramatic absolute increase, and a rapid rate of growth, in the space of eight years. Less than 1% of the antenatal clinic attendee population in 1990 was HIV+, but this rose to almost one quarter in 1998. Rates of infection were doubling approximately each year between 1990 and 1994, and despite a slowing in the doubling time since then the trend has continued upwards.

The number of reported AIDS cases is low (Table 2.11, figures from Mann and Tarantola 1996, Appendix A). This reflects poor reporting (see also comments on AIDS surveillance in 2.2.6).

Table 2.11: AIDS cases in South Africa reported to the World Health Organization, 1979-1994[4]

Year	Number of cases reported
1979-84	15
1985	9
1986	34
1987	48
1988	94
1989	176
1990	304
1991	393
1992	658
1993	1267
1994	2774

The national picture of HIV infection conceals important geographical variation (Table 2.12). Though trends since 1990 are complicated by the

Table 2.12: HIV prevalence among antenatal clinic attendees in South Africa by province, 1990-8

Province (population in 1996, in millions)	1990	1991	1992	1993	1994	1995	1996	1997	1998
Western Cape (3.6)	Cape as a whole 0.16% in 1990 and 1.3% by 1993				1.1	1.7	3.1	6.3	5.2
Eastern Cape (6.7)					4.5	6.0	8.1	12.6	15.9
Northern Cape (0.7)					1.8	5.3	6.5	8.6	9.9
Free State (2.8)	0.6	1.5	2.9	4.1	9.2	11.0	17.5	19.6	22.8
KwaZulu-Natal (8.5)	1.6	2.9	4.8	9.6	14.4	18.2	19.9	26.9	32.5
Mpumalanga (2.8)	Estimates for Transvaal, including homelands, covering a similar area, were 0.5% in 1990 and 3.1% by 1993				12.2	16.2	15.8	22.6	30.0
Northern Province (5.1)					3.1	4.9	8.0	8.2	11.5
Gauteng (6.9)					6.4	12.0	15.5	17.1	22.5
Northwest (3.5)	N.A.	N.A.	N.A.	N.A.	6.7	8.3	25.1	18.1	21.3
SOUTH AFRICA	0.8	1.5	2.7	4.7	7.6	10.4	14.1	16.1	22.8

[4] South Africa has not reported AIDS cases internally, and therefore also not to WHO, since 30 October 1996 Hence the figures quoted extend only as far as 1995. As of the last report on 30 October 1996, a cumulative 12 825 cases had been reported (S. Lazzari, Communicable Diseases Surveillance, WHO, personal communication, May 31st 2000).

fact that provincial boundaries were changed in 1994, the epidemic is most severe in the province with the highest population total - KwaZulu-Natal - and least serious in the Western Cape (1998 seroprevalence figures of 32.5% and 5.2% respectively). The Western Cape appears to have experienced little change 1997-8, though wide confidence intervals around point estimates make small changes difficult to interpret. Several other provinces, each with relatively high or close to average populations, have a seroprevalence close to that of KwaZulu-Natal, including Mpumalanga, Northwest, Gauteng, and Free State. In every part of the country, incidence is high and prevalence has not yet stabilised. As a consequence, the situation is going to get worse.

Within each province, it has been suggested that although the epidemic in rural areas is lagging behind that in urban areas, it is progressing at a similar rate.

2.4 The Health Sector in South Africa

2.4.1 Overall resource availability and the public/private mix

The health sector in South Africa is relatively well resourced by developing country standards. An estimated 8% of GDP is spent on health care, and with a per capita GNP of US$2 900 in 1997, this equates to approximately US$230 per capita. However, a large fraction of this expenditure – approximately 60% - occurs in the private sector, which caters for only a limited proportion of the population. 80% of the white population (11% of total population) has private insurance, but the figure is just 15% for the African and Coloured population (Benatar, 1997), who account for 86% of the South African population. In 1992/3, 31% of all hospital beds were private, with 68% and 1% in the public and military sectors respectively.

2.4.2 Main levels of care in the public sector

Within the public sector, on which most of the population relies, there are 4 main levels of health care provision. The first is primary clinics. These offer largely outpatient care and are mostly staffed by nurses. The second is community hospitals, which offer general medical, surgical and maternity care but no specialist facilities. Secondary hospitals provide more specialist care, with specialities including at least obstetrics and gynaecology, paediatrics, internal medicine and surgery. Tertiary hospitals provide the most specialised services including cardiology, cardiothoracic surgery, dermatology, neurology, neurosurgery, nuclear medicine and opthalmology. Academic hospitals are defined as a site where students are trained; in practice they are usually tertiary facilities.

Overall, most hospital beds are in community hospitals (43%), with the remainder fairly evenly distributed. However, there is important variation by province (Table 2.13). The proportion of beds in community hospitals is particularly high in Eastern Cape, Northern Province, North-west,

Mpumalanga and Northern Cape and notably low in Western Cape and, especially, Gauteng. Free State and KwaZulu-Natal are close to average.

Table 2.13: Distribution of hospital beds by province

Province	% in academic facilities	% in tertiary facilities	% in secondary facilities	% in community hospitals
Western Cape	38	14	18	30
Eastern Cape	7	22	13	59
Northern Cape	0	0	44	56
Free State	31	10	17	42
KwaZulu-Natal	8	31	21	40
Mpumalanga	0	6	38	56
Northern	0	29	5	66
Gauteng	58	9	20	13
Northwest	0	19	18	63
SOUTH AFRICA	19	20	18	43

In contrast to national patterns, academic hospitals account for a disproportionately large share of beds in Gauteng and Western Cape.

2.4.3 Financial resource availability in the public sector

Real public recurrent health sector expenditure grew 0.5% p.a. 1983/4-1992/3, but real per capita expenditure is projected to decline slightly 1995/6-2000/1, from R516 to R512 (approximately US$93 at the 1998 average exchange rate of US$1=R5.53). Figures vary by province (Table 2.14 and Figure 2). Public sector funds are highest in the Western Cape and Gauteng. KwaZulu-Natal (ranked exactly in the middle), Free State and Eastern Cape are notably similar and extremely close to the national average. Mpumalanga is particularly poorly resourced.

Table 2.14: Resource availability by province, 1995/6–2000/1 (real terms*)

Province	Provincial budget/capita, 1995/6 (% difference from national average)	Provincial budget/capita, 1997/8 (% difference from national average)	Provincial budget/capita, 2000/2001 (% difference from national average)
Western Cape	919 (+86)	846 (+ 61)	711 (+41)
Eastern Cape	388 (-22)	433 (-18)	442 (-13)
Northern Cape	405 (-18)	429 (-24)	398 (-21)
Free State	538 (+9)	536 (+2)	504 (0)
KwaZulu-Natal	460 (-7)	470 (-11)	462 (-9)
Mpumalanga	290 (-41)	308 (-41)	324 (-36)
Northern	229 (-54)	398 (-24)	330 (-35)
Gauteng	895 (+81)	912 (+73)	912 (+81)
Northwest	351 (-29)	355 (-33)	351 (-30)
Average, all provinces	495	527	505
Total (including national budgets)	516	536	512

**year in which amounts expressed not stated in original source*

Figure 2: Resource availability in South Africa by province, 1995/6

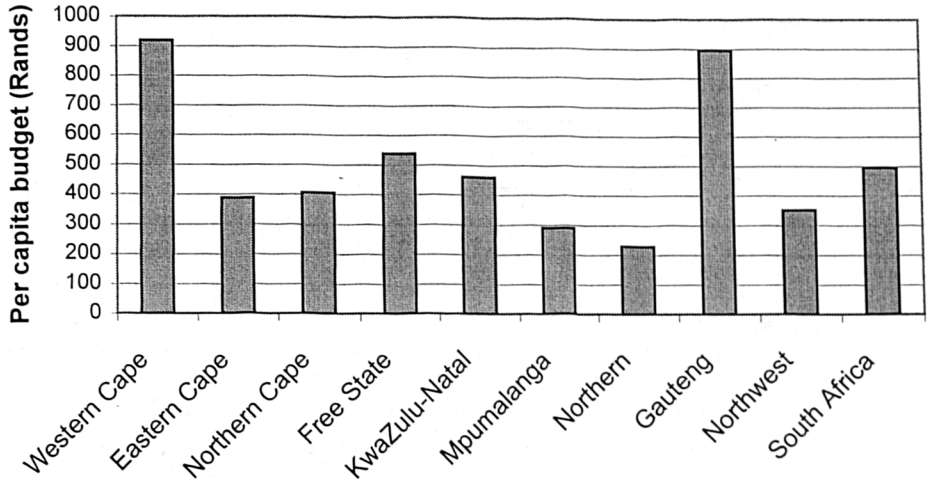


Figure 3: Population per clinic in South Africa by province, 1993

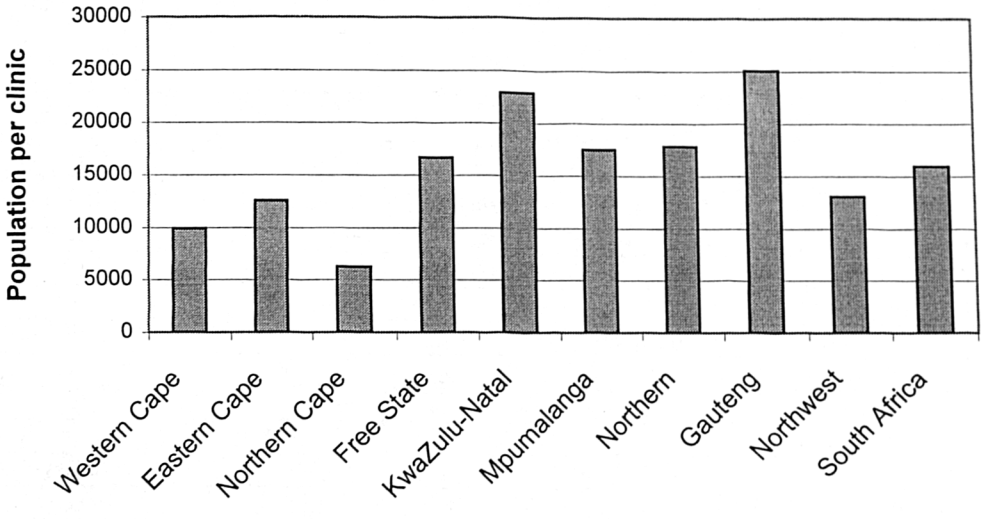


Table 2.15: Availability and utilisation of health services in 1993, by province, before the HIV/AIDS epidemic exploded (ranking)

Province	Population per clinic	Nurses/ 100 000 population	Doctors/ 100 000 population	Public beds per 1000 population/ community hospitals*	Beds per 1000 population (all beds)	Acute admissions/ 1000 population per year	Average length of stay
Western Cape	9 918 (2)	686 (1)	144 (1)	2.6/0.8 (3,8)	5.4 (2)	115 (2)	6.5 (5)
Eastern Cape	12 576 (3)	321 (6)	31 (6)	2.3/1.3 (5,3)	3.5 (6)	70 (8)	9.5 (1)
Northern Cape	6 261 (1)	432 (3)	38 (5)	3.2/1.8 (1,1)	4.0 (4)	140 (1)	5.0 (9)
Free State	16 694 (5)	382 (5)	47 (4)	2.2/0.9 (6,7)	4.1 (3)	96 (4)	5.8 (7)
KwaZulu-Natal	22 919 (8)	432 (3)	54 (3)	2.9/1.2 (2,5)	3.8 (5)	89 (5)	8.8 (2)
Mpumalanga	17 521 (6)	266 (9)	28 (7)	1.7/1.0 (9,6)	2.1 (9)	73 (7)	5.7 (8)
Northern Province	17 842 (7)	293 (7)	16 (9)	2.2/1.5 (6,2)	2.5 (8)	78 (6)	6.7 (4)
Gauteng	25 080 (9)	618 (2)	127 (2)	2.5/0.3 (4,9)	6.0 (1)	111 (3)	6.1 (6)
Northwest	13 085 (4)	274 (8)	23 (8)	2.1/1.3 (8,3)	3.3 (7)	64 (9)	8.8 (2)
SOUTH AFRICA	15 979	421	60	2.4/1.1	4.0	88	7.3

*inferred from p86-7 Health Services Review 1995

The overwhelming majority of public expenditure occurs in hospitals. In 1992/3, academic and other tertiary hospitals accounted for 44% of total expenditure, secondary hospitals for 11%, community hospitals for 21% and chronic hospitals (which largely provide care for tuberculosis patients) for 5%. The remaining 19% of expenditure was accounted for by primary care (11%) and "other". Within the private sector, the most important expenditure categories in the same year were medicines (32%), medical specialists (18%), private hospitals (also 18%), general practitioners (12%) and dentists (10%).

South African health policy is now directed towards equalising resources at provincial level. One of the major principles of reform is "reallocation of budgets strictly in line with the populations of each of the nine provinces" (Benatar, 1997). However, projections to 2000/1 show that while the Western Cape will move closer to the national average, Gauteng will not. The Eastern Cape will improve, but the gap between the provincial and the national average is not expected to narrow for Mpumalanga, North West and Northern provinces. KwaZulu-Natal and Free State are projected to remain closest to the national average.

2.4.4 Non-monetary measures of resource availability

Non-monetary measures of resource availability and utilisation of services are shown in Figures 3-9 and Table 2.15 (these figures have not been updated in more recent Health Services Reviews).

The Western Cape and Gauteng have a relatively high number of hospital beds, doctors, and nurses. They also have a relatively high number of acute admissions per 1000 population. KwaZulu-Natal ranks exactly in the middle in terms of acute admissions per 1000 population and beds per 1000 population, and higher (2nd or 3rd) in terms of community level hospital beds, doctors and nurses. It is relatively poorly supplied with clinics, but overall is broadly similar to the average indicators for South Africa as a whole. Mpumalanga, Northwest and Northern are the most under-served provinces.

The overall number of hospital beds is much higher than for sub-Saharan Africa as a whole (4.0 vs. 1.1 per 1000 population) but is almost identical to figures for other middle-income countries (4.1). Meanwhile, bed occupancy in 1992/3 was 68% in community hospitals, 74% in tertiary and secondary hospitals, 80% in chronic hospitals and 82% in academic hospitals (Health Expenditure and Finance in South Africa, HST and World Bank).

It is important to note that health services staff are likely to have the same exposure to sexual transmission of HIV as the general population, in addition to occupational exposure. This may cause important morbidity and mortality, adversely affecting the supply of staff to the health sector (see also Chapter 3).

Figure 4: Nurses per 100 000 population in South Africa by province, 1993

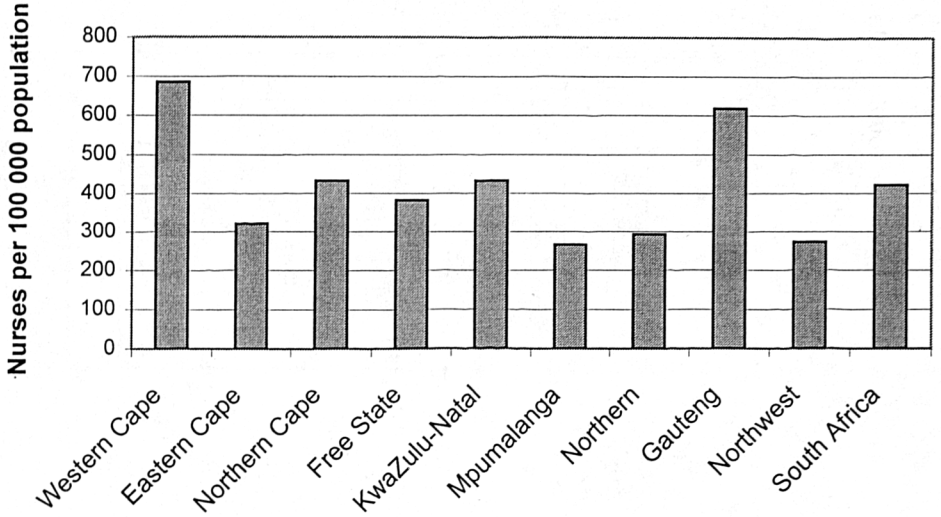


Figure 5: Doctors per 100 000 population in South Africa by province, 1993

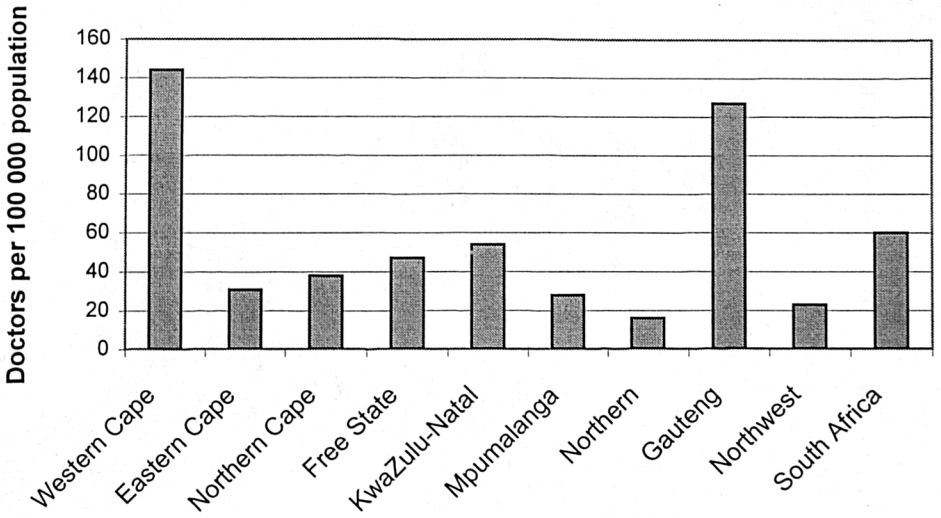


Figure 6: Public hospital beds per 1000 population in South Africa by province, 1993

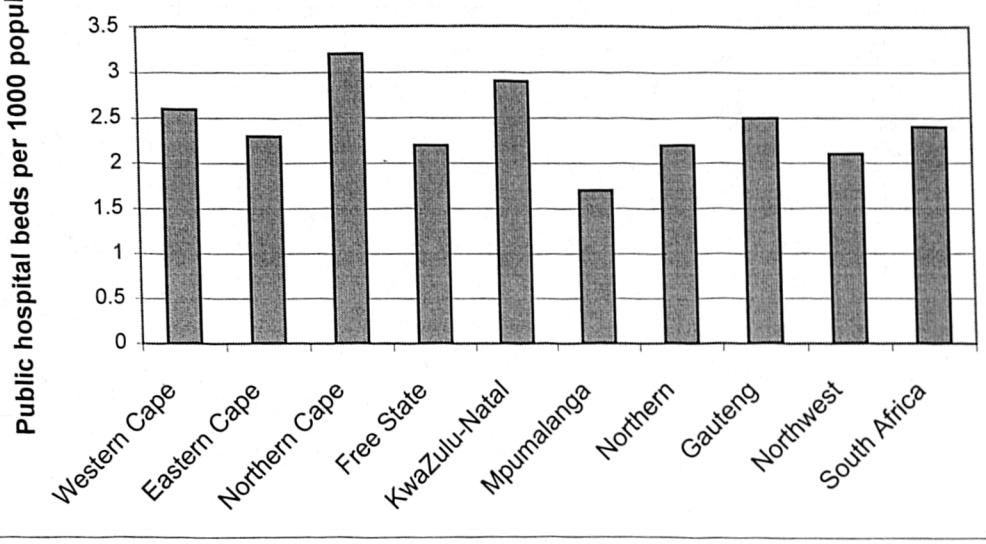


Figure 7: Hospital beds (all types) per 1000 population in South Africa by province, 1993

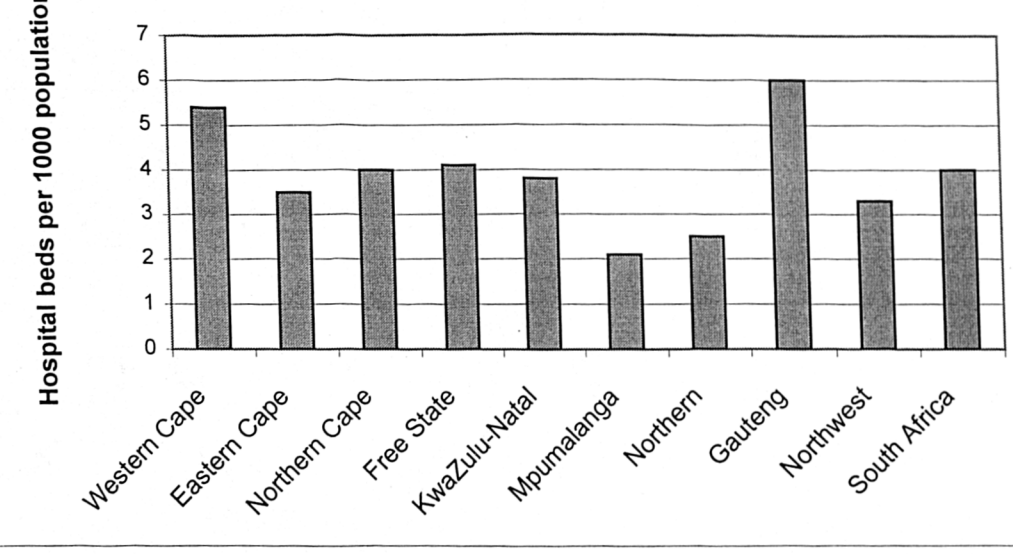


Figure 8: Acute admissions per 1000 population in South Africa by province, 1993

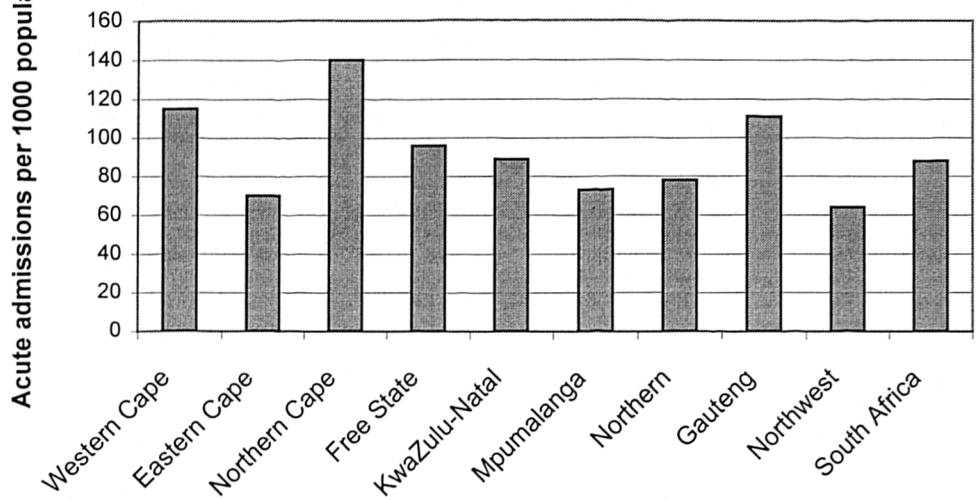
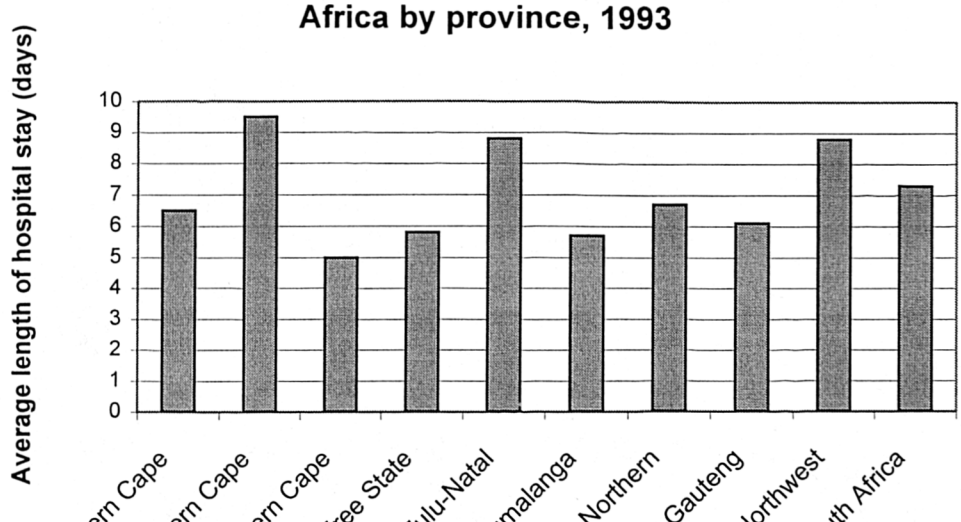


Figure 9: Average length of hospital stay in South Africa by province, 1993



2.4.5 Conclusions

Health sector provision in South Africa is variable and rankings are not consistent for all indicators. However, it is clear that Western Cape and Gauteng stand out as being relatively favoured in terms of the availability of financial, human and physical resources. Free State and KwaZulu-Natal are similar to one another and the closest to the national average, while Mpumalanga, Northern and North West provinces are the most disadvantaged. The Eastern Cape is also usually below the national average, while Northern Cape is typically either close to or below the average for South Africa as a whole for most measures of resource availability.

CHAPTER 3: LITERATURE REVIEW

The overall goal of the research was to assess the economic impact of the HIV/AIDS epidemic on a district health system in rural South Africa, and to identify affordable and cost-effective ways of responding to this impact. The literature review presented in this chapter covers literature on economic aspects of the HIV/AIDS epidemic as a whole, rather than being confined only to literature concerned with the economic impact of HIV/AIDS on health systems and economic evaluations of ways of responding to this impact. This is to enable the research to be set in a relatively broad context, for the sake of completeness, and because the existing literature on economic aspects of the HIV/AIDS epidemic is still relatively limited.

The chapter is divided into four main sections, which are:

- methodology used to review existing literature (3.1);
- detailed review of the literature, which covers twenty major topic areas (3.2);
- discussion of the existing literature, which highlights key findings arising from the review, identifies existing gaps and limitations in the literature, and explains why these are important (3.3); and
- summary of research undertaken in Hlabisa, which briefly explains, in tabular form, how the research reported in this thesis addressed some of the important gaps and limitations identified in the literature (3.4).

3.1 How existing literature was reviewed

A variety of sources were used to identify existing literature concerning economic aspects of the HIV/AIDS epidemic. The focus was on original research papers in peer-reviewed journals, supplemented by conference abstracts and books. Letters or editorials in journals, and working papers, were only retrieved when these appeared particularly pertinent. The two main sources were the Medline and Economic Literature databases for the period 1984-98. The Popline database was also used, although this yielded fewer references. Relevant papers were identified using a variety of search terms. For Medline and Popline, the key words HIV and/or AIDS were searched in combination with each of the following terms: costs; cost-effectiveness; economics; health services/care utilisation; care; financing; budgets; and Africa. For the economic literature database, only the search terms HIV and/or AIDS were used. Any additional references cited in the papers retrieved through these searches that concerned the economic impact of HIV/AIDS on the health sector, or economic evaluations related to ways in which the health sector could respond to this impact, were also noted and the papers retrieved. This enabled a particularly thorough review of the literature most directly relevant to the area of research that was the focus of the studies included in this thesis. Publications from 1999 are only included where they are particularly relevant to the research reported in this thesis.

Database searches of original research papers were supplemented by detailed review of key journals likely to contain relevant references, to try to ensure that relevant references not identified through databases were accessed. This is more feasible for HIV/AIDS than for many subjects because it was first recognised only in 1984. The journals reviewed in the this way were either those of general medical interest, those which specialise in HIV/AIDS, or those that often include an economic focus but which do not appear on the Medline or Economic Literature databases. They included the Lancet, the British Medical Journal, the Journal of the American Medical Association (JAMA), Health Policy and Planning, Health Policy, Social Science and Medicine, AIDS, the Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology, and the South African Medical Journal.

Books with relevant chapters were identified through searching library databases using the key words HIV and AIDS, and through citations in papers. Abstract books from recent World AIDS conferences were consulted, but since these report largely preliminary results were given less emphasis. Most attention was paid to the 1998 Geneva conference, since this illustrated emerging research findings.

"Grey" literature was obtained through writing to, or meeting with, people working on HIV/AIDS who held senior positions in key international institutions e.g. World Bank, DFID, WHO. The PhD thesis of Susan Foster was also read, since this was known to concern many of the issues that were the focus of the research in South Africa. This was submitted in 1996 and was a useful source of otherwise unpublished work.

Finally, researchers who were already known to have undertaken work on HIV/AIDS in South Africa were contacted to identify any on-going or planned studies on similar or related topics to the research envisaged in Hlabisa. This included staff at the University of Natal, Durban; Medical Research Council researchers; and individuals who had formerly worked at the Centre for Health Policy and who had subsequently focused on consultancy work on HIV/AIDS.

3.2 Detailed Review of Existing Literature

The review suggested a division of the literature into 20 key topic areas. These were:

- the impact of HIV/AIDS on demand for health care in developed countries;
- the impact of HIV/AIDS on demand for health care in developing countries;
- the impact of HIV/AIDS on supply of health care in developed countries;
- the impact of HIV/AIDS on supply of health care in developing countries;
- the cost of HIV/AIDS prevention;

- the cost of care where the focus is on both developed and developing countries;
- the cost of care in developed countries;
- the cost of care in developing countries;
- ways of reducing the costs of care;
- cost-effectiveness analyses of prevention strategies in developed countries;
- cost-effectiveness analyses of prevention strategies in developing countries;
- cost-effectiveness analyses of care in developed countries;
- cost-effectiveness analyses of care in developing countries;
- cost-benefit studies;
- financing of HIV/AIDS health care;
- the indirect costs of HIV/AIDS;
- the economic impact of HIV/AIDS at household level;
- the economic impact of HIV/AIDS on firms or particular industries/service sectors;
- the macro-economic impact of HIV/AIDS; and
- the link between economic factors and HIV.

This section (3.2) reviews each of these topics in turn. Most emphasis is given to the first fourteen topics, because these are concerned with the health sector specifically; and to those studies where either the methodology or subject matter is particularly germane to the research reported in later chapters. This additional attention is also in line with the extra thoroughness with which literature was searched for these subject areas. The review presented for the final six topic areas is primarily designed to provide a flavour of the research that has been done, and should not be seen as an exhaustive coverage.

3.2.1 The impact of HIV/AIDS on demand for health care services in developed countries

The HIV/AIDS epidemic has largely affected young adults, in whom health status would normally be relatively good and use of health services comparatively low. HIV/AIDS is therefore likely to cause an increase in demand for health care – especially in Africa where a high percentage of the adult population is infected (see Chapter 2). However, the extent to which it will do this is hard to predict.

In developed countries, where the natural history of HIV infection is reasonably well understood and careful surveillance makes the estimated numbers of people with HIV infection relatively reliable, estimates of the increased health services utilisation caused by HIV/AIDS are possible based on the anticipated number, type, duration and timing of morbidity episodes. Even then, difficulties include:

- unequal access to care (especially in the USA, where not everyone has health insurance coverage);

- variation in health-seeking behaviour over time, for example in response to the extent to which HIV/AIDS is stigmatised and evolving perceptions about what health services can offer;
- changing availability of treatment, which affects both morbidity, life expectancy, costs of drug care, and need for inpatient care; and
- heterogeneity among those with HIV infection – with differences among well-defined risk groups such as injecting drug users, homosexual men and heterosexual women particularly likely.

Most recently, the advent of combination antiretroviral treatments make previous estimates of HIV-associated morbidity and mortality unreliable at best and obsolete at worst.

Several studies in developed countries have assessed what impact the HIV/AIDS epidemic has had, or will have, on demand for care in the health sector. These are summarised in Tables 3.1-3.3.

It is worth highlighting that while later sections are specifically devoted to cost studies, cost data are included in these tables where they have been used to indicate the total impact of HIV/AIDS. This is justified on the grounds that total cost estimates are a measure of the additional care demands being generated by the epidemic. Later sections may be distinguished by the fact that they focus on costs at the level of the individual patient, rather than across the health sector as a whole.

Studies have typically relied on estimates based on existing cost and utilisation data for particular groups of patients (e.g. those treated under the US Medicaid programme), databases specially established to monitor the impact of the HIV/AIDS epidemic, nation-wide surveys of hospitals, postal questionnaire surveys, or modelling. The first two are probably the most reliable; the others less so, which may explain the variability in estimates. In the USA, an exception worth highlighting is the research on the HIV/TB epidemic in New York. This relied on a detailed retrospective review of hospital records, with initial screening of cases using ICD codes that could be related to HIV/TB followed by analysis of data by two independent observers. In the UK, a notable exception is the study in Edinburgh, which used comprehensive empirical data for known HIV+ patients.

Despite variability in results and methods, the findings consistently show the overall impact of HIV/AIDS is not large in the context of health services as a whole. In certain areas or types of facility, and for certain types of disease, impacts may be more marked. Notable examples are teaching hospitals in the north-east region of the USA, and infectious disease clinics and TB in New York.

Studies on the impact of antiretroviral mono-therapy are relatively limited (Table 3.3). However, research appears to be rapidly emerging on combination therapy: this was the subject of the bulk of economic-related abstracts at the most recent (1998) World AIDS conference. For zidovudine (ZDV) mono-therapy, the results (Table 3.3) are very mixed.

Table 3.1: Summary of studies concerned with impact of HIV/AIDS on demand for care in North America

Subject of Study	Main Findings	Main comments	Source, Date
In-patient care, national level, USA	1) Estimated that the first 10 000 cases of AIDS would consume 1.7 million hospital days and cost US$1.4 billion.	1) Impact not yet v. large	1) Hardy et al, 1986
	2) Total annual cost of AIDS care would increase from US$630 million in 1985 to US$8.5 billion in 1991, 0.2% and 1.4% of national health expenditure respectively	2) Cost small compared to US spending	2) Scitovsky and Rice, 1987
	3) Cumulative costs 1985-91 incurred by Medicaid for care of AIDS patients estimated as US$10 billion, but could be as low as US$2 billion or as high as US$47 billion		3) Pascal, 1987
	4) Total cost for AIDS cases diagnosed 1981-91 <US$22 billion	4) As for 2)	4) Bloom and Carliner, 1988
	5) Total costs for patients with ARC or AIDS projected to be US$2-4 billion in 1991	5) < previous estimates	5) Hay et al, 1988
	6) 325/1158 surveyed hospitals had treated one or more AIDS patients in 1988. HIV+ patients without AIDS =35% all HIV-related admissions, 29% inpatient costs, 35% inpatient revenue losses	6) Focusing on AIDS only under-estimates impact	6) Andrulis et al, 1992(a)
	7) Days of hospital care/100 000 population increased from 53 to 883, 1984-90		7) Kozak et al, 1993
	8) US HIV-related hospitalisations increased six-fold 1985-90, associated with estimated 1.1 million hospital days and costs of US$5.7-7.4 billion	8) Claimed to be first study based on nationally representative sample	8) Rosenblum, 1994
	9) Public hospitals in north-east most affected by epidemic and HIV+ patients increased 68% 1988-91	9) Public teaching hospitals care "magnets"	9) Andrulis et al, 1995
In-patient care, specific areas	1) AIDS and ARC patients cost US$7.7 million in N. Carolina 1987-8 Disproportionate impact on tertiary facilities	1) Impact relatively small – 0.3% total hospital charges	1) Campbell et al, 1991
	2) utilisation by AIDS patients increased 5 fold in Vancouver, Canada 1987-91, general medical wards played major role in terminal care		2) Goldstone, 1992
	3) HIV+ patients with CD4 count <200 more likely to be hospitalised than HIV- men in 5 major US cities		3) Zucchoni et al, 1994
	4) HIV+ patients = 0.4% total Maryland hospitalisations in 1988, 1.1% in 1992	4) Impact small	4) Fortgang and Moore, 1995
	5) % of admissions accounted for by HIV+ patients stable 1991-4 in Ontario, Canada		5) Hyland, 1997
Outpatient services	1) HIV-related visits <5% attendances at all clinics in New York except methadone (22%) and infectious disease (97%) clinics		1) Greenberg, 1992
	2) HIV+ students visited a student health service 3x more often than HIV- students		2) Bennett et al, 1992a
	3) 43% of total charges for HIV+ individuals accounted for by outpatient care in Denver	3) Outpatient care important	3) Reitmeijer, 1993a
TB/HIV epidemic	1) TB hospitalisations increased 148% 1983-90 in New York City, from 3 233 to 8 016; total cost in 1990 estimated as US$179 million. HIV+ TB admissions increased 4 216%, from 97 (3% total) to 3 687 (46% total); 55% TB patient days associated with HIV infection, with length of stay longer for HIV+ TB patients (30 vs 20 days)	1) First study on economic impact of resurgent TB; impact tracked evolution of HIV epidemic	1) Arno et al, 1993
	2) Hospitalisations due to TB doubled in USA 1985-90, costs increased 3x, total cost over period estimated as US$0.9-1.1 billion		2) Rosenblum et al, 1994
Specific patient groups	1) 30% of paediatric AIDS patients hospitalised over 6-month period in major survey		1) Fahs et al, 1991
	2) Male injection users with AIDS 20% more likely to be hospitalised than women with AIDS		2) Hellinger, 1993a

They are also difficult to interpret because the only study that included random allocation to the treatment reported data for a one-year period only (Scitovsky et al, 1990). The weight of evidence suggests it increased demand for care, especially given that the authors who used particularly large databases and were able to make direct comparisons between HIV+ patients using and not using ZDV (e.g. Cosler and Lambrinos, 1992; Beck et al, 1996a) reached this conclusion. Though it is still rather early to draw definitive conclusions, research to date indicates that combination therapy has reduced demand for inpatient care.

Table 3.2: Summary of studies concerned with impact of HIV/AIDS on demand for care in Western Europe

Subject of Study	Main Findings	Main comments	Source, Date
Multi-country impact of AIDS on hospitals	1) Provision of care projected to require 10 000 to12 000 beds in the EU in 1999, a 20-60% increase compared to estimated 1995 level. This demand required a maximum of 0.7% of total European Union hospital beds	1) Demand not high in context of health sector as a whole	1) Postma et al, 1997
Impact on hospitals, national level	1) Demand doubled in the Netherlands 1987-91 2) 220 hospital beds required in Netherlands if incidence stabilised, and total costs would account for approx. 0.5% all hospital costs 3) 22 000 AIDS patients estimated to be treated in Spain in 1995, and together with pre-AIDS HIV+ patients would account for 3 million hospital stays. This demand estimated to require 8 000 dedicated beds 4) Drug users accounted for 1.2% of male hospitalisations and 0.4% of female hospitalisations, large fraction of these HIV-related	2) Limited demand compared to other diseases 4) Limited impact in context of all health services	1) Dijkgraaf et al, 1995 2) Postma et al, 1995 3) Antonanzas-Villar, 1995 4) Van Haastrecht et al, 1996
In-patient care, specific areas	1) 46 beds estimated to be required in London, UK in 1986 (total number of beds in London not quoted to set in context) 2) 2 069 admissions 1985-92 among HIV+ patients in Edinburgh, UK, with 21 934 bed-days utilised (52% by AIDS patients). By 1992 each registered patient used 1 admission and 11.6 bed-days each year. Fraction of admissions to Regional Infectious Diseases Unit accounted for by HIV/AIDS patients rose from 15% to 21%; fraction of bed-days increased 25% to 32% (figures not set in context of all hospital services)		1) Johnson, 1986 2) Brettle et al, 1994

3.2.2 The impact of HIV/AIDS on demand for health care services in developing countries

HIV/AIDS is likely to result in an increase in demand for health care in developing countries for the same reasons that apply to developed countries, but predictions about demand for care are hampered to an even greater degree (though antiretroviral treatments and many prophylactic treatments that are now the standard of care in wealthier countries are still largely irrelevant). There is much more uncertainty about both the proportion of people who seek care and the numbers of people who are

Table 3.3: Summary of studies concerned with impact of antiretroviral therapy on demand for care

Subject	Main Findings	Main comments	Source, Date
Zidovudine (ZDV) monotherapy	1) Hospital admissions fell 4-fold and bed-days 9-fold after introduction in San Francisco, USA	1) Effects might be temporary*	1) Scitovsky et al, 1990
	2) 2-fold reduction in time spent in hospital among AIDS patients treated in 9 of the 20 hospital units with the highest AIDS caseload, after introduction in Italy		2) Greco et al, 1990
	3) Increased utilisation of health care among Medicaid patients in New York, USA	3) Findings contradict 1)	3) Cosler, Lambrinos, 1992
	4) Increased utilisation of health care among AIDS patients in Maryland, USA		4) Moore et al, 1994
	5) Increased utilisation of health services in London, UK		5) Beck et al, 1996a
	6) In Edinburgh, UK, decline in hospital use by AIDS patients first 2 years after introduction; by 1990 utilisation back to 1987 levels		6) Brettle et al, 1998
Combination therapy	1) Associated with 35% fall in hospital bed-days in 10 French AIDS reference centres		1) Mouton et al, 1997
	2) In Edinburgh, UK, associated with 39% reduction in admissions, 44% reduction in bed-days; fall in drug use associated with opportunistic infections (e.g. by 20% for anti-CMV** therapy)	2) Caution required: effects of ZDV proved temporary	2) Brettle et al, 1998
	3) Use of inpatient care decreased among Medicaid patients in USA, total costs stable	3) good clinical outcomes for no increase in cost	3) Gebo et al, 1999
	Geneva Abstracts, 1998 World AIDS Conference		
	4) By 2000, bed needs in EU projected to fall by 30% compared to 1995 levels (8 100 beds required) under HIV combination therapy scenario but increase 60% (to 0.65% of all beds in EU) in an AIDS combination therapy scenario	4) Decreases might be transient; lifetime needs might increase	4) Postma et al
	5) Cost-neutral for US Medicaid programme if 18% fall in drug prices	5) New ARVs affordable	5) Kahn et al,
	6) Associated with reduced hospitalisations and antibiotics cost-savings in Marseille	6) May be cost-neutral	6) Estadieu et al
	7) Associated with reduced hospitalisation in Colorado (6.4 to 1.1 days/patient year), reduced inpatient costs (by US$1.4 million 1995-6), fall in incidence of PCP, MAC and CMV		7) Johnson et al
	8) Associated with fall in total hospital costs, increased outpatient/day hospital costs in Toronto		8) Chan et al
	9) Associated with falling hospitalisations (-37%) and increase in outpatient visits (+26%) and day hospital admissions (+6%) in Paris	9) need to follow up to see if results persist	9) Bourdillion et al
	10) Associated with 30% fall in total AIDS hospitalisations patients 1996-7 in Paris hospital		10) Chieze et al
	11) Associated with decreases in total HIV+ hospitalisations in one Barcelona hospital		11) Domingo et al
	12) Total annual cost of ARVs C$62.4 million per year in Ontario, Canada	12) ARVs = 50% HIV-related costs in Ontario	12) Palmer and McMurchy
	13) Cost/month for hospital care reduced by 79%; nursing home care costs/month fell 94%; home health care costs/month fell 96% (mostly due to reduction in CMV), in West Los Angeles.	13) Combination therapy has reduced care costs	13) Ruane et al

* mortality may be postponed, but new diseases may replace classic HIV-related problems e.g. increase in malignancy and ischaemic heart disease secondary to highly-active antiretroviral therapy

** CMV= Cytomegalovirus

Table 3.4: Impact of HIV/AIDS on demand for care, Central, West and East Africa

Country	Main Findings	Method	Source
Côte D'Ivoire	1) 50% medical admissions HIV+ in 2 Abidjan hospitals in 1991* 2) 21% hospital beds occupied by AIDS patients, 7% total health expenditures for AIDS treatment in 1995 3) Health sector "little challenged" by HIV/AIDS. Few hospitals had occupancy rates >100%; suggest most care costs borne by households	1) Survey 2) Rapid appraisal** 3) Survey of patients health staff/facilities	1) Lucas et al, 1993 2) Shepard et al, 1996 3) Soucat et al, 1998
DR Congo	1) AIDS = 19% health expenditures 1988 2) 50% medical admissions to tertiary referral hospital in Kinshasa were HIV+; 25% had AIDS; 53% beds occupied by HIV+ patients, in 1989	1) Rapid appraisal 2) Survey	1) Over et al, 1988 2) Hassig et al, 1990
Guinea-Bissau	1) 20% medical admissions to National hospital in capital city HIV+ in 1989/90; 8% had HIV-related disease, 4% had AIDS	1) Survey	1) Naucler et al, 1991
Kenya	1) HIV+ medical admissions per day rose from 4.3 in 1988/9 to 13.1 in 1997; HIV prevalence increased from 19% to 40%. Total admissions increased 37%. Between 1992 and 1997 fewer HIV+ patients presented with AIDS, indicating chronically ill HIV+ patients no longer using the hospital 2) 57% increase in TB caseload at Infectious Diseases Hospital in Nairobi 1985-90 3) AIDS estimated to account for 23% total health spending in 1990, if every case sought care	1) Surveys 2) Routine data 3) Rapid appraisal	1) Gilks et al 1992; Gilks et al, 1998; Arthur et al, 1998 2) Nunn et al, 1993 3) Ainsworth and Over, 1994
Malawi	1) TB admissions increased 288% 1987-94 in Zomba, an urban area; much of this linked to HIV 2) AIDS estimated to account for 35% of health sector spending, if every case sought care	1) Routine data, survey 2) Rapid appraisal	1) Harries et al, 1997 2) Ainsworth and Over, 1994
Rwanda	1) HIV estimated to cause 20 000 to 29 000 extra hospitalisations p.a., substantial in context of 185 919 nationally, in 1990 2) Estimated 66% of total health spending in 1990 accounted for by AIDS patients, if all cases sought care 3) 57% medical admissions HIV+ in main Kigali hospital, 19% had AIDS	1) Cohort study 2) Rapid appraisal 3) Survey	1) King et al, 1994 2) Ainsworth and Over, 1994 3) Ladner et al, 1995
Tanzania	1) 3% of total factory clinic attendances in Mwanza = HIV-related 1991-4 2) Estimated 31% of total health sector expenditure accounted for by AIDS patients in 1988 3) Up to 50% government recurrent budget in 1991 accounted for by AIDS patients 4) AIDS patients could account for 41% of total health spending in 1990 5) Estimated 14% of total health sector expenditure in 1993 accounted for by AIDS care 6) Medical ward admissions to Bugando Medical Centre, Mwanza, fell (1641 to 1309) 1994-6; % beds occupied by HIV+ patients fell from 48% to 38%.	1) Survey 2)-5) All rapid appraisals 6) Survey and routine data	1) Kikumbih et al, 1997 2) Over et al, 1988 3) World Bank, 1992 4) Ainsworth and Over, 1994 5) Shepard et al, 1996 6) Kaluvya et al, 1998
Uganda	1) 56% of medical admissions in one Kampala hospital HIV+ in 1992; 22% fitted clinical case definition for an AIDS case 2) Drugs for AIDS patients could consume substantial part of national health budget	1) Survey 2) Empirical data analysis	1) Tembo et al, 1994 2) Okello, 1991

*it is important to note that no study reporting HIV prevalence among admissions used attributable fraction calculations to indicate what proportion of these might actually be *attributable* to HIV infection

** rapid appraisal means that estimates were established in a limited period of time with recourse to estimation of several key influences on demand for care and utilisation of only readily available data

infected; there is much more uncertainty about where people seek care; and there is much more uncertainty about the natural history of HIV infection (which cannot be readily extrapolated from, for example, US or UK data-sets, because general levels of health status, predisposition and exposure to different diseases are markedly different). There is also still a great deal of stigma surrounding HIV/AIDS.

The studies that have been done are summarised in Tables 3.4–3.6. These cover a variety of countries, with relatively more for East and Central Africa than other regions. Many studies have been based on rapid appraisal methodologies, typically involving use of local clinician opinion concerning HIV-related morbidity and associated health services utilisation, estimates of the national number of AIDS cases, and assumptions concerning what proportion of people seek care. Surveys tend to be focused on medical wards, and have commonly been undertaken in urban areas – often capital cities. Overall, most studies indicate that the impact in developing countries is highest – and substantial - in Africa. There are few empirical data for outpatient services, but those that exist indicate that the biggest impact of HIV is at in-patient hospital level.

Other related literature

Apart from studies that have attempted to measure or model demand for care for particular countries, there has also been one attempt to illustrate the potential impact of HIV/AIDS more broadly (DeCosas and Whiteside, 1996; see also Lancet editorial 1995). Using the modelling assumptions and results of the World Bank assessment in Tanzania in 1992 (Table 3.4), and an analysis of medical insurance claims in Zimbabwe, it was estimated that morbidity for adults with AIDS was between 170% to 340% higher (Tanzania data) and 700% higher (Zimbabwe data) than that of an HIV-adult. It was then assumed that all HIV+ individuals will develop AIDS after 6 years and that additional demand for health care occurs only in the last year of life. Low and high estimates of additional health demand over a period of six years for different levels of HIV seroprevalence were then projected. This was done by dividing assumed seroprevalence by six and then multiplying the resulting figure by 700 and 170 for the high and low estimates respectively.

Methodological

No published literature has specifically addressed methodological issues in assessing the impact of HIV/AIDS on demand for care. However, it is worth noting that it has been pointed that many studies have not captured the full extent of HIV/AIDS disease, focusing on AIDS and often not capturing early HIV-related morbidity (Gilks, 1993); and that figures for the percentage of patients in hospital who are HIV+ can be a misleading, since not all HIV+ people are in hospital because of their HIV infection (Buvé, 1997: see 3.4 and Chapter 4 for a fuller discussion of this point).

Table 3.5: Impact of HIV/AIDS on demand for care in Southern Africa

Country	Main Findings	Method	Source
South Africa	1) Cost of AIDS estimated to vary from R197 million-R9.6 billion in 1995 and R6-90 billion in 2000	1) Rapid appraisals and models, assumed all cases seek care	1) Spier, 1990; van der Merwe, 1988; van Nierkerk, 1988; Taylor, 1991; Osborne, 1990; Whiteside, 1990
	2) R94 million in 1991 and R7.4 billion in 2000, 0.5-0.8% health expenditure in 1991 and 34-75% in 2005. Dominant cost hospitalisation for AIDS care (76-83% costs in 2000)	2) Rapid appraisal and model; did not assume all cases would seek care	2) Broomberg et al, 1991
	3) 16% HIV prevalence rate among hospital patients in KwaZulu-Natal, and up to 50% in one TB specialist hospital. TB most common HIV-related disease reported	3) Survey of health staff perceptions	3) Whiteside and Wilkins, 1994
Swaziland	1) HIV/AIDS had potential to cause 50% of beds to be occupied by HIV+ patients, could be 10% if primary health care/clinic network better used	1) Rapid appraisal	1) Whiteside and Wood, 1994
Zambia	1) HIV-related disease 39% of admissions, 51% of patient days, 47% of total costs in one rural Zambian hospital in 1991. TB most important single disease – 42% of HIV-related disease costs, 48% of bed-days and 8% of all admissions. Average length of stay much longer for HIV+ patients. 3% of clinic attendances had HIV-related disease. 7.3% of outpatient attendances had signs and symptoms characteristic of HIV disease	1) Survey and detailed costing	1) Foster, 1996
	2) 62-75% admissions to four different medical wards HIV+ in teaching hospital in Lusaka in 1992	2) Survey	2) Foster, 1993
Zimbabwe	1) AIDS may have accounted for 27% of total health sector expenditures in 1990	1) Rapid appraisal	1) Ainsworth and Over, 1994

Table 3.6: Impact of HIV/AIDS on demand for care outside sub-Saharan Africa

Country	Main Findings	Method	Source
Brazil	1) 1.4% health sector expenditure in 1995	1) Rapid appraisal	1) Shepard et al, 1996
Haiti	1) HIV+ patients had higher number of admissions than HIV- controls (3.9 vs 2.7), though if hospitalised length of stay similar; and more outpatient visits (3.9 vs 2.9), in 1990/1	1) Survey	1) Ollé-goig et al, 1994
Mexico	1) 0.8% health sector expenditures consumed by AIDS in 1988 2) AIDS care estimated 1.9% of 1996 total health sector expenditures, prevention 0.2%	1) Rapid appraisal 2) Rapid appraisal	1) Tapia-Conyer et al, 1990 2) Shepard et al, 1996
Puerto Rico	1) Paediatric AIDS accounted for 1 320 patient days, total cost US$874 216, in country's largest public teaching hospital in 1991/2 (not set in context of total health sector expenditure)	1) Empirical data	1) Rodriguez et al, 1993
Thailand	1) AIDS treatment estimated 1.5% of all health sector expenditure; prevention 2.7%, in 1994 2) Total costs estimated as US$0.8-1.7 million in 1991 and US$21-65 million in 2000 3) AIDS patients treated in Bangkok hospital observation room rose from 572 to 1205 1993-5 4) Rise in TB caseload linked to HIV in Chiang Rai 1987-95, though increase not consistent year-on-year	1) Rapid appraisal 2) Rapid appraisal 3) Empirical data 4) Routine data	1) Shepard et al, 1996 2) Viravaidya et al, 1993 3) Suwanagool et al, 1997 4) Supawitkul et al, 1998

3.2.3 The impact of HIV/AIDS on the supply of health care services in developed countries

The additional demands placed on health systems by the HIV/AIDS epidemic would be expected to generate some supply-side responses – for example, attempts to reduce length of stay or costs; restrictions on what type of patients are admitted to hospital; and rising bed occupancy. Better understanding of HIV over time may also affect how care is supplied. In addition, HIV/AIDS is likely to have a very direct impact on the supply of care by causing morbidity and mortality among health staff themselves.

Those studies that offer relevant data consistently suggest that average length of hospital stay among HIV+ people has declined over time, and that admissions per year have been reduced. For example, in Maryland the average length of stay among HIV+ patients fell from 11.7 in 1988 to 9.5 days in 1992 (Fortgang and Moore, 1995). In Vancouver, Canada, admissions per patient fell 1987-91, linked to aggressive out-patient management, primary and secondary prophylaxis for pneumomcystis carinii pneumonia (reported as the first AIDS-defining condition in 50% of patients), and use of antiretroviral drugs (Goldstone, 1992). Also in Canada, length of stay was reported to have fallen dramatically across 10 hospitals in Ontario 1991-4 (Hyland, 1997). In Europe, a 40% reduction in length of stay was found among 121 symptomatic patients studied in the Netherlands 1987-91 (Dijkgraaf et al, 1995); and a shift to outpatient care and reduced hospitalizations is supported by detailed studies in London (Beck et al, 1994 and 1996b – see also section 3.2.7) and recent studies from Canada and the USA (Robinson et al, 1998, in Ontario; Turjanica, 1998, in Virginia).

It has been concluded that ownership is a strong determinant of investment in HIV-related services in the USA (Le Blanc and Hurley, 1995). For-profit hospitals were least likely to formally provide HIV-related services; those providing comprehensive care were typically either secular not-for-profit or public hospitals.

3.2.4 The impact of HIV/AIDS on the supply of health care services in developing countries

HIV/AIDS would be expected to have an effect on the supply of health care in developing countries for the same reasons that apply to developed countries. However, in principle the impacts may be more marked: the epidemic is of much greater magnitude; the supply of trained health care professionals is more limited; adjustments may have to be more drastic given greater constraints on resources; and there is probably less margin to cope with more demand for care.

In Zaire, it has been argued that the substantial numbers of HIV+ admissions in the tertiary referral hospital in Kinshasa, Zaire, were crowding out (displacing) HIV- patients (Hassig et al, 1990). This was supported by evidence that mortality rates had risen among the HIV-

patient population, and that the hospital had been functioning at capacity before the advent of the HIV/AIDS epidemic. A similar interpretation was made using data from Kenyatta National Hospital in Nairobi (Arthur et al, 1998; Gilks et al, 1998). Mortality rates among HIV- patients increased between 1988/9 and 1992, and the case mix among this group shrank, suggesting that only the most sick HIV- patients were being admitted and that rationing of care in favour of HIV+ patients was occurring. In addition, the hospital did not appear to be adjusting to more HIV+ admissions through reduced length of stay: instead, this remained unchanged while bed occupancy rose from 100% to 187%. Also in Nairobi, bed occupancy at the Infectious Diseases hospital increased from 68% to 81% 1985-90, possibly linked to the 57% increase in patient numbers (Nunn et al, 1993).

Detailed data have also been reported for a rural district hospital in Zambia (Foster, 1996). HIV/AIDS (see section 3.2.2) did not appear to have been associated with large increases in bed occupancy (78% in 1991 compared to an average 82% for the province as a whole in 1988 - though rates were not quoted for the adult medical wards specifically where HIV disease was concentrated, and figures there may have been higher). This Zambian case-study also included an analysis of the direct impact of HIV on the supply of health care staff. The rate of nursing absenteeism was reported as 16%, half of which was due to illness among nurses themselves and half to time spent caring for others. Mortality rates among nurses had risen from 2 per 1000 nurse-years in the 1980-5 period to 26 in the period 1987-89. Also in Zambia (Foster, 1993), average length of stay was reported to have fallen to 4 days in the University Teaching Hospital in the capital city, Lusaka (earlier comparative figures were not quoted). Doctors were reported to be concerned that patients with chronic conditions such as diabetes, hypertension, stroke and malaria were being discharged too early - after 4-5 days rather than the 15 that would have been typical ten years earlier. Bed occupancy had increased for the hospital as a whole, from 97% in 1989 to 120% in 1992.

Most recently, it has been reported that mean length of stay fell from 19.5 to 12.7 days in one hospital in Tanzania 1994-6, mainly due to earlier discharge of TB patients. The recent fall in HIV+ medical admissions was also linked to changes in health-seeking behaviour (as in Kenya, interestingly – see Arthur et al, Table 3.4), general health sector changes, and changes in hospital admission and discharge policies (Kaluvya et al, 1998). In Brazil, a decline in AIDS hospitalisations covered by the Brazilian Unified Health System (SUS) 1995-6 has been associated with a trend towards outpatient care and the use of new AIDS drugs (Portela et al, 1998)

3.2.5 The cost of HIV/AIDS prevention

A sizeable number of studies concerned with the cost-effectiveness of prevention report cost data. A more limited number of studies have been concerned with costs only, and it is these that are covered in this section.

The costs of six broad prevention strategies have been estimated for different parts of the world, using case studies selected on the basis of availability of cost and output data, and likely generalisability (Soderlund et al, 1993). The per capita cost of each strategy was: US$0.06 to US$0.3 for mass media programmes; US$0.5 to US$1.9 for person-to-person education; US$0.1 to US$0.7 per condom distributed; approximately US$10 for STD treatment and prevention services when these were delivered through general primary care services and US$50 when provided as a targeted intervention; US$2.3 to US$12.6 for prevention of unsafe drug practices among injecting drug users; and US$34.5 to US$51.6 per unit of safe blood provided for transfusion. The annual global cost of implementing these strategies was appraised as between US$1.5-2.9 billion; half of this amount would be needed for Asia; 15% for Africa. This is large in the context of total global spending of US$2.6 billion circa 1993, 86% of which was in "high-economy" countries (Laws, 1996).

Other global cost assessments related to prevention include an appraisal of the likely costs of an HIV vaccine programme. This suggested that the cost would be likely to be several billion dollars (Petricciani, 1993).

In the USA, mandatory premarital HIV screening was estimated to cost US$167 million nation-wide in the USA in 1988 (Peterson et al, 1990). This was judged to be expensive in the context of other HIV prevention programmes (80% of the cost of all spending by CDC on public health HIV control measures). Also in the USA, an appraisal of the cost of a mandatory HIV and Hepatitis B programme designed to prevent patients being exposed to health care workers with HIV or Hepatitis B infection (Geberding, 1991) in one public teaching hospital in California suggested that the costs of a national programme would be "staggering" (though the analysis was criticised in a subsequent paper – see La Croix and Russo, section 3.2.14[5]).

Methodological papers

Only one paper has specifically addressed methodological issues (Gorsky, 1996). This suggested a methodology for assessing the costs of counselling, including how to identify the resources used in counselling, determining unit costs, and calculating total costs. The paper was designed to provide a standardised framework, particularly relevant to cost-effectiveness and cost-benefit analyses.

3.2.6 The cost of care where the focus is on both developed and developing countries

Most research concerned with the cost of care has focused on either a single developed or developing country. This is reviewed in sections 3.2.7 and

[5] For example, financial rather than economic costs were considered; some costs were included as "additional costs" whereas they would have been incurred anyway, in the absence of a screening programme; and the costs of a national programme were not compared with the benefits that could be associated with it).

3.2.8. Only five studies that simultaneously addressed costs of care in both types of setting were identified. One of these is essentially a review of the results of other studies (Over and Scitovsky, 1988); these individual studies are covered in the relevant sections (either 3.2.7 or 3.2.8) below.
Two studies have estimated the cost of providing triple combination therapy in different regions of the world, and related this to overall resource availability (Floyd and Gilks, 1997; Hogg et al, 1998). Both concluded that treatments were unaffordable at 1997/1998 prices in most regions of the world, especially Africa. Costs would exceed existing health sector expenditures in some cases and in Africa could exceed GDP if provided to all people living with HIV or AIDS. Treatments were clearly affordable in North America and Western Europe (<1% total health expenditure), and might be affordable in the Caribbean and Latin America, especially if restricted to those with AIDS. A third study (Sclar et al, 1997) provided a quantification of likely total costs for therapy, but did not set these in context.

The one cross-cutting study that has not been concerned with antiretroviral treatments has estimated the relationship between AIDS care costs and per capita GNP, using linear regression analysis and data for a variety of countries. This indicated that AIDS care costs per year could be estimated as 2.7x per capita GNP (Ainsworth and Over, 1997).

Methodological

Methodological issues in costing HIV/AIDS care were considered in some detail by Over and Scitovsky (1988). Key issues highlighted included:

- the distinction between the cost of care actually provided and the cost of ideal/standard of care treatment;
- whether patients studied are chosen at random or are convenience samples;
- whether costs or charges are considered;
- the absence of purchasing power parity rates for developing countries, making conversion of costs into a truly common currency difficult; and
- the distinction between lifetime costs, costs per patient alive at any time, and costs per person year.

They recommended that costing studies should in future:

- be based on prospective random samples with patients followed for at least 1-2 years;
- collect detailed data on resource use, including for a sample at least data on drugs and other out-of-pocket expenditures;
- compare the cost of HIV/AIDS with other diseases; and
- present lifetime and cost per person year figures to avoid confusion when different life-spans are assumed.

3.2.7 The cost of care in developed countries

There have been numerous studies concerned with the cost of HIV-related health care in developed countries.

Costs of care for AIDS

Most early studies (Tables 3.7 and 3.8) focused on the medical care costs associated with an individual with AIDS i.e. they did not include the costs associated with pre-AIDS morbidity. Absolute costs are generally high though variable (e.g. US$20 000 to US$147 000 in the USA) among countries and over time.

Table 3.7 Estimates of the cost of AIDS care in the USA, entire period with AIDS unless stated (*indicates outpatient costs were included)

Place	Year	Cost	Source
Virginia	1983-6	US$27 264	Kaplowitz et al, 1988
San Francisco	1984	US$27 571	Scitovsky et al, 1986
Atlanta, Georgia	1984	US$147 000	Hardy, 1986, based on 35 cases
Washington State	1984/5	US$19 200	Lafferty et al, 1988
Massachussetts	1984/5	US$46 505 per year (91% for inpatient care)	Seage et al, 1986, based on 45 AIDS patients*
Maryland	1979-85	US$26 828	Berger, 1985
USA as a whole	1985	US$37 600 per year	Andrulis et al, 1987 (national survey)
New York	1985	US$38 200	Thomas and Fox, 1988
California (medicaid enrollees)	1985/6	US$20 000 to US$30 000 (inpatient expenditure 90-94% total)	Andrews et al, 1991*
USA as a whole	1986	US$20 354 to US$54 250 per year	Scitovsky and Rice, 1987*
Los Angeles, California[6]	1986/7	US$55 600 for year after diagnosis	Pascal, 1990*
USA as a whole	1987	US$27 950-40 455 per year	Hay et al, 1988*
California	Patients diagnosed 1984-90	US$57 514 for terminal care (91% for inpatient care) for patients diagnosed 1984-7; US$53 347 for terminal care (91% for inpatient care) for patients diagnosed 1987-90	Bennett et al, 1995
Brooklyn, New York	1989/90	US$33 002 per year among IDUs (73% for inpatient care)	Bennett et al, 1992b*
USA as a whole	1992	US$38 300 per year, lifetime with AIDS cost = US$102 000	Hellinger, 1992*
USA as a whole	1993	US$69 100	Hellinger, 1993b*

In addition to these studies, it has also been reported that much of the cost of care for AIDS patients can be concentrated in the period immediately preceding death (Fleishman et al, 1995) and in the last three years of life (Schneider et al, 1998). The tendency for early cost estimates to be too high and the implications of this has also been highlighted: it has been

[6] study included costs for non-formal care provided by family and volunteers (others do not)

argued that the consequences of initial over-estimation in the USA included successful lobbying by the insurance industry to screen applicants for HIV (Green et al, 1994).

Table 3.8: Costs of care for people with AIDS in developed countries outside the USA, entire period with AIDS unless stated (*indicates outpatient costs included)

Place	Year	Cost	Source
Australia	1986	US$15 800	Whyte et al, 1987
Belgium	late 1980s	US$21 000 per year	Lambert, Carrin, 1990
Canada	1983	US$32 100 to US$44 900	Fanning et al, 1987
France	1986	US$ 21 900	Drummond and Davies, 1988
Germany	1987	US$12 600-40 200	Drummond et al, 1988
Italy	1990	US$10 505 to US$27 764 per year	Tramarin et al, 1992
New Zealand (Auckland)	1988	Varies from <NZ$1 000/month to NZ$3 500 per month	Carlson et al, 1993
Spain	late 1980s	US$25 400 to US$27 800	Ginestal et al, 1990
Switzerland	1988	US$57 000 per year	Cameron, Shepard, 1990
UK (London)	1985	UK£6 800, based on 33 cases	Johnson, 1986
UK (London)	1983-9	Varied from UK£8 163 to £42 214 in 1989; average of £35 649 per year in 1983, £13 224 in 1989	Beck et al, 1994 and 1996b*
UK	1986	US$36 300	Rees et al, 1988*

Studies providing costs according to stage of infection

Studies of costs that have divided HIV infection into three distinct periods are summarised in Table 3.9. These generally find that costs per year increase as patients change from being asymptomatic to having symptomatic HIV disease to being diagnosed with AIDS.

Table 3.9: Examples of annual costs according to stage of infection

Place, time	Asymptomatic	Symptomatic non-AIDS	AIDS	Source
Germany, 1985-6	DM8 000 (87% inpatient care)	DM9 500 (92% inpatient care)	DM24 000 (97% inpatient care)	Beske et al, 1988
Holland, 1987-9	US$2 064	US$1 769[1]	US$19 507	Borleffs et al, 1990
London, 1989	UK£938 (outpatient costs > inpatient costs)	UK£3 070 Per year	UK£13 324 per year	Beck et al, 1994
Sheffield, UK, 1984-93	UK£1 001 (1993 prices)	UK£3 683	UK£14 131	Nageswaran et al, 1995
London, 1992-3	UK£4 515	UK£8 836	UK£15 268	Petrou et al, 1996

[1] The reduction in cost from asymptomatic to symptomatic was commented on by the authors, who suggested that further research was required to explain it

Other studies have used other categorisations of HIV infection. In a number of related studies in the USA (e.g. Hellinger: 1992, 1993b), estimates of total costs for the entire period spent in four distinct disease

stages have been produced. The methodology for each study was similar; examples from the most recent study (1993) estimated costs of US$69 100 for AIDS; US$12 276 for HIV positive without AIDS, CD4 count <200; US$18 920 for HIV positive without AIDS and CD4 count 200 to 499; and US$18 978 for HIV+ without AIDS with a CD4 count above 500.

Interestingly, an analysis using Denver Department of Health data has illustrated that these national forecasts may substantially over-estimate costs in some areas of the country (Reitmeijer, 1993b). For each stage of disease, much lower costs were identified (e.g. US$19 702 for AIDS). However, the increase in costs by disease stage was replicated, as it has been in several other studies (Weiss, 1993; Byornson et al, 1991; Moore, 1998; Moore and Chaisson, 1997a; Hurley et al, 1995; Kennelly et al, 1995; Pene et al, 1990; Seror et al, 1995); and in an analysis based on treatment protocols rather than empirical data (Gable et al, 1996).

Some research has simply compared patients with AIDS with patients who are asymptomatic or defined as "non-AIDS", finding much higher costs for both adult (Bez, 1989; and Viens-Bitker et al, 1991, in France; Brettle et al, 1997, in Edinburgh, UK) and child (Carlin et al, 1996, in Australia; Hsia et al, 1995, in the USA; Sculpher et al, 1998, in the UK) AIDS patients. These findings are supported by earlier studies for staging definitions used at the beginning of the epidemic, which found that AIDS was much more costly than "AIDS-related complex" (Hay et al, 1988; Seage et al, 1988).

Only two studies have suggested that costs may not always increase consistently by stage of infection. In one case this may reflect the fact that the analysis was restricted to drugs (Serrais et al, 1997). In the other, it was pointed out that large variability in costs means that they do not always increase consistently from one stage to the next (Seror et al, 1995).

Lifetime costs of care

Lifetime costs of care for HIV infection have been estimated in a variety of studies. A series of detailed analyses to estimate lifetime costs of care for adults in the USA has been produced (Hellinger: 1988; 1991; 1992; 1993b). These used data from the AIDS Cost and Service Utilisation Survey, estimates of the time spent in each stage of infection from the San Francisco Men's Health Study, and the assumption that a person would be identified and treated immediately following infection. Lifetime costs were estimated as US$57 000 in 1988, US$75 000 in 1990, US$85 333 in 1991, US$102 000 in 1992, and US$119 274 in 1993. Increases reflected increased longevity and higher hospital charges. Another estimate was even higher - US$133 500 among Medicaid patients in Maryland 1992-5 (Moore and Chaisson, 1997a). The most recent assessment suggests a lifetime cost of US$195 000 in 1997, with the much greater cost explained by recent but expensive advances in treatment, increased survival due to the use of highly-active antiretroviral therapy, and use of the newly recommended 3% (as opposed to the previous 5%) discount rate (Holtgrave and Pinkerton, 1997a).

Outside the USA, lifetime costs have been estimated at US$70 000 in Australia in 1996, when discounted at 5%; but when adjusted to the 0% discount rate used by Hellinger, the figure was 17% higher than his latest figures for the USA (Hurley et al, 1996). In England and Wales, lifetime costs were assessed as £84 522 for those treated 1992-5 (Petrou et al, 1996).

Mean lifetime costs for children in the USA have been estimated as US$491 936 (83% for hospital care) 1987-95 (based on 29 children) and US$90 347 in New York (Hegarty, 1988). The discrepancy may reflect the small sample of the first study. A much lower figure – of US$48 174 – was obtained in an Australian study (Carlin et al, 1996).

The most recent assessment was based on UK data, where lifetime costs were estimated as £73 855 for children whose infection was identified early, following screening of the mother during pregnancy. The figure was £59 004 for children whose infection was identified later on, due to lower life expectancy and later initiation of treatment including antiretroviral therapies (Sculpher et al, 1998).

Cost comparisons other than by stage of infection

Comparative cost analyses for patients with HIV infection have not been confined to stage of infection. Other studies have suggested that annual costs of care are higher for children than adults in the USA (Parrott, 1991; Andrews et al, 1991), and that among adults costs may be higher among IDUs compared to other HIV+ patients (Andrews et al, 1991; Stein, 1994; Seage et al, 1993). One study indicates that costs may be higher for women than for men (Andrews et al, 1991, in California); another suggests the opposite (Moore and Chaisson, 1997a).

It has also been reported that costs for those with AIDS who died over a given period were higher than for those alive at the end of the same period (Hellinger et al, 1994), and that lower costs may be associated with Health Maintenance Organizations (HMOs) compared with fee-for-service systems (Wilson et al, 1998).

Studies comparing HIV+ with HIV- patients

Compared with HIV- children, two studies have indicated that HIV+ children have higher costs per admission (Andrulis et al, 1990; Ball, 1989). For adults, costs have consistently been found to be higher for HIV+ patients, though different types of care were assessed: drugs (Bozek et al, 1995, in Maryland); outpatient visits (McDermott et al, 1991, in Auckland); hospices (Tehan, 1991, in California); and neurological disease (Dal Pan et al, 1997). Other comparisons have been more mixed. In Spain, HIV+ patients were lower cost than TB admissions but higher cost than patients with viral hepatitis (Rabanaque-Hernandez, 1992). In the USA, the lifetime cost of AIDS has also been assessed as less than that for end-stage renal

disease (Scitovsky et al, 1986). The total cost of HIV-related illness among immigrants to Canada has been evaluated as lower than that for coronary heart disease (Zowall et al, 1992).

Studies focused on costs of particular opportunistic infections

Some studies report the costs of particular opportunistic infections. The earliest detail was provided in 1986 and concerned the single admission costs of different diagnoses (Scitovsky et al, 1986). Costs varied substantially, with the lowest cost for diseases of the blood and the highest for pneumocystis carinii pneumonia (PCP). Charges paralleled lengths of stays. More recently, the mean cost of PCP per episode has been estimated in a US survey (Bennett et al, 1996).

Detailed cost estimates have also been provided for different opportunistic diseases in the USA, using treatment protocols (Gable et al, 1996). Examples included US$2 194 for oesophageal candidiasis; US$2 924 for tuberculosis; US$17 264 for cryptococcal meningitis; US$3 545 to US$32 609 for pneumonia, depending on severity; US$100 337 for cytomegalovirus retinitis; and US$5 902-US$10 744 for Kaposi's Sarcoma.

Costs of particular aspects of care

The costs of particular aspects of care have been the focus of a number of studies. Counselling and testing in the USA (Holtgrave et al, 1997b), HIV testing in antenatal clinics in London (Chrystie et al, 1995), investigations of patients following the discovery that they have been treated by an HIV+ physician (Danila, 1991), laboratory testing in the USA (Freedberg et al, 1994), voluntary screening programmes in Texas, USA (Harris et al, 1990), outpatient care in Puerto Rico and the USA (Nykamp et al, 1997), and oral health care in the USA (Schneider et al, 1993), have all been considered.

Trends in costs over time

Few studies have used longitudinal data to assess trends in costs over time. However, one very detailed study from London, UK, has provided evidence of declining annual per person care costs over time, particularly for AIDS patients. Reductions were mainly linked to reduced in-patient care (Beck et al, 1994; 1996b). Out-patient costs showed a tendency to increase, and drug costs increased markedly for those with asymptomatic or symptomatic HIV disease. Another study from the UK showed marked year on year variation and no clear trend (Nageswaran et al, 1994). Studies in the USA have also indicated falling costs per year over time (Andrulis et al, 1989; Scitovsky, 1989), though as suggested above, lifetime costs may have increased over time.

Impact of antiretroviral treatments on costs

The impact of antiretroviral treatments on the costs of care has been the subject of several studies. Three found that the introduction of ZDV therapy increased costs (Beck et al, 1996a, in London; Cosler and Lambrinos, 1992, in the USA; Moore et al, 1994, in the USA). The exception to this consensus is the first published study in San Francisco (Scitovsky et al, 1990). This found a reduction in care costs associated with ZDV use among seven patients followed up for a year as part of clinical trials of the drug in San Francisco. However, this was qualified by the observation that costs started to rise after 6 months, so that the authors concluded that cost reductions were likely to be temporary. Not surprisingly given its restriction to drug costs, another study in France reported that drug costs had doubled 1990-4, due to the introduction of new treatments (Peyron et al, 1997).

Early data concerning the impact of combination therapies suggested that they have increased costs for ambulatory HIV-infected people in the USA, especially those with AIDS (Perdue et al, 1998). However, a very recent study among Medicaid patients, also in the USA, indicates that while drug costs have increased, inpatient costs associated with opportunistic infections have fallen even more, and overall health care payments were found to be lower for those being treated with combination therapies that included protease inhibitors (Gebo, et al, 1999). This is consistent with UK research, where combination therapy has been reported as cost-neutral, due to reduced costs for opportunistic infections and hospitalisation (Brettle et al, 1998). Emerging research presented at the recent 1998 World AIDS conference largely supports these findings, with either significant reductions in total costs (Choudhri et al; Rains et al; Rawlings et al; all in the USA or Canada) or at least reductions in in-patient costs (McMurchy, in Canada; Le Pen et al, in Paris). However, two studies from Canada found the opposite. One reported non-pharmaceutical costs to be relatively unchanged except for those with CD4 counts <75 (Gill et al, 1998) and a second reported an increase in costs except for those with a CD4 cell count <75 (Ostrop et al, 1998).

Methodological

Literature specifically focused on methodological issues is rare. At an early stage of the epidemic, it was pointed out that most standard theoretical and statistical approaches were not applicable to assessing the cost of AIDS care because of the scarcity and non-representative nature of available data (Hay, 1988); methods for estimating the direct and indirect costs of illness in this context were discussed.

With the numerous costing studies that have now been done, this observation is less pertinent, and subsequent papers have also suggested approaches to costing (Lim, 1994; Scitovsky and Over, 1988). However, it is important to note that a study of HIV+ patient care costs between 1985 and 1989 (Solomon et al, 1992) found that 12-15% of care costs were unrelated to HIV infection. The authors used this finding to illustrate that

other care costs estimates might be over-estimates by an important margin, if they did not separate out HIV-related care from care not related to HIV.

Most recently, the effect of choice of discount rate and access to care on lifetime cost estimates has been illustrated, using the Hurley and Gable studies described above for illustration (Pinkerton and Holtgrave, 1997a). The importance of these issues for economic evaluations of prevention programmes was also highlighted.

3.2.8 The cost of care in developing countries

Cost of care for AIDS

Studies of the costs of AIDS in developing countries are summarised in Table 3.10 below. They have variously estimated costs for the entire

Table 3.10 Estimates of the cost of care for people with AIDS in developing countries (period with AIDS unless indicated)

Place	Year	Cost	Source
Barbados	1992	US$4 550	Roach and Martin, 1992
Benin	1996	US$170	Fourn and Ducic, 1996
Brazil	late 1980s	US$25 000	Cordeiro, 1988
Brazil (state of Sao Paolo)	1995	US$15 363 (3x per capita GNP)	Shepard et al, 1996
Brazil	1995/6	Cost/admission US$900 in a university hospital; US$480 in other hospitals	Portela et al, 1998*
Chile	late 1980s	US$1 560 per year	Quinn et al, 1990
Cote D'Ivoire	1995	US$1 037 (1.7x per capita GNP)	Shepard et al, 1996
Honduras	1992	US$500 to US$1 500 per admission	Flores et al, 1992*
Jamaica	1987	US$2 700	Jillson-Boostrom, 1987
Kenya	1992	US$938	Forsythe et al, 1992
Malawi	1992	US$210	Forsythe et al, 1993
Mexico	1990	US$1 430 per year	Tapier-Conyer et al, 1990
Mexico	1995	US$8 360 (2x per capita GNP)	Shepard et al, 1996
Mexico	1995/6	Average cost of hospitalisation/day US$187 Average hospitalisations per year = 1.3	Saavedra Lopez et al, 1998
Puerto Rico	1991-2	US$28 200 per year for hospital care in a teaching hospital; US$13 499/admission	Rodriguez et al, 1993*
Rwanda	1988-91	US$358 for hospital care	Shepard and Bail, 1991*
South Africa	1991	US$1 850-11 800	Broomberg et al, 1991
Tanzania	1987/8	US$104 to US$631 per "Symptomatic Adult"	Over et al, 1988
Tanzania	1992	US$290 per adult; US$195 per child	World Bank, 1992
Tanzania	1993	US$84 (0.6x per capita GNP)	Shepard et al, 1996
Thailand	1991	US$658-1 016 per year	Viravaidya et al, 1993
Thailand	1988-91	US$333 per admission for AIDS/ARC patients in provincial hospitals	Kongsin et al, 1993*
Thailand	1994	US$964 (0.4x per capita GNP)	Shepard et al, 1996
Thailand	1995	B1 132/month for patients attending HIV and counselling clinic	Suwanagool et al, 1997*
Uganda	1991	US$24.5/AIDS admission US$6.6 per outpatient visit	Okello, 1991*
Zaire	1987/8	US$132 to US$1 585 per "Symptomatic Adult"	Over et al, 1988
Zaire	1988	US$90 per hospital admission for an adult	Mposo et al, 1989*
Zimbabwe	1991	US$3 095	Hore, 1996*

**based on actual rather than theoretical cost and utilisation data*

period a person has AIDS, costs per year with AIDS, or costs per AIDS-related admission or attendance. Many are theoretical estimates, not based on resource use in practice. However, as suggested by Over and Ainsworth (1997), costs do appear to bear some relation to income levels.

Costs by stage of infection

Four studies have extended a cost analysis beyond AIDS to assess costs according to stage of infection. In one rural hospital in Zambia, costs were found to be highest for those in stage 3 (US$77), largely because this is how most HIV+ patients with pulmonary tuberculosis are classified (see Chapter 2). For those in stages 4, 2 and 1, average costs were US$66, US$40 and US$31 respectively (Foster, 1993; 1996). Also in Zambia, but in the University Teaching Hospital in Lusaka, costs for those with HIV disease but not AIDS were reported to be US$182 per year, and US$541 for those with AIDS (Hira et al, 1993).

In South Africa (Karstaedt et al, 1996), a retrospective review of 218 HIV+ patients who used inpatient services at Baragwanath Hospital in Johannesburg between 1988 and 1992 found that costs per year were R1 277 for stage 2, R2 161 for stage 3 and R6 783 for stage 4 (AIDS). A related study of outpatient services (Kinghorn et al, 1996) in the same hospital, using retrospective data concerning 179 HIV+ clients seen between 1989 and 1992, found a similarly consistent increase in costs by stage (R73-201 in stage 1, R135-513 in stage 2, R285-613 in stage 3 and R453-791 in stage 4).

Costs for particular diseases associated with HIV infection

Two studies have provided details concerning the costs for particular diseases related to HIV. In one rural hospital in 1991 in Zambia (Foster, 1996), the average cost of admissions for pneumonia, diarrhoea, peripheral neuropathy, Kaposi's Sarcoma, abscess, extra-pulmonary TB and pulmonary TB was US$5, US$37, US$56, US$86, US$88, US$91 and US$110 respectively. In Malawi, costs for different diseases associated with HIV were estimated among paediatric admissions to a hospital in Lilongwe, Malawi, in 1992 (Nelson et al, 1995). Costs for diseases that were particularly associated with children classified as "probably AIDS" were reported as US$5.7 per admission for diarrhoea, US$15.9 for malnutrition and US$5.9 for respiratory disease.

Costs for particular aspects of care

Other costing studies have focused on particular aspects of care. In Uganda, lifetime drug costs for AIDS patients were estimated as US$13.8, based on assumptions about the type and number of disease episodes (Armstrong, 1995)[7]. With WHO guidelines, costs would increase to twenty times this level. The total annual cost of drugs was also estimated for

[7] it is worth noting that, at the time of the study, Uganda had a very limited supply of drugs and laboratory tests

different diseases associated with AIDS for the period 1991-5, for a variety of formal health service utilisation rates. An earlier study in the country reported that in 1991, annual drug costs for an AIDS patient (based on a chart review of 785 patients) were US$15.7 for an adult and US$5.2 for children (Mubiru et al, 1993). However, these figures excluded tuberculosis drug costs. Also in Uganda, counselling costs were estimated as US$18 per visit in Uganda in 1992 and at US$12 in 1996 (Mansergh et al, 1996).

HIV testing costs have been assessed as US$7 for an ELISA test in Uganda (unpublished); and US$1.7 for the recurrent costs associated with testing one specimen in Mwanza, Tanzania 1988-91 (Kigadye et al, 1993). The cost of the HIV Dipstick test algorithm was estimated as US$3-3.8 per client tested in a study from three rural Zambian hospitals (Plourde et al, 1998), with the cost of different types of dipstick test also reported (US$2 for the PATH dipstick; US$2.8 for the Capillus dipstick; and US$3.5 for HIV-SPOT). In Burkina Faso, an integrated care package cost US$20/month per person (Sawadago et al, 1998).

The cost of home-based care has been analysed in three southern African countries. In Zambia, costs per patient per year were estimated as between US$39 and US$269, with community-initiated programmes found to have the lowest cost (Chela et al, 1993; Foster, 1993). In Zimbabwe, costs were US$16-42 per home visit in 1995 in three evaluated programmes (Hanson et al, 1995). In Botswana, the cost/home visit was appraised as US$19 in 1994 (Cameron et al, 1996).

Comparisons of cost of care for HIV+ and HIV- patients

Comparisons of the cost of caring for HIV+ and HIV- patients have been made in a number of settings. In Haiti, the annual cost of hospital care was approximately 71% higher for adult HIV+ patients compared to HIV- patients, and 32% higher per hospital admission (Ollé-goig, 1994). In Zambia, HIV- patients had lower costs per hospital admission than patients in stages 3 or 4, but higher costs than HIV+ patients in stages 1 or 2 (Foster, 1996). Among adult TB patients in Kenya, drug costs were higher for HIV+ patients in 1991 (Nunn et al, 1993). In Tanzania, outpatient costs at a factory clinic were 15% higher than those for HIV- clients (Kikumbih et al, 1997). Among children, studies have also indicated higher costs per admission for HIV+ patients in Zaire (Mposo et al, 1989), Malawi (Nelson et al, 1995), and South Africa (Robertson and Beatty, 1992).

Other research indicates that costs can be similar. One study in Zaire found no significant differences in costs per admission for HIV+ and HIV- patients (Hassig et al, 1989), though costs prior to admission were significantly higher for HIV+ patients. In South Africa, costs were also similar in one large teaching hospital (Karstaedt et al, 1996) and in a general hospital in Cape Town (Peter et al, 1994). A recent study from Kenyatta National Hospital in Kenya also indicates similar costs per admission (Gilks et al, 1998).

Methodological

One paper has been focused on methodological issues in costing HIV/AIDS care in developing countries (Over et al, 1989). It provides guidelines for rapid appraisal of the direct and indirect costs associated with HIV infection, in situations where time and available data are limited. For direct costs, they suggest interviews with clinicians for health service utilisation and estimation of unit costs from data for other diseases or analysis of institutional budget documents/records. For indirect costs, the human capital approach is recommended, with discounting and use of weights to account for productivity differences among age groups.

3.2.9 Ways of reducing the costs of care

Various studies have assessed how the costs of care may be reduced.

HIV testing

Strategies found to reduce HIV test costs have included use of particular peptides (Gueye-Ndiaye et al, 1993); use of Ministry of Health Guidelines in Ghana (Adu-Sarkodie, 1997); IVIAP (in vitro induced antibody production) testing (Bellei et al, 1996); use of the WHO testing strategy in Brazil (Carvalho et al, 1996); use of the Chiron RIBA HIV-1/HIV-2 Strip Immunoblot Assay instead of the Western Blot test (Kline et al, 1996); use of GACPAT, a modified commercial particle assay instead of ELISA testing (Klokke et al, 1995) in Tanzania; a testing algorithm using ELISA and HIV Chek with Western Blot used only for discordant results, in Zaire (Laleman et al, 1991; Van de Groen et al, 1991); use of the ICL Dipstick ELISA test, in Zimbabwe (Ray et al, 1997); use of a heat-mediated ICD p24 assay combined with a signal-amplification-boosted ELISA instead of polymerase chain reaction testing (Schupbach et al, 1996; Rich et al, 1997); use of cytopathic infectivity assays instead of p24 formats (Wu et al, 1996); and pooling of serum samples before testing (Tamashiro et al, 1993; Kantanen et al, 1996; Mendoza et al, 1996; Ghirardini et al, 1998).

Other tests related to HIV/AIDS

Strategies to reduce costs have also been suggested for other tests related to HIV/AIDS. These include use of a CD4 Test Kit instead of standard laser-based flow cytometry (Moss et al, 1996); monitoring of patients using total lymphocyte counts and beta 2-microglobin analyses instead of CD4 counts (Pascale et al, 1997); omission of the 0.001 microM concentration and using duplicate rather than triplicate wells for zidovudine susceptibility testing (Marschner et al, 1997); and use of absolute rather than CD4 lymphocyte counts for staging of disease (Beck et al, 1996c).

Home-based care

Studies also suggest that home-based care can help to reduce costs. This reduced the costs of care for AIDS patients with cytomegalovirus retinitis in Oxford, UK (Kayley et al, 1996), and was associated with a 6-7% reduction in care costs for AIDS patients in Vincenza, Italy (Tramarin et al, 1992). In a related study, the "balance of care" approach to planning was found to reduce home-based care costs by 9% (Tramarin et al, 1997). In the USA, an AIDS-specific Medicaid waiver programme to provide home and community-based care reduced costs by 22-27% per month for participants compared to those not accessing the programme (Anderson and Mitchell, 1997).

In developing countries, more mixed results have been reported. Using a spreadsheet model for Botswana, it has been suggested that the introduction of home-based care might lead to cost-savings in comparison with reliance on hospital-based care (Cameron et al, 1996). A 1993 study in Zambia was also optimistic (Chela et al, 1993). It estimated that home-based care would result in a 40% reduction in unnecessary hospital care for patients referred to home-based care compared to those not referred. However, this saving was not compared with the additional costs associated with home-based care. In Cape Town, South Africa, a home-based programme using lay people has been indicated to reduce costs compared with care provided by professional nurses (Scheepers et al, 1998).

Other studies have been more pessimistic. In addition to low coverage rates, costs appeared high in studies in both Zimbabwe and Zambia. In Zimbabwe, the cost of two home visits per week over an illness episode lasting 3 months was estimated to be equivalent in cost to 89 in-patient days in a rural area and to 38 in-patient days in one urban scheme. 56-75% of costs were for two items that were not of direct benefit to patients: transport and staff time spent travelling (Hanson et al, 1997). In Monze District, Zambia, one home visit was equivalent to 3.7 days in hospital (Foster, 1993).

Outpatient Care

Promotion of outpatient care has also been indicated to be capable of achieving cost-savings. It has been associated with significant cost-savings compared to hospital care for cytomegalovirus retinitis and severe recurrent candida (Wiselka and Nicholson, 1997), and administration of intravenous pentamidine treatment (Yeung et al, 1996).

In South Africa, promotion of one particular element of outpatient care - primary clinics - has been suggested[8]. In a sample of HIV+ patients attending a hospital outpatient department in Johannesburg, it was found that 80% could have been cared for at clinics, where care would have been lower cost (Kinghorn et al, 1996).

[8] however, it is worth noting that this may be difficult in practice. Concerns about confidentiality and visibility to the community mean that many people prefer to attend an anonymous hospital.

Other

Other cost-saving strategies that have been suggested include "carve-out contracting" in the USA, whereby the responsibility for managing specific types of care and its cost is contracted out to specialist providers, possibly on a capitated payment basis (Pristave et al, 1995); use of universal precautions rather than pre-operative HIV testing plus extra precautions for those found to be HIV+ in Texas (Lawrence et al, 1993); use of oral rather than intravenous ganciclovir in the treatment of cytomegalovirus retinitis, due to reduced home-care expenditures and adverse events (Sullivan et al, 1996; Davies and Maynard, 1996; von den Schulenburg, 1996); rationalisation of prescribing through the use of clinical guidelines for oral and oesophageal candidiasis (Taylor et al, 1996); use of oral fluconazole treatment for those with esophageal symptoms rather than use of endoscopy followed by treatment (Wilcox et al, 1996); use of low-dose fluconazole given thrice-weekly rather than higher dose treatment given daily (Singh et al, 1996); pre-donation haemoglobin screening in the USA, to reduce wastage of blood screened for HIV (Bernstein et al, 1996); use of nursing centres for supportive outpatient treatment, which can forestall hospital admissions and re-admissions (Schroeder, 1993); use of ondansetron in palliative care (Currow et al, 1997); centralised preparation of dilute solutions of ganciclovir in Belgium (Teisser et al, 1997); use of low dose filgrastim (Rancourt et al, 1998); a "rationalised care" package in Cote D'Ivoire (Kacou et al, 1998); use of interrupted combination therapy in Russia (Yurin et al, 1998), and use of didanosine for ZDV intolerant patients (Bozzette et al, 1994).

A cost-saving strategy that has been observed, but is not advocated, is "red-lining" by insurance companies, whereby certain areas or people are automatically refused coverage. In the USA, this has apparently been used to contain HIV-related medical claims (Li, 1996).

3.2.10 Cost-effectiveness analyses of prevention strategies in developed countries

The cost-effectiveness of a variety of strategies for prevention of HIV infection has been assessed. Tables 3.11 and 3.12 summarise results and the key method for topics that have been the subject of more than one study. Though the measure of effectiveness chosen is not uniform, these studies indicate that the most cost-effective strategies are blood screening programmes, programmes targeted at gay men, and antiretroviral therapy for pregnant women. Programmes for IDUs also seem to be relatively cost-effective and some studies suggest they could be cost-saving. Post-exposure prophylaxis is of middling cost-effectiveness, and the least cost-effective options appear addition of more sophisticated tests to basic HIV blood screening, and screening of health workers.

Table 3.11: Summary of cost-effectiveness analyses of preventive strategies, USA

Prevention Strategy	Methods	Main Results	Source, Date
Blood Screening	1) Model	1) US$3 600/QALY for HIV screening. Incremental cost/QALY for addition of RNA PCR and p24 antigen tests US$2 million and US$2.3 million respectively	1) Aubuchon et al, 1997
	2) Model	2) US$1-2.3 million/QALY for Hepatitis B screening	2) Busch et al, 1997
	3) Model	3) US$80 million/infection prevented through syphilis screening to help screen blood in HIV "window period" (i.e. before HIV antibodies detectable)	3) Herrera et al, 1997
	4) Rapid appraisal	4) HIV-2 screening not cost-effective (no quantification provided)	4) Hanson, 1996
	5) Model	5) US$14 450 per infection detected through voluntary screening	5) Harris et al, 1990
Post-exposure prophylaxis	1) Model	1) US$37 000 per QALY for triple combination antiretroviral prophylaxis (occupational exposure)	1) Pinkerton et al, 1997b
	2) Model	2) US$6 254-71.1 million/QALY depending on type of exposure (sexual exposure)	2) Pinkerton et al, 1998
Counselling and testing	1) Empirical data	1) Rapid testing more cost-effective than strategy in which client must make a second visit (no quantification provided)	1) Farnham et al, 1996
	2) Model	2) US$753 million/health care worker infection averted	2) Lurie et al, 1994
	3) Threshold analysis	3) Cost-effective if one out of 260 clients changes behaviour	3) Gorsky et al, 1995
Screening health workers	1) Model	1) US$0.9-91.8 million per infection prevented	1) Chavey et al, 1994
	2) Model	2) US$126 000/case detected	2) Levine and Sandler, 1992
	3) Model	3) US$147 000-687 000/year of life saved by screening surgeons, most likely estimate US$458 000	3) Owens et al, 1995
	4) Model	4) US$1.1 million/infection averted by screening dentists and physicians	4) Phillips et al, 1994
	5) Model	5) US$139 571 and US$ 899 336/infection prevented for one-time screening programme for surgeons and dentists respectively; US$63.3 and US$2.2 for an annual mandatory screening programme	5) Sell et al, 1994
Programmes targeted at IDUs	1) Model	1) US$34 278/infection prevented for a hypothetical programme designed to increase access to sterile syringes and needles	1) Holtgrave et al, 1998
	2) Model, threshold analysis	2) US$0.15-0.97 per syringe distributed; cost-neutral if annual HIV seroincidence 0.3-2.1%	2) Lurie et al, 1998
Programmes targeted at gay men	1) Model	1) US$12 657/QALY for a lecture plus group skills training programme	1) Pinkerton et al, 1997c
	2) Model	2) US$6 180/QALY for a targeted intervention including counselling, peer-education, optional HIV testing and psychosocial services	2) Tao and Ramafedi, 1998
Antiretroviral treatment during pregnancy	1)-4) Used empirical effectiveness data from clinical trial; empirical cost data also used	1)-3) Assessed intervention to be cost-saving	1) Lewis et al, 1995
		4) Cost-saving if national seroprevalence >0.9%; at the existing national seroprevalence of 0.15% assessed to cost US$195 510/infection prevented	2) Gorsky et al, 1996
			3) Mauskopf et al, 1996
			4) Ecker, 1996
Antenatal screening	1) Model	1) US$255 158/case prevented by mandatory screening, US$367 998 for voluntary screening (key assumption behaviour after discovering status)	1) Myers et al, 1998

Other

Other topics have been the concern of only one study. Use of site-specific guidelines for HIV screening has been suggested to be more cost-effective than generic guidelines (Owens and Nease, 1997). Partner notification in Japan has been estimated to cost US$4 930 per life year gained (Rahman et al, 1998; see also 1996). Mandatory pre-marital HIV testing has been assessed to cost US$70-127 000 per infection prevented (McKay et al, 1991). Universal precautions as recommended by CDC, Atlanta was found to cost C$129 million per infection prevented under "probable" assumptions in Ontario, Canada (Stock et al, 1990). An information/ education/communication strategy targeted at high-risk urban women and aimed at promoting condom use was evaluated to cost US$2 000 per QALY in the USA (Holtgrave and Kelly, 1996a). Targeting preventive interventions has been suggested to be more cost-effective than no targeting, with the number of infections prevented estimated to range from 0.4 in very low risk populations to 164 in high-risk populations per US$1 million annual spending (Kahn, 1996). Finally, threshold analysis in the UK has suggested that surveillance would only need to prevent a small number of infections in order to be considered cost-effective - and would be cost-neutral if 27 were averted (Morris et al, 1996).

Table 3.12: Summary of cost-effectiveness analyses of preventive strategies outside the USA

Prevention Strategy	Methods	Main Results	Source, Date
Blood Screening	1) Model 2) Model	1) Combination of tests unlikely to be cost-effective (Germany) 2) Cost/infection prevented by blood screening = FF676 596 (France)	1) Abel and Kiessing, 1995 2) Sailly et al, 1997
Post-exposure prophylaxis	1) Model	1) Cost-saving compared to no prophylaxis, but only because indirect costs included (Canada)	1) Allen UD et al, 1992
Programmes targeted at IDUs	1) Model 2) Model 3) Speculative	1) Needle-exchange programme cost-saving under conservative assumptions (Canada) 2) HIV testing followed by early treatment cost-saving in baseline analysis (prevalence 0.5%), US$8 400-33 500/year of life saved in areas of medium (0.3%) and high (0.6%) prevalence (Italy) 3) May be cost-saving	1) Gold et al, 1997 2)Villari et al, 1996 3) Wodak, 1993
Antenatal screening	1) Model 2) Model	1) UK£36 000-205 000/infection prevented; suggested selective testing policy might be more cost-effective 2) FF42 000-178 000/HIV+ women detected; incremental cost/HIV+ women detected through general compared to selective screening based on questionnaire FF303 320 to 619 000/HIV	1) Dunn et al, 1995 2) Le Gales and Moatti, 1990

Methodological

Several papers have examined methodological issues in cost-effectiveness analysis of prevention programmes. At a general level, a number of factors which make assessing the cost-effectiveness of prevention strategies

complicated have been highlighted (Rowley and Anderson, 1994). Examples include difficulties in collecting relevant data, the fact that the impact of prevention may be highly non-linear (e.g. more effective at the beginning of an epidemic), the long incubation period of HIV, and the rate of spread of HIV prior to the introduction of a preventive intervention. The summary of studies in Table 3.11 and 3.12 (and this applies to those reported in sections 3.11-13 as well) also shows that, even setting aside difficulties in estimating effectiveness, there is no standardised approach to cost-effectiveness analysis. For example, the discount rate chosen varies and the measure of effectiveness chosen is not uniform. This means that comparisons among interventions are not straightforward, and that (sometimes widely) different assessments for the same type of intervention can be made.

Given difficulties in estimating effectiveness, the value of threshold analysis has been pointed out (Holtgrave and Qualls, 1995). This identifies how many infections would need to be prevented in order to make an intervention cost-saving or cost-effective when it is difficult to estimate effectiveness precisely. These authors suggest that in the USA the threshold cost per HIV infection averted was US$417 000 in 1993 dollars, but could range from US$185 000 to US$648 000 depending on how much society was willing to pay per quality adjusted life year gained. Updated estimates of the cost of illness and quality of life with HIV infection have also been provided for the USA, since these are crucial for cost-effectiveness analyses and have evolved as treatments have changed and prognosis has improved (Holtgrave and Pinkerton, 1997a). Care costs of US$195 000 per HIV infection were indicated when future costs are discounted at the recently recommended USA rate (in 1996) of 3%; and estimated updated values for QALYS were: 1 for those unaware of HIV status; 0.9 for full health, aware of HIV status and CD4 count 250-499; 0.65 for full health for persons with AIDS as defined by CD4 count < 200; and 0.4 for those with AIDS defined by clinical condition.

The relevance of choice of discount rate has also been raised in two papers (Phillips and Holtgrave, 1997a; Pinkerton and Holtgrave, 1997a). The first highlighted how economic evaluation methods may systematically under- or over-state the cost-effectiveness of prevention programmes. The second article illustrated the impact of choosing different discount rates, using the Gable et al and Hurley et al estimates (see section 3.2.7) of lifetime costs for HIV/AIDS care.

The importance of accounting for differential participation rates in general screening programmes has been illustrated. While it is typical to assume that HIV prevalence is the same in screening programmes as it is in the general population, there is evidence that this is not always the case (Paltiel and Kaplan, 1997). Care is also needed when assessing cost-effectiveness results when the costs considered vary. While only one study included indirect costs (Allen UD et al, 1992), this distorted results in comparison with other evaluations of the same intervention.

Table 3.13: Summary of cost-effectiveness analyses of preventive strategies in developing countries

Prevention Strategy	Place	Key Methods	Main Results	Source, Date
Blood screening	1) Zimbabwe	1) Empirical cost and effects data	1) Initial screening with questionnaire followed by testing of those without risk factors averted most cost-effective (US$127-773/infection averted); cost-saving compared to no use of questionnaire	1) Mcfarland et al, 1995
	2) Rural Zambia	2) Model	2) Cost/undiscounted year of life gained US$1.3	2) Foster and Buvé, 1995
	3) Uganda	3) Empirical data	3) Cost/HIV infection averted US$172	3) European Commission, 1995
STD treatment	1) Tanzania	1) Effectiveness data from randomised controlled trial, empirical cost data	1) Cost/DALY US$10.3 using Tanzanian life expectancy; range from US$2.5-47.9 when (a) the most favourable and (b) the most unfavourable assumptions about costs and effects were combined	1) Gilson et al, 1997
Intervention targeted at commercial sex workers	1) Kenya	1) Model of HIV transmission for effectiveness estimates	1) US$8-12 per HIV infection prevented by condom promotion and STD treatment	1) Moses et al, 1991
	2) Cameroon	2) Detailed costing and mathematical model for estimate of effectiveness	2) Cost/infection averted "low" for a peer education programme	2) Kumaranayake et al, 1998
Bottle-feeding	1) Soweto, South Africa	1) Costing of bottle-feeding strategy, model of morbidity and mortality with (a) breast feeding and (b) bottle-feeding	1) US$200 to US$331/year of life saved	1) Soderlund et al, 1999
VCT services	1) Tanzania, Kenya	1) Costing of services, model of effectiveness based on assumed changes in behaviour	1) US$303/infection prevented in Tanzania; US$241 per infection prevented in Kenya	1) Sweat et al, 1998
Antiretroviral therapy for pregnant women	1) Sub-Saharan Africa as a whole	1) Model for short-course ZDV using efficacy data from randomised controlled trial in USA and many assumptions for key parameters e.g. HIV seroprevalence (average for sub-Saharan Africa); compliance with treatment; averted treatment costs (extrapolated from adult costs in Zaire and Tanzania)	1) US$3 748/infant HIV infection prevented (US$1 115 if productivity losses were included in the analysis)	1) Mansergh et al, 1996
	2) Thailand	2) Model	2) US$1 667/QALY	2) Prescott et al, 1997
	3) Sub-Saharan Africa	3) Model, efficacy estimated from long-course treatment parameters and on-going trials in 4 African cities	3) US$60/DALY to US$274/DALY for short-course combination treatment, depending on regimen used.	3) Marseille et al, 1998
	4) S. Africa	4) Markov model, efficacy data from trials, cost data from S. Africa	4) CDC "Thai" regimen (short-course ZDV) most cost-effective – appeared cost-saving.	4) Soderlund et al, 1999
	5) Sub-Saharan Africa	5) trial results and cost data from a variety of sites in Africa	5) Nevirapine most cost-effective antiretroviral intervention – US$5-11 per DALY	5) Marseille et al, 1999

3.2.11 Cost-effectiveness analyses of prevention strategies in developing countries

In developing countries, cost-effectiveness analyses have been undertaken for blood screening, STD treatment, antiretroviral treatment for pregnant women, targeting of particular risk groups, bottle-feeding, and voluntary counselling and testing (Table 3.13). Results indicate that, in cost/year of life or DALY terms, blood screening is the most cost-effective intervention, followed by STD treatment and nevirapine for prevention of mother-child HIV transmission. Programmes targeted at commercial sex workers appear likely to be more cost-effective – results were either not converted into these more generic measures or quantified, but appear favourable based on cost/infection averted figures quoted by Marseille et al (1998). Short-course combination antiretroviral treatment for pregnant women, and bottle-feeding, appear the least cost-effective of the strategies evaluated.

3.2.12 Cost-effectiveness analyses of care strategies in developed countries

Studies on the cost-effectiveness of care in developed countries cover a variety of topics. The major ones are shown in Tables 3.14 and 3.15.

Table 3.14: Summary of cost-effectiveness analyses of care strategies in Europe

Care Strategy	Methods	Main Results	Source, Date
Combination ARV therapy, ZDV plus zalcitabine	1) Model using early trial results for effect on CD4 count, expert opinion concerning opportunistic infections with the 2 alternative treatment strategies (extrapolated from early trial results concerning effect of double therapy on CD4 counts)	1) Incremental cost/year of life saved with combination therapy (compared to ZDV treatment only) ECU12 188 in Italy to ECU20 708 in UK (£15 264) if double therapy had impact for one year only (France, Switzerland, Germany within this range)	1) Simpson et al, 1994
Combination ARV therapy, ZDV plus lamivudine	1) Model; efficacy data for ZDV for a large cohort of patients; early clinical trial results for combination therapy	1) Incremental cost/QALY UK£6 276, varied from 2) UK£5 227-9 076 in sensitivity analysis	1) Chancellor et al, 1997

These indicate that pneumococcal vaccination and prophylaxis for PCP may be the most cost-effective interventions[9]. Combination antiretroviral therapy and early ZDV therapy may be as or more cost-effective, but the uncertainty surrounding key parameters used in modelling means that there

[9] though a recent MRC-funded trial in Uganda found that pneumococcal vacincation for HIV+ adults was not effective (see French N et al, 2000)

Table 3.15: Summary of cost-effectiveness analyses of care strategies in the USA

Care Strategy	Key Methods	Main Results	Source, Date
Prophylaxis for opportunistic infections	1) Model 2) Efficacy data from clinical trials 3) Model 4) Model 5) Model 6) Model using efficacy data from clinical trials, baseline incidence of opportunistic infections from major national database	1) US$13 400/QALY for prophylaxis for PCP using dapsone (trimethoprim-sulfermethoxole and aerosolized pentamidine less cost-effective) 2) US$58 200-US$179 100 for prophylaxis for Mycobacterium avium complex (MAC), depending on the drug used 3) US$240 000/year of life gained among patients with CD4 count <200 for fluconazole to prevent fungal infections 4) US$76 676/QALY for prophylaxis for cytomegalovirus (CMV) disease for patients with CD4 count <50 5) US$1 762 517/year of life saved for prophylaxis for cytomegalovirus disease for patients with CD4 counts < 50, US$495 158 for strategy of periodic testing + prophylaxis if positive 6) US$16 000/QALY for prophylaxis for PCP and toxoplasmosis, using trimethoprim-sulfermethoxole; US$35 000-74 000 for prophylaxis for MAC; US$100 000 for fluconazole for prevention of fungal infections; US$ 314 000 for oral ganciclovir to prevent CMV (all estimates for patients with CD4 count <300; also pre-combination therapy, which was suggested to worsen results but leave rankings the same)	1) Freedberg et al, 1991 2) Freedberg et al, 1997 3) Scharfstein et al, 1997 4) Moore and Chaisson, 1997b 5) Rose and Sacks, 1997 6) Freedberg et al, 1998 (note: discrepancy for CMV between 4) and 5) reflects different estimates of care costs without prophylaxis and life expectancy with and without CMV; discrepancy between these studies and 6) reflects, at least in part, different CD4 count of patients considered)
Diagnosis of PCP	1)-4) Empirical data	1) Non-invasive oxygen saturation measurement during exercise can improve the cost-effectiveness of diagnosis compared to the traditional strategies of induced sputum or bronchoalveolar lavage (BAL) 2) and 3) Induced sputum followed by BAL in those negative on induced sputum more cost-effective than BAL alone 4) Induced sputum followed by BAL in those negative on induced sputum less cost-effective than BAL alone	1) Chouaid et al, 1993a 2) Chouaid et al, 1993b; 3) Kirsch et al, 1990 4) O'Brien et al, 1989
Treatment of opportunistic infections	1) Empirical data 2) Empirical data	1) For esophageal candidiasis, cost/complete response US$2 706 for treatment of all patients with symptoms with oral anti-fungal agent for 4 weeks; US$3 141 for strategy involving initial esophagogastroduodenoscopy 2) US$94 528-US$305 795/year of life saved for treatment of AIDS-related PCP or severe respiratory failure	1) Rabeneck and Laine, 1994 2) Wachter et al, 1995
Influenza and pneumococcal vaccination	1) Model: key parameters based on mixture of expert opinion, empirical evidence	1) Pneumococcal vaccination relatively cost-effective and cost-saving if CD4 count <200; influenza vaccination US$84 399/year of life saved; results relatively unaffected by sensitivity analysis	1) Rose et al, 1993
ZDV monotherapy	1) Model, exploratory analysis 2) Model, early clinical trial data	1) Could be cost-effective 2) US$6 553 to 70 526 for early treatment of asymptomatic patients, depending on whether treatment benefits lasted one year only or provided continuous benefit (clinical trial results were for 1 year only so could not indicate long-term efficacy)	1) Paltiel and Kaplan, 1991 2) Schulman et al, 1991
Epoetin treatment	1) Model, some empirical data	1) Cost/unit of blood saved among AIDS patients on ZDV US$1 007	1) Cantor et al, 1993

is a very large range in estimates. Prophylaxis for opportunistic infections other than PCP is much less cost-effective. Other strategies are hard to evaluate, since the measures of outcome used do not allow comparison with other types of intervention

Other

Miscellaneous topics covered in other studies have suggested that in San Francisco, USA, community-based care may be cost-effective because it was associated with reduced hospitalisations (Cunningham et al, 1996); home-based care can be cost-effective in Italy for stage 3 patients, with cost-utility ratios of US$482 compared to US$791 for hospital-based care (Tramarin et al, 1992); mandatory screening of trauma patients does not appear cost-effective in the USA, with high testing costs and no demonstrable benefit (Mullins and Harrison, 1993); screening followed by prophylactic treatment (ZDV and prophylaxis for PCP with aerosolised pentamidine) for those found to be HIV+ has been estimated at US$11 000 to US$40 000 per year of life gained in the USA, depending on HIV prevalence and expected efficacy of ZDV (McCarthy et al, 1993); and in acute care settings, screening followed by early medical care for those found to be HIV+ was estimated to cost US$47 200 per year of life gained (Owens et al, 1997) - though this might be higher if the effect of knowing HIV status on patients' quality of life was taken into consideration.

Though not quoting cost-effective ratios, three other studies are indicative. One suggested that rapid testing was more cost-effective than the conventional strategy of requesting patients to return at a subsequent date for results in an STD clinic in Dallas (Kassler et al, 1997) – more people received their results and costs were reported to be the same. In Austria, a day clinic appeared more cost-effective than conventional hospital care for HIV+ patients, being both lower cost and preferred by patients (Armbruster, 1994; 1995). And in the USA, HMOs may be more cost-effective than fee-for-service service systems– with lower costs and no reported detrimental impacts on functional outcomes or patient satisfaction (Wilson et al, 1998).

3.2.13 Cost-effectiveness of care strategies in low-income, developing countries

Studies concerned with the cost-effectiveness of care in developing countries are summarised in Table 3.16. Evaluations of tuberculosis treatment are included even when they were not undertaken specifically in relation to HIV/AIDS. This is because they are relevant given that tuberculosis is one of the main illnesses associated with HIV infection in developing countries.

The results consistently indicate that "short-course" chemotherapy for tuberculosis is more cost-effective than "standard" courses of drugs. It is not easy to draw conclusions from the other studies, given there is only one

Table 3.16: Summary of cost-effectiveness analyses of care strategies in developing countries

Strategies evaluated	Methods	Main Results	Source, Date
Outpatient/ Community based care vs hospital-based care	1) Analysis of costs of two care programmes for people with AIDS in Puerto Rico; some comments on effectiveness	1) *Described* as a cost-effectiveness analysis, but cost-effectiveness results not quoted. Comprehensive care package emphasising outpatient care and alternative forms of care (e.g. home and hospice care) substantially reduced costs (to US$3 869/patient) compared with previously used hospital-oriented approach (US$15 188 per patient). Quality improved on some measures e.g. waiting times reduced for laboratory results; better access to doctors	1) Kouri et al, 1991
Prophylaxis to prevent TB among HIV+ individuals in Uganda	1) Cost data from other studies; effectiveness modelled using efficacy data and estimates of secondary infections caused per TB case from elsewhere	1) Cost/QALY US$114-260 if medical care costs only considered. Assessed as cost-saving if productivity losses and prevention of secondary cases included in analysis	1) Bell et al, 1998
TB treatment for HIV+ patients in Kenya	1) Model using evidence on side-effects and impact of education from other studies	1) Education of patients on possibility of side-effects of thiacetazone, with replacement of thiacetazone with ethambutol if side-effects occurred, most cost-effective strategy at HIV prevalence rate of 1-90%. Abandonment of thiacetazone and its replacement with ethambutol was the most cost-effective strategy when HIV prevalence exceeded 90%	1) Van Gorkem and Kibuga, 1996
Short-course vs standard course chemotherapy for tuberculosis	1) Effectiveness data from Tanzania, Mozambique and Malawi 1982-1988; cost data from 1988-9 2)-4) Empirical cost and effectiveness data	1) Cost/year of life saved US$$0.9-2.6 for short-course chemotherapy; US$0.9-US$3.4 for standard chemotherapy. Impact of HIV not explicitly considered but suggested treatment of HIV+ patients cost-effective due to impact on prevented onward transmission 2)-4) Short-course chemotherapy more cost-effective than standard course treatment in Thailand, Indonesia. Botswana	1) Murray et al, 1991; de Jonghe et al, 1994 2)-4) Chunhaswasdikul et al, 1992; Joesoef et al, 1989; Barnum, 1986 and Murray et al, undated
Two approaches to case management of short-course chemotherapy for TB	1) Empirical cost data; empirical effectiveness data for conventional strategy, assumed effectiveness for ambulatory care strategy	1) Ambulatory care in which patients visit clinics once per week to collect their drugs found to be lower cost (US$115) than the conventional strategy of two months hospitalisation at treatment outset (US$190); also appraised to be more cost-effective (US$165-230 per cure vs. US$316-380 per cure)	1) Saunderson, 1995
ARV therapy for HIV+ adults	1) Estimated life expectancy, empirical cost data	1) US$33 000 per QALY	1) Prescott, 1997

Table 3.17: Cost-benefit studies related to HIV/AIDS prevention and care

Strategy evaluated	Method	Main results	Source, date
Testing hospital in-patients in USA	1) Model with assumptions all referenced from recent literature	1) Benefits < costs from perspective of hospital workers; if benefits to patients and their sex partners included, benefits > costs in high HIV prevalence areas; in low-medium prevalence areas, results sensitive to impact knowledge of HIV- status had on behaviour	1) La Croix and Russo, 1996
Mandatory testing of health care workers in USA	1) Model with questionable assumptions e.g. HIV-infected person dies as soon as they are infected	1) Cost:benefit ratio 9-13:1	1) Russo and La Croix, 1992
Mandatory screening of pregnant women in the USA	1) Model 2) Analysis based on empirical evidence concerning costs of screening; efficacy of ZDV in preventing maternal-child transmission, and costs of paediatric care	1) Benefits likely to exceed costs, due to impact of counselling on behaviour and consequent prevention of infectin among adult contacts 2) Could result in large savings: illustrative appraisal suggested costs of US$72 million/year and benefits due to averted paediatric care costs of US$392 million	1) Brandeau et al, 1992 2) Wilfert et al, 1994
Mandatory pre-marital HIV-testing in the USA	1) Model	1) Benefit:cost ratio 3-28:1	1) McKay and Phillips, 1991
Counselling, Testing, Referral and Partner notification services, USA	1) Model	1) Benefits > costs in all scenarios considered; baseline scenario benefit:cost ratio 20:1	1) Holtgrave et al, 1993
ZDV therapy for pregnant women, USA	1) Empirical data for cost of an intervention and efficacy of ZDV; estimates of paediatric care costs	1) Benefits (averted paediatric care costs) likely to exceed costs	1) Johnson, 1996
Screening immigrants in Canada	1) Analysis of care and screening costs	1) Benefits likely to exceed costs	1) Zowall et al, 1990
Isoniazid preventive therapy for tuberculosis (Zambia and South Africa)	1) Model based on several assumptions, some based on empirical data 2) Spreadsheet model	1) In Zambia, baseline analysis benefit:cost ratio 1.16:1; 1.7:1 if prevention of one index case prevented further 5 cases 2) In South Africa, treatment of hypothetical cohort of 100 000 people associated with costs of R51.3 million and benefits of R91.1 million	1)Foster et al, 1997 2) Masobe et al, 1995
Safe Blood in Zambia	1) Empirical data on costs, HIV prevalence among donors	1) Benefit:cost ratio of 2.7-3.5:1	1) Foster and Buvé, 1995

evaluation for each subject area and empirical evidence on effectiveness is lacking for some strategies. It is worth noting that while tuberculosis prophylaxis was assessed to be cost-saving if indirect costs and prevention of onward transmission were considered, estimation of secondary cases was based on a simple model and it is not common practice to include the monetary value of years of life saved in cost-effectiveness analyses (this actually makes the analysis more of a cost-benefit study).

3.2.14 Cost-benefit studies

Several studies have considered interventions in cost:benefit terms (Table 3.17). Most have been undertaken in the USA and there are only one or two studies for each topic. In the USA, results suggest that benefits exceed costs for mandatory screening of pregnant women, pre-marital HIV testing, counselling and testing services, and ZDV therapy for pregnant women. Screening of immigrants to exclude HIV+ individuals appeared worthwhile in Canada. In developing countries, benefits exceeded costs for blood screening in Zambia, and isoniazid prophylaxis for tuberculosis in South Africa and Zambia.

Methodological

Only one paper has focused on methodological issues. This highlighted the distinction between financial and economic costs (Russo and La Croix, 1992), illustrating with reference to an earlier paper on the same topic (Geberding, 1991).

3.2.15 Financing of HIV/AIDS care and prevention

Financing aspects of the HIV/AIDS epidemic have been given relatively limited attention. Most research has been in the USA, where the focus has been on how HIV/AIDS care is being funded, and on issues related to insurance coverage.

Main sources of finance for care in the USA

Various studies (Andrulis et al, 1995; Arno et al, 1993; Ballard, 1993; Buchanan, 1988; Roper and Winkenwerder, 1988; Bartnyska et al, 1995; and Fleishman, 1998) have reported that public funding (particularly Medicaid and Medicare) was either a major or the predominant source of funding for care. Indeed, Green and Arno (1990) talk of the "medicaidization of AIDS". Related to this, one study has illustrated how people with HIV/AIDS can become eligible for Medicaid coverage (Buchanan, 1996).

Health Insurance

Health insurance has been the subject of several papers, all focused on the USA. These have found that insurance status can be associated with variation in treatment and outcome for PCP among AIDS patients (Horner

et al, 1995); that type of insurance (public, private), together with payment mechanisms (managed care; fee for service) can be associated with perceived quality of care – patients with private insurance where payment was on a fee-for-service basis were more satisfied with their interpersonal relations with their clinicians, but less satisfied with their finances, though there were no significant differences between private insurance with managed care, and public insurance (Katz et al, 1997); and that public insurance may be associated with lower utilisation of health services compared to those with private insurance or managed care plans in California – for example, 61% were receiving PCP prophylaxis compared with figures of 93% and 83% for private and managed care respectively (Katz et al, 1995). In addition, the ethical issues related to underwriting of insurance in the context of HIV/AIDS have been discussed (Daniels, 1990), as has adverse selection in insurance markets in the context of HIV (Doherty and Thistle, 1996) and the links between insurance status among people with AIDS and their socio-demographic characteristics and service use (Fleishman and Mor, 1993).

Other papers have concerned the response of the insurance industry to HIV/AIDS. It has been reported that homosexual men with AIDS can lose private health insurance (Kass et al, 1991); that risk-adjustment in Californian insurance companies now includes adjustment for AIDS (Luft, 1996); that HIV testing has been used to eliminate poor risks, with cost-conscious employers also seeking to exclude AIDS patients from group insurance policies (Oppenheimer and Padgug, 1986); and that the insurance industry took advantage of the AIDS epidemic to introduce reforms (Milton, 1990).

Financing mechanisms, general

More generally, but still focused on the USA, a case for capitated funding for care in centres of excellence has been made - as a means to cut costs and improve outcomes (Knowlton, 1995). It has also been argued that mandated workplace insurance and extension of Medicaid eligibility in required to cope with HIV/AIDS (Makadon et al, 1990); others have suggested promotion of high-risk insurance pools and bringing AIDS into the mainstream of the health care financing system (Roper and Winkenwerder, 1988). Meanwhile, it has been reported that the Ryan White Care Act has succeeded in financing care for those it was intended to reach (Marx et al, 1997), and has equalised access to services for racial minorities and women (a detailed analysis of how these funds have been spent has also been undertaken (McKinney et al, 1993).

Surveys of international funding of the Global AIDS strategy

At international level, two major surveys of the funding of the "Global AIDS strategy" have been undertaken. The most recent survey (Laws, 1996), using data from 1992/3, showed that while funding doubled in real terms 1985-90, it has since been relatively stable (in 1993 it actually declined). The major funders were the USA, Japan and France, and overall

a shift from funding through WHO to bilateral funding was observed. By 1993, approximately 65% of funding for AIDS was through bilateral channels, with NGOs receiving a growing share. Funds were also relatively concentrated: six countries - Uganda, Haiti, Tanzania, Thailand, Zambia and Kenya - received 27% of the total.

An increasing number of countries have borrowed from the World Bank to fund their AIDS strategies: over the period 1986-94, 49 projects were initiated in 35 countries, with further loans subsequently awarded to India and Brazil and 19 new projects due to start in 1995/6. Total World Bank financing was approximately US$600 million for these projects, meaning it was of considerable importance in funding HIV/AIDS prevention and care (bilateral/multilateral aid totalled US$257 million in 1993).

Similar findings were reported in a subsequent analysis (Pyne, 1997) of the AIDS in the World II survey data and a database managed by the Global Programme on AIDS and UNAIDS. Additional major results included the fact that low-income countries received the most funding, but that upper-middle income countries received more than lower-middle income countries; most funds went to countries with developing epidemics; bi-laterals had a higher percentage of expenditure in low income countries than did multi-laterals; and "care" was the intervention area most frequently included in projects – 51% included this element, compared with figures of 3%, 8%, 12% and 29% for blood safety, STD treatment, condom promotion and Information-Education-Communication (IEC) respectively.

Other

Other miscellaneous studies have illustrated growing public funding of counselling and testing services in the USA (MMWR, 1992), and that funding is mainly from the public sector in France (Lambert, 1995). In the UK, concerns have been raised about inequality in funding for HIV/AIDS care among the different health regions (Bellis et al, 1997), and about how inaccurate information on place of residence has hampered allocation of funds appropriate to needs (McCarthy and Layzell, 1993). The "rhetoric of scarcity" for HIV funding in the USA has also been discussed, arguing that this is inconsistent with the rise in financial support for AIDS (Chambre, 1996). In the USA, too, it has been illustrated that AIDS patients can be responsible for important operating losses in hospitals, due to lengths of stay in each "diagnostic related group" – which forms the basis of much reimbursement by insurance in the USA – being longer than the average upon which reimbursement rates are based (Campbell et al, 1991; Chupka et al, 1992; Arno et al, 1993; Andrulis et al, 1995); and that the political process can be a decisive factor in the allocation of government funds for HIV/AIDS (Felman, 1994). Recently, Wolfson (1997) has illustrated, using Florida as an example, how financing for the new "protease inhibitor" drugs has the potential to undermine existing HIV/AIDS care and prevention activities, due to diversion of limited funds from other activities.

Other authors have discussed insurance coverage in Canada (Moran, 1993); public spending on AIDS education in the USA (Philipson and Posner, 1994); the link between withdrawal of funding for methadone maintenance programmes in California and increased risk of HIV among those eligible for such programmes (Rosenbaum et al, 1996); and the finding that male dentists appear more concerned about the financial burden of infection control and loss of practice patients due to treating HIV+ clients than women dentists (McCarthy and MacDonald, 1996).

3.2.16 The indirect costs of HIV/AIDS

Various studies have attempted to assess the indirect costs associated with HIV/AIDS, using a human capital approach i.e. the costs associated with lost productivity due to HIV-related morbidity and (particularly) premature mortality (Table 3.18). These generally assess costs to be high, particularly in relation to direct costs (i.e. those for medical care).

Table 3.18: Estimates of the Indirect Costs associated with HIV/AIDS

Place	Estimate	Source
Canada	US$39.7 billion for those who died 1987-91 (all causes), HIV responsible for 5.3%; exceeded only by ischaemic heart disease, suicide, motor vehicle accidents and lung cancer (discounted at 3%)	Hanvelt et al, 1994
Caribbean	2-5% GNP by 2010	Newton et al, 1994
India	US$20 710 per case (discounted at 5%)	Pandav et al, 1997
Kenya	Indirect costs 24x per capita GNP (discounted at 5%)	Forsythe et al, 1992
Korea	US$240 000, almost 60 times direct cost (discounted at 3%)	Yang, 1991
Malawi	Indirect costs 18x per capita GNP (discounted at 5%)	Forsythe et al, 1992
Malaysia	US$38 300 (discounted at 5%), compared to US$2 528 for direct costs	Lim, 1991
South Africa	Ratio of indirect:direct costs 1.3:1 in early years of epidemic, 3.2:1 by 2000. Total indirect cost estimated as R285 million in 1991; R8 183 million in 2000 (discounted at 4%)	Broomberg et al, 1991; Broomberg, 1996
Tanzania, Zaire	Indirect costs per AIDS case exceed direct costs by factor of 8:1 to 9.5:1; 34x per capita GNP in Tanzania; 6x per capita GNP in Zaire (discounted at 5%)	Over et al, 1988
Thailand	Indirect cost US$22 000 (discounted at 5%)	Viravaidya et al, 1991
USA	US$4.8 billion for the first 10 000 cases (discounted at 4%)	Hardy et al, 1986
USA	US$3.9 billion in 1985, US$7 billion in 1986; US$55.6 billion in 1991 (discounted at 4%)	Scitovsky and Rice, 1987

One study in the USA has also compared workdays lost by HIV+ patients in comparison with those without HIV infection (Leigh et al, 1995). This found that the number of workdays lost by people with AIDS was more than three times that for people with HIV infection but not AIDS and

fourteen times higher than that for who were HIV-negative (38 vs 12, and 38 vs 2.5 respectively, both $p<0.0001$).

3.2.17 The economic impact of HIV/AIDS at household level

HIV/AIDS can be expected to have an important economic impact at household level. It may affect household productivity and cash income, due to premature morbidity and mortality among working-age adults; it may necessitate increased out-of-pocket expenditures for items such as health care, special provisions, and funerals; and it may necessitate the sale of assets.

Cost of care provided at home by family members

The economic cost of time spent by family members providing care has been quantified in one study in the USA (Ward and Brown, 1994). Time inputs were substantial for both men and women, and using market valuation of the types of work done, this care cost US$25 858 per patient per year.

Expenditure on health care, developing countries

The cost of health care may also be substantial for the household. In Zaire, one study found that the cost of one hospitalisation for a paediatric AIDS case was three times the average household monthly income, while the cost of a funeral was equivalent to 11 months income (Davachi et al, 1988). In the same hospital, a subsequent study found that health expenditure prior to admission was significantly higher for HIV+ adults than for those who were not infected (Hassig et al, 1990). Also in Zaire, a cohort study found that the cost of a single hospital admission for an HIV+ patient was more than three times higher, on average, than that for HIV- controls (Mposo et al, 1993). In a 1990-1 study in the Kagera region of Tanzania, it was found that 15% of those who had died from AIDS had visited a hospital at least three times in the last year of life, compared with 3% of those dying from other causes (Mujinja and Over, 1993). However, in Zambia health expenditure per illness episode was similar for both HIV+ and HIV- patients (Foster, 1996). Counselling and testing has been estimated to cost patients US$2.6 in Kenya and US$7.8 in Tanzania, mostly due to lost wages (Sweat et al, 1998).

Outside Africa, studies in Thailand have found that annual health care costs per patient were 30-50% of average household income (Viravaidya et al, 1993), and more recently that health care was the only expenditure item for which spending was higher (by 50%) among households where there had been an AIDS death than for households experiencing no deaths or the death of an HIV- person (Janjaroen et al, 1996). Among patients admitted to Thai provincial hospitals between 1988 and 1991, the costs per admission incurred by patients with AIDS/ARC was US$46.2 (Kongsin et al, 1993). Among 24 AIDS patients surveyed in Mexico, an average of 52% of household income was being used for the patient's treatment and

general well-being, and the average household income had fallen 22% as a result of AIDS-related illness (Tapia-Conyer et al, 1991).

General household expenditure and assets

Several studies have reported the effect of HIV/AIDS on general household expenditure and assets. In Zambia, it has been shown that funeral expenditure can be large in relation to wages and can lead to indebtedness; it may also precipitate the sale of assets, including productive assets such as animals (Foster, 1996). Similar dis-saving, borrowing and sale of assets has been identified in Thailand (Pitayanon et al, 1994); and in Uganda, where a study focused on adult deaths among 15-50 year olds found a decrease in household assets after an HIV+ death, compared with an increase in assets for those where no adult death occurred and no change where the death was of an HIV- person (Menon et al, 1996). A recent study in Thailand has reported that household consumption was lower (approximately 22%) for those households where there had been an AIDS death compared to those in which there had been no death or the death of an HIV- person – though, interestingly, consumption had been higher prior to death, implying living standards had originally been higher among households experiencing deaths from AIDS (Janjoroen et al, 1996).

No study has assessed the extent to which households may increase savings to anticipate the impact of AIDS, though this possibility has been pointed out (Ainsworth and Over, 1994). However, anecdotal evidence in several African countries indicates that HIV is affecting the cost, size, extent and obligation to attend funerals (e.g. in Uganda people now only attend the funerals of close relatives and friends).

Some studies from developed countries have found that expenditure for HIV+ individuals can be significant, especially for someone with AIDS (Bowie et al, 1996, in New Zealand; Epstein et al, 1995 in the USA). Most recently, out-of-pocket expenditure was found to be relatively low in Ontario, Canada (Mumford and McMurchy, in Ontario, Canada, 1998), and attention has been paid to the costs incurred for "alternative therapies" (Leeb and McMurchy, 1998; Vogl et al, 1998).

General household income

Few studies report household income effects. In Thailand, a survey of HIV+ women recruited during pregnancy found that 18-24 months post-partum, income was reduced in 30% of families. Where a partner was sick or had died, 63% reported reduced income compared to 24% where the partner was asymptomatic (Monaipaiboon, 1998). In Rakai, Uganda, it was also suggested that households with orphans were of lower socio-economic status than those without orphans (Konde-Lule et al, 1994).

Productive capacity

Several studies (Evans, 1992; Barnett and Blaikie, 1992; Gillespie, 1989; Foster, 1993; 1996; Pitayanon, 1994) have suggested that HIV/AIDS will have a detrimental impact on household's productive capacity, through reducing the available quantity and quality of labour. In one Zambian district, it was estimated that the average number of rural household productive units would fall by 19%, and that this would be particularly serious if loss of productive capacity coincided with the maize growing season (Foster, 1996). In both Zambia and Thailand, households with HIV+ members were smaller and had fewer people in the most productive age groups (Foster, 1996; Janjaroen, 1996). In a study in Uganda, household size was larger among HIV+ households prior to a death occurring, and smaller thereafter (Menon et al, 1996). Also in the same Ugandan study, households that later experienced an adult death had a lower dependency ratio than those not experiencing a death when data were initially collected; by the end of the study, they had a higher dependency ratio.

Impact on carers

Few data exist concerning the impact of HIV on carers. Only one study – in Zambia - appears to have addressed this topic (Foster, 1996). This found that most carers were middle-aged women, irrespective of whether or not the patient was male or female. Many (59%) were not able to work while looking after the patient at home (86% of carers had to stop their usual work to look after the patient in hospital). However, there were no significant differences for carers looking after HIV+ patients compared to those providing care for HIV- patients.

3.2.18 The economic impact of HIV/AIDS on firms or particular industries/service sectors

Various studies on the impact of HIV/AIDS on firms or particular industries/services sectors have been done. In Africa, these include preliminary studies that have characterised impacts on the agricultural sector in Tanzania, Uganda, Zambia and Rwanda (Barnett and Blaikie, 1992; Tijaibuka, 1997; Gillespie, 1989). These predict adjustments such as a shift from more to less labour-intensive crops. In the industry/service sector, an extensive survey of firms in Ghana, Kenya, Tanzania, Zambia and Zimbabwe suggested that the impact of AIDS on work force attrition, and the effect of worker attrition on firms costs and performance, were both minor (Biggs et al, 1996). Another study in Kenya (Forsythe and Roberts, 1995) estimated that HIV/AIDS was costing a typical company US$45 per employee in 1992, and that this could rise to US$122 in 2005 – the equivalent of 9% of an average employee's salary. They concluded that HIV/AIDS represented a costly but not devastating loss of profits. Evidence of rising mortality in Zambian businesses has also been linked to HIV/AIDS (Baggaley et al, 1994), and it has also been suggested that AIDS

was having an important impact on the Uganda Railway Corporation by 1992 (Panos Institute, 1992).

In Asia, it has been estimated that the cost of medical care, sick leave, life insurance paid on death and other death-related costs (e.g. funerals), lost production, and replacement costs in the trucking industry in Thailand would rise substantially 1991-2000, from US$36 700 to US$14.5 million (Giraud, 1991). The potential impact of HIV/AIDS among overseas contract workers from the Phillipines has also been argued to warrant prevention programmes (Solon and Barrozo, 1991).

In the USA, it has been suggested that the impact on industry was minor (Cowell, 1991), with another study suggesting costs of an HIV infected worker of US$17 000 over a five-year period (Farnham, 1994). Elsewhere, the economic impact of the AIDS epidemic on Hollywood and the film industry, and what responses have been made, has been discussed (Prindle, 1991).

3.2.19 The macro-economic impact of HIV/AIDS

Studies on the macro-economic impact of HIV/AIDS generally indicate the impact is relatively small – though important in the context of poor countries that already have a substantial fraction of the population living below the poverty line. In Tanzania (Cuddington, 1993), it has been estimated that GDP growth may slow by 0.8% p.a. and per capita GDP by 0.1% (under the assumptions, which they consider to be most likely, that all treatment is financed from savings, population growth slows by 0.7%, and a worker with AIDS is half as productive as one without). In Malawi, using similar assumptions, it has been predicted that GDP growth will be reduced by 1.5% p.a. and per capita income by 0.3% (Cuddington and Hancock, 1994). One study in South Africa has also suggested that macro-economic impacts will be relatively small and sustainable (Broomberg et al, 1996), with the current value of lost earnings ranging from 0.3% of GNP in 2000 to 1.5% in 2005. Meanwhile, a model that differentiated between a high-productivity urban sector and a low productivity rural sector indicated that across 30 sub-Saharan African countries, GDP growth would slow by 0.9% p.a. and per capita growth by 0.2% in the scenario considered most likely (Over, 1992). The figures were 1.2% and 0.3% respectively for the ten worst-affected countries.

Across 51 developing and industrialised countries, it has been argued that these studies over-estimate the impact of AIDS, due to the existence of surplus labour, the possibility that HIV will increasingly affect the poor the most, the emergence of coping strategies, and the evidence that model projections can over-estimate the number of AIDS cases (Bloom and Mahal, 1997). Using empirical national-level data, they argue that the AIDS epidemic has had an insignificant effect on growth in per capita income, and compare it to the Black Death in England and France in the Middle Ages in this regard. Consistent with this, it has been indicated that

in Cameroon, AIDS may increase the per capita wage of remaining workers (Kambou et al, 1992).

3.2.20 The link between economic factors and HIV

Several studies have assessed or commented on the interaction between HIV/AIDS and general economic factors. Key results have included the suggestion that in the USA, HIV/AIDS is increasingly associated with poorer neighbourhoods (Fife and Mode, 1992; Simon et al, 1995); and that lower socio-economic status is associated with shorter survival in Canada (Hogg et al, 1994), and with lower health services utilisation in Italy (Tramarin et al, 1997).

In developing countries, it has been commented that there may be a link between HIV/AIDS and development generally, suggesting the most important socio-economic impact will be an increasing gap between rich and poor, and the feminisation of poverty (DeCosas, 1996). The importance of urbanisation, migration, the poor socio-economic status of women, economic recession and structural adjustment programmes in the spread of HIV/AIDS in Africa has also been highlighted (Sanders and Sambo, 1991). Another commentary has focused on the role of the IMF and the World Bank in creating socio-economic obstacles to HIV prevention and treatment (Lurie et al, 1995). Meanwhile, early empirical evidence showed an association between higher socio-economic status and lower HIV prevalence among prostitutes in Nairobi (Kreiss et al, 1986), but also an association with higher HIV prevalence among the general population in the Central African Republic, Côte d'Ivoire, Kenya, Togo and Zaire (Cleland et al, 1992; Carael et al, 1990; Ryder et al, 1990; Ndilu et al, 1988), and with the socio-economic status of husbands for women in Rwanda attending prenatal clinics (Allen et al, 1991). More recent evidence indicates that HIV may now be more associated with low socio-economic status (Ainsworth and Over, 1997).

Linking economic and social factors, it has recently been suggested that wealth and "social cohesion" can be used to define four major categories of countries according to their "susceptibility" and "vulnerability" to HIV/AIDS (Barnett and Whiteside, 1999). This is the so-called "Jaipur paradigm". The four categories are high wealth and high social cohesion; high wealth and low social cohesion; low wealth and high social cohesion; and low wealth and low social cohesion. The authors argue that this categorisation can be used to predict and explain the extent to which a country is affected by HIV/AIDS. For example, they indicate that it offers an interpretation of why the epidemic is much less serious in Senegal (high social cohesion and low wealth) than it is in South Africa or Botswana (low social cohesion and low wealth), but less serious still in the UK (high social cohesion and high wealth).

3.2.21 Miscellaneous

Various topics that have an economic aspect to them, but which do not fit neatly into any of the categories discussed above, can also be found in existing literature. Examples include the responsiveness of demand for condoms to local AIDS prevalence (Ahituv et al, 1996); the role of global research and development networks in the pharmaceutical industry, illustrated with the case of Merck and their AIDS programme (Bower and Whitaker, 1993); the failure of state welfare as illustrated by AIDS orphans (Kaijage and Tibaijuka); examples of public/private responses to HIV/AIDS in developing countries (van der Gaag, 1995); the effects of subsidies on STD testing, with special reference to HIV (Philipson and Posner, 1995); whether laissez-faire should prevail in the market supply of HIV testing (Thompson, 1989); regulation of drug treatments (Salbu, 1994); and the economics of catastrophes, with AIDS used as one of the examples (Zeckhauser, 1996).

3.3 Discussion of the existing literature

3.3.1 Summary of main conclusions to be drawn from existing literature

A number of important conclusions can be drawn from the existing economic literature on the HIV/AIDS epidemic. The impact in developed countries is relatively small and readily manageable in the context of total health sector expenditure and national GDP, though prevention and care programmes are largely dependent on public funding. This holds even in the context of new and expensive antiretroviral treatments. In some developing countries – Africa particularly – its effect is much more severe. Though modelling suggests that macro-economic impacts are comparatively minor and certainly sustainable, existing evidence indicates that this is not true for particular sectors or affected households. Within the health sector, the epidemic has the potential to generate an important increase in the burden of disease and demand for care, to consume a substantial share of available resources, and to cause substantial dislocation to existing service provision. Where HIV prevalence is high, antiretroviral therapies are only affordable for a small minority of the population. At household level, HIV/AIDS can have major and possibly devastating consequences for income, expenditure, assets and productive capacity.

At an individual level, costs of health care per person are high – typically 1-3x per capita GNP for AIDS - and on annual basis usually increase with stage of infection. Even so, costs are comparable with those of other diseases in North America and Europe, and with the exception of drug costs have tended to fall over time, with greater experience of the disease and more pro-active demand for, and use of, outpatient management. On a per hospital admission basis at least, evidence is mixed but does indicate that costs are probably similar or not substantially higher than those for other

health problems in developing countries. Some empirical evidence indicates tuberculosis is the single most costly disease, with the largest overall impact on health services (possibly because patients with late/chronic HIV disease and terminal HIV-related illness are less likely to be taken to hospital). Meanwhile, a number of ways in which care costs may be reduced have been suggested, particularly in relation to HIV test costs and out-of hospital care.

Preventive strategies are available, but the resources allocated to them are minimal compared to estimated requirements in developing countries. Recent trends in international funding mean this is likely to remain the case for the forseeable future. Most global expenditure is in developed countries, which have the smallest HIV/AIDS problem.

Where funds are available, interventions worth funding in both developed and developing country settings, in either cost-effectiveness or cost-benefit terms, appear to be screening of blood for HIV and voluntary counselling and testing services. In developing countries, existing evidence indicates that improvement of STD treatment services and programmes targeted at commercial sex workers are also comparatively cost-effective. In developed countries, a number of additional strategies appear relatively cost-effective. These include prophylaxis with antiretroviral drugs following occupational exposure to HIV and, in certain instances, following sexual exposure; educational interventions for gay men; needle-exchange programmes for injecting drug users; antiretroviral therapy for pregnant women; and, possibly, mandatory antenatal screening and pre-marital HIV testing.

For individuals already living with HIV in developed countries, prophylaxis for PCP appears to easily pass any reasonable test of cost-effectiveness (such as being of at least equivalent cost-effectiveness to existing widely accepted interventions). Prophylaxis for MAC may also be justified in these terms. Existing analyses indicate that prophylactic treatments for other opportunistic infections are not particularly cost-effective. The evidence on antiretroviral treatment for asymptomatic patients is mixed. There is conflicting evidence about whether ZDV mono-therapy for AIDS patients is cost-effective, but early analyses imply that combination therapy for people at later stages of infection may be cost-effective. Several ways to improve the initial cost-effectiveness of care for opportunistic infections and terminal care have also been identified, generally involving home or out-patient care and drug regimens with lower or less frequent dosages and fewer side-effects.

For people living with HIV in developing countries, care options with the potential to be cost-effective include prophylaxis for those at high risk of developing tuberculosis, education on the risks of side-effects due to use of thiacetozone for tuberculosis treatment followed by its replacement when side-effects do occur, and voluntary counselling and testing[10]. It is difficult

[10] It is worth noting that a recent study in Côte D'Ivoire has suggested that prophylactic treatment with co-trimoxazole may reduce mortality among HIV+ patients. The low cost of co-trimoxazole may mean that the

to draw clear conclusions, however, because studies are restricted to a few low-income settings only, and cost-effectiveness was not always compared with other types of health intervention in these studies. Overall, while evaluations were not undertaken in the context of HIV, a relevant and consistent finding is that treatment of tuberculosis using "short-course" chemotherapy is more cost-effective than use of the earlier and longer "standard course" drug regimens.

3.3.2 Limitations of Existing Studies/Important Gaps

These general findings are useful, but the existing literature has some important limitations and major gaps in knowledge remain. These are explained in the following section, with especial reference to developing countries and South Africa in particular.

General limitations

One of the simplest illustrations of general limitations is Table 3.19 below. This shows that research to date has been conducted predominantly, and for some topics overwhelmingly, in the USA. Numerous studies have been undertaken there, right down to the most efficient way to diagnose particular opportunistic infections associated with HIV. Studies in developing countries, which are contending with the most severe HIV

Table 3.19: Number of studies concerned with the health sector specifically, by topic area and location

Topic Area	Developed Countries (including USA)	USA	Developing Countries (including S. Africa)	South Africa
Demand for care	49	27	45	7 (1988-91)
Supply of care	9	1	9	0
Cost of prevention	4	1	1	1 (a multi-country study that included S. Africa)
Cost of care	118	68	54	4
Strategies to reduce costs of care	35	22	14	2 (promotion of primary health clinic care; home based care)
Cost-effectiveness of prevention	48	35	11	1
Cost-effectiveness of care	30	21	11 (5 specifically in context of HIV epidemic; others on TB indirectly relevant)	0
Cost-benefit studies	10	9	3	1
TOTAL	303	184	148	16
% all studies	**67**	**41**	**33**	**4**

treatment is cost-effective, though this remains to be demonstrated and is the subject of planned clinical trials in Malawi and South Africa.

epidemics, are extremely limited by comparison – the number is approximately equal to the total number of countries in this category.

Studies of impact on demand and supply of health care

There is most balance in the number of studies on the impact of HIV/AIDS on the demand for and supply of care in developed and developing countries. However, the number of studies remains small in comparison with the extent of the HIV/AIDS epidemic, and for many countries there has been no published research. Moreover, many early studies focused on AIDS only, and neglected to consider pre-AIDS but still HIV-related health services utilisation. In both types of setting, the early focus was also on inpatient care, with very few examples of data concerning the impact of HIV/AIDS on outpatient or community level services. In developing countries, there is also very little knowledge concerning HIV-related demand for care within the private or traditional sectors, despite the fact that these are relatively important providers of services; and there has been only one study for a district as a whole (in Zambia), even though there has been much emphasis on decentralisation to district level in recent years and that, in theory at least, the district is the basic planning unit of many health systems.

Most of these problems have been rectified in more recent studies in developed countries – notably the USA and the UK. This has often been permitted through the development of extremely detailed longitudinal databases and through the efforts of specialised research groups.

In developing countries, they remain; and a range of other deficiencies can also be identified.

More specific limitations in developing countries

Most empirical studies have been cross-sectional in nature, so that impacts over time have not been documented and a snapshot picture only of the impact of the HIV/AIDS epidemic has been presented. Data at the level of an individual patient usually concern a single admission or attendance only, or the period with AIDS: there are no published data concerning the average HIV-related health care utilisation associated with an individual from the time of infection with HIV through to death or according to disease stage. Studies have typically been confined to specific hospital wards, often in tertiary hospitals in capital cities (the one study from South Africa was undertaken in Baragwanath Hospital, a tertiary facility in Johannesburg): data from rural areas are virtually non-existent. All longitudinal data sets concern general medical services, tuberculosis programmes, or – as in South Africa - HIV+ patients only. Overall, this means that virtually no studies set the impact of the HIV/AIDS epidemic in the context of either hospital or health services as a whole, none both set it in context and illustrate its impact over time, and none indicate what demand for care per individual with HIV/AIDS will be. Most studies also

date from several years ago (South Africa is again a prime example – the studies are from 1992 or earlier). No studies reporting the proportion of patients who are HIV+ on particular wards have attempted to indicate what fraction of these HIV+ admissions can actually be attributed to their HIV infection, despite the fact that epidemiological methods (based on the principles of attributable risk) to enable this are available.

Meanwhile, more than half of the studies concerned with demand for care – and this is notably true of six of the seven identified for South Africa – were based on rapid appraisal methodologies or models whose accuracy is questionable, resting as they do on many important assumptions that may not hold in practice. One key assumption is the proportion of people who actually seek care for HIV-related illness: yet as two economists from the World Bank have affirmed "demand is difficult to predict, particularly as studies have yet to measure the percentage of Africans with AIDS who seek medical care". The seventh study from South Africa, based on the perceptions of health staff, may also be unreliable: as the authors themselves commented "it is possible that the information recorded was not accurate... some respondents stated that they had to guess... several... were unable to answer the questions... results reflect the perceptions of respondents and not necessarily the actual status of the epidemic".

Finally, many of the data quoted for developing countries are from reports or unpublished parts of PhD theses, not peer-reviewed publications. This makes their quality less reliable.

Costs of care

Cost data are abundant in developed countries, and compared to other topic areas are relatively numerous in developing countries. However, there are a number of limitations on those that exist for developing countries. They are largely restricted to the costs of care for people with AIDS, and even these are frequently estimated rather than based on resource use in practice. Where they are based on actual utilisation, data usually come from a limited number of facilities and locations, typically – as for studies of demand and supply side impacts – tertiary hospitals in urban locations. Most studies are out-of-date. There are hardly any data concerning either the costs of treatment pre-AIDS or the costs of particular care components such as counselling services. There are no published data concerning the average cost of HIV-related health care utilisation associated with an individual from the time of infection with HIV through to death.

Economically viable ways of preventing or coping with the epidemic

Evaluations of economically viable ways of preventing or coping with the epidemic are especially skewed in favour of the USA – 60% of all studies on the cost-effectiveness of prevention strategies, 51% of those on cost-effective mechanisms for providing care, and 69% of cost-benefit studies. Only a handful has been undertaken in developing countries and just four were identified for South Africa. More specifically, the analyses of

antiretroviral therapy for pregnant women have relied on assumptions for sub-Saharan Africa as a whole or on data averaged across the four urban areas where clinical trials are underway, with affordability and capacity to implement the intervention given little or no attention. There has been just one evaluation of alternative ways of delivering short-course chemotherapy for tuberculosis, and this used empirical effectiveness data for only one of the two strategies considered. There have been no evaluations of alternative ways of delivering short-course chemotherapy for tuberculosis that use a community-based approach.

All but one of the papers concerned with strategies to reduce the costs of care have been concerned with either HIV testing or home-based care. This represents a very narrow focus. HIV testing is a relatively small component of total costs in any care or prevention strategy (though it is easy to analyse and cost). Home-based care is mostly relevant to AIDS patients, who constitute only a small fraction of the HIV+ population as a whole (especially when one considers that many people with AIDS are not willing to be open about their status, which makes accessing a home-based care programme problematic).

More technical limitations of studies concerned with cost-effectiveness also exist. For prevention strategies, almost all evaluations rely on epidemiological modelling to estimate effectiveness. They are therefore intrinsically limited by the accuracy with which the incidence of HIV infection in the absence and presence of an intervention can be predicted. As has been pointed out by eminent modellers, such prediction is extremely difficult; and most models have to estimate the values of key parameters using a variety of sources at different points in time. While sensitivity and threshold analyses can help and are frequently a key component of these cost-effectiveness analyses, they are not fool-proof. In this regard, the recent economic evaluation of improved STD treatment stands out, being based on both empirical cost and effectiveness data from both control and intervention districts (though even here there were wide confidence intervals around the point estimate for effectiveness; and prevention of secondary infections was not included in the analysis).

3.3.3 Why are these limitations and gaps important?

Overall, it is clear that the existing body of research has a number of limitations and that gaps in knowledge remain. As has been commented "The effect of HIV on health care is lamentably under-researched" (Decosas and Whiteside, 1995); and "....the information required to make resource allocation decisions ... is largely absent" (Hanson, 1992). However, the key question is: does this matter? This section argues that it does, with reference to each of the topics distinguished in section 3.3.2.

Demand for and supply of care

Existing limitations and gaps in research on demand and supply-side health service impacts matter because an understanding of the extent to which

services are being affected, which types of service are most affected, and how providers of care are responding, can help to inform the planning of well-targeted response strategies. It can indicate where additional resources are required, or where the identification of more efficient approaches to service delivery is especially urgent. As has been observed: "In order to plan adequately for the epidemic, it is imperative to quantify the impact of the epidemic on health care systems at both the macro and micro-level. This information is critical for planning and designing alternative patient care programmes" (Tembo et al, 1994).

Deficiencies in existing knowledge seriously hamper such planning or informed resource allocation. Lack of longitudinal data and the restriction of many data to particular diseases, patients or services make it difficult to set the impact of the epidemic in historical perspective or in the context of hospital or health services as a whole, to understand how the epidemic has evolved since its outset, and to project its likely course in future. With most data from the late 1980s or early 1990s, it is hard to characterise the existing situation - the HIV epidemic is an evolving not static phenomenon and findings from over five years ago are unlikely to represent an accurate picture of its current or even recent impact. The fact that virtually all data are from urban tertiary hospitals means that impacts may be over- or under-estimated and unlikely to be representative of general or secondary level facilities – especially if they are care magnets (as they have been demonstrated to be in the USA). Demand in urban hospitals is difficult to extrapolate to rural areas because catchment populations are so hard to define in urban areas, and access to care is likely to be different – yet in Africa in particular rural areas are where the majority of people live. The lack of data concerning typical utilisation from infection to death makes it hard for planners to project how demand for care will evolve over time.

Even if these deficiencies did not exist, it is worth highlighting the fact that studies in South Africa specifically are of value even though some exist for other countries. A recent commentary makes this point clearly: "The HIV epidemic in sub-Saharan Africa is heterogeneous. The HIV prevalence and the social and gender profile of those infected may vary greatly, even between such close neighbours as Ghana and Ivory Coast. This lack of uniformity, and the fact that the type and quantity of health care demanded in different countries varies widely, limits the usefulness of calculations of additional demand on a continental, regional and sometimes even national scale" (Decosas and Whiteside, 1996). In relation to this, it is worth noting that in South Africa, the rapidity with which the HIV epidemic has emerged is unusual; overall standards of living and health care facilities are higher than in other African countries already affected; and the type of morbidity associated with HIV may be different – for example, tuberculosis may be more significant, given the especially high incidence of the disease in South Africa even prior to the HIV epidemic.

Finally, more empirical data are important for indicating the extent to which modelling predictions are correct, and therefore the degree to which they may be relied upon.

Evaluations of cost-effective care/prevention strategies in developing countries

The paucity of economic evaluations in developing countries concerned with prevention of HIV or provision of care for those with HIV/AIDS is important for two major reasons. The most fundamental is that while resources are scarce everywhere, this is especially true of developing countries. It is not unusual for there to be declining resources available to the health sector specifically. Therefore, in coping with an epidemic that places additional and sometimes substantial pressure on health services and households, economic evaluations can play a valuable role by indicating how to make most efficient use of those resources that are available.

The second reason why the shortage of economic evaluations in developing countries is a problem is that it is not possible to extrapolate from the many studies undertaken in developed countries. There are four explanations for why this is so.

The first is that absolute cost levels can vary enormously between high and low or even middle-income settings – for example because of differences in labour costs and the general standard of care provided. This is an especially important consideration when the cost-effectiveness of primary prevention or secondary prevention (i.e. interventions for those already who are HIV+, such as drug treatments to prevent opportunistic infections) programmes is very influenced by averted care costs and the cost of drugs. In developed countries, averted treatment costs are likely to be high because of the standard of care available; in developing countries they will be much lower.

Evaluations of antiretroviral therapy for HIV+ pregnant women offer a useful illustration of this point. This is consistently found to be cost-saving in the USA, because averted paediatric medical care costs are so high in relation to the costs of the drugs used for treatment. In developing countries, drug costs may be much the same (though drug companies have appeared increasingly willing to offer them at discounted prices), but likely averted treatment costs are substantially lower.

Differences in income levels are also important when drugs account for a large proportion of an intervention's costs. Even when drug costs are high in absolute terms they are still usually relatively low in comparison with other care costs in high-income settings. However, in developing countries they may be unaffordable - either in relation to averted treatment costs or other components of care, or because the sheer numbers of people eligible for treatment are so much greater. Good examples of this are some of the prophylactic and therapeutic drugs for opportunistic infections, combination antiretroviral therapy, and antiretroviral prophylaxis following occupational or sexual exposure.

A second explanation is that the effectiveness of any given intervention is likely to be significantly different. This is partly related to the nature of the

epidemic itself, which is relatively concentrated in particular locations and among certain risk groups in developed countries (e.g. London and Edinburgh in the UK; San Francisco and New York in the USA; Vancouver in Canada), but is much more widespread – both geographically and in the population as a whole - in developing countries. It is also linked to the major gulf that exists in general education levels, which mean that the success of some interventions will vary; and to social and cultural norms and the status of women, which affect an individual's capacity to protect themselves and the probability that the at-risk population as a whole will respond to prevention messages or the availability of care options.

A third factor is that the type of prevention or care strategies that may be appropriate can vary. Evaluations of interventions targeted at drug users or gay men in North America are of limited relevance in developing countries, where heterosexual transmission causes most new HIV infections. The types of health problems associated with HIV also vary. PCP is the most common opportunistic infection in the USA but is much rarer in Africa; conversely, tuberculosis is very commonly associated with HIV in developing countries but is of comparatively small importance in the USA. In South Africa, it has been suggested that "there is an urgent need for investigation of how to minimise the potential impact of HIV-related TB" (Broomberg, 1996).

Finally, HIV/AIDS prevention and care programmes in developed and developing countries are competing with different kinds of alternative interventions. Given the level of health care already achieved in places such as the USA and Europe and the general overall level of resource availability, HIV/AIDS strategies do not need to meet such a high standard of cost-effectiveness to be considered worthwhile in economic terms (though in practice they may be implemented for other reasons, such as political factors). In developing countries, where many basic but potentially highly cost-effective services are not yet universally available, HIV/AIDS interventions need to meet a far more stringent cost-effectiveness test. This means that even if a strategy had equal costs and effects, it might be cost-effective in the USA but far from cost-effective in Africa.

Though these arguments are particularly relevant to extrapolations from developed to developing country settings, it is also the case that extrapolating results from middle-income to low-income, from one low-income setting to another, and even from one part of a country to another, can be problematical. For example, programmes may have different effectiveness when the prevalence or incidence of HIV varies markedly; and they will almost certainly have different costs when per capita income levels are substantially different and labour accounts for a large proportion of intervention costs. As has been argued recently, these points imply that "ideally, we would like to have measures of cost-effectiveness across multiple interventions for a single country" (Ainsworth and Over, 1997).

More specifically, evaluations of alternative approaches to provision of short-course chemotherapy for tuberculosis are important because evidence from elsewhere in Africa suggests that the HIV epidemic will cause a large increase in caseload, which will have to be managed within existing resource constraints. Evaluations of community-based approaches are especially relevant, since they can relieve some of the pressure on health systems and if well designed may not impose an unreasonable burden on lay-people. Evaluations of antiretroviral therapy for pregnant women are required because while this has the potential to prevent a large number of paediatric HIV infections, it is necessary to assess whether or not it represents a cost-effective use of resources.

Costs of prevention/care

Some of the limitations with developing country cost data are important for similar reasons to those identified for supply/demand impacts and economic evaluations. Knowledge of costs is important for planning and budgeting; and by definition, any cost-effectiveness analysis requires cost data. Of especial note here is that the conclusions to be drawn from evaluations of prevention strategies may depend crucially on the magnitude of the medical care costs that are likely to be averted through prevention of an HIV infection. This makes the lack of data from developing countries concerning HIV-related care costs from infection through to death a particularly notable gap.

Overall conclusions

Overall, this analysis suggests that in developing countries, further data concerning the impact of the HIV/AIDS epidemic on both demand for and supply of care, the costs of care, and cost-effective ways of coping with the epidemic are important. This is as true for South Africa as it for other countries.

3.4 Summary of research undertaken in Hlabisa

To begin to address some of the important limitations and gaps in the existing body of research concerned with economic aspects of the HIV/AIDS epidemic, several inter-related studies were initiated in Hlabisa District, South Africa, in 1996. The way in which these addressed important limitations or gaps in the existing literature, and therefore why the results from them represent an original contribution to knowledge, is summarised in Table 3.20 on the following page.

The next chapter (4) provides a more detailed explanation of the research objectives and the over-arching methodological issues relevant to achieving them. Methods specific to individual studies are covered in subsequent chapters (5 through 9), which report each individual study in turn.

Table 3.20: Summary of how research undertaken in Hlabisa, South Africa addressed important gaps/limitations in existing research

Limitation/gap	Importance of limitation/gap	How limitation/gap was addressed in Hlabisa, S. Africa
Research on impact of HIV/AIDS epidemic on demand for care in South Africa >5 years old, based on perceptions or models, or confined to urban tertiary hospitals. No longitudinal data to illustrate how impact has evolved over time. No empirical data sets impacts in context of hospital or health services as a whole. No analysis of what fraction of HIV+ patients use of health care may be attributable to their HIV infection No studies on supply-side responses/impacts in South Africa; generally, evidence is extremely limited in developing countries No longitudinal data from outset of epidemic	Projections indicate that the health sector in South Africa will be one of the most severely affected in the world. To inform planning, data that illustrate impacts in practice, and which set them in an overall context, are required e.g. to answer questions such as which services which will be most affected? which require priority attention? Modelling predictions and perceptions may not be accurate: their accuracy needs to be explored Cross-sectional data provide a snapshot picture only and may be misleading Studies in urban areas may not be generalisable to rural areas where a large fraction of the population live, especially if urban hospitals studied are "care magnets" Figures for % of patients HIV+ can over-estimate HIV impact Supply side responses/impacts may have implications for access to care, quality of care, and capacity to provide care. Need to understand whether such impacts/supply side responses are neutral, adverse or favourable Evolution of HIV impact has not been described	Series of 4 complementary studies in Hlabisa Distict, South Africa, a rural area in one of the provinces worst affected by the HIV epidemic where a general community hospital and 12 clinics are the major sources of care. Each used to assess how serious an impact the HIV epidemic has had to date, which services are most affected, and which (if any) require priority attention 1) Trends in demand for in-patient care assessed 1991-8 2) 2 detailed studies of the economic impact of the two HIV-related impacts that can be identified retrospectively: HIV-attributable tuberculosis; and clinical AIDS (excluding tuberculosis). Impact assessed for 1991-9. Particular reference to supply-side responses in the case of HIV-attributable TB. Use of attributable fraction calculations to assess what % of HIV+ TB cases due to HIV infection 3) Detailed economic analysis of impact of HIV on general adult medical services in 1998: unlike retrospective studies, HIV status known for all patients recruited to the study. Study of impact of HIV on demand for care in private and government sector clinics Longitudinal data cover period from outset of epidemic to high prevalence
Only one economic evaluation of possible strategies for coping with HIV/AIDS epidemic in S. Africa (a modelling of cost-effectiveness of isoniazid preventive therapy) No evaluations of HIV-related interventions for the same area No evaluations of community-based DOT, or any country-specific evaluations of antiretroviral therapy for pregnant women	Additional demands likely to be placed on health services by HIV/AIDS in context of highly constrained resources, thus important to try to identify affordable and cost-effective ways of responding to the epidemic Costs and effects may vary significantly by country so hard to extrapolate results from elsewhere DOT is the approach to TB treatment recommended by WHO, and there is increasing interest in community-based approaches HIV-related TB may be one of the most important causes of increased demand for care – caseloads have risen dramatically elsewhere in Africa – identification of most efficient way to deliver short-course chemotherapy important Antiretroviral therapy can prevent HIV infection: important to assess if it is worth investing in	Economic evaluation of 2 strategies: 1) community-based directly observed therapy for tuberculosis, in comparison with strategies being widely used elsewhere in South Africa and in Africa more generally 2) antiretroviral therapy to prevent mother-child transmission of HIV

CHAPTER 4: Overview of research goal, objectives and methodology

4.1 Introduction

The literature review indicated that there were several areas where there were either important gaps or limitations in existing economic research concerned with the HIV/AIDS epidemic in developing countries.

In terms of the economic impact of HIV/AIDS on the health sector, general limitations included:

- a small number of studies in a few countries only;
- no studies in South Africa for a district as a whole, despite the current emphasis on decentralisation to district level and the fact that a district is – theoretically at least - the basic planning unit of many health systems; and
- few data from recent years, since many studies were undertaken in the late 1980s or early 1990s.

More specific limitations related to the subject matter of existing studies included:

- a focus on AIDS with little attention given to pre-AIDS morbidity;
- a focus on single admission costs in empirical research, with costs over the lifetime of HIV infection not documented for any developing country;
- a focus on inpatient care in the public sector, with little attention given to outpatient services or to the private/traditional sectors; and
- very limited data concerning health service supply-side responses to the impact of HIV/AIDS.

In terms of the methodologies used, limitations included:

- frequent reliance on rapid appraisal methodologies or on modelling using assumptions that were often not evidence-based, so that assessments may not be very accurate;
- most empirical studies were cross-sectional, presenting a snapshot picture only, with very few longitudinal data to illustrate impacts over time. The only longitudinal data were confined to either medical wards, tuberculosis services, or to HIV+ patients only (with no comparison to HIV-negative individuals);
- impacts were usually not related to general hospital or health services as a whole, and therefore could not be placed in an overall context;
- no studies used the epidemiological principles of attributable risk to assess what fraction of morbidity among HIV+ patients could actually be attributed to HIV infection; and
- almost all studies were confined to tertiary hospitals in urban areas, which may not be representative of other types of facility, especially if they are "care magnets". They are particularly unlikely to be

representative of rural areas where a substantial proportion of developing country populations live.

In terms of economic evaluations of ways in which the health sector could respond to HIV/AIDS, limitations included:

- a very small number of studies overall, and just two in South Africa;
- only one evaluation of alternative ways of delivering short-course tuberculosis treatment, and for one of the two strategies evaluated in this study there was no evidence of the outcomes that would be achieved in practice. This lack of research was despite the fact that HIV/AIDS has been recognised to be capable of causing a substantial increase in the tuberculosis caseload of some countries (Chapters 2 and 3). There were no evaluations in South Africa, and none anywhere concerning community-based directly observed therapy, despite the fact that DOTS is now advocated by the World Health Organization and that community-based approaches have been seen as a potential way of relieving pressure on health services; and
- no evaluations of antiretroviral drug therapy for pregnant women to prevent maternal-child transmission for South Africa specifically, even though this preventive option is being encouraged by international agencies in middle-income developing countries. Moreover, neither of the two papers published to date considered either affordability or capacity to implement the intervention in terms of the availability of human or physical resources.

In 1996, a series of studies was planned in South Africa to address some of these limitations. In some instances, the content of these studies could be clearly defined at the beginning of the research. In other cases, their exact content was not always defined at the outset but evolved with both greater understanding of data availability and the emergence during the research of new care/prevention possibilities (the most noteworthy example being the role of antiretroviral treatment in prevention of mother to child transmission).

South Africa was chosen as the country for the research for several reasons. First, it was a country experiencing one of the world's most severe HIV epidemics to date. Second, only a small number of studies had yet been undertaken. These were confined to modelling exercises, surveys of health staff perceptions, or empirical data from urban tertiary hospitals in Cape Town and Johannesburg during the late 1980s and early 1990s. Third, the newness of the epidemic (a relatively low HIV seroprevalence as recently as the early 1990s) meant that it was likely to be possible to use retrospective data to quantify the impact on health services from the epidemic's onset through to a time when HIV prevalence had reached high levels. This might have been difficult or impossible in countries where the epidemic has been present for some time and data from early years might no longer have been available. However, apart from these justifications for conducting research in South Africa specifically, it was also anticipated that some of the findings would have broader applicability, particularly to other countries in sub-Saharan Africa.

While subsequent chapters report each study in detail in a format similar to that of a paper, this chapter is designed to provide a broad overview of the research aims, objectives and methods as a whole. It is structured in five major sections, which are:

- **Goal and Objectives** (4.2), which defines both the overall aim of the research and the specific objectives designed to achieve it;
- **General methodological issues** (4.3), which explains why Hlabisa was chosen as the study site, describes the study site, and assesses the degree to which it is representative of other places;
- **General methodological issues related to definition of objectives for economic impact studies** (4.4), which discusses constraints and complementary studies that affected the scope of the research;
- **General methodological issues related to the collection and analysis of data used for economic impact studies** (4.5), which focuses on data reliability, costing methods, and the application of the epidemiological principles of attributable risk; and
- **General methodological issues related to economic evaluations** (4.6), which outlines how the cost-effectiveness analyses that were undertaken were designed to meet the criteria and/or recommendations of existing international guidelines and textbooks.

4.2 Goal and Objectives

The hypothesis underlying the research reported in this thesis was that because the HIV/AIDS epidemic in South Africa was affecting a large proportion of young adults whose demand for health care would normally be comparatively low, it would have an important economic impact on health services. Given that it appeared unlikely that new resources would be made available to cope with this (Chapter 2), it was also anticipated that identification of more affordable as well as cost-effective approaches to care would be necessary to mitigate this impact.

The goal and objectives were therefore defined with these two hypotheses and its implications in mind. However, it is important to emphasise that the precise definition of objectives was inextricably linked with 2 key methodological issues - choice of study site(s) and data constraints in the chosen site of Hlabisa District (though it is worth stressing that these constraints were generic and not unique to Hlabisa). These are discussed in more detail in sections 4.3 and 4.4. It was also inextricably linked to what strategies were available for evaluation. This, too, reflected choice of study site, but in addition evolved over time, due to rapid developments in the availability of certain preventive treatments during the period in which the research was undertaken (1996-1999). This is explained in more detail in Chapter 9. A third factor was that objectives were defined in the context of what studies were being undertaken or were planned by other researchers. This is covered in section 4.4.4.

4.2.1 Goal

The overall goal was to assess the economic impact of the HIV/AIDS epidemic on health services in rural South Africa, and to identify affordable and cost-effective ways of responding to this impact.

4.2.2 Objectives

The specific objectives, designed to address existing limitations or gaps in existing research wherever possible, were then defined as:

1. To assess the HIV/AIDS epidemic's impact on demand for in-patient care in a rural South African district hospital 1991-8.
2. To provide a detailed quantification of the economic impact of HIV-attributable tuberculosis and AIDS (excluding tuberculosis) in a rural South African district hospital 1991-9.
3. To provide a detailed quantification of the economic impact of the HIV/AIDS epidemic at hospital in-patient, government clinic and private clinic level in 1998.
4. To conduct an economic evaluation of alternative approaches to delivery of short-course tuberculosis treatment, including the option of community-based directly observed therapy.
5. To appraise the affordability and cost-effectiveness of antiretroviral therapy for the prevention of maternal-child transmission, and to assess existing capacity to implement such an intervention.

The objectives related to the economic impact of HIV/AIDS therefore included a strong emphasis on longitudinal data, empirical data collection rather than modelling, a focus on a rural district, inclusion of pre-AIDS morbidity impacts (2. and 3.), and an assessment of supply-side responses (included within 2. and 3.). Clinics and the private sector were also considered. The objectives related to economic evaluations (4. and 5.) had a major focus on alternative approaches to the management of tuberculosis cases and the emerging issue of antiretroviral drug therapy in South Africa.

4.3 General Methodological Issues

4.3.1 Choice of Study Site(s)

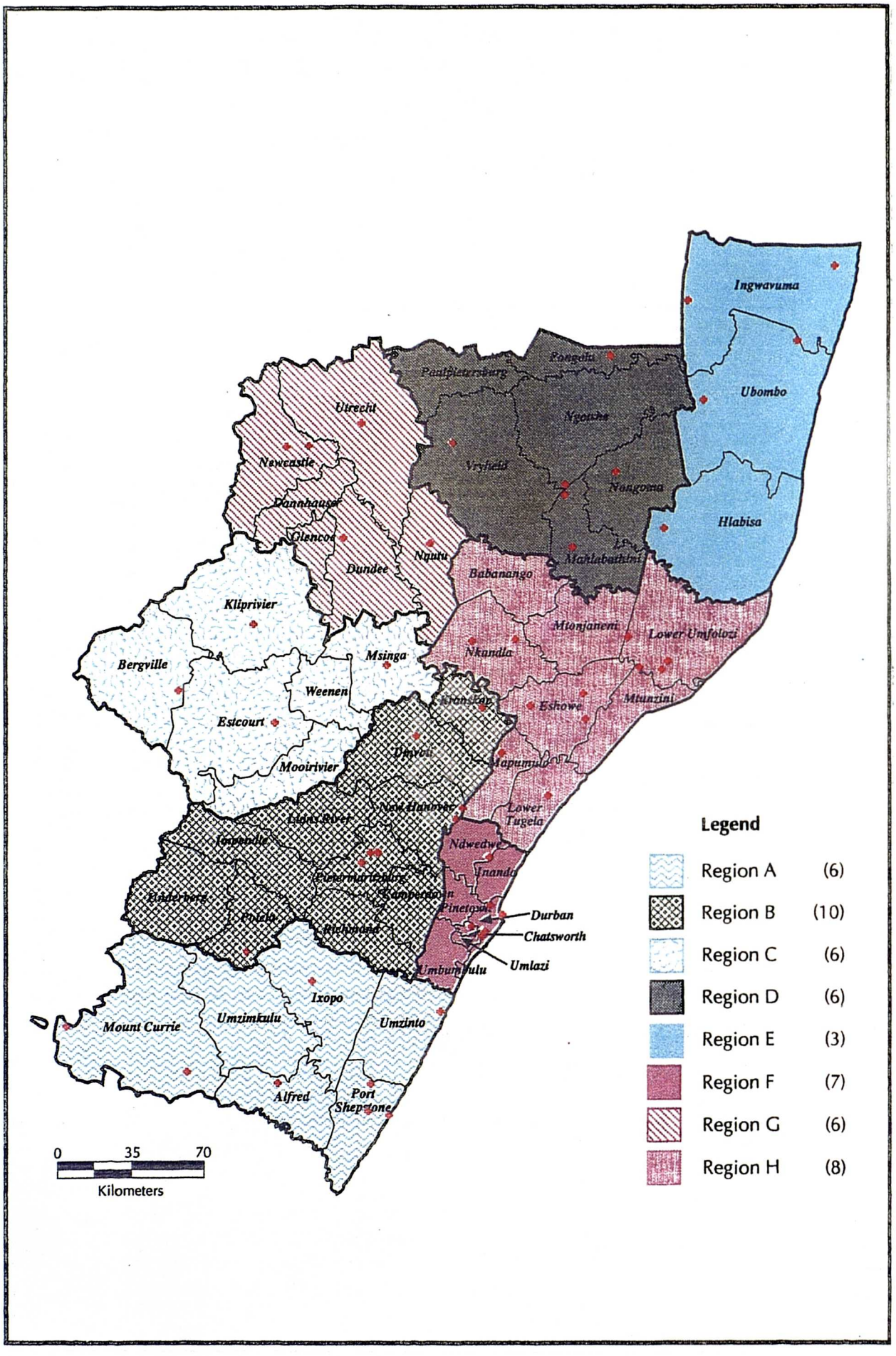
Hlabisa District, in the province of KwaZulu-Natal, was chosen as the study site for several reasons. As Chapter 2 showed, KwaZulu-Natal was (and continues to be) the part of the country experiencing the most explosive HIV/AIDS epidemic, with the highest incidence and prevalence rates in South Africa. It was therefore at the forefront of the HIV/AIDS epidemic and likely to be the province where impacts were already becoming apparent and the need for response strategies most urgent.

Within KwaZulu-Natal, Hlabisa offered a variety of advantages that in combination made it unique. It was a rural site with a general community hospital (rather than a secondary or tertiary facility) as the focus of inpatient care. It therefore fulfilled the need for research to broaden out from urban to rural areas, and from tertiary hospitals to lower-level facilities. It was also the only district in the country to have longitudinal data concerning HIV sero-prevalence among antenatal clinic attendees and tuberculosis patients dating from the early 1990s, when the HIV epidemic first began to emerge. These data were important because they made it possible to link health service impacts to the evolution of the epidemic. Of particular importance given the sensitivities that surround the issue of HIV, access to health services data was available through a research collaboration with the district's medical superintendent. Finally, a wide variety of complementary research activities were either already underway or planned.

Other sites did not have this combination of characteristics. This meant that the random selection and in-depth study of several sites – which in theory might have been the ideal research design – was considered to be an inferior approach. No other district offered HIV seroprevalence data that would have enabled impacts to be linked to the documented evolution of the epidemic, so that retrospectively collected data would have been difficult to interpret. HIV/AIDS was and remains an enormously sensitive issue. Access to the data required to understand its impact would have been difficult to achieve in other places, where the full support of the most senior manager in the district might not have been as reliable or available. Third, other rural sites did not have other researchers with complementary skills – such as clinical and epidemiological research – on-site, which would have made analysis of some of the retrospective data (such as that requiring definition of AIDS cases) difficult to do.

A final reason for the focus on one site only was that the resources – both human and financial – that would have been required to support more extensive studies were not available. The collection and analysis of retrospective data in particular is extremely time-consuming in South Africa. Health information systems are generally poor and rarely computerised, and no special databases or patient cohorts have been established to facilitate analyses of HIV/AIDS-related use of health services – as has been done, for example, in the USA. Extension of the research to other places would therefore have necessitated less thorough research in all sites. This might have compromised data reliability. There was therefore an important trade-off to be made between ensuring data reliability (internal validity) and ensuring generalisability (external validity).

The best approach to this trade-off was felt to be collection of detailed and reliable data from one site with unique advantages for research, and to be rigorous in assessing its more widespread generalisability. The following two sub-sections therefore assess the extent to which KwaZulu-Natal is


Ingwavuma
Ubombo
Hlabisa
Paulpietersburg
Pongola
Ngotshe
Vryheid
Nongoma
Utrecht
Newcastle
Dannhauser
Glencoe
Dundee
Nquthu
Mahlabathini
Babanango
Klipriver
Bergville
Msinga
Nkandla
Mtonjaneni
Lower Umfolozi
Weenen
Kranskop
Eshowe
Mtunzini
Escourt
Mapumulo
Mooirivier
Lower Tugela
Ndwedwe
Inanda
Durban
Chatsworth
Umlazi
Umbumbulu
Ixopo
Umzimkulu
Umzinto
Mount Currie
Alfred
Port Shepstone
0
35
70
Kilometers
Legend
Region A (6)
Region B (10)
Region C (6)
Region D (6)
Region E (3)
Region F (7)
Region G (6)
Region H (8)

representative of the rest of South Africa, and the extent to which Hlabisa is typical of both KwaZulu-Natal and districts in other provinces.

4.3.2 How representative is KwaZulu-Natal of South Africa?

KwaZulu-Natal province (see map) is an amalgamation of the former White province of Natal and the homeland of KwaZulu, and is the province with the largest population in South Africa. It includes a large metropolitan area centred on Durban and major urbanisation in Pietermaritzburg and its surroundings, both of which were also formerly part of Natal. Most of the area that was formerly in KwaZulu is rural, with small trading towns and no large cities. Manufacturing is the most important economic sector, contributing 30% of provincial GDP, followed by community, social and personal services (19%), transport and communications (13%), commerce, catering and accommodation (12%), financing, insurance and real estate (10%), and agriculture (8%). The province has two of the continent's largest ports (Durban and Richards Bay) and a well-developed road and rail network. While some parts of the economy are booming – such as Richards Bay – the rural economy has been described as "stagnant and vulnerable" (Whiteside and Wilkins, 1994). The average income is approximately US$1 700, but there is important income inequality and in the rural areas high levels of poverty. A large proportion of the male population work as migrant labourers – in 1991, the male absenteeism rate was 15% (ibid.). For administrative purposes, the province is divided into eight regions (A through H; see map). In most regions the vast majority of the population is rural (Health Systems Trust and Department of Health, 1996) – the figures vary from 80-98% in Regions A, C, D, E and H. Regions B and G have figures of 66% and 57% respectively. Only Region F (which includes Durban) is highly urbanised (72% of total population).

Several general and health services-specific indicators show that KwaZulu-Natal is close to the average for South Africa as a whole (Chapter 2). It is also clear that it is most similar to Free State, considerably disadvantaged compared to Gauteng and the Western Cape, and depending on indicator is either relatively favoured or similar to other provinces. In terms of the HIV/AIDS epidemic, KwaZulu-Natal is more badly affected than any other province, but Mpumalanga, Free State, North West and Gauteng are not far behind. Eastern Cape may be experiencing a similar epidemic with only a slight lag-time, particularly given that it has many of the factors that predispose an area to a serious epidemic and is similar socially, culturally and economically to KwaZulu-Natal. Western Cape, Northern Cape and Northern provinces are currently much less affected.

4.3.3 How representative is Hlabisa District of KwaZulu-Natal?

Demographic, social and economic characteristics

Hlabisa District was formerly part of the homeland of KwaZulu, and was until recently in Region E (it has recently transferred to Region D). Like

the Region as a whole, where only 2% of the population is urbanised, it is a predominantly rural area with a largely African population of approximately 220 000 people. The local economy is based on subsistence agriculture, remittances from migrant labourers, and pensions. Recent research indicates that approximately 60% of households in Hlabisa have one or more male migrants (UNAIDS, 1998). Many work in Durban, Johannesburg or the Free State Goldfields. There is only one small town – Mtubatuba – which serves as a commercial centre for the surrounding area. Within KwaZulu-Natal, these characteristics make it broadly typical of the areas that were formerly part of KwaZulu. They also make it similar to other parts of South Africa that were formerly homelands.

Health service availability and utilisation in Hlabisa District and KwaZulu-Natal

Health service provision in KwaZulu-Natal is not uniform. Indicators for various measures of resource availability and utilisation are shown in Tables 4.1 and 4.2 below, and in Figures 1-12 (Health Systems Trust and Department of Health, 1996). Health services in Hlabisa consist of a 400-bed community hospital, twelve clinics, and community health workers. Indicators for the district are shown where relevant. Spending per capita and hospital beds per 1000 population are not included – these would be meaningless figures for comparison with regional data. Regional data include provision for secondary and tertiary health facilities that provide services for several districts; Hlabisa has no such facilities.

Linked to the previous division into a White Province and a Black "homeland", all the indicators show that Regions B and F – which include Pietermaritzburg and Durban respectively – stand out as being relatively well-resourced in relation to total population. They are the only regions with tertiary facilities, and only Region F has academic hospitals. 61% of hospital beds are in secondary, tertiary or academic hospitals in Region F; 36% are tertiary in Region B. They serve 15% and 32% respectively of the overall population (Health Systems Trust and Department of Health, 1996).

Higher resource provision is to some extent matched by relatively high rates of hospital admissions in relation to population levels. However, admissions per nurse and per bed remain low in Region B. In Region F admissions per bed are close to average and admissions per nurse are comparatively high. Length of stay is above average in both regions.

In the remaining regions, population is more evenly distributed (6-14% of the population is found in each region, and density ranges from 40 to 98 per square kilometre – compared to 1 064 in Region F) but health service provision and utilisation is variable. Region E has the lowest spending per capita after Region C and fewer nurses relative to population than all regions except C and A. It has the lowest number of doctors and only Region C has fewer beds per 1000 population. However, hospital bed indicators are distorted by the location of secondary facilities serving more than one region: in terms of first-level facilities - community hospitals –

Table 4.1: Indicators of public health service availability by region in KwaZulu-Natal (Hlabisa) 1995/6

Region	Spending per capita (SA Rands)	Nurses per 100 000 population	Doctors per 100 000 population	Hospital beds per 1000 population	Community hospital beds per 1000 population
A	195	173	12.4	2.6	1.8
B	553	352	29.7	4.8	0.2
C	154	151	8.9	1.9	0.9
D	222	254	7.2	3.2	0.8
E *(Hlabisa)*	166	215 *(131)*	5.2 *(5.0)*	2.8	1.7 *(1.8)*
F	694	346	37.5	4.9	0.2
G	242	305	7.3	3.3	0.4
H	213	274	12.3	3.1	1.3
TOTAL	410	286	21.8	3.6	1.2

Table 4.2: Indicators of public health service utilisation by region in KwaZulu-Natal (Hlabisa), 1995/6

Region	Hospital admissions per 100 000 population (all hospital types)	Community hospital admissions per 100 000 population	Admissions per bed, all hospitals	Admissions per bed, community hospitals	Admissions per nurse	Average length of stay	Bed occupancy
A	12 431	10 207	48	57	72	6.4	99
B	10 028	1 589	21	79	28	9.4	75
C	7 598	3 713	40	41	50	8.6	95
D	9 878	4 164	31	52	39	6.5	89
E *(Hlabisa)*	5 671 *(4 606)*	3 501 *(4 606)*	20	21 *(33)*	26 *(35)*	16 *(14)*	92 (92)
F	15 171	729	31	36	44	9.4	87
G	9 180	2 286	28	57	30	6.5	91
H	11 636	4 426	38	34	42	7.5	68
TOTAL	11 562	3 064	32	26	40	8	85

Figure 1: Financial resource availability in KwaZulu-Natal, by region, 1995/6

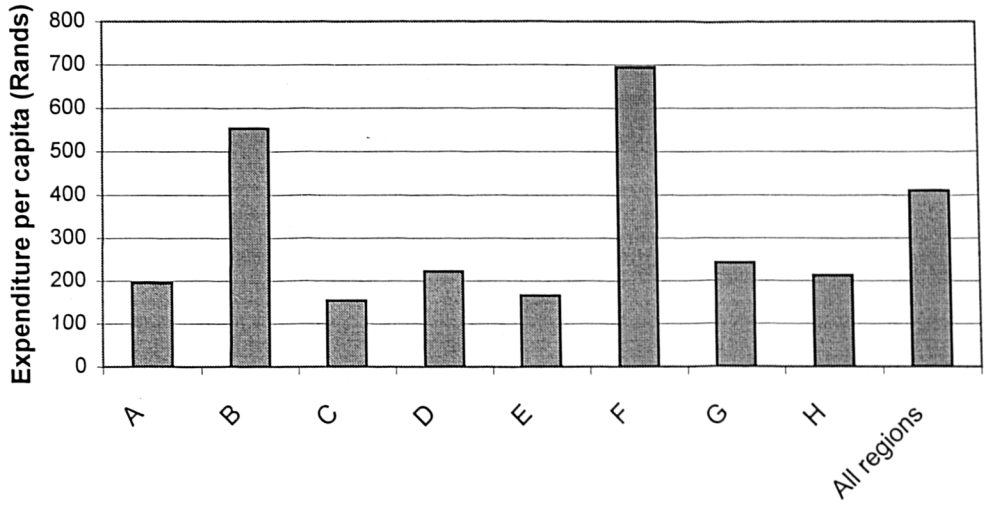


Figure 2: Availability of nurses in KwaZulu-Natal, by region, 1995/6

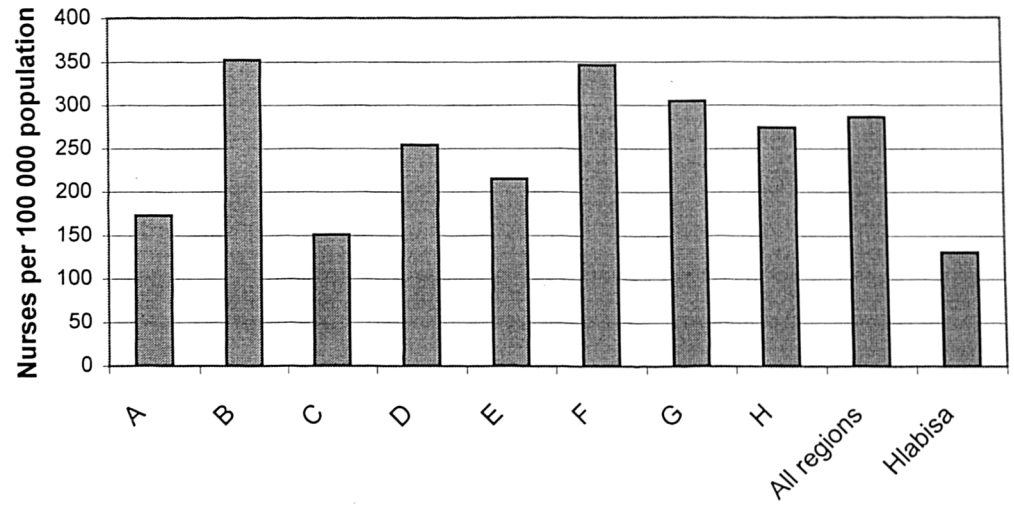


Figure 3: Availability of doctors in KwaZulu-Natal, by region, 1995/6

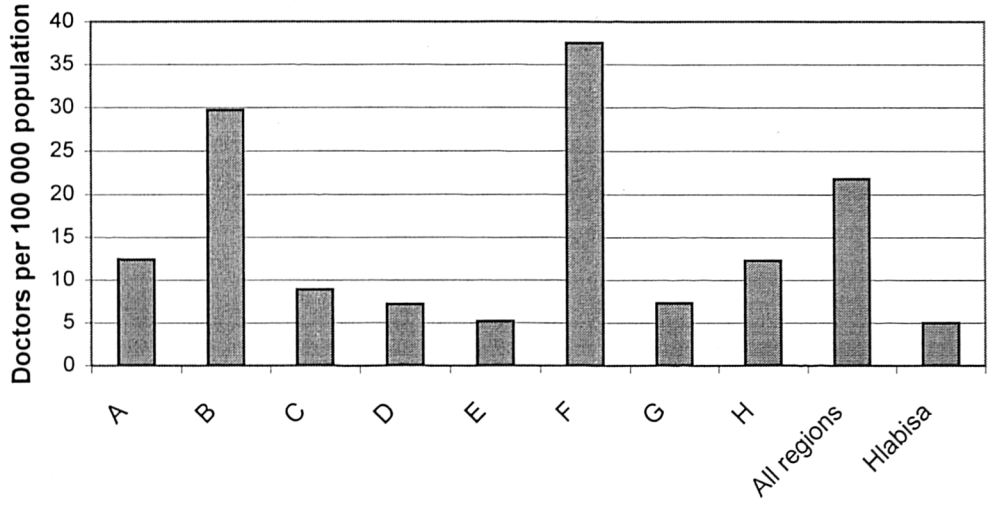


Figure 4: Availability of hospital beds in KwaZulu-Natal, by region, 1995/6

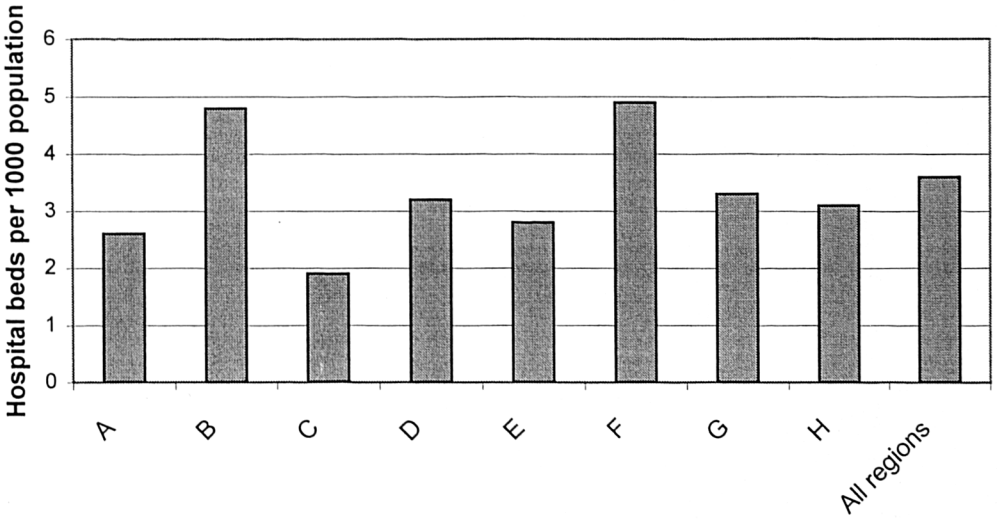


Figure 5: Availability of community hospital beds in KwaZulu-Natal, by region, 1995/6

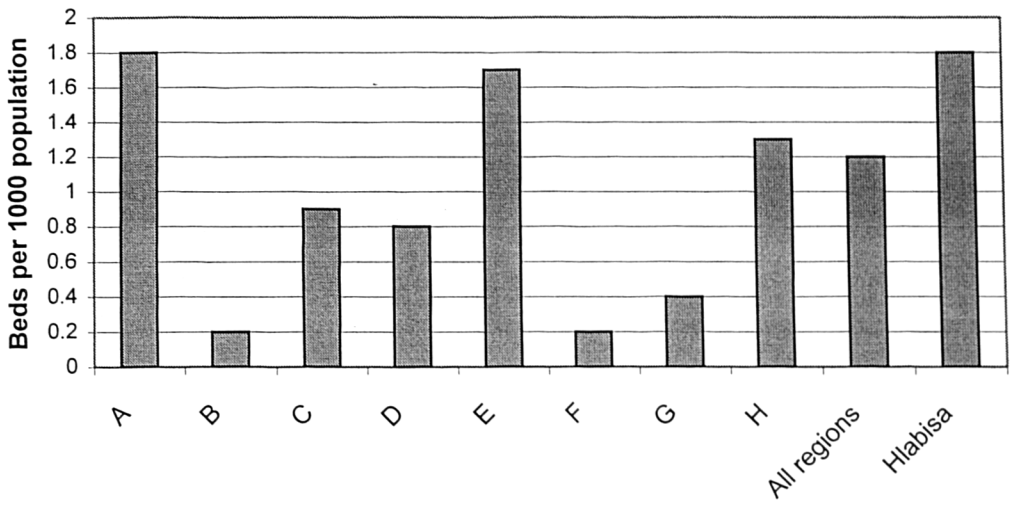


Figure 6: Hospital utilisation in KwaZulu-Natal, by region, 1995/6

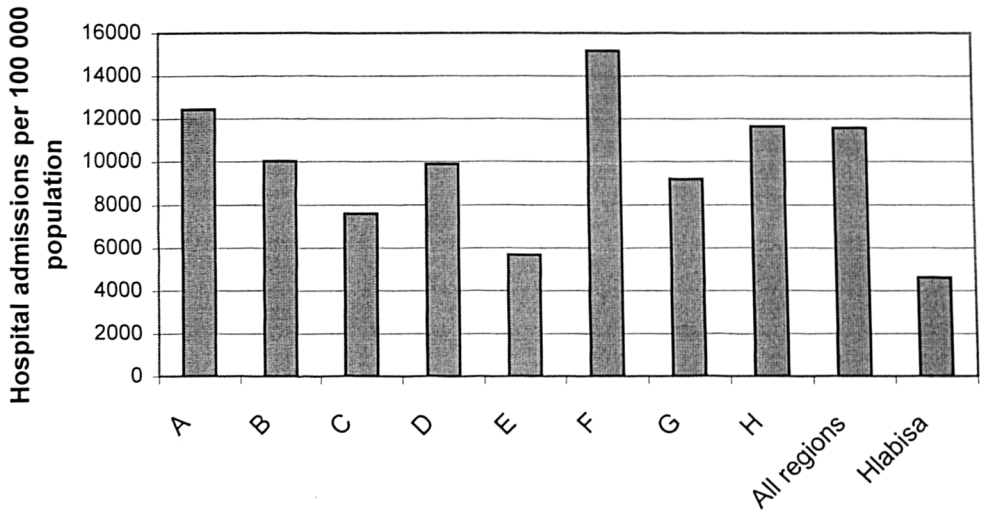


Figure 7: Community hospital utilisation in KwaZulu-Natal, by region, 1995/6

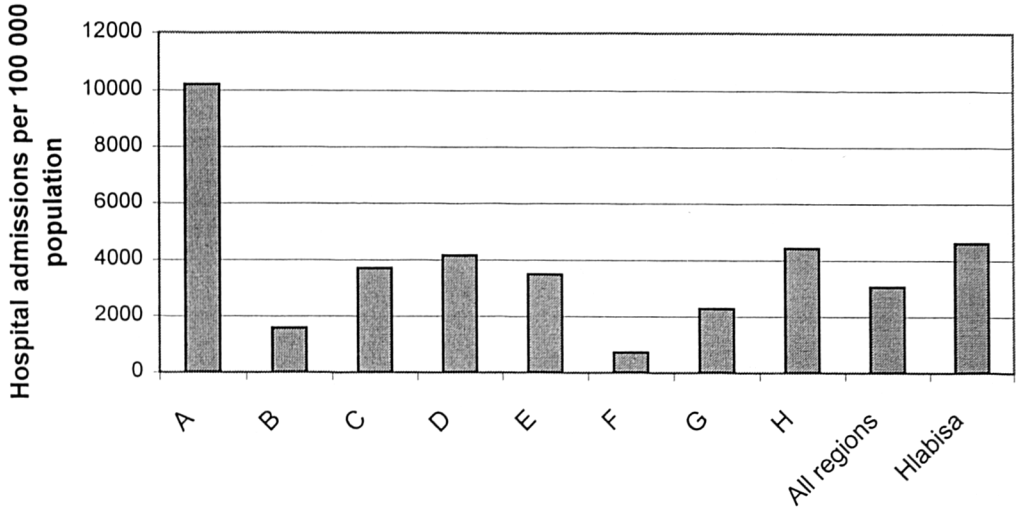


Figure 8: Utilisation of hospitals in KwaZulu-Natal, by region, 1995/6

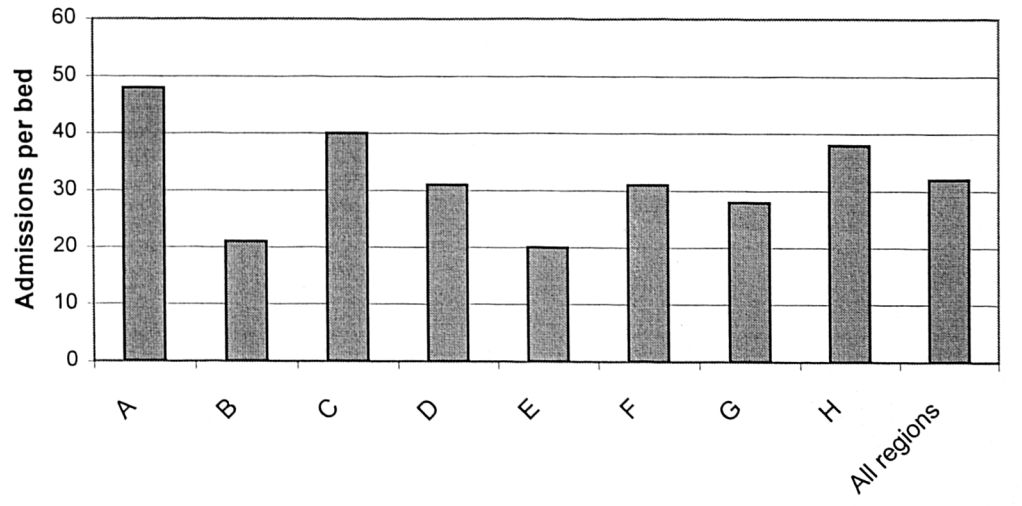


Figure 9: Utilisation of community hospitals in KwaZulu-Natal, by region, 1995/6

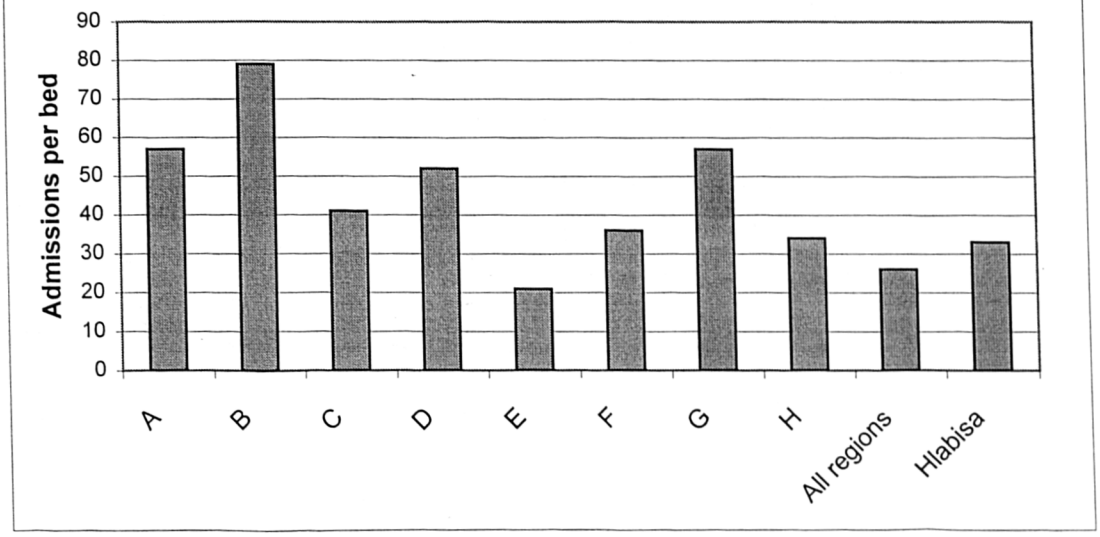


Figure 10: Utilisation in relation to nurse availability in KwaZulu-Natal, by region, 1995/6

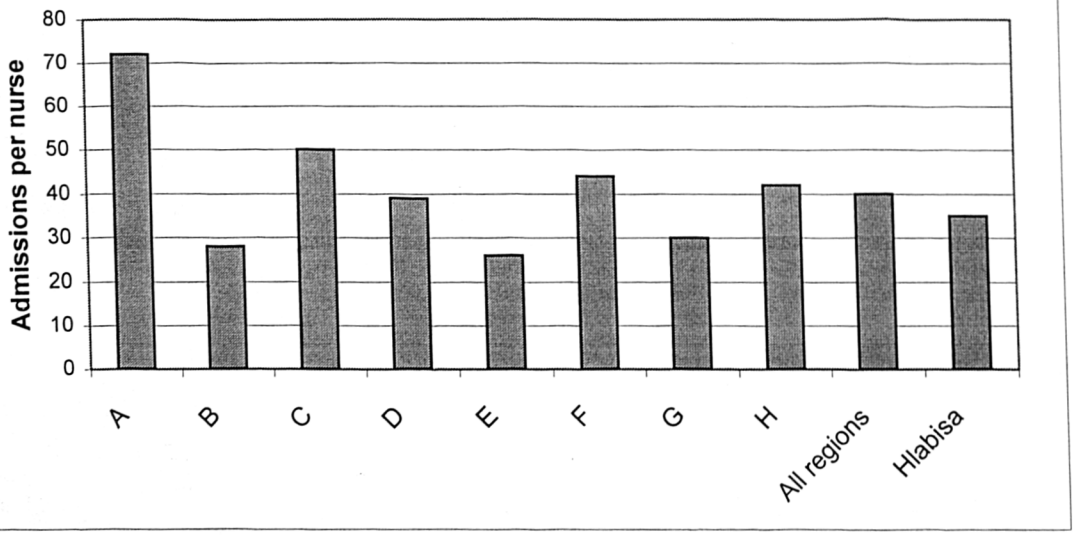


Figure 11: Average length of stay in hospitals in KwaZulu-Natal, by region, 1995/6

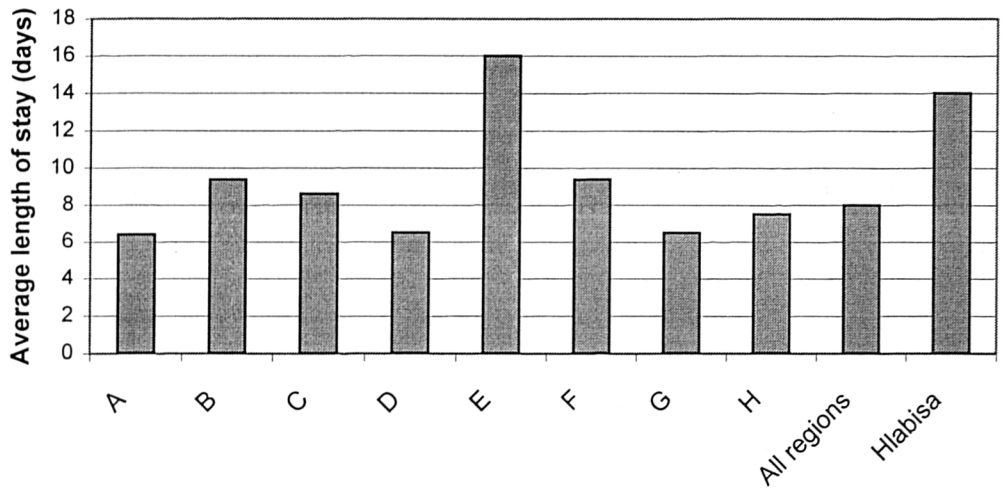
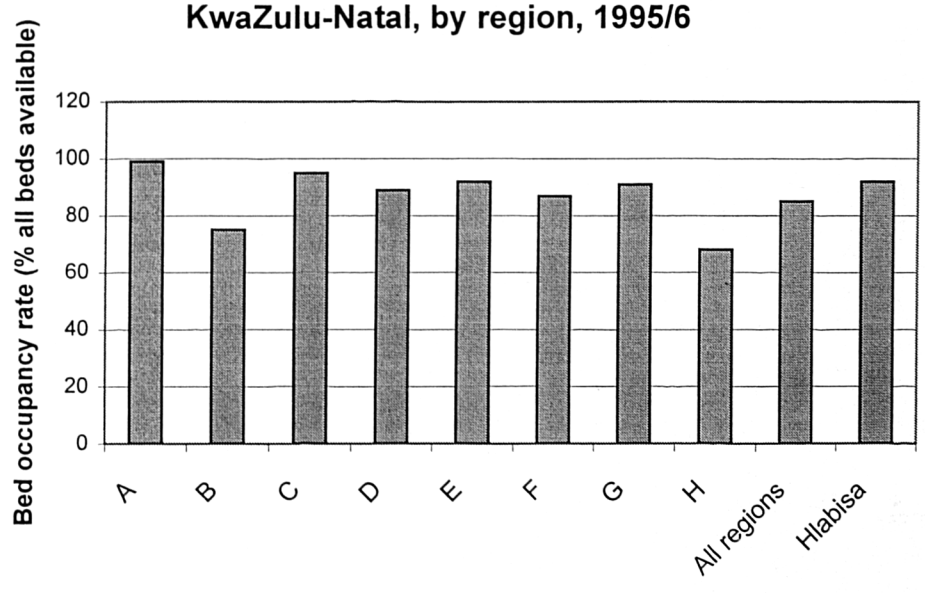


Figure 12: Bed occupancy in hospitals in KwaZulu-Natal, by region, 1995/6



Region E is better resourced than D, C, G and H and very close to A. In addition, the low admission rate relative to population means that Region E has the lowest admissions per nurse and per bed.

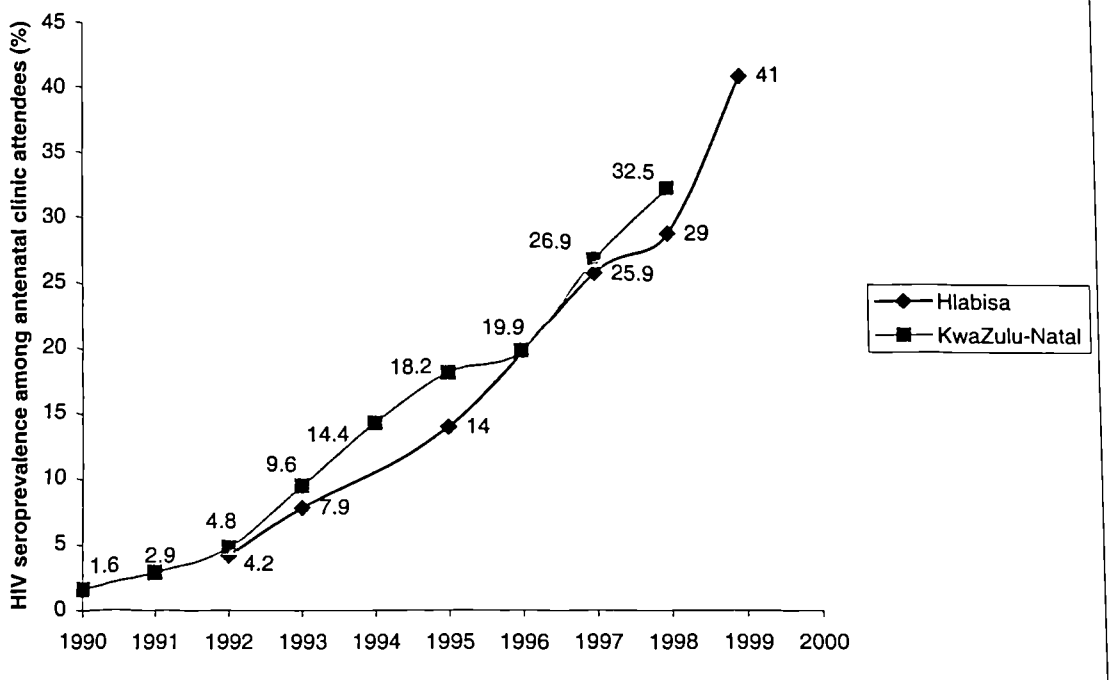
The availability of community hospital beds in Hlabisa District itself is relatively high compared to other regions, and while the number of nurses relative to population is comparatively low, this is compensated for by the low admission rate. In 1996 average length of stay was high in comparison with other regions[11], though slightly lower than that for Region E as a whole. The population per clinic, at approximately 18 000, is slightly better than the average for the province (22 919).

Bed occupancy rates were high and similar everywhere in 1995/6, except for Regions B and H where these were comparatively low.

The HIV/AIDS epidemic in Hlabisa and KwaZulu-Natal

The evolution of the HIV/AIDS epidemic in Hlabisa District has been dramatic during the 1990s (Figure 13). The trend is similar to that for the province of KwaZulu-Natal as a whole, though until 1998 at least lagging slightly behind (consistent with the suggestion reported in Chapter 2 that the epidemic in rural areas is behind that in urban locations).

Figure 13: The HIV/AIDS epidemic in Hlabisa and KwaZulu-Natal, 1990-1999



[11] It is not clear why: for example, when asked, neither of the two medical superintendents in post 1991-1999 had an explanation for this

In KwaZulu-Natal, less than 2% of the antenatal population was HIV-infected in 1990, and in 1992, the figure was still relatively low in Hlabisa, at under 5%. However, as in the country as a whole (Chapter 2), this has grown rapidly. Prevalence has doubled approximately every two years, reaching the alarmingly high level of 41% (confidence interval 35-48%) in 1999 (Wilkinson et al, 1999). Globally, this is one of the highest seroprevalences ever reported among the general population, and is approaching the highest levels ever recorded among "high-risk" groups such as gay men in the early years of the epidemic in the developed world, when its causes were unknown; and commercial sex workers.

Conclusions on the extent to which Hlabisa is representative

Hlabisa appears very typical of KwaZulu-Natal in terms of the extent and rate of spread of the HIV epidemic. In demographic, social and economic terms, it is also broadly typical of the predominantly rural parts of the province, most of which were formerly part of the KwaZulu homeland. Its setting is very different from the highly urbanised parts of the province around Durban and Pietermaritzburg, which are also where the majority of the White and Indian populations live and where there is a high concentration of academic, tertiary and secondary hospitals. In terms of its health services, Hlabisa has a comparatively low number of nurses and a lower than average number of hospital beds per head of population, but also a comparatively low number of admissions relative to population levels and to nursing availability. Length of stay is high both in Hlabisa and the region of which it is a part, while bed occupancy rates are generally similar and high across the province. Hlabisa is broadly typical in terms of the availability of clinics.

These observations suggest that, within KwaZulu-Natal:

- levels of HIV-related morbidity are likely to be similar to those in Hlabisa in much of the province;
- for a given level of HIV-related morbidity, any increase in demand for care in Hlabisa is likely to be matched or exceeded in other areas, since utilisation per head of population is higher elsewhere;
- experience in Hlabisa has limited relevance to regions B and F, which are highly urbanised, have different socio-economic and demographic characteristics, and are dominated by secondary, tertiary and academic facilities;
- Hlabisa, in common with the rest of Region E, has more capacity than other regions to compensate for increased demand by reducing length of stay;
- spare capacity in Hlabisa is similar to that in all hospitals across the province except those in regions B and H, being limited. This implies that extra demand for care will exert similar pressure on services and that supply-side responses in Hlabisa may occur to a comparable or a greater extent elsewhere. There is less scope for reducing average length of stay elsewhere, since this is already much lower than the level in Hlabisa;

- experience in Hlabisa is most likely to be representative of other community hospitals, which account for 33-40% of all public sector beds (depending on data source), especially if the referral system works properly. It is much more difficult to assess its relevance to secondary, tertiary, or academic hospitals; and
- the impact of HIV at clinic level in Hlabisa is likely to be representative.

Beyond KwaZulu-Natal, results from Hlabisa should have relevance to community-level hospitals and clinics in other provinces with (a) similar levels of health service availability (b) similar socio-economic and demographic characteristics and (c) an HIV/AIDS epidemic that is already of similar proportions or likely to reach a similar scale to that occurring in Hlabisa. Such areas include the Eastern Cape and Free State. Results from Hlabisa may under-estimate impacts in Mpumalanga and Northwest provinces, where health service provision is inferior but where the HIV epidemic is approaching the magnitude of that in KwaZulu-Natal.

4.4 General methodological issues related to definition of objectives for economic impact studies

Ideally, all HIV-related economic impacts at hospital, health clinic and private practitioner level would have been identified for the period since HIV was known to have emerged in Hlabisa District. This would have included identification of HIV related utilisation and costs, the direct impact of HIV on staff, and supply-side responses such as changes in length of stay, admission patterns and bed occupancy rates. In addition, a cohort of individuals – both adults and children - would have been established, with regular HIV testing and a long follow-up period. This would have enabled health care utilisation and associated costs from HIV infection through to death to be determined.

However, the definition of objectives related to the economic impact of HIV/AIDS was affected by data constraints, sensitivities surrounding HIV/AIDS, resource availability, and what complementary studies were planned. This meant that it was not possible to address some of the important limitations or gaps in existing research identified in Chapter 3. It also meant that in some cases potential areas of research were deliberately excluded - though key results are referred to in later chapters where relevant.

The following four sub-sections explain each of the factors affecting definition of objectives in turn.

4.4.1 Data constraints

Data constraints existed at both hospital and clinic level.

Hospital in-patient services

At hospital level, data for inpatients were not computerised, diagnostic codes were not assigned to admissions, and whether or not an admission was (or was likely to be) HIV-related was not routinely recorded. In addition, for some patients, aetiology and accurate diagnostic labels were not established. This meant that retrospective analysis of the kind done for HIV/TB epidemic in New York (Arno et al, 1993: see Chapter 3), which was able to identify all HIV-related hospitalisations through screening of data by diagnostic code, was not possible.

Since trends in specific types of HIV-related admission could not be readily identified, an alternative approach was used to assess the impact of HIV/AIDS on demand for in-patient care. Admission trends at the level of nine different wards were documented for the period since HIV began to emerge in the district through to the latest year for which data were available at the time the research was undertaken i.e. 1991-8. These trends were analysed in combination with HIV seroprevalence data among antenatal clinic attendees, paediatric medical admissions, and tuberculosis patients, and what is known about the clinical manifestations of HIV. Although not as precise an approach as might have been ideal, this methodology enabled the important question of what changes in hospital demand for care had occurred in the years in which HIV had emerged rapidly in the district's population to be addressed (Objective 1). It was also felt to be justified on the grounds that any important impacts would stand out in these data; and that if no obvious trends existed, HIV/AIDS was probably not having a discernable impact on demand for care.

Detailed longitudinal economic analyses (Objective 2.) had to be confined to the two HIV-related impacts that could be identified from available retrospective data. These were (a) HIV-attributable tuberculosis and (b) admissions that met the WHO expanded surveillance criteria for an AIDS case (see Chapter 2), excluding tuberculosis. Tuberculosis was analysed in its own right for two reasons. First, while HIV+ tuberculosis cases meet the WHO surveillance criteria for an AIDS case, not all of them have tuberculosis because of their HIV infection (see also Chapter 2). Second, standard epidemiological methods are available to estimate what fraction of HIV+ tuberculosis cases can actually be attributed to HIV (see 4.5.4 for explanation of these methods).

For non-tuberculosis AIDS, a further limitation was that analysis had to be limited to particular time periods. After mid-1997, HIV testing was not routinely available (public funding of HIV tests was cut), and the definition of AIDS used to identify cases in earlier years (which relied on the presence of an HIV+ test result in patient case notes) could no longer be

applied. Data for 1997 was therefore restricted to the first 4 months of the year, and data from 1998 was restricted to a 2-month period when HIV status was known for all medical admissions as part of a research study.

Detailed and comprehensive analysis of the economic impact of HIV-related morbidity on the adult medical wards specifically had to be confined to a cross-sectional study in 1998. Over a 2-month period in this year, HIV status and detailed diagnostic data - recorded prospectively by a clinical researcher - were available for all adult medical patients (Objective 3).

Clinic and hospital out-patient department level services

At clinic and hospital outpatient department level, pilot studies showed that data were inadequate for retrospective analysis of HIV-related utilisation. This was not surprising given that even in the Netherlands, data have been reported to be inadequate for assessing HIV-related utilisation at outpatient level (Postma et al, 1995, Chapter 3). The main limitation in Hlabisa was that diagnostic data – required to identify the reason for an attendance - were usually poor or non-existent.

It was also not possible to organise a prospective study of HIV-related attendances at the hospital outpatient department. This was principally because while doctors could have made an assessment for their consultations, a sizeable proportion of patients are seen only by nurses; and no specialist clinical researcher was available to collect data. Assessment of the impact of HIV on demand for care at these levels was therefore restricted to a prospective assessment in 1998 at government and private clinic level. At government clinics, a team of one doctor and two experienced nurses were available to collect data; at the main private GP clinic in Mtubatuba, the two doctors employed there, who between them see all attending patients, recorded data. In these clinic studies, the main emphasis had to be on patients who met the WHO surveillance definition for an AIDS case that does not rely on HIV testing. While HIV testing of inpatients is feasible without special efforts to collect samples (since blood is routinely taken for other testing purposes and can subsequently be tested for HIV), samples would have to be taken for no other reason than to perform an HIV test in the case of many outpatients.

As in previous research, most emphasis was therefore placed on inpatient care. However, it is at inpatient level that most resources are consumed in the South African health sector (Chapter 2), and was where anecdotal reports and general observation indicated the major HIV-related impacts were occurring. Therefore, this weakness is probably not unduly serious.

Personnel Data

Though it was recognised that HIV/AIDS may have an important direct impact on the supply of care through causing morbidity and mortality among health care staff, data availability made this difficult to study.

Personnel records were not computerised and reasons for absenteeism, sick leave, or leaving employment were often not recorded. Prospective research, including use of qualitative methods, was made difficult by the sensitivities surrounding HIV/AIDS among health care staff (see 4.4.2).

4.4.2 Sensitivities surrounding HIV/AIDS

HIV/AIDS was and remains an enormously sensitive issue in Hlabisa District – as it is in South Africa generally. This had implications for research concerning the direct impact of HIV/AIDS on staff, and for the feasibility of establishing a cohort of patients.

HIV was not a subject that most staff were prepared to talk openly about, making more qualitative approaches difficult. In addition, at the time that a range of research projects was being initiated in Hlabisa District, there was clearly concern and hostility to research considering staff directly. It was therefore decided to focus on other research topics. This was especially important given that successful achievement of other objectives relied on collaboration with health services staff: data collection on such a sensitive issue as the impact of HIV on staff might have seriously compromised this.

The sensitivity of the issue of HIV/AIDS also meant that recruiting a cohort of HIV-infected people to enable assessment of health care utilisation and costs associated with HIV-related morbidity presented enormous challenges. Relatively few people come forward voluntarily for counselling and testing, and those that do probably represent a biased sample of the HIV-infected population. In addition, they may not be prepared for detailed follow-up, because this may disclose status within the family and to the community generally.

4.4.3 Resource availability

While the constraints related to establishment of a cohort of patients highlighted may be resolvable, the funding required to support such a study was not available. Such cohort studies are very expensive, which is probably why there is currently only one in place in Africa. This is in Uganda, where funding from the UK Medical Research Council (the cost is approximately UK£500 000 per year[12]) facilitated the establishment of a large cohort, including both HIV+ and HIV- people, in 1990. Detailed follow-up and regular HIV testing is generating data on incidence and the natural history of HIV infection, with the time at which someone is infected relatively closely defined.

4.4.4 Complementary Studies

A detailed analysis of whether the HIV/AIDS epidemic had been associated with important supply-side responses on the adult medical wards as well as within tuberculosis services was recognised as an important issue, since this

[12] Gilks CF, Professor of Tropical Medicine, Liverpool School of Tropical Medicine, personal communication, 1999

is where much HIV-related morbidity would be concentrated. However, for the adult medical wards, assessment of changes in mean age of admissions, average length of stay, altered case-mix, and patient dependency levels between 1991 and 1998, was undertaken by another researcher (though some input was provided to design and analysis). Findings are referred to where relevant in this thesis.

4.5 General methodological issues related to the collection and analysis of data used for economic impact studies

The major methodological issues relevant to the economic impact studies (Objectives 1. to 3.) were:

- quality of retrospective data;
- reliability of data collection, entry and analysis;
- costing methodology;
- use of the epidemiological principles of attributable risk for assessments of the fraction of tuberculosis cases and medical ward admission costs that could be attributed to HIV; and
- the extent to which influences besides the HIV/AIDS epidemic on the demand for, and supply of, care, were important during the study period.

These 5 issues are discussed in the following subsections 4.5.1 to 4.5.5.

4.5.1 Quality of retrospective data

Retrospective data may be regarded as problematic, especially in developing countries where their quality cannot be controlled by the researcher. This was recognised as a key issue in studying the longitudinal impact of HIV in Hlabisa, since prior to 1996 - when the research was initiated – the research relied entirely on the collection and analysis of retrospective data. This section discusses the quality of the retrospective data used, and the specific efforts that were made to ensure or confirm their accuracy. It covers the eight broad areas that were critical for the two studies involving retrospective data (Chapters 5 and 6). These were: identification of all tuberculosis patients diagnosed in Hlabisa since 1991; ward admission data; length of stay data; data concerning numbers and allocation of staff; expenditure data; patient-day data for the hospital as a whole and for individual wards; use of transport and fieldworkers for tuberculosis care; and data regarding consumption of drugs, laboratory tests and x-rays.

Identification of tuberculosis patients

Lists of adult tuberculosis patients were generated for all studied periods except January 1st-May 28th 1991 using a detailed tuberculosis programme EpiInfo database. This has always been maintained by the doctor responsible for the tuberculosis programme. Reasons to believe that the database is of high quality include the fact that tuberculosis has been the

focus of particular interest and research since mid-1991, it has been compiled prospectively, and that the database has formed the basis of many publications in peer-reviewed journals (e.g. Wilkinson 1994; 1996; 1997a through e). Patients diagnosed during the first 5 months of 1991 were identified from ward registers and the numbers identified were cross-checked with the results of an earlier analysis done by the person who was medical superintendent 1991-1997.

Ward admission data

Ward registers were the primary source of data for the study concerned with demand for inpatient care, in which admissions to each ward were assessed for the period 1991-1998 (Objective 1 and Chapter 5). These were reviewed, and appeared very well kept, particularly before 1996. Data were neatly recorded and key data (e.g. sex, age, diagnosis, date of ward admission) were almost always complete for each patient. This perception was confirmed by discussions with management staff at the hospital, who indicated that, while some admissions may be missed, these registers were generally regarded to be of high quality. One reason given for this is that nurses follow strict protocols for such administrative tasks. Observation during visits to Hlabisa indicated that these were adhered to.

The accuracy of ward registers was also cross-checked using a second source. This was the general hospital admission register kept by admission clerks, in which a unique hospital number is recorded for each admission. This is regarded as extremely accurate, because no patient can be admitted without a hospital number. While it does not provide a breakdown of the number of admissions by ward, it does provide annual admission totals. Therefore, these annual admission totals were compared to those suggested by the ward registers. There was close correspondence between the two (see Chapter 5 for details), suggesting ward registers could be relied upon (they would not be expected to be exactly the same, since some patients are admitted to more than one ward and are therefore "double-counted").

Length of stay data

Retrospective length of stay data were critical to the analysis of the economic impact of (a) HIV-attributable tuberculosis and (b) clinical AIDS, excluding tuberculosis (Chapter 6). They were required for allocation of several types of cost (see also 4.5.2) and for analysis of trends in length of stay and bed occupancy.

For the study concerned with the economic impact of HIV-attributable tuberculosis, individual patient-level data were retrieved from four main sources. These were the general hospital register, which records date of admission and discharge for all patients; the tuberculosis ward register, which also records dates of admission from the general medical ward and dates of discharge from hospital; the tuberculosis programme register, which records date of admission to the tuberculosis ward and date of

discharge from hospital; and the general medical ward registers, which record dates of admission and discharge from these wards.
There were therefore at least two sources of each piece of key data, allowing cross-checking of all information. These sources agreed in 96% of cases, suggesting the data were of high quality. Where there was disagreement, the source considered to be most likely to be accurate was used (the general admission and ward registers).

For the study of the impact of clinical AIDS (excluding tuberculosis), initial screening to identify any patient who could possibly have been an AIDS case was based on the general adult medical ward registers. This was followed by detailed review of case notes by an experienced doctor to confirm or eliminate the diagnosis. For confirmed cases, length of stay was recorded directly from patient case notes, which include a record of admission and discharge dates.

Numbers and allocation of staff

Retrospective data concerning nursing allocations to wards were taken from two sources. The first was nursing allocation books dating back to 1987. These were kept by the Chief Matron and record the location at which each employed nurse was working in the district for each month of the year (including clinics and community programmes as well as individual hospital wards and the hospital outpatient department). There were separate books for each of the three major categories of nurse - professional nurses, enrolled nurses and nursing auxilliaries. The second source was allocation books for pupil nurses, dating back to 1990, which were kept by the senior tutor at the Nursing School located at Hlabisa hospital. Both sources were considered to provide accurate data. This was because they have been consistently maintained by the same two people, both of whom were senior members of staff, and are essential for staff management.

Allocation of doctors to wards in earlier years was based on interviews with the medical superintendent who was in this post 1991-1997, and interviews with a clinical research fellow who was also employed as a doctor at the hospital throughout the period August 1996 to July 1999. The small numbers of doctors at any given time meant that it was straightforward for these people to accurately identify the situation in each year of interest.

Definition of the numbers of staff not involved in direct patient care, according to "cost centre" (see following section for definition of these), was possible from retrospective payroll data. These consisted of payroll sheets, with individual lists for the district hospital and for each of the clinics, which showed the name of all those employed and their job title (e.g. administrative clerk; cleaner; laundry supervisor; telecom operator). Since these data are crucial for payment of staff and for reporting to regional and provincial level, they were considered accurate.

Expenditure data

Retrospective expenditure data were considered to be an acceptable data source for three major reasons. First, the same expenditure line item names were used throughout the period studied, meaning that variation caused by changes in expenditure codes (including confusion caused by name or number changes) should not have occurred. Second, expenditure records were the responsibility of senior staff (the senior administrator and his deputy), and these posts were occupied by the same people throughout the period studied. Third, financial data have to be submitted regularly to the Provincial Department of Health (and formerly to the KwaZulu government), where they are reviewed by auditors and senior financial managers.

Data for patient days for wards and the hospital as a whole

The costing methodology involved allocation of many costs on the basis of the patient days accounted for by different wards and the hospital as a whole (see also section 4.5.2 and Table 4.3). Midnight bed state statistics, which show the total number of patients on each ward for each day of the year, were used as the source for these data. Their quality was considered to be good for several reasons. First, collection and submission of these data to administrative staff and the Chief Matron are an important part of nursing protocols. Second, they are not difficult data to collect, since they rely only on a head count on the ward each day. Third, the statistics have been compiled by the same senior member of staff throughout the period studied (the deputy Matron). Fourth, random checking of the calculations (at least one full month for each year studied) indicated they were accurate.

Use of transport and fieldworkers for tuberculosis care

An important element of tuberculosis care was transport and the input of fieldworkers and drivers to supervision of patients. Vehicle logbooks dating back to 1991 were still available to assess the average distance travelled per trip. Interviews with multiple sources (fieldworkers, medical superintendent, tuberculosis programme manager, Chief Matron and senior TB ward sister) were used to establish the number of trips made per week in each of the years of interest. The information provided was very consistent, and the fact that the two primary sources were the two experienced doctors who had managed the programme over the study period, suggested that these data were accurate.

Utilisation of drugs, laboratory tests and x-rays

For the study of HIV-attributable tuberculosis, retrospective drug consumption was straightforward to establish. There is a standard drug regimen and numbers of patients in each year were known. For laboratory tests and x-rays, some assumptions were necessary. The total number of laboratory tests was estimated based on patient numbers, the proportion of patients accounted for by the three major types of tuberculosis case (smear-

positive pulmonary, smear-negative pulmonary and extra-pulmonary), and documented evidence concerning the proportion of cases that are detected after one laboratory test (i.e. a sputum smear) and after two. It was assumed that approximately one x-ray was done for each patient, according to South African and WHO guidelines and corroborated by interviews with the doctor responsible for managing the tuberculosis programme. The need to make these assumptions was not considered problematic, since (a) there were good justifications for them and (b) x-ray and laboratory tests were a comparatively minor part of total care costs.

For the study of the impact of patients with AIDS (excluding those with tuberculosis), drug, laboratory and x-ray consumption data were taken directly from patient case notes, in which original request and result forms are included.

4.5.2 Reliability of data recording, entry and analysis

Data recording

The conceptualisation, design and analysis aspects of the studies were done by the researcher alone in each case. This was usually true of data collection as well – and in these cases, data recording is considered to have been accurate. A great deal of care was taken in collecting and recording data, and the accurancy of recording was assisted by the fact that no adjustment (e.g. re-coding; numerical transformation) to data was required during recording itself. Data were always either directly recorded during a patient interview or copied directly from documents. However, there were 4 exceptions where data were collected by others, or jointly with a second person. These were:

- admission data for the adult male medical and surgical wards, reported in Chapter 5, were collected by a clinical research fellow based at Hlabisa Hospital (Dr. Alasdair Reid). This was necessary because, unlike the adult female or paediatric wards, both adult medical and surgical admissions were recorded in the same register. Clinical knowledge was required to identify which was which;
- data for patients with AIDS-defining conditions other than tuberculosis, reported in Chapters 5 and 6, were collected jointly with the person who was medical superintendent at Hlabisa Hospital 1991-7 (Dr. David Wilkinson). This was necessary because clinical knowledge was required for initial screening of which admissions might have these conditions, and for confirming or eliminating the diagnosis once patient case notes had been retrieved;
- some of the non-economic data essential to the analysis in Chapter 7 (e.g. HIV status; whether or not a patient fitted the WHO surveillance definition for an AIDS case; diagnosis) were collected by the clinical research fellow mentioned above, or by a research assistant under their supervision (though input was provided to design of data collection sheets, and direction and supervision was also provided to the research assistant during visits to Hlabisa); and

- clinic attendance data included within Chapter 7 were collected by a Masters student (Ms. Georgina Mawer) and doctors based in Hlabisa (Dr. Yvonne Ganley and Dr. Neil Jorgenson).

As the explanations above indicate, the first two exceptions reflected the need for clinical knowledge in some of the data collection. The second two exceptions were due to the need for efficiency with regard to time spent in the field, and the fact that the time constraints would have made the data collection impossible without additional input.

In each of the 4 cases explained above, data collection is considered to have been accurate. The clinical research fellow is considered to be a very thorough and accurate collector of data, and the data are not difficult to collect for someone with a medical training. The medical super-intendent (now Professor David Wilkinson at the University of Southern Australia) has an established track record in clinical and epidemiological research. The research assistant worked under the close supervision of the clinical research fellow. The people who collected the clinic data were well-educated, experienced doctors or nurses with research training, and data collection was discussed in detail with them prior to implementation of the study.

Data entry and data cleaning

Any data requiring statistical analysis (e.g. length of stay data) were entered using spreadsheet (Microsoft Excel version 7.0) or statistical packages (usually SPSS version 8.0; Stata version 6.0 was used for part of the analysis reported in Chapter 5). Two specific steps were taken to minimise data entry errors. First, single transfer coding (i.e. the data to be entered are already in the correct format) was always used. Second, except for the non-economic data collected as part of the study reported in Chapter 7, data entry was done with the assistance of a qualified statistician with considerable professional experience (7 years) of data entry and analysis. The non-economic data used in Chapter 7 were double-entered by the clinical researcher.

Following data entry, data were also "cleaned" in two main ways. First, outliers were identified and the data checked a second time. Second, all entries were checked for inconsistencies. For example, the length of stay data collected as part of the study reported in Chapter 6 were checked to confirm that the length of total hospital stay – typically consisting of time spent on a medical ward and the general tuberculosis ward – was at least equivalent to the stay recorded for a single ward.

Data re-coding and analysis

All data re-coding and statistical analysis was done using either SPSS or Stata. Assuming the data themselves were reliable, the results produced in these analyses should therefore be reliable.

Sampling

Samples were always randomly generated, designed to reflect the precision with which any given variable needed to be estimated, and chosen in consultation with a statistician. This meant large samples for any variable with an important influence on the analysis. For example, comprehensive data were collected for staffing allocations and salaries (rather than relying on a sample of months or employees); and large samples were always used for estimating average length of stay in hospital (an important variable given the costing methods employed – see also 4.4). When the population being studied in Hlabisa was small (e.g. patients with AIDS-defining conditions other than tuberculosis; see Chapter 6), or where collection of data for the entire population was practical (e.g. length of stay data for tuberculosis patients in 1991, 1993, and 1995; see also Chapter 6), data for the entire population being studied were collected. Costs that were of relatively minor importance, and where a small increase in precision would have necessitated a very large investment of time (see also 4.4), were the only examples of both small samples and relatively imprecise estimation (large standard errors relative to the mean).

4.5.3 Costing methods

Costing was undertaken according to standard methods described in key textbooks (Drummond et al, 1997) and guidelines (Phillips et al, 1993; BMJ, 1996; JAMA, 1996). Since some of these are relatively general and do not always address specific issues in detail (e.g. hospital costing, especially allocation of costs shared by many services), the analysis also drew upon the methods described in key papers that were either related to hospital costing in general (Mills et al, 1993) or to costing of HIV/AIDS related care (see Chapter 3). These highlight (see particularly Drummond et al, 1997) the following important methodological considerations:

- the viewpoint of the analysis (e.g. from the perspective of patients; from the perspective of health services);
- that costing has two key elements: first, the measurement of quantities of resources used; and second, the assignment of unit costs or prices;
- how shared or overhead costs should be handled;
- whether or not existing market prices need to be adjusted to reflect true "opportunity costs";
- how values are imputed for non-market items;
- how to cost capital outlays (e.g. buildings, equipment, vehicles);
- the relative order of magnitude of costs – pointing out that it is worth investing most time in assessing those costs that are relatively large and likely to influence results the most, with less precision necessary for comparatively minor costs;
- how accurate costing needs to be, with alternatives at hospital level ranging from micro-costing (the most detailed, in which each component of resource use is estimated and a unit cost derived for each) through costing by case-mix group, by broad disease/service group, and average daily cost across all categories of patient; and

- whether average or marginal costs should be assessed.

The way in which each of these was addressed is explained below.

Viewpoint of the analysis

For the retrospective analysis, the viewpoint of the analysis was that of government health services alone. This was because data on costs incurred by patients could not be collected retrospectively. Since the main objective of the studies was to assess economic impacts on health services, this perspective was maintained in the prospective hospital study (Objective 3).

Measurement of quantities and assignment of unit prices, and allocation of shared costs

The measurement of quantities, assignment of unit prices, and allocation of shared costs was undertaken in a variety of ways (Table 4.3). Points worth highlighting are that:

- an "ingredients" approach was used i.e. all relevant inputs for the patients of interest were identified, a unit cost calculated for each, and then unit costs multiplied by the relevant quantity;
- costs were established at the level of individual patients, major categories of patient (e.g. tuberculosis patients), or wards wherever feasible. However, costs for staff not involved in direct patient care, general buildings and equipment, and non-personnel recurrent overheads, could not be established at the level of individual patients, patient categories or wards. This meant that these costs were allocated to relevant wards/patients of interest using a "step-down" costing procedure, in which costs were allocated to cost centres of interest in a series of steps, according to various allocation criteria. These criteria were chosen with reference to what seemed most appropriate in the Hlabisa context (e.g. what allocation bases were most likely to reflect resource use), and methods used or recommended in detailed costing studies and textbooks;
- quantities were established very precisely for all types of staff, for the inputs to supervision of tuberculosis patients, for buildings, for drugs, and for laboratory tests and x-rays except for tuberculosis patients where some estimation methods were used (see above); and
- it was not possible to quantify the use of any non-personnel recurrent inputs other than drugs, laboratory tests and x-rays at either ward or individual patient level in non-monetary terms. For these costs (e.g. water, electricity, general supplies, catering, linen etc.), only aggregated expenditure data for the whole hospital existed. Costs in each year were therefore estimated in 1998 terms by inflating expenditure data according to the consumer price index for South Africa.

Patient days, as shown in column 4 of Table 4.3, were important for allocation of costs to individual wards or particular groups of patients.

Table 4.3: How quantities and unit costs were established, and costs allocated, for different components of care

Cost component	How quantities measured	How unit costs established	How costs allocated to specific cost centres and types of patient
Medical staff	Proportion of medical staff time spent working on the relevant wards and in the outpatient department	Unit cost in 1998, from payroll data	Costs established at the level of cost centres; at the level of each ward, costs allocated to particular patient groups according to fraction of patient days accounted for by patient group of interest
Nursing staff	Number of different categories of nurse allocated to different wards, operating theatre and outpatient department	As above	As above
Staff not involved in direct patient care	Number of different types of staff, categorised by job title, established for each of 10 cost centres not concerned with direct patient care (administration, "other staff related", cleaning, domestic services, kitchen, laundry, maintenance, transport, security and miscellaneous) *NB:* transport costs not included as an overhead in Chapter 6, as use of transport services could be precisely defined for tuberculosis patients (see below)	As above	Maintenance first allocated to relevant cost centres on the basis of floor area; kitchen and laundry costs allocated entirely to inpatient care and then to individual wards/types of patient groups on the basis of patient days; "other staff related" costs allocated to individual wards according to the proportion of direct care staff costs for which they accounted, then to individual patients on those wards according to patient days; remaining costs first allocated to inpatient or outpatient care according to the fraction of direct care staff costs accounted for by each, then to individual wards/types of patient group according to patient days
All non-personnel recurrent costs except drugs, lab tests and x-rays	Only expenditure, not quantity data available. For each year, each line item inflated to 1998 values according to the consumer price index (CPI) for South Africa. CPI data from South African Reserve Bank/IMF Financial Statistics Yearbook 1998	Unit cost/day established according to allocation procedure described in column 4	Allocated first to one of the 10 overhead cost centres, as appropriate, then to outpatient/inpatient care and wards as described above for staff not involved in direct patient care
Drugs	Number and type of drug doses recorded in individual patient case notes/specially designed study forms (for prospective 1998 study); standard regimen for TB patients	Unit prices in 1998 for each type of drug, taken from pharmacy price list	N.A. – costs established at level of individual patient or patient groups
Laboratory tests	Number and type of tests reported in individual patient case notes/specially designed study forms; or, for TB patients, estimates based on number and proportion of patients with each type of TB	Unit prices in 1998 for each type of test, as established by provincial authorities using international standards (e.g. for workload associated with tests)	As above for drugs
X-rays	Number reported in case notes or specially designed study forms; or quantities that should be done according to guidelines for TB	Total cost of x-ray department inputs for each year (established by combining quantification of all inputs with 1998 unit prices for each input) divided by number of x-rays done each year	As above for drugs
Supervision of TB patients	Number of kilometres travelled per supervisory trip, number of trips per week, number of drivers and fieldworkers involved calculated	Unit cost per km in 1998, quoted by Ministry of Health and designed to cover all non-personnel costs; unit cost for drivers and fieldworkers in 1998	None required – calculated for TB patients specifically
Building and equipment costs	Floor area for relevant buildings established; type of equipment used listed	Cost per square metre in 1998, from government quantity surveying department; 1998 purchase price new for equipment	Established for individual wards directly and non-direct care cost centres. For the latter, then allocated as for non-direct care staff costs

Patient days were quantified at the level of individual patients for those groups of specific interest – tuberculosis patients, AIDS patients excluding those with tuberculosis, and all medical admissions in the 1998 prospective study. They were also quantified in all relevant years for each individual ward, and for the hospital as a whole.

Methodology for inflation of non-personnel recurrent data

The financial year runs from April 1st to March 31st in KwaZulu-Natal, while expenditure data were not available on a monthly basis prior to 1997. Therefore, on average, it was assumed that the value of expenditure for each financial year reflected values as of October 1st. Expenditure was therefore inflated for the last 3 months of the year for which data were being inflated (according to the average monthly rate in that year, deduced from the annual rate), then by the annual inflation rate for any subsequent year except 1998, and finally for the first 9 months of 1998 (see Appendix 1 for a worked example for 1995). This was still an approximation – expenditure varies by month. However, it was considered acceptable, since the inflation of health sector non-personnel recurrent expenditure can only ever be an approximation when it relies on the consumer price index, rather than a price index for the health sector specifically (which is absent for South Africa).

Adjustment of market prices to reflect true "opportunity costs"

Although some market prices may not reflect true opportunity costs (e.g. this was possible for some categories of staff), no adjustments were made to market prices. This was because there was no obvious basis on which to do this.

Valuation of non-market items

Valuation of non-market items was not relevant to the retrospective studies. It was relevant to the economic evaluations that adopted a societal perspective (see 4.6).

Costing of capital outlays

Capital costs were handled using standard methods (e.g. Drummond et al, 1997; Phillips et al, 1993). This involved the conversion of purchase prices new into annualised costs, using annualisation factors appropriate to the estimated useful life of each input, and a discount rate of 8%.

Theoretically, the discount rate chosen should be the difference between the inflation rate and the interest rate. This varied in the years studied (Chapter 2), but was only higher than 8% in 1998. In practice, it had little impact on the analysis because capital costs accounted for a small percentage of costs. 8% was chosen to be consistent with the rate used in an economic evaluation undertaken in 1996 and reported in Chapter 8 (when the real discount rate was 8%; see also Chapter 2 Table 2.7), and because it has

been used in several health sector evaluations in South Africa (Edina Sinanovic, Health Economics Unit, University of Cape Town, written communication, April 27th 1999).

Relative order of magnitude of costs

Preliminary analyses of aggregate expenditure records and budgets showed that staff costs were the most important category of costs. Therefore, particular attention was paid to collection of detailed data concerning the numbers of each type of staff and where they worked. It was also recognised that length of stay was a key influence on costs, and therefore patient-level data were collected for all patient categories in which there was a particular interest (patients with tuberculosis, non-TB AIDS, and all adult medical patients over a 2-month period in 1998).

Pilot work showed drugs, laboratory tests and x-rays were relatively minor costs. Nevertheless, for the retrospective studies, data were collected for all AIDS patients and were carefully estimated for tuberculosis patients. This was especially important for analysis of the drug, laboratory and x-ray costs associated with AIDS patients, because costs were quite variable and numbers of cases relatively low. Quantities of these items were estimated less precisely for adult medical patients other than those with clinical AIDS or tuberculosis for the retrospective studies, using sampling (these data were required to enable total costs for these items on the adult medical wards to be estimated – with total costs required for setting costs for tuberculosis patients and AIDS patients in the context of total ward resource consumption). Only the minimum sample size required for reasonable precision was initially used (n=30). Since this demonstrated that these costs were relatively minor even using the upper limit of the 95% confidence interval, samples were not supplemented. For the prospective study, these data were collected for a much larger sample size. This was feasible because data were collected using specially designed study forms that could be completed as an integral part of the study.

Level of accuracy to be achieved

Each component of resource use (e.g. laboratory tests, length of stay by ward, drugs, nursing care, medical care, buildings, recurrent overhead costs) was quantified and a unit cost derived for each. This applied even to non-personnel recurrent overhead costs, since quantities were estimated using expenditure data and a unit cost (in the form of a cost/day) was calculated. The level of accuracy, according to the different benchmarks defined by Drummond et al (1997), was therefore that of "micro-costing" (i.e. the most precise).

The methods can be distinguished from case-mix group or disease-specific per diem costing (the second and third most precise approaches), because data were collected for individual patients and not for broad diagnostic or disease categories. With regard to the distinction between micro- and disease-specific costing for tuberculosis patients, the approach was micro-

costing because although tuberculosis patients represented a disease category, quantity and unit cost data were collected for each patient and were not averaged across all patients. It can also be clearly distinguished from average per diem costing (the least precise) because with the exception of non-personnel recurrent overheads ("hotel" costs), all cost and quantity data were collected at the level of particular types of patient and wards.

Whether to focus on average or marginal costs

Whether or not to focus on average or marginal costs is not a straightforward issue. In economic theory, marginal costs (the change in cost when output changes by one unit) can differ from average costs (total costs divided by total units of output) for several reasons (Figures 14 and 15).

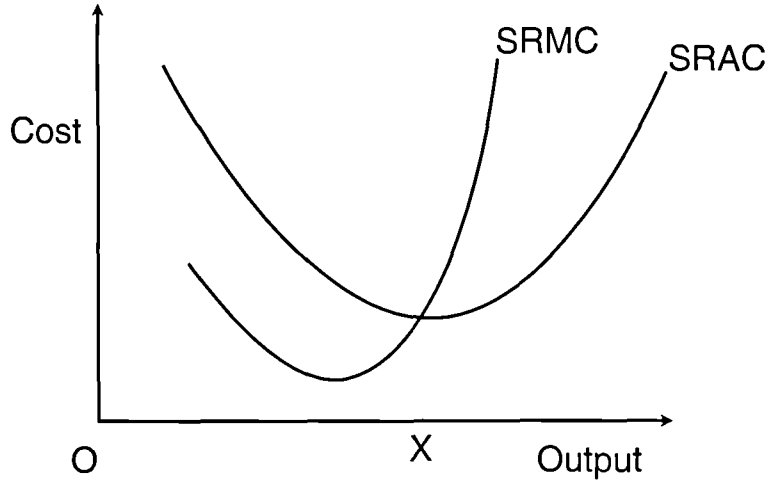
In the short-run, at least one input to production of a good or service is fixed, and resources may be under- or over-utilised. Fixed costs, which are incurred whatever level of output is produced, are included in average cost calculations but not in marginal cost calculations. The latter include only variable costs (i.e. those which do vary with output). Therefore, marginal costs will be lower than average costs until certain, or all, inputs, are fully utilised (Figure 14, between O and X). When fixed inputs start to be over-utilised, diminishing returns set in (Figure 14, output greater than X). This means that the quantity of variable inputs required for a unit increase in output starts to rise, so that marginal costs exceed average costs.

In the long-run, when all inputs are variable, economic theory suggests that initially marginal costs are lower than average costs (Figure 15). This is because economies of scale are realised as output rises (so that marginal costs are lower than average costs), and "sunk" costs (those that must be incurred whatever the level of service provision, even in the long-run) are included in average cost but not marginal cost calculations. However, at relatively high output levels and in the long-run, marginal and average costs tend to be equivalent – as sunk costs are spread over a high number of units of output and all economies of scale are realised.

In practice, the inter-related issues of which costs are sunk and which are variable, whether the focus should be on the short- or long-run, and whether to focus on average or marginal costs, are not clear-cut. This is illustrated by the following observations:

- some authors suggest that all staff costs are variable in the long-run (e.g. Dranove, 1996);
- practical experience suggests that some health services staff costs are sunk (e.g. a medical superintendent; an administrator) and that, even with substantial increases in particular types of patients (e.g. those with HIV-related illnesses), there would be no need for extra staff in some categories even over a relatively long time-frame (e.g. five years);
- it can be argued that planners should be most concerned with long-run rather than short-run situations. Since average costs may be the best

Figure 14: Theoretical Relationship between Average and Marginal Costs in the Short-run

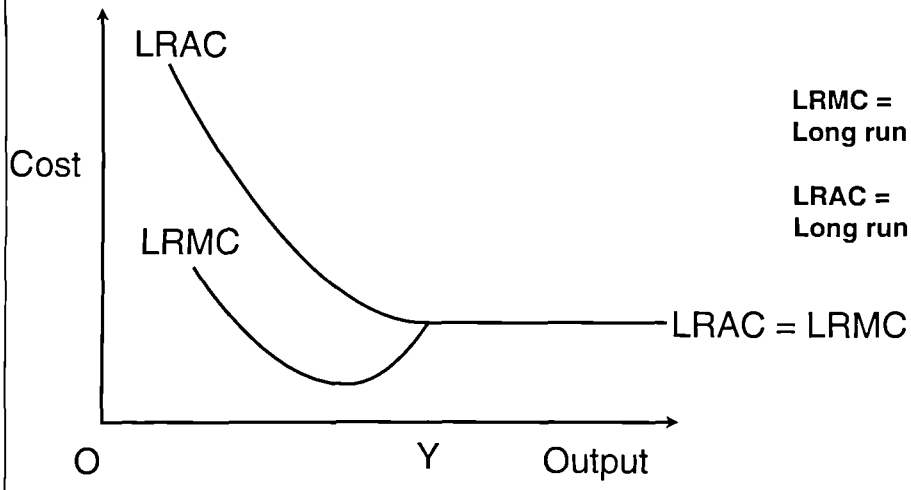


SRMC =
Short run marginal cost

SRAC =
Short run average cost

O to X: economies of scale
Above X: diseconomies of scale

Figure 15: Theoretical Relationship between Average and Marginal Costs in the Long-run



LRMC =
Long run marginal cost

LRAC =
Long run average cost

O to Y:	economies of scale
Above Y:	average/marginal costs stable over large range of outputs
Point Y:	Known as "minimum efficient scale" ie minimum output level where all economies of scale are realised

measure of true variable costs in the long run (BMJ guidelines, 1996), this would indicate a focus on average costs;
- pragmatically, it has been commented that many analysts report average costs in their primary analysis, and then assess how marginal costs may be different to these.

In the cost analyses reported in this thesis, the focus was on average costs. This was done for four reasons. First, the costs associated with HIV-related care are a long-run issue. Second, there is room for disagreement over which costs are sunk, so the analysis included all costs. Third, sunk/fixed costs were relatively small. Fourth, services were operating at, close or beyond capacity. Ignoring the issue of which costs are sunk, this meant that – for a given level of care (e.g. doctor/nursing time available per patient; bed space), average and marginal costs should be similar – and that average costs should at least not substantially over-estimate marginal costs, which is the usual concern.

4.5.4 Application of epidemiological theory to estimate what fraction of morbidity among HIV+ patients could be attributed to their HIV status

In much of the economics-related research on HIV/AIDS to date, simple reporting of the proportion of patients who were HIV infected, and their costs, has been used when assessing economic impact. In the studies included in this thesis, however, it was recognised that not all HIV+ admissions are related to HIV infection (as also pointed out by Buvé, 1997); and that if data are reported in this way, the impact of HIV on health services will appear exaggerated. Among HIV+ patients, specific attention was therefore paid to estimating what fraction of their morbidity, and costs, could actually be attributed to their HIV status.

The methods used to do this were standard epidemiological ones, and major epidemiology textbooks can be referred to for a full explanation (e.g. Hennekens and Buring, 1987, pp. 73-82 and 87-96). Here, the key principles are explained with reference to the main example included in this thesis: tuberculosis among HIV+ patients.

Disease and exposure

In epidemiology, two important terms are "disease" and "exposure". Disease in any given individual is likely to be related to a variety of "exposures" – factors that affect their risk of developing disease. Exposures could include age, occupation, and family history. A classic example of an exposure is smoking (for the diseases lung and throat cancer). As understanding of the HIV epidemic has improved, it has become clear that HIV infection is an exposure that places individuals at increased risk of developing tuberculosis.

Relative Risk and the rate ratio, risk ratio and odds ratio

The epidemiological measure known as the Relative Risk (RR) describes the extent to which a given exposure increases the chance of developing disease. There are 3 commonly used measures of Relative Risk:

- the "rate ratio";
- the "risk ratio"; and
- the "odds ratio".

The rate ratio is the incidence rate of disease in the exposed group divided by the incidence rate of disease in the unexposed group.

The risk ratio is the proportion of individuals who become diseased over a fixed period of time in the exposed group divided by the proportion of individuals who become diseased over the same fixed time period in the unexposed group.

Traditionally, a **cohort** study, where individuals are followed up over time and disease events are recorded for defined groups (according to exposure), has been used to estimate risk and rate ratios.

The odds ratio is discussed below in the context of **case-control** studies.

The "attributable risk percent" (AR%)

Risk and rate ratios can be used to deduce the percentage of disease *among the exposed group* that is actually *attributable* to that exposure. This percentage is known as the "attributable-risk percent", or "AR%".

For example, if the incidence of tuberculosis is 40 per 100 000 person-years among HIV- individuals and 280 per 100 000 person-years among HIV+ individuals, the rate ratio is 7. Another way of looking at these figures would be to say that, among patients with both the disease (in this case tuberculosis) and the exposure (in this case HIV infection), 1 out of every 7 (i.e. 14.3%) would have acquired disease anyway, irrespective of their HIV status (since 40 per 100 000 is the incidence in the unexposed group). The fraction of cases that would have occurred anyway can also be expressed as 40/280; a general way of writing this mathematically is (1/RR). It follows from this that the percentage of disease attributable to the exposure – the AR% - can be written as $\{1 - (1/RR)\} \times 100$. Since this can be rearranged more neatly to $\{(RR-1)/RR\} \times 100$, a standard epidemiological equation is:

$$AR\% = \{(RR-1)/RR\} \times 100.$$

If the fraction of all cases with the exposure is known, another useful measure is the fraction of all cases that are attributable to the exposure. This is the "population attributable risk percent" (PAR%), and is calculated as AR% x percentage of cases with the exposure.

Case-control studies and odds ratios

Unfortunately, in many instances it is not possible to estimate the incidence of disease in both an exposed and unexposed population. Prospective cohort studies usually take time and are relatively expensive.

To analyse how morbidity and mortality are related to particular exposures, epidemiologists frequently use "case-control" studies. In these, data are collected for two groups of patients recruited not according to exposure (as in cohort studies) but to disease. In classic case-control studies, data are collected for one group of patients that have disease and who may or may not have a particular exposure; and for a group of patients who do not have disease, and who may or may not have a particular exposure (though see below for recent developments in case-control study design which have introduced some modifications to this). In studying what fraction of HIV+ tuberculosis patients have disease because of their HIV status, case-control studies have typically studied (i) tuberculosis patients and (ii) either antenatal clinic attendees or blood donors.

In classic case-control studies, individuals belong to one of 4 distinct groups:

- those with disease and exposure (a);
- those with exposure and not disease (b);
- those with disease but without exposure (c);
- those without disease and without exposure (d).

Typically, these are represented in a two-by two table, as illustrated below with data from Hlabisa in 1998.

Exposure (HIV infection)	**Disease (Tuberculosis)**	
	Yes	**No**
Yes	131 (a)	99 (b)
No	56 (c)	241 (d)

Such data can be used to provide an estimate of the *exposure odds ratio*. The odds, as used in betting, represents the ratio of the probability of failure to the probability of success. In epidemiology, data of the kind typically collected in case-control studies can be used to estimate the odds of exposure for each of (i) cases and (ii) controls. From this, an *exposure odds ratio* may be calculated: that is, the ratio of the number of people with disease and exposure to the number of people with disease but without exposure, divided by the ratio of the number of people without disease but with exposure to the number of people without disease and without exposure. In the above example, this would be (131/56)/(99/241); more generally, this is (a/c)/(b/d), which can be rewritten as ad/bc.

Although not obvious, it can be demonstrated, mathematically, that in the above situation the *exposure odds ratio is equivalent to the disease odds ratio*. Therefore, it is standard practice in epidemiology to use the odds

ratios calculated from case-control studies as a measure of relative risk. The mathematical formula for the disease odds ratio is {p1/(1-p1)}/{p2/(1-p2)}, where p1 is the probability of disease in the exposed group, and p2 is the probability of disease in the unexposed group. *When the disease under study is rare* in both exposed and unexposed groups, the odds ratio is almost identical to the risk ratio (because 1-p1 and 1-p2 are both very close to 1, so the odds ratio is very close to p1/p2). It can also be shown that the risk ratio is almost identical to the rate ratio *when a disease is rare.* Following from this, it is standard practice to use the odds ratio as a measure of relative risk for calculations of the AR% (i.e. the percentage of patients with both disease and exposure that have disease because of their exposure). In the above example, the odds ratio is 5.69 and the AR% is 82.4% [i.e. {(5.69-1)/5.69}x 100]. Since 70% of tuberculosis patients were HIV+ (i.e. 131/187), the PAR% is 57.7%.

In Hlabisa, there were no available data concerning the incidence of different diseases for the HIV+ and HIV- populations separately. However, data on exposure in various diseased groups and one non-diseased group (antenatal clinic attendees) were available. These were therefore used to calculate odds ratios, which in turn were used to estimate the measures RR, AR% and PAR%. Further details are presented in the relevant chapters (6 and 7).

The rare disease assumption

As highlighted above, the use of odds ratios from a classic case-control study to estimate a rate ratio or a risk ratio is valid when a disease is rare. This point, in combination with the need to rely on odds ratios for some of the analyses presented in Chapters 5 to 7, raises an important question. Is the rare disease assumption valid for those diseases for which odds ratios were used to estimate Relative Risk in Hlabisa?

This question was explored by examining the case of tuberculosis for the period 1991-1998/9. Tuberculosis was chosen because it was the most common disease among HIV+ admissions (both male and female) in Hlabisa. Therefore, if the rare disease assumption held for tuberculosis, it could be assumed to hold for other diseases as well.

The analysis is summarised in Table 4.4. The number of adult tuberculosis patients (defined as those > 15 years of age) was based on a tuberculosis programme database (see also Chapters 5 and 6). The estimated number of adult HIV+ tuberculosis patients was estimated by multiplying the total number of adult tuberculosis patients by the proportion estimated to be HIV+ (with this proportion estimated from HIV testing of a random sample of patients – see also Chapters 5-7). The adult population as a whole was estimated by using 1996 census data to calculate the number of people over 15 (see also Chapter 5). The estimated number of HIV+ adults was estimated by multiplying the adult population by the proportion estimated to be HIV-infected (with this proportion estimated from surveys of women attending antenatal clinics, see also Chapters 5-7).

Table 4.4: Assessment of the extent to which the "rare disease" assumption is valid for tuberculosis in Hlabisa

Year	Number of adult tuberculosis patients	Estimated number of HIV+ adult tuberculosis patients	Estimated adult population	Estimated number of HIV+ adults in the general population	HIV+ adult tuberculosis patients as a proportion of estimated total number of HIV+ adults
1991	303	33	102 109	2 042	0.016
1993	598	209	102 109	8 067	0.026
1995	834	484	102 109	14 295	0.034
1997	1 157	787	102 109	26 548	0.030
1998/9	1 442	1 009	102 109	29 612	0.034

The key result is in the final column. This shows the estimated number of HIV+ tuberculosis patients as a proportion of the estimated total HIV+ adult population - a measure of the extent to which tuberculosis is a rare disease among HIV+ adults. As this column shows, the proportion is approximately 3% in each year except 1991, when it was lower. This suggests that the rare disease assumption is acceptable for tuberculosis.

For the second most common disease among HIV+ admissions and for which HIV-attributable calculations are presented in Chapters 6 and 7, the absolute number of admissions was less than half those for tuberculosis – making the estimated annual risk of disease close to 1%. The absolute number of patients admitted for other diseases for which similar calculations were done was much lower again, indicating an annual risk of disease per year of less than 1%. For these other diseases, therefore, the rare disease assumption also appears to be valid.

Further discussion of the use of odds ratios, including how those estimated for Hlabisa compare with risk and rate ratios calculated from cohort studies done elsewhere (and therefore the extent to which odds ratios for Hlabisa may under- or over-estimate the AR%) are provided in the relevant chapters.

A brief note on some recent developments in case-control study design

Recently, modifications to control selection have been suggested in which the exposure odds ratio is a direct estimate of either the disease risk ratio or the disease rate ratio (and *not* the disease odds ratio as in the classic case-control study design explained above). With these modifications, the rare disease assumption is not required. However, it is required that *exposure status does not change over the study period.*

In order to estimate a disease risk ratio from an exposure odds ratio, controls should be a random sample of the whole population from which the cases came – i.e. diseased individuals are included among the control group. In order to estimate a disease rate ratio from an exposure odds ratio, cases and controls should be selected concurrently – i.e. whenever a case is

recruited, a control should be selected from among the *currently* non-diseased population.

In the present study, controls were selected from ante-natal clinic attendees, over a period of approximately one month. This means that controls may have had disease, and also that they were not selected at the same time as cases (where recruitment was for the whole of the study year). Therefore, the criteria required to estimate a disease rate ratio from an exposure odds ratio were not met.

Meanwhile, in the context of a rapidly emerging HIV epidemic, the exposure status of ante-natal clinic attendees is not stable. Therefore, the criteria for a design that enables an exposure odds ratio to estimate a risk ratio were also not met.

The above points mean that in the studies in Hlabisa, the exposure odds ratio was not a direct estimate of either the disease rate ratio or the disease risk ratio. The analysis was therefore based on classic case-control methodology, assuming that the exposure odds ratio estimated in the current study was a disease odds ratio.

4.5.5 Extent to which influences besides the HIV/AIDS epidemic on the demand for, and supply of, care, were important during the study period

Two of the studies of the economic impact of HIV (presented in Chapters 5 and 6) covered a relatively long time period of 8 years. This makes it important to analyse whether there were any major changes in factors besides the HIV/AIDS epidemic that could have affected the demand for care, the way care was supplied, and the costs of care. If there were major changes, this could distort results and – if atypical – affect the generalisability of results from Hlabisa District.

The extent to which there have been changes in factors besides the HIV/AIDS epidemic that could have influenced the demand for, and supply of, care, is addressed in the Discussion section of Chapter 5[13]. However, since this is a general methodological chapter, the issue is also discussed here.

General factors

There was a rise in the number of physicians employed in Hlabisa district hospital between 1991 and 1993. During this period, the number of doctors working at the hospital increased from 3 to 8. This may have encouraged

[13] this Chapter is based on a paper published in JAMA in September 1999 (Floyd K, Reid RA, Wilkinson D and Gilks CF. Admission trends in a rural South African hospital during the early years of the HIV epidemic. 1999. Journal of the Amercian Medical Association (JAMA). Volume 282:1087-91). The Discussion section of this chapter is almost identical to the "Comment" section of the paper. Additional comments on the issue of the role of factors besides the HIV/AIDS epidemic were specifically added to the "Comment" section after initial review, to incorporate consideration of the queries made by (a) one of the reviewers and (b) the editor responsible for accepting the paper.

higher overall utilisation of the hospital after 1993. On the other hand, numbers have subsequently been stable, and the evidence that maternity and paediatric surgical admissions have been relatively stable (see Chapter 5 results) indicates that the availability of more doctors has not led to a general increase in demand for care.

Population growth and changes in demographic structure are likely to have had some effect on demand for care. Nevertheless, overall this appears limited. Preliminary 1996 census data indicate an increase in population of less than 10% for the period 1991-1996 (Curtis B., Medical Research Council, Durban, South Africa, written communication, 20 January 1999), while demographic structure tends to change only slowly.

Other potential causes of change in the demand for and supply of care were not applicable to Hlabisa over the period 1991-8:

- diagnostic protocols at hospital and clinic level were not altered;
- there were no major changes in available tools and equipment;
- hospital bed numbers were stable;
- there were no hospital openings or closures in adjacent districts; and
- the services provided by clinics and the type of nurses employed within them were not modified.

Standard of care for HIV/AIDS diagnosis and treatment specifically

The standard of care for HIV diagnosis and treatment was also consistent throughout the study period:

- no new treatments for opportunistic infections were made available;
- there was no access to antiretroviral drugs;
- there were 1-2 dedicated counsellors at the hospital to provide HIV counselling and testing services;
- except for a brief period in 1996 when rapid testing was available as part of a research study (Wilkinson et al, 1997c), the time between HIV testing and availability of results was 3-4 weeks; and
- according to senior hospital medical staff, HIV testing was encouraged whenever there was clinical suspicion of HIV infection.

Tuberculosis

There was a major change in the delivery of tuberculosis *treatment* in mid-1991, when a community-based directly observed therapy programme replaced a strategy relying on 4 months of inpatient care at treatment outset was introduced (Wilkinson, 1994). However, there were no other substantive changes between mid-1991 and early 1998. Deliberate changes in policy regarding length of stay after diagnosis, and the days on which patients could be discharged, were made in March 1998. These changes are described, and their impact discussed, in Chapter 6.

Tuberculosis *diagnosis* has consistently been based on clinical examination, sputum smear microscopy, and radiology, with high

sensitivity and specificity demonstrated for sputum smear microscopy (Wilkinson and Sturm, 1997a; Wilkinson et al, 1997b).

4.6 General methodological issues related to economic evaluations

Standard methods were applied for all the economic evaluations. These largely drew on a standard textbook (Drummond et al, 1997), and on guidelines produced for the British Medical Journal (1996) and the US public health service (published in JAMA, 1996). In particular, it was ensured that the criteria for a good economic evaluation defined within books and guidelines were met.

In introducing the evaluation, this meant:

- explaining the importance of the topic the evaluation was addressing, including its relevance to decision-making and policy; and
- ensuring that the question the analysis was addressing was well-defined and answerable.

In explaining the methods used, it meant:

- defining the viewpoint of the evaluation (e.g. societal; health system; patient);
- providing a comprehensive description of the alternatives being compared;
- including and sourcing evidence concerning the effectiveness of the strategies being evaluated;
- identifying all important costs and consequences, and explaining how they were valued;
- including both capital and recurrent costs;
- explaining and justifying the discount rate used; and
- explaining how joint costs were handled.

In presenting results, it meant:

- reporting quantities of inputs used as well as costs;
- reporting an incremental cost-effectiveness analysis, if relevant (i.e. if the higher cost strategy was also most effective); and
- including a sensitivity analysis for any parameters for which there was some uncertainty (e.g. assumptions used in modelling) or where there may be important variation among locations (e.g. hospital and transport costs), and justifying the choice of alternative values.

In discussing results, it meant:

- comparing results with similar evaluations if these had been done, making allowance for methodological differences where appropriate;
- assessing the generalisability of the results; and
- considering other important factors relevant to choice among the alternatives being analysed, including the feasibility of implementing different alternatives given existing financial or other constraints.

4.7 Conclusions

This chapter shows that the research goal and objectives were designed to address important gaps in knowledge. It has highlighted the difficulties involved in conducting research on HIV/AIDS, but also shows that useful studies are possible – including those that require retrospective data. In addition, the chapter has demonstrated that the methods employed should be considered appropriate, and therefore that the results reported in Chapters 5-9 should be reliable. Furthermore, it has suggested that Hlabisa is broadly typical of several other areas in South Africa. This indicates that with careful analysis and appropriate application of sensitivity analyses, results may have quite widespread applicability.

CHAPTER 5: The impact of the HIV/AIDS epidemic on demand for hospital care in Hlabisa District, 1991 through 1998[14]

5.1 Introduction

As Chapter 2 explained, the emergence of the HIV epidemic since the early 1980s has changed the pattern of disease in affected communities. Previously rare health problems have become more commonplace, and in developing countries there have been large increases in the caseload of already important diseases such as tuberculosis. Since HIV infection mainly affects young adults in whom health status is normally relatively good and utilisation of health services comparatively low, the epidemic is likely to increase rather than merely change both the burden of ill-health and demand for health care (Chapters 2 and 3).

In Africa – the continent most affected by the epidemic (Chapter 2) - Chapter 3 also illustrated that research addressing this issue is limited. Most studies have been cross-sectional, restricted to general medical services, or undertaken in urban settings. Longitudinal data are scarce and focus on specific wards, diseases, or patients. As a result, little is known about how the epidemic's impact has evolved over time, or its importance in the context of health services as a whole - particularly in rural areas, where the majority of the population lives. This is an important gap. A quantification of how demand for care changes as the HIV epidemic emerges, and the economic ramifications of this, is critical for improving understanding of the impact of HIV/AIDS on health systems, and for guiding the development of appropriate coping strategies (Chapter 3). Since the early 1990s, Chapters 2 and 4 presented data which show that South Africa has been experiencing one of the most rapidly emerging and severe HIV epidemics to date - the country had the eighth highest adult HIV prevalence in the world and ranked second only to India in terms of number of cases in 1998. To explore what economic consequences this has had for health services and to assist in the planning of appropriate response strategies, a series of three inter-related studies was undertaken in Hlabisa District (Objectives 1 to 3, Chapter 4). These studies (Chapters 5-7) become progressively more detailed, starting with a relatively general and straightforward analysis of admission trends in Hlabisa Hospital 1991-1998 (a proxy measure of demand for hospital care), and ending with a detailed cross-sectional study of the economic impact of HIV/AIDS on the adult medical wards in 1998.

This chapter is concerned with Objective 1 – the impact of the HIV/AIDS epidemic on demand for inpatient care in a rural South African hospital between 1991 and 1998. In the absence of a sophisticated health information system with detailed diagnostic data for patients admitted to hospital (see also Chapter 4), it is based on a comparatively simple analysis

[14] This chapter has been published as a paper. The reference is: Floyd K, Reid RA, Wilkinson D and Gilks CF. Admission trends in a rural South African hospital during the early years of the HIV epidemic. 1999. Journal of the Amercian Medical Association (JAMA). Volume 282:1087-91.

of routine ward and hospital admission data. Nevertheless, it was considered important for addressing 4 four key questions:

- what changes have occurred in demand for hospital care, as measured by admission numbers, during the years in which HIV and AIDS have emerged in Hlabisa District?
- to what extent can observed trends be related to the HIV epidemic?
- which types of service appear to most affected by HIV/AIDS?; and
- is there evidence that HIV/AIDS will have an important impact on demand for care, or will its role be relatively minor in the context of health services as a whole?

The chapter is structured in three sections. These are:

- **Methods (5.2)**, which explains what data were collected, sources of data, data analysis, and how the quality of retrospective data was assessed;
- **Results (5.3)**, which presents trends in admissions to Hlabisa hospital for each of the nine wards and for specific types of admission likely to be related to HIV, details the results of the statistical analyses of these trends, compares the results directly with HIV seroprevalence data, and provides evidence concerning the quality of the retrospective data sources used; and
- **Discussion (5.4)**, which assesses the extent to which documented trends reflect the emergence of the HIV epidemic, the relative importance of the impact of HIV-related admissions on demand for care in the context of the hospital as a whole, and the implications of the data for the future.

5.2 Methods

5.2.1 Data Collection

Hlabisa hospital has 9 main wards: adult male medical, adult male surgical, adult female medical, adult female surgical, paediatric medical, paediatric surgical, adult tuberculosis, paediatric tuberculosis, and maternity. It also has a small high-care unit (HCU). This has no special equipment but the nurse-to-patient ratio is much higher than on other wards (usually 1:1 vs. 1:10-20 elsewhere), and patients are always seen daily by physicians.

Each ward has an admission register that is used to record name, age, hospital number, admission diagnosis, discharge diagnosis, admission date, and discharge date for all patients. Referral data are not routinely recorded. These registers were used to count admissions to each ward for the years 1991-1998. Individual patients admitted to more than 1 ward during their hospital stay would therefore be counted more than once. A general hospital admission register is also kept by admission clerks to assign in-patients a unique hospital number, which is entered only once. The accuracy of this register is considered high, because no patient can be admitted without a hospital number. The general registers were used to

record the total number of individual patients admitted in each year and to evaluate the reliability of ward register data.

Almost all patients with tuberculosis are initially admitted to the medical wards, with re-admission during tuberculosis treatment only for medical conditions other than tuberculosis. The annual number of general medical admissions excluding tuberculosis was estimated by subtracting the number of adult male, adult female, and paediatric tuberculosis cases (identified from a detailed computer database that records key data for all tuberculosis patients registered in the district) from the number of adult male, adult female, and paediatric medical admissions in each year.

An experienced physician assessed the impact of patients with late-stage HIV disease but not tuberculosis. Using admission and discharge diagnostic data recorded in adult medical ward registers, the hospital numbers of all patients who could possibly have fulfilled the WHO expanded surveillance definition for a non-tuberculosis AIDS case (Maher and Harries, 1996: see also Chapter 2) were identified for the first 4 months of 1991, 1993, 1995, and 1997. Clinical case notes were then retrieved and used to confirm or eliminate the diagnosis.

5.2.2 Data Analysis

Ward admission patterns were analysed in STATA 6.0 using poisson regression. Trends in adult tuberculosis and non-tuberculosis clinical AIDS admissions were compared with HIV seroprevalence data.

5.3 Results

The total number of patients admitted to Hlabisa hospital increased 81% from 6 562 to 11 872 between 1991 and 1998, with close agreement between ward and general register admission totals (Table 1). The adult tuberculosis ward experienced the largest increase in admissions (360%), and a consistent upward trend persisted throughout the period studied (Figure 1; Table 2). By 1998 adult tuberculosis cases accounted for 11% of total hospital admissions, 47% of adult male medical ward admissions, and 30% of female medical ward admissions, compared to figures of 5%, 26%, and 10%, respectively, in 1991. The other consistent and dramatic trend was the rising number of patients with non-tuberculosis AIDS (Tables 1 and 2). In 1997 non-tuberculosis AIDS cases accounted for 4% of adult medical admissions during the 4-month period studied, compared to 0.2% in 1991. The growth in both types of admission appeared clearly linked to rising HIV seroprevalence (Figure 2).

Figure 1: Trends in Ward Admissions in Hlabisa Hospital 1991-8

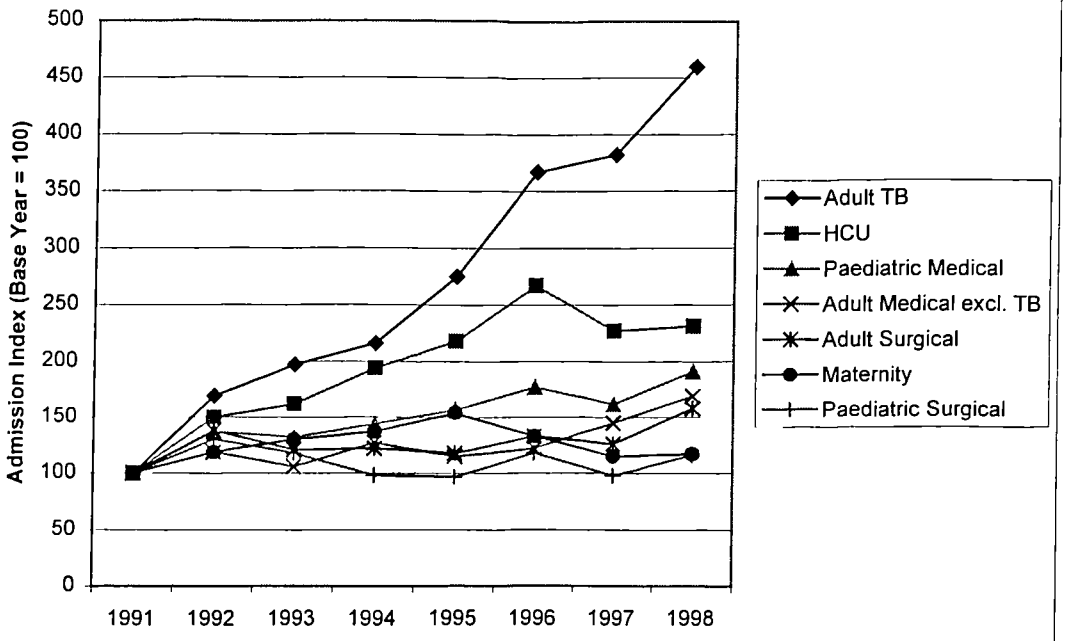
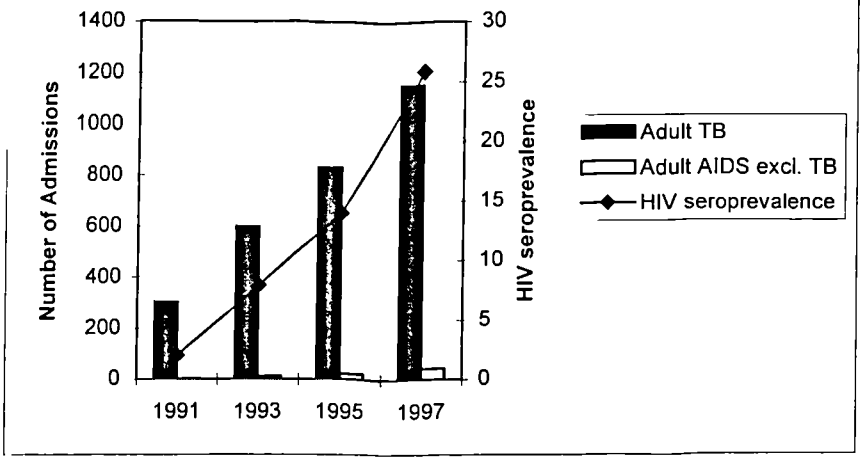


Figure 2: Increasing tuberculosis and non-tuberculosis AIDS admissions associated with rising HIV seroprevalence



*HIV seroprevalence in Hlabisa in 1991 estimated as 2% based on figures for KwaZulu-Natal province. Surveys in Hlabisa in 1992, 1993, 1995 and 1997 have found that seroprevalence among antenatal clinic attendees in the district has mirrored that for the province as a whole (Chapter 4).

Table 1: Admissions to Hlabisa Hospital 1991-1998

Ward/type of admission	1991	1992	1993	1994	1995	1996	1997	1998
Adult tuberculosis ward (1)	303	513	599	653	832	1 112	1 157	1 393
Non-tuberculosis AIDS cases[1] admitted to adult male medical ward (2)	0	N.A.	4	N.A.	12	N.A.	16	N.A.
Non-tuberculosis AIDS[1] cases admitted to adult female medical ward (3)	1	N.A.	8	N.A.	10	N.A.	27	N.A.
HCU ward (4)	381	571	617	740	832	1 016	865	882
Adult male medical ward (5)	845	998	995	1 314	1 175	1 308	1 510	1 607
Adult female medical ward (6)	851	1 162	1 083	1 100	1 255	1 508	1 661	2 147
Adult male medical ward admissions excluding tuberculosis (7)	628	683	643	889	659	637	808	853
Adult female medical ward admissions excluding tuberculosis (8)	765	964	837	872	937	1 067	1 206	1 508
Adult male surgical ward (9)	489	729	620	571	517	560	560	802
Adult female surgical ward (10)	724	946	844	914	910	1 050	974	1 121
Paediatric tuberculosis ward (11)	83	154	183	136	100	138	161	134
Paediatric medical ward (12)	837	1 150	1 105	1 207	1 310	1 481	1 355	1 595
Paediatric medical excluding tuberculosis (13)	754	996	922	1 071	1 210	1 343	1 194	1 461
Paediatric surgical ward (14)	468	608	550	458	455	552	457	545
Maternity ward (15)	2 297	2 711	2 976	3 158	3 526	3 049	2 632	2 688
Total Ward Admissions (i.e. 1 + 4 + 5 + 6 + 9 + 10 + 11 + 12 + 14 + 15)	7 278	9 542	9 571	10 251	10 914	11 774	11 332	12 914
Estimated total number of individual patients admitted to hospital based on ward registers (i.e. 1 + 4 + 7 + 8 + 9 + 10 + 12 + 14 + 15)	6 892	8 875	8 790	9 462	9 980	10 524	10 014	11 387
Total number of individual patients admitted to hospital as recorded in general hospital admission register (% estimated total based on ward registers)	6 562 (95)	8 811 (99)	8 436 (96)	9 678 (102)	10 134 (102)	10 759 (102)	10 749 (107)	11 872 (104)

[1]AIDS figures are for the first four months of each year only

Table 2: Analyses of ward admission patterns - poisson regression results

Ward/type of admission	Reduction in model deviance for fitting linear trend[1], $df^2 = 1$ (p-value, $p<0.0001$ unless specified[3])	Reduction in model deviance if linear trend not assumed, df = 6 (p-value, $p<0.0001$ unless specified[3])	Total model deviance, df=7	% model deviance explained by linear trend[4]
Adult tuberculosis ward	1168.5	44.6	1213.1	96.3
Non-tuberculosis AIDS cases	51.3	4.4 *(p=0.62)*	55.7	92.1
HCU ward	318.5	106.0	424.5	75.0
Adult male medical ward admissions excluding tuberculosis	31.3	76.9	108.2	28.9
Adult female medical ward admissions excluding tuberculosis	301.0	73.9	374.9	80.3
Adult male surgical ward	12.2 *(p=0.0005)*	116.2	128.4	9.5
Adult female surgical ward	79.5	32.6	112.1	70.9
Paediatric tuberculosis ward	2.1 *(p=0.15)*	53.7	55.8	3.8
Paediatric medical ward admissions excluding tuberculosis	287.6	49.6	337.2	85.3
Paediatric surgical ward	0.5 *(p=0.48)*	46.9	47.4	1.1
Maternity ward	17.7	328.5	346.2	5.1

[1] in poisson regression, significance is assessed through reductions in model deviance

[2] df=degrees of freedom

[3] even small departures from linearity are detected as statistically significant because the counts in each year are high. Therefore in interpreting results the focus was on the percentage of model deviance that was explained by a linear trend (i.e. column 5)

[4] analagous to R^2 (percentage of total variation explained by model) in linear regression

Other admission patterns showed more year-to-year variation and the magnitude of changes (ranging from 16% to 131%) was smaller (Table 1; Figure 1). There was some evidence of an upward trend in adult female and paediatric medical admissions (both excluding tuberculosis), and to a lesser extent in HCU and female surgical ward admissions (Table 2, column 5). Patterns for other types of admission were relatively erratic and there was no convincing evidence that any trends existed (Table 2, column 5).

5.4 Discussion

5.4.1 Summary of main findings

This study shows that during the years in which HIV seroprevalence has increased dramatically in Hlabisa, there have been substantial changes in demand for hospital care. In terms of magnitude, consistency of trend, and rate of increase, two impacts stand out. These are the growing numbers of adult tuberculosis and non-tuberculosis AIDS admissions.

5.4.2 Evidence that the increase in tuberculosis cases is HIV-related

The dominant impact - the growth in adult tuberculosis admissions - can be clearly linked to the HIV/AIDS epidemic. The much higher risk of acquiring tuberculosis among those with HIV infection has been well documented in Africa (Selwyn et al, 1989; Selwyn et al, 1992; Allen S et al, 1992; Braun et al, 1991; Moreno et al, 1993; Hawken et al, 1993). In Hlabisa, surveys among tuberculosis patients found an HIV prevalence of 35% in 1993, 58% in 1995 (Wilkinson and Davies, 1997d) and 68% in 1997 (Wilkinson and Davies, 2000, submitted). In 1995, an estimated 50% of cases were directly attributable to HIV; in 1997, the figure was 57% (author calculations – see also Chapter 6). These estimates, based on the epidemiological principles of attributable risk (see also Chapter 4), are probably conservative - they do not account for the possibility that some of the HIV-negative tuberculosis patient caseload may be related to HIV, due to increased transmission. The observed increase in caseload is also consistent with modelling predictions that the HIV epidemic may double or treble caseloads (Smith and Moss, 1994).

5.4.3 Explanations for the increase in tuberculosis caseload besides the HIV epidemic

The HIV epidemic has not been the only influence on tuberculosis admissions. It is not possible to explain rising admissions in terms of changes in diagnostic strategy - this has consistently been based on clinical examination, sputum smear microscopy, and radiology, with high sensitivity and specificity demonstrated for sputum smear microscopy (Wilkinson and Sturm, 1997a; Wilkinson et al, 1997b). However, much of the increase in 1991-1992 was probably due to the introduction of a community-based directly observed therapy programme (Wilkinson, 1994).

In mid-1991, this replaced case management based on a 4-month in-patient stay, and may have resulted in greater willingness to seek care. Continued increases cannot be related to altered tuberculosis treatment programme design, as there have been no further changes since 1991.

5.4.4 Non-tuberculosis AIDS

All of the non-tuberculosis AIDS cases are assumed to be due to HIV/AIDS. Following an HIV/TB epidemic, a second - though as yet much smaller - epidemic of severe HIV-related disease appears to be rapidly emerging. Numbers of this type of admission are still comparatively low. This is not surprising, given the relatively long lag-time between HIV infection and development of AIDS-defining conditions other than tuberculosis. It is also likely that the total number of cases was underestimated, due to reliance on retrospective case note data. However, the trend in reported cases is likely to be accurate, since distortion caused by variation in approach to HIV testing should be limited. Senior hospital medical staff report that, throughout the period studied, testing was encouraged whenever there was clinical suspicion of HIV infection. Management of patients with severe HIV-related disease may soon become a major challenge.

5.4.5 Interpretation of other admission patterns

Increase in general medical admissions

Interpretation of other admission patterns is not straightforward. Given HIV is known to cause more medical than surgical health problems, the divergence in admission patterns between the paediatric medical and surgical wards may in part reflect the effect of HIV infection. HIV seroprevalence among paediatric medical admissions was 26% in 1996 (Yeung et al, 1999). Given rates of HIV infection among antenatal clinic attendees and a vertical transmission rate of 30% (Dunn et al, 1992), the maximum HIV seroprevalence among children in the community in 1998 was likely to be 9% in those less than 12 months old. This indicates that a large number of medical admissions are attributable to HIV. Further research is required to understand the reasons for the growth in adult surgical and HCU ward admissions.

Factors besides HIV that may be important

Several general factors besides the HIV epidemic could have affected all admission patterns. However, even in combination they appear unable to explain the largest increases observed. Population growth and changes in demographic structure are likely to have had some effect, but overall this appears limited. The most rapidly growing populations in sub-Saharan Africa have been increasing at approximately 4% per year (UNDP, 1997). In 8 years the population in Hlabisa is therefore unlikely to have grown by more than 32%, and by 20% if the actual growth rate was the same as South Africa's average – 2.6% per year – for the period 1960-1994 (UNDP,

1997). Preliminary 1996 census data indicate an increase of less than 10% for the period 1991-1996 (Curtis B., Medical Research Council, Durban, South Africa, written communication, 20 January 1999).

A rise in the number of physicians employed at the district hospital, from 3 to 8 during 1991-1993, may have encouraged higher overall utilisation of the hospital. Nevertheless, numbers have subsequently been stable and a general increase in demand for care is contradicted by relative stability in maternity and paediatric surgical admissions. Other possible causes of increased admissions do not apply in Hlabisa. Diagnostic protocols have not been altered, there have been no major changes in available tools and equipment, bed numbers have been stable, there have been no hospital openings or closures in adjacent districts, and the services provided by clinics and the type of nurses employed within them has not been modified. The standard of care for HIV diagnosis and treatment has also been consistent. Throughout the study period, no new treatments for opportunistic infections have been made available, there has been no access to antiretroviral drugs, and there have been 1-2 dedicated counsellors at the hospital to provide HIV counselling and testing services. Except for a brief period in 1996 when rapid testing was available as part of a research study (Wilkinson et al, 1997c), the time between HIV testing and availability of results has been 3-4 weeks. Finally, the limited discrepancies between ward and general register totals indicate routinely collected data are reliable, so trends do not reflect variability in the way data have been recorded.

5.4.6 Overall conclusions

Despite the relevance of other factors, the evidence that the HIV epidemic has caused a substantial increase in demand for tuberculosis and general medical services in Hlabisa appears clear and convincing. Furthermore, the growth in tuberculosis cases alone is equivalent to a 17% increase in the 1991 level of total hospital admissions. This is large in the context of health services as a whole. If generalised, these trends present a major challenge for health services in South Africa. In KwaZulu-Natal province, the observed trend in HIV prevalence among antenatal clinic attendees is strikingly similar to that recorded in surveys conducted in Hlabisa (Chapter 4). In several other provinces, rates of infection are also high or rising rapidly (Chapter 2).

If these trends are seen in other rural areas of South Africa, the extent of this care burden needs to be recognised and appropriate response strategies implemented. The data from Hlabisa suggest that one clear priority is planning for the care of people with late-stage HIV disease, before numbers increase beyond their currently relatively low levels. They also indicate that the major challenge appears to be finding effective ways to manage rising tuberculosis caseloads.

CHAPTER 6: The economic impact of HIV-related disease in Hlabisa Hospital 1991 through 1999

6.1 Introduction

In many parts of Africa, one of the clearest manifestations of the HIV/AIDS epidemic has been a substantial growth in tuberculosis caseloads. As the HIV epidemic develops, it is also evident that the number of people with AIDS will increase, and that this is likely to cause an important increase in demand for health care. In addition, research has indicated that early HIV-related morbidity may be important (Gilks, 1993).

During the period in which the HIV epidemic has emerged in the Hlabisa District of South Africa, Chapter 5 illustrated that a large increase in tuberculosis cases stood out as the most dramatic trend in hospital admissions. The other obvious trend was the rising number of adult non-tuberculosis AIDS cases. However, while a general analysis of hospital admissions is useful for identifying major effects on demand for care, it cannot identify some of the other important economic aspects of the HIV epidemic's impact on health services. For example, HIV-related disease may put large upward pressure on costs, lead to high bed occupancy rates on some hospital wards if extra resources are not made available and reductions in average lengths of stay are not achieved, and reduce access to care for HIV-negative individuals. Alternatively, supply-side responses may generate improvements in efficiency that enable costs to be contained and the quality and effectiveness of care maintained.

At present, there is limited empirical evidence concerning the economic impact of HIV-related disease on health services in Africa. For many countries seriously affected by HIV/AIDS, there are no published data. As explained in Chapters 3 and 5, most studies that have been undertaken focus on medical wards only or on particular diseases, in urban rather than rural settings; and the impact of HIV/AIDS is rarely set in the context of health services as a whole. Also, most studies have been cross-sectional in design. These present a snap-shot picture only of the HIV epidemic's impact, and do not contribute to an understanding of how this has evolved. Nor can they indicate what supply-side responses may have emerged over time.

Data concerning the impact of the HIV/TB epidemic, which the documented rise in caseloads suggests may have the most important impact on services, are especially scarce. There are only two published studies from Africa. In Kenya, drug and laboratory costs for HIV+ patients treated between 1985 and 1990 in one hospital in Nairobi were found to be higher than those for patients without HIV infection (Nunn et al, 1993). Other costs were not considered. In Zambia, the cost of tuberculosis care for people who were HIV+ was found to account for a large proportion of medical ward and hospital costs in a rural district hospital in 1991 (Foster, 1996). Trends over time were not assessed. Neither study evaluated the

epidemic's impact on the cost-effectiveness and quality of care provided. In South Africa, it has been suggested that AIDS will have a more important impact on health services than HIV-related tuberculosis (Broomberg et al, 1991), but there are no published empirical data to indicate whether or not this has been the case in practice.

More data are required for four main reasons. First, to improve understanding of the cost implications of the epidemic and the importance of these costs in the context of health services as a whole. Second, to indicate the ways in which health services have responded to rising demand for care over time, and whether or not these have affected the effectiveness, efficiency, or quality of care. Third, to inform resource allocation to health services in the context of a rising and rapidly changing burden of disease. And fourth, to assess the extent to which there is a need to identify new approaches to provision of care.

This chapter concerns a study of the longitudinal economic impact of those HIV-related impacts that could be identified retrospectively in Hlabisa hospital, South Africa, for the period 1991 to 1999 (Objective 2, Chapter 4)[15]. It builds on the previous chapter by assessing, in detail, the economic consequences of the substantial increase in tuberculosis hospital admissions that occurred over this period; and the dramatic though numerically smaller rise in non-tuberculosis clinical AIDS admissions. It is structured in three major sections, which are:

- **Methods (6.2)**, which describes the approach to care of tuberculosis cases and patients with other AIDS-defining conditions, and explains the costing and epidemiological methods used in the analyses;
- **Results (6.3)**, which documents trends in the total costs associated with tuberculosis care as a whole and the costs associated with HIV-attributable tuberculosis and non-tuberculosis AIDS specifically, compares the relative magnitude of these two impacts, and sets costs in the context of total medical ward and hospital costs as a whole. Data concerning average cost, bed occupancy (a measure of quality of care) and length of stay (a key supply-side response indicator) are then reported. For tuberculosis, the average cost per cure and the average cost per death averted (two measures of cost-effectiveness and hence the efficiency of care) in each year are also presented. Sensitivity analyses are included;
- **Discussion (6.4)**, which uses the findings to assess and compare the importance of the economic impact of HIV-attributable tuberculosis and non-tuberculosis AIDS in Hlabisa district hospital to date, and considers the extent to which findings are generalisable. It also highlights the role of a community-based directly observed therapy programme – an important supply-side innovation introduced in 1991. The implications of the results for health services in South Africa are then considered.

[15] A paper based on this chapter and Chapter 7 has been selected for a keynote oral presentation at the XIII International AIDS conference in Durban, South Africa, on July 12th 2000. The paper is entitled "The economic impact of the HIV/AIDS epidemic on health services in rural South Africa".

6.2 Methods

6.2.1 Perspective of the study

The lack of retrospective data for the private sector and individual patients meant that the study was undertaken from the perspective of government health services only.

6.2.2 Types of patient studied

Two major categories of patient were studied. These were adult tuberculosis cases, and adult medical patients with AIDS-defining conditions other than tuberculosis. These two types of patient were chosen because HIV-attributable tuberculosis and AIDS were the two types of HIV-related hospital admission that could be identified from retrospective data. Children (i.e. patients aged less than 13) were excluded from the analysis of tuberculosis because HIV seroprevalence data were only available for 1996. This made attributable fraction calculations impossible for other years. In addition, children represented less than 10% of total tuberculosis cases in all years, there was no strong evidence that the caseload had increased in line with the HIV epidemic (Chapter 5), and tuberculosis accounts for a small proportion of paediatric admissions. They were excluded from the medical ward study because identification of paediatric AIDS is difficult, as reflected by the low specificity of the AIDS surveillance definition suggested by WHO (see Chapter 2).

6.2.3 Time periods studied

Tuberculosis patient care was studied for the years 1991, 1993, 1995, 1997 and the period April 1st 1998-March 31st 1999. The latter 12-month period was chosen to enable assessment of the impact of a deliberate change in approach to care for tuberculosis patients introduced in March 1998 (see section 6.2.4). Non-tuberculosis AIDS cases were studied in 1991, 1993, 1995, the first 4 months of 1997, and the period March 4th-May 6th 1998. The years were chosen to cover the period in which HIV seroprevalence rose from a level characteristic of a nascent epidemic to a time when it had reached a level typical of a well-established one. In some instances, the exact time periods studied reflected data constraints (see below).

6.2.4 Description of how care for tuberculosis and non-tuberculosis AIDS patients is provided

Patients who present at clinics with signs and symptoms characteristic of tuberculosis are referred to hospital. Others present directly at the hospital outpatient department. Any patients suspected of having tuberculosis are then admitted to the adult medical wards of Hlabisa hospital for diagnostic work-up. This consists of standard laboratory tests, clinical examination, x-rays, and, sometimes, a trial of antibiotics. After diagnosis, patients are normally transferred to the tuberculosis ward although there may be transfer delays.

During the first six months of 1991, an 8-month drug regimen was used to treat tuberculosis. The standard approach was that for the first 4 months of treatment, patients stayed in hospital. For the final 4 months, treatment was on an unsupervised outpatient basis, with patients expected to collect their drugs once per month. In June 1991, a new community-based approach to treatment, using the DOT approach and a new six-month drug regimen, was introduced (Wilkinson, 1994). Until March 1998, this involved patients receiving the first 2 weeks of treatment in hospital, after which hospital stay was dependent on clinical condition. Since March 1998, patients have been discharged as soon as the medical doctor who manages the tuberculosis programme considers them well enough to go home.

While in hospital, patients receive daily treatment with four drugs (isoniazid, rifampicin, pyrazinamide and ethambutol) and, with the help of fieldworkers, identify someone to directly observe every treatment dose after discharge. On discharge, fieldworkers transport patients to their supervision point in a hospital vehicle. Supervisors are given the pre-packed drugs required for completion of treatment, which are the same as those given in hospital but in higher dose. Drugs must be taken twice a week. Fieldworkers visit supervisors monthly to check compliance, collect patient outcome data, and trace absconders. A hospital doctor manages the programme.

There are no standard protocols, as yet, for the care of people who present at clinics or the district hospital with AIDS-defining conditions other than tuberculosis. Referral to hospital, and admission from the hospital outpatient department, reflect individual medical opinion on what constitutes appropriate care.

6.2.5 Identification of tuberculosis and non-tuberculosis AIDS cases

Tuberculosis patients diagnosed after June 1991 were identified from a computer database established when the community-based DOT programme was introduced. For all patients treated in the district since this time, this includes data concerning name, age, sex, type of tuberculosis diagnosed, year of diagnosis, supervisor chosen to observe treatment, address, and hospital inpatient number. Patients treated in the first six months of 1991 were identified from medical and tuberculosis ward registers, in which diagnosis, name, age, sex, hospital number, and dates of hospital admission and discharge are recorded.

For non-TB AIDS cases, identification of patients in 1991, 1993, 1995 and 1997 was through an initial screening based on ward registers followed by detailed review of patient case notes. The screening process was undertaken by an experienced doctor, who reviewed admission and discharge diagnostic data recorded in adult medical ward registers to identify the case note numbers of all patients whose diagnostic data suggested that they might have fulfilled the expanded WHO surveillance definition for a non-tuberculosis AIDS case (WHO, 1996; see also Chapter 2). Where no diagnostic data were entered in these registers, case notes

numbers were also recorded, given the possibility that these patients might also be non-TB AIDS cases and could not be excluded by initial screening of diagnostic data. All case notes were then retrieved and reviewed to confirm or eliminate the diagnosis of non-TB AIDS. The first 4 months of 1997 only were studied because in later months HIV testing was not routinely available and therefore the WHO case definition used for previous years could no longer be applied. The last 4 months of 1995 were not studied for male patients because of a change in the male medical ward register used from September 1st 1995 until mid-1996. No diagnostic data were recorded in this register, so the initial screening used for other time periods was not possible. The only available alternative – retrieval of all case notes for this time period – was not considered feasible because of the high numbers of patients (approximately 500) involved.

In 1998, data came from a prospective study of 624 consecutive patients admitted to the adult medical wards between March 4th and May 6th 1998. In this study, all patients were tested for HIV, and an assessment of whether or not a patient fitted the WHO surveillance definition for an AIDS case was undertaken by a clinical research fellow.

6.2.6 Costing

6.2.6.1 Type of costs identified, and packages used to analyse data

Total and average costs were calculated for each year or time period studied (see Appendix 1 for a full worked example of the costing methodology, using data from 1995 – the mid-point year of the study). For all inputs to care, it was necessary to use primary data sources that were not computerised: data for unit costs were not readily available, as they would be in some developed country health systems. All data were entered and analysed using the spreadsheet package Excel 7.0 and the statistical package STATA 6.0.

6.2.6.2 Costing of inputs specific to tuberculosis patients and patients with AIDS-defining conditions other than tuberculosis

The numbers and grades of medical and nursing staff, the size of buildings, and the type of equipment used were quantified for both the medical and tuberculosis wards in each year. Total costs for each ward were established by multiplying quantities by unit prices in 1998. Medical ward costs were allocated to tuberculosis patients, or to patients with AIDS-defining conditions other than tuberculosis, according to the proportion of patient days for which they accounted. Tuberculosis ward costs were split between adults and children using the same patient-days criterion.

The use of vehicles, drivers, fieldworkers, and distances travelled for supervision and delivery of tuberculosis patients were then quantified for each year, and total costs established by multiplying quantities by unit prices in 1998. These are the major transport costs associated with tuberculosis patients. More general use of transport services could not be

established for particular patient groups from available data. However, transport costs represented less than 4% of total hospital costs in each year. Since there is a standard approach to diagnosis and treatment of tuberculosis, the total cost of x-rays, laboratory tests and drugs was calculated according to the number of tuberculosis patients in each year and the unit costs of these items. For patients with AIDS but not tuberculosis, laboratory, drug and x-ray consumption data were recorded for each identified patient (length of stay and outcome data were also recorded). The total costs of these items for the adult medical wards as a whole were estimated by generating a random sample of patients (n at least 30[16]), using this to estimate the average cost per patient, and multiplying this by the number of patients admitted to the ward in each year. Though a relatively small sample size, the comparatively small importance of these costs (less than 10% of total costs for patients with non-tuberculosis clinical AIDS and less than 5% of the costs associated with tuberculosis patients) meant that it was not considered worthwhile to supplement these data further.

6.2.6.3 Costing of inputs not specific to tuberculosis patients and patients with AIDS-defining conditions other than tuberculosis

A "bottom-up" approach to costing, focusing on defining costs at either (a) the level of individual patients, (b) the level of particular categories of patients or (c) the level of individual wards, was used wherever feasible. However, there were 9 major types of cost ("overhead costs") that could not be identified at any of these 3 levels. These were: administrative services; kitchen services; laundry services; domestic services; security; maintenance; cleaning; "other staff-related" items; and miscellaneous. For these costs, a "step-down" costing procedure (e.g. see Drummond et al, 1997; Chapter 4, section 4.4.3; and Appendix 1 for full details using a worked example) using standard allocation criteria was therefore used to calculate an average cost per patient-day.

The step-down costing consisted of 6 major steps. First, cost centres were defined as individual wards; the outpatient department; x-ray; laboratory; pharmacy; administrative services; kitchen services; laundry services; domestic services; security; maintenance; cleaning; "other staff-related" items; and miscellaneous. Second, all staff not involved in direct patient care and each budgetary line item of non-personnel recurrent expenditure were assigned to the appropriate cost centre. The size of buildings and the type of equipment used within each cost centre were also quantified. Total costs were calculated by multiplying quantities by 1998 unit prices, except for non-personnel recurrent expenditure data - these were inflated to 1998 values using the consumer price index for South Africa[17]. Third, maintenance costs were allocated to other cost centres (including those providing direct patient care i.e. the wards and outpatient department) on

[16] In generating a sample it was anticipated that a small number of case notes would be missing. Therefore, the initial sample consisted of 32. This always generated at least 30 valid case notes, but numbers were sometimes higher than 30 (when 31 or all 32 were available). This is why the total number of observations in Tables 6.8 and 6.9 is sometimes >30

[17] Therefore, except for recurrent non-personnel overhead costs, cost calculations exactly reflect the real quantity of resources used. Since all quantities were multiplied by 1998 unit prices and converted at the US$:Rand exchange rate for 1998, costs calculations are also not distorted by exchange rate fluctuations over the study period.

the basis of floor area. Fourth, "other staff related" costs were allocated to individual wards or the outpatient department according to the proportion of direct care staff costs for which they accounted. Fifth, the total cost of the remaining seven "overhead" cost centres was allocated to either inpatient or outpatient services. Kitchen and laundry costs were allocated entirely to inpatient care and all remaining costs were allocated according to the fraction of direct care staff costs accounted for by inpatient and outpatient care. Finally, a cost per patient-day was calculated for each type of overhead cost. For "other staff related" and maintenance costs, which were allocated to ward level, this was done by dividing total allocated costs by the total annual number of patient days on the relevant ward. For the remaining types of overhead cost, this was done by dividing the total costs allocated to inpatient care by the total annual number of patient days for the hospital as a whole.

The total annual costs of care for (a) tuberculosis patients as a whole (b) tuberculosis patient time spent on the medical wards and (c) patients with non-tuberculosis clinical AIDS, were then calculated by multiplying total patient days in each category by the cost per day of each overhead cost. The total cost of the adult male and female medical wards were calculated in the same way.

Patient days for tuberculosis patients were calculated by recording dates of admission and discharge to the medical and tuberculosis wards for all tuberculosis patients in 1991 (n=303), 1993 (n=599) and 1995 (n=832), and for a random sample of patients in 1997 (n=109 for male patients, n=109 for female patients, 16% and 24% respectively of the total) and 1998/9 {n=215 for males and n=154 for females (27% and 23% respectively of the total)}. A larger sample size was chosen for the latter year because this was required to investigate whether there had been a significant reduction in length of stay after the approach to tuberculosis case management was deliberately altered in March 1998. For patients with AIDS-defining conditions other than tuberculosis, patient days were established by calculating length of stay for each patient from admission and discharge data recorded in case notes.

6.2.6.4 How capital costs were handled and conversions to US$ undertaken

Capital costs were annualised using 1998 replacement prices, the assumption that the life expectancy of buildings, equipment and vehicles was 30, 10 and 5 years respectively, and a discount rate of 8% (see Chapter 4 for justification of this choice). Costs are reported in 1998 US$, using the average exchange rate prevailing in 1998 (R5.53= US$1, Gary McCrystal, Reserve Bank of South Africa, written communication, June 1st 1999).

6.2.6.5 Sources of data

Sources of data included: nursing allocation books; interviews with hospital staff; hospital expenditure records: the district payroll; the Regional Laboratory Manager; the 1998 pharmacy price list; quantity surveyors

employed by the Provincial Department of Health; the Provincial Department of Transport; vehicle logbooks; medical equipment companies; Economist Intelligence Unit Country Reports for South Africa and the South African Reserve Bank; x-ray department record books; the tuberculosis programme computer database; patient case notes; and midnight bed state statistics. For tuberculosis patients, admission and discharge date data were recorded from the general hospital admission register and from the tuberculosis programme register, and then checked using medical and tuberculosis ward registers.

6.2.6.6 Estimation of tuberculosis care costs attributable to HIV

All admissions of patients who fitted the WHO expanded surveillance definition of an AIDS case were attributed to HIV/AIDS. This was justified because, in the absence of HIV infection, people do not fall sick with the conditions that together constitute a diagnosis of AIDS. However, this was not possible for tuberculosis. Tuberculosis was an important cause of hospital admissions prior to the HIV epidemic, so an HIV+ person with tuberculosis could not be assumed to have the disease because of their HIV status. This meant that even if HIV status had been known for all tuberculosis patients (which it was not), this would not have been sufficient to estimate the number of HIV-related tuberculosis cases.

The fraction of tuberculosis that could be attributed to HIV in each year was therefore estimated using standard epidemiological methods (Hennekens and Buring, 1987; see Chapter 4, 4.4.4 for explanation). The calculations were undertaken in 4 steps: the data are shown in Table 6.1.

Table 6.1: Data used to calculate odds ratios, calculated odds ratios, and the estimated AR%

Year	HIV seroprevalence among antenatal clinic attendees (number in survey)	HIV seroprevalence among tuberculosis patients (number in survey)	Odds ratio[1] [95% confidence interval]	AR%	PAR%
1991	2% (n=2000)	*Inferred[2] as 11%*	Estimated[3] as 6.25 [5.17, 7.56]	84.0	9.5
1993	8% (n=709)	35% (n=350)	6.32 [4.35, 9.17]	84.2	29.5
1995	14% (n=314)	58% (n=80)	8.3 [4.55, 15.15]	88.0	51.0
1997	26% (n=2001)	68% (n=273)	6.12 [4.6, 8.15]	83.7	56.9
1998	29% (n=340)	70% (n=187)	5.69 [3.72, 8.72]	82.4	57.7

[1] in calculating odds ratios, more decimal places than those presented in columns 1 and 2 were used

[2] [{p1 ÷ (1-p1)} ÷ {(p2÷ (1-p2)}] = average OR, where p1 is the probability of HIV infection among TB patients and p2 is the probability of HIV infection among antenatal clinic attendees. Can infer p1 because p2 is known (0.02)

[3] Mantel-Haensel weighted average based on 1993, 1995, 1997 and 1998 data

First, odds ratios were calculated using survey data from Hlabisa District concerning HIV prevalence among tuberculosis patients and antenatal clinic attendees (who were assumed to act as tuberculosis-negative controls). Second, odds ratios were used as a measure of the relative risk

(RR) of contracting tuberculosis for HIV+ compared to HIV- individuals[18]. Third, the proportion of HIV+ tuberculosis patients whose tuberculosis could be attributable to HIV (the attributable risk %, AR%) was calculated as AR% = [{(RR-1)/RR} x 100]. Fourth, the fraction of all tuberculosis cases attributable to HIV (the population attributable risk %, PAR%) was then calculated as {(AR% x number of HIV+ tuberculosis patients) ÷ total annual number of tuberculosis patients}.

As the table indicates, HIV seroprevalence among tuberculosis patients was unknown in 1991. However, it could be inferred using HIV seroprevalence data among antenatal clinic attendees for this year and the average odds ratio based on combining data for all other years. Combining data from all years was justified because there was no evidence of a trend over time in the odds ratio (p=0.79).

In the baseline analysis, it was assumed that length of stay was, on average, the same for HIV+ and HIV- patients, so that the share of total cases attributable to HIV was estimated to reflect the proportion of total costs attributable to HIV. This was justified for two reasons. First, there is a defined approach to case management. Second, analysis of length of stay data from 1993, 1995 and 1997 showed no clear-cut evidence of a difference according to HIV status (Tables 6.2a to 6.2c).

Table 6.2a: Length of stay for tuberculosis patients according to HIV status, 1993 [95% confidence intervals]

HIV status	Length of stay, Medical Ward	Length of stay, TB ward	Total length of stay in hospital
HIV+	11.3 (n=194) [9.6, 13.0]	19.7 (n=198) [16.8, 22.7]	30.5 (n=188) [27.6, 33.5]
HIV-	8.8 (n=259) [7.6, 10.1]	24.5 (n=263) [21.2, 27.9]	33.0 (n=251) [29.4, 36.7]
Status unknown	5.3 (n=109) [4.0, 6.6]	19.1 (n=110) [14.8, 23.4]	25.0 (n=106) [20.3, 29.7]

Table 6.2b: Length of stay for tuberculosis patients according to HIV status, 1995 [95% confidence intervals]

HIV status	Length of stay, Medical Ward	Length of stay, TB ward	Total length of stay in hospital
HIV+	12.2 (n=141) [9.4, 15.0]	25.0 (n=146) [19.3, 30.6]	37.0 (n=139) [30.6, 43.4]
HIV-	7.4 (n=104) [5.7, 9.1]	19.7 (n=108) [15.3, 24.1]	27.5 (n=103) [22.9, 32.1]
Status unknown	8.1 (n=567) [6.9, 9.4]	20.2 (n=571) [17.5, 22.9]	28.5 (n=565) [25.6, 31.4]

HIV+ patients had a lower average length of stay than HIV- patients in 1993 and a higher average length of stay in 1995, and both groups had a higher length of stay than those for whom status was unknown. This suggested that those tested were patients whose clinical condition was most

[18] Odds ratios were used since the data available meant that neither rate nor risk ratios could be calculated – see also Chapter 4

suggestive of HIV, and therefore represented a biased sample. Data from a random sample in 1997 showed a virtually identical length of stay for HIV+ and HIV- patients.

Table 6.2c: Length of stay for tuberculosis patients according to HIV status in Hlabisa hospital, 1997 [95% confidence intervals]

HIV status	Total length of stay in hospital
HIV+ (n=185)	21.0 [18.8-23.2]
HIV- (n=88)	21.1 [18.0-24.2]

6.2.7 Supply-side responses

6.2.7.1 Efficiency

Difficulties in interpreting the reasons for variation in outcomes and low numbers of patients meant that no attempt was made to assess changes in the efficiency of care for non-tuberculosis AIDS patients. However, trends in efficiency were explored for tuberculosis patients, through assessing the cost-effectiveness of tuberculosis treatment for the period 1991-9.

The average cost per tuberculosis patient was estimated as explained in 6.2.6. Effectiveness was then estimated in terms of the number of cures and deaths averted per patient treated, in 6 steps.

The first step was to use the tuberculosis programme database in Hlabisa to analyse patient outcomes according to the standard tuberculosis treatment outcome measures used by WHO. The results are shown for (a) smear-positive tuberculosis patients and (b) smear-negative pulmonary and extra-pulmonary tuberculosis patients in Tables 6.3a and 6.3b below[19].

Table 6.3a: Outcomes for smear-positive pulmonary tuberculosis patients in Hlabisa 1991-8/9

Year	Cured, or completed treatment but cure not confirmed (%)	Died (%)	Failed treatment (%)	Defaulted or transferred out (%)
1991 (n=201)	84.8	1.7	0.0	13.5
1993 (n=337)	72.2	5.7	0.0	22.1
1995 (n=459)	63.1	8.8	0.0	28.1
1997 (n=619)	59.3	5.9	0.2	34.7
1998/9 (n=981)	58.5	9.9	0.3	31.3

The WHO approach for measuring programme success in treating smear-positive pulmonary tuberculosis patients is to quote the cure or "successful treatment" rate. The successful treatment rate is calculated as the percentage cured added to the percentage who completed treatment but for whom cure was not confirmed (since completion of treatment is assumed to

[19] failed treatment category is only relevant for smear-positive pulmonary patients as it is defined as a positive smear at the end of treatment

result in cure and therefore represent "successful treatment"). Sputum smears are not routinely tested for sputum conversion in Hlabisa, so cure is not usually "confirmed". Therefore, cure rates in each year were estimated as equivalent to the percentage "successfully treated". In addition to the WHO use of the "successful treatment" rate to measure programme success, an additional justification for this is evidence from Hlabisa that almost all patients who complete treatment will be cured (Wilkinson et al, 1997e).

Table 6.3b Outcomes for smear-negative pulmonary/extra-pulmonary tuberculosis patients in Hlabisa 1991-8/9

Year	Completed treatment (%)	Died (%)	Defaulted or transferred out (%)
1991 (n=102)	70.8	8.3	20.9
1993 (n=261)	69.0	8.5	22.5
1995 (n=375)	56.7	15.2	28.1
1997 (n=538)	52.8	11.5	35.7[20]
1998/9 (n=461)	58.3	17.0	24.7

For smear-negative pulmonary or extra-pulmonary patients, for whom cure cannot be established by sputum smear-conversion during treatment, the completion of treatment rate is usually used to measure programme effectiveness. In this analysis, as for smear-positive pulmonary patients, completion of treatment was assumed to be equivalent to cure.

While these effectiveness measures are useful, in cost-effectiveness analyses it is also important to consider what outcomes occurred in the "defaulted" and "transferred out" categories; and to account for the fact that in the absence of treatment, some tuberculosis patients will self-cure. The second step in the cost-effectiveness analysis was therefore to calculate minimum and maximum cure/death rates that incorporated the range of outcomes possible in the "defaulted" and "transferred out" categories. This was done by assuming that the cure/death rate among patients in these categories ranged from the cure/death rate among those for whom outcomes were known (for the estimated maximum cure and minimum death rates) to the cure/death rate that could be expected in the absence of treatment (for the estimated minimum cure and maximum death rate).

To estimate the cure and death rates that would occur with no treatment, the following assumptions were made:

- HIV- patients would have a self-cure rate of 20% (De Jonghe et al, 1994);
- no self-cure would occur among HIV+ patients (Dye et al, 1998);
- the death rate among HIV- patients would be 60-70% for untreated smear-positive tuberculosis patients and 40% for other types of tuberculosis (De Jonghe et al, 1994);
- the death rate would be 100% for HIV+ patients, irrespective of the type of case (Dye et al, 1998).

[20] row totals do not always sum to 100 due to rounding errors

These assumptions were used in combination with HIV seroprevalence data for tuberculosis patients in Hlabisa (Table 6.1), to estimate cure and death rates in the absence of treatment (Tables 6.4a-d).

Table 6.4a: Minimum and maximum cure rates, and estimated cure rates in the absence of treatment, for smear-positive pulmonary tuberculosis patients in Hlabisa 1991-1998/9

Year	Minimum cure rate	Maximum cure rate	Estimated cure rate in absence of treatment	Estimated minimum net cure rate[21]	Estimated maximum net cure rate[22]
1991	84.8	98.0	17.8	67.0	80.2
1993	72.2	92.7	13.0	59.2	79.7
1995	63.1	87.8	8.4	54.7	79.4
1997	59.3	90.8	6.4	52.9	84.4
1998/9	58.5	85.2	6.0	52.5	79.2

Table 6.4b: Minimum and maximum cure rates, and estimated cure rates in the absence of treatment, for smear-negative pulmonary and extra-pulmonary tuberculosis patients in Hlabisa 1991-1998/9

Year	Minimum cure rate	Maximum cure rate	Estimated cure rate in absence of treatment	Estimated minimum net cure rate	Estimated maximum net cure rate
1991	70.8	89.5	17.8	53.0	71.7
1993	69.0	89.0	13.0	56.0	76.0
1995	56.7	78.9	8.4	48.3	70.5
1997	52.8	82.1	6.4	46.4	75.7
1998/9	58.3	77.5	6.0	52.3	71.5

Table 6.4c: Minimum and maximum death rates, and estimated death rates in the absence of treatment, for smear-positive pulmonary tuberculosis patients in Hlabisa 1991-1998/9

Year	Minimum death rate with treatment	Maximum death rate with treatment	Estimated death rate in the absence of treatment
1991	2.0	11.6	64.4-73.3
1993	7.3	23.5	74.0-80.5
1995	12.2	33.4	83.2-87.4
1997	9.0	37.3	87.2-90.4
1998/9	14.4	31.8	88.0-91.0

The third step was to estimate a minimum and maximum *net* cure/death rate (Tables 6.4a to d) i.e. the difference between the minimum cure/death rate and the cure/death rate in the absence of treatment, and the difference between the maximum cure/death rate and the cure/death rate in the absence of treatment.

[21] i.e. minimum cure rate achieved – estimated cure rate that would apply without treatment
[22] i.e. minimum cure rate achieved – estimated cure rate that would apply without treatment

Table 6.4d: Minimum and maximum death rates, and estimated death rates in the absence of treatment, for smear-negative pulmonary and extra-pulmonary tuberculosis patients in Hlabisa 1991-1998/9

Year	Minimum death rate	Maximum death rate	Estimated death rate in the absence of treatment
1991	10.5	18.0	46.6
1993	11.0	22.2	61.0
1995	21.1	36.2	74.8
1997	17.9	40.3	80.8
1998/9	22.5	26.8	82.0

The fourth step was to estimate the minimum and maximum number of cures and deaths averted per patient treated (Tables 6.5a and b). The minimum and maximum number of cures was calculated as the estimated minimum and maximum net cure rate divided by 100. The estimated minimum and maximum number of deaths averted was calculated by dividing, by 100, the difference between (a) the maximum death rate in the presence of treatment and the maximum death rate in the absence of treatment[23] and (b) the minimum death rate in the presence of treatment and the maximum death rate in the absence of treatment.

Table 6.5a: Estimated minimum and maximum number of cures and deaths averted per smear-positive pulmonary tuberculosis patient treated in Hlabisa 1991-1998/9

Year	Minimum number of cures	Maximum number of cures	Minimum number of deaths averted	Maximum number of deaths averted
1991	0.67	0.80	0.68	0.71
1993	0.59	0.80	0.57	0.73
1995	0.55	0.79	0.54	0.75
1997	0.53	0.84	0.53	0.81
1998/9	0.53	0.79	0.59	0.77

Table 6.5b: Estimated minimum and maximum number of cures and deaths averted per smear-negative pulmonary or extra-pulmonary tuberculosis patient treated in Hlabisa 1991-1998/9

Year	Minimum number of cures	Maximum number of cures	Minimum number of deaths averted	Maximum number of deaths averted
1991	0.53	0.72	0.29	0.36
1993	0.56	0.76	0.39	0.50
1995	0.48	0.71	0.39	0.54
1997	0.46	0.76	0.41	0.63
1998/9	0.52	0.72	0.55	0.60

Fifth, since costs were calculated for tuberculosis patients as a whole, the overall estimated number of cures and deaths averted per patient treated

[23] not the minimum, because, for patients for whom outcomes are not known, the maximum death rate in the presence of treatment assumes the maximum death rate in the absence of treatment. It would be inconsistent to compare this with a figure for the minimum death rate in the absence of treatment for all patients.

was calculated as a weighted average of the figures for (a) smear-positive pulmonary tuberculosis patients and (b) smear-negative pulmonary and extra-pulmonary patients, according to the numbers of patients in each category (Table 6.6).

Table 6.6: Overall estimated number of cures and deaths averted per tuberculosis patient treated in Hlabisa 1991-1998/9

Year	Minimum estimated cures per patient treated	Maximum estimated cures per patient treated	Minimum estimated deaths per patient treated	Maximum estimated deaths per patient treated
1991	0.62	0.77	0.55	0.59
1993	0.58	0.78	0.51	0.63
1995	0.52	0.75	0.47	0.66
1997	0.50	0.80	0.47	0.73
1998/9	0.53	0.77	0.58	0.72

Finally, cost-effectiveness was calculated as the average cost per patient treated divided by the minimum/maximum number of cures or deaths averted per patient treated, as appropriate.

6.2.7.2 Cost-cutting/reductions in average length of stay/bed occupancy

To explore how health services were responding to additional HIV-related demand for care, 2 main analyses were undertaken. First, trends in average costs and average length of stay were analysed for tuberculosis patients and non-TB AIDS patients, using the patient level data collected as part of the costing analysis. Second, trends in average length of stay on the adult medical wards, and bed occupancy rates on the adult medical and tuberculosis wards, were explored. Average length of stay for the medical wards as a whole was estimated by dividing the total annual number of ward patient days (calculated from midnight bed state statistics) by the annual number of admissions (using admission data presented in Chapter 5). Bed occupancy rates were calculated from midnight bed state statistics.

6.2.8 Sensitivity analyses

Hospital length of stay was the major influence on the costs associated with tuberculosis patients, but there was considerable variation in this figure (standard deviations were close to means in all years). There was also possible imprecision in the estimation of Relative Risk (used to estimate the proportion of tuberculosis cases attributable to HIV infection), for 3 reasons:

- an odds ratio is an approximation to a risk ratio (see also Chapter 4 section 4.4.4);
- sampling error - odds ratios were based on data (HIV seroprevalence among antenatal clinic attendees and tuberculosis patients) from a sample only, rather than the entire population of tuberculosis patients or antenatal women; and

- antenatal clinic attendees may not be representative of the population without tuberculosis, so that the estimates of HIV seroprevalence in the non-diseased population may be biased.

Sensitivity analyses using the 95% confidence intervals for both odds ratios and mean lengths of stay were conducted, to explore the impact of such imprecision/possible bias on results.

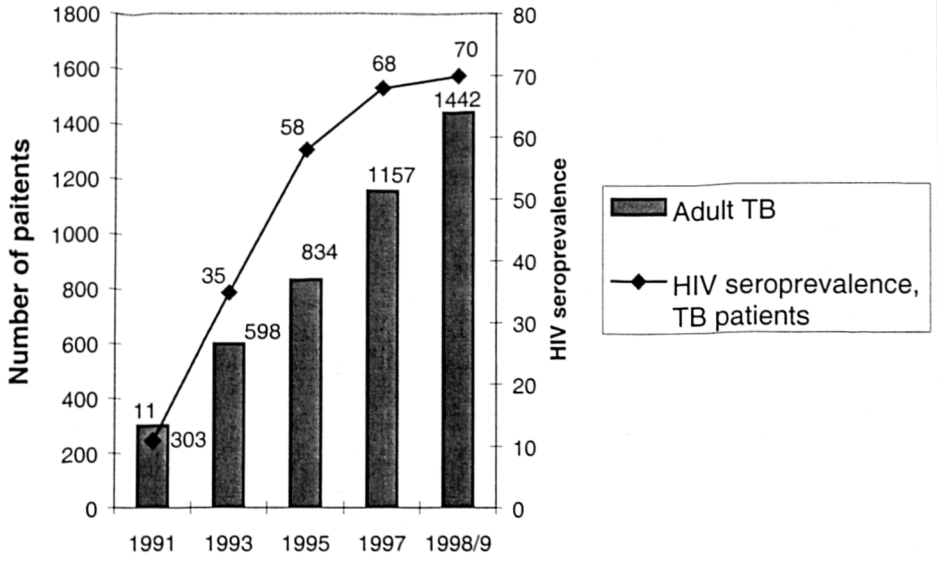
While there was also considerable variation in the average cost per patient with non-tuberculosis AIDS, formal sensitivity analyses were not undertaken. This was because the number of observations was too small to obtain reliable 95% confidence intervals for these patients' lengths of stay.

6.3 Results

6.3.1 Total costs of care, tuberculosis patients

The total number of adult tuberculosis patients increased from 303 in 1991 to 1 442 in the period April 1st 1998 to March 31st 1999, while estimated HIV seroprevalence among patients rose from 11% to 70% (Figure 1).

Figure 1: Trends in number of tuberculosis patients diagnosed and treated in Hlabisa Hospital, and HIV seroprevalence, 1991-1998/9



The 376% growth in caseload was associated with a much smaller rise in total care costs (Table 6.7 and Figure 2). These rose 40% in absolute terms

Table 6.7: Total cost of care for tuberculosis patients in Hlabisa Hospital 1991-1998/9, 1998 US$ (% total)

Cost Item	1991	1993	1995	1997	1998/9	% change 1991-1998/9
Medical and nursing staff, tuberculosis ward	119 753 (22)	116 463 (22)	158 354 (23)	173 253 (20)	166 344 (22)	39
Medical and nursing staff, male medical ward	27 761 (5)	32 314 (6)	50 832 (7)	68 395 (8)	33 490 (4)	21
Medical and nursing staff, female medical ward	23 577 (4)	50 663 (10)	63 993 (9)	36 678 (4)	27 774 (4)	18
Administration	88 101 (16)	67 617 (13)	90 359 (13)	106 234 (12)	98 531(13)	12
Kitchen	63 308 (12)	49 387 (9)	64 477 (9)	120 437 (14)	88 354 (12)	41
Laundry	26 563 (5)	20 219 (4)	27 698 (4)	34 760 (4)	30 531 (4)	13
Maintenance	35 950 (7)	34 951 (7)	37 451 (5)	61 358 (7)	58 082 (8)	62
Cleaning	26 563 (5)	21 213 (4)	27 244 (4)	30 844 (4)	29 606 (4)	11
Miscellaneous overheads (e.g. water; electricity)	88 101 (16)	70 931 (13)	90 359 (13)	115 051 (13)	109 633 (14)	24
Drugs	11 138 (2)	21 804 (4)	30 285 (4)	42 115 (5)	52 489 (7)	371
Laboratory tests	487 (0.1)	823 (0.2)	1 170 (0.2)	1 783 (0.2)	2 206 (0.3)	353
X-rays	2 182 (0.4)	3 175 (0.6)	5 943 (0.8)	8 034 (0.9)	11 291 (1)	306
Male medical ward buildings and equipment	2 361 (0.4)	1 963 (0.3)	3 130 (0.5)	3 957 (0.5)	2 230 (0.3)	- 6
Female medical ward buildings and equipment	1 866 (0.3)	3 666 (0.7)	3 710 (0.5)	2 128 (0.2)	2 143 (0.3)	15
Tuberculosis ward buildings and equipment	16 835 (3)	14 143 (3)	15 431 (2)	17 894 (2)	20 184 (3)	20
Arrangements and overall supervision of community-based DOTS	9 545 (2)	20 397 (4)	23 758 (3)	30 285 (4)	30 285 (4)	48[1]
TOTAL	544 091	529 729	694 194	853 206	763 173	40
TOTAL estimated to be attributable to HIV (%)	51 689 (9.5)	156 270 (29.5)	354 039 (51.0)	485 474 (56.9)	440 350 (57.7)	752
Percentage of total hospital costs accounted for by HIV-attributable tuberculosis (percentage of total hospital costs accounted for by all tuberculosis cases i.e. both HIV+ and HIV-)	1.1 (11.8)	3.0 (10.1)	6.8 (13.5)	8.4 (14.8)	8.5 (14.7)	467

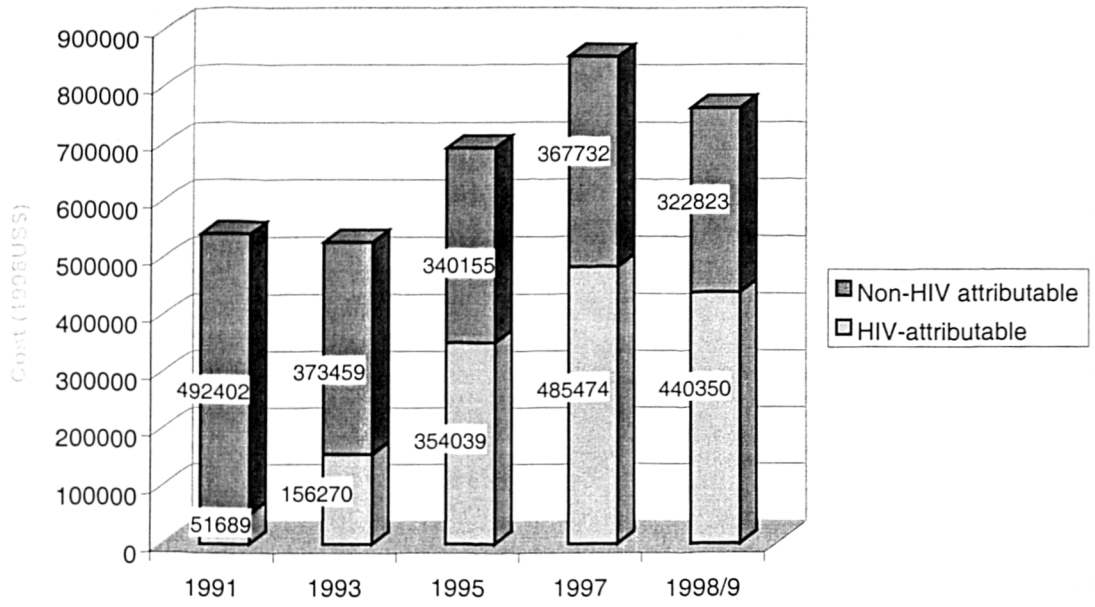
Number of patients: 1991 = 303; 1993 = 599; 1995 = 832; 1997 = 1 157; 1998/9 = 1 442 (+376% 1991-1998/9)

[1] increase is for 1993-1998/9, since fieldworker supervision only began in June 1991 and therefore comparisons with 1991 are misleading

and 25% (from 11.8% to 14.7%) as a proportion of total hospital costs during the years 1991-1998/9 (Table 6.7). The cost breakdown was largely unchanged: medical and nursing staff, and general hospital overheads, were consistently the most important costs; other costs were relatively minor.

There was a substantial 752% increase in the total costs associated with HIV-attributable tuberculosis during the years 1991-1998/9 (Figure 2 and Table 6.7). By 1998/9 this accounted for 8.5% of total hospital costs, compared to 1.1% in 1991, and 58% of total tuberculosis care costs.

Figure 2: Increasing cost of HIV-attributable tuberculosis in Hlabisa Hospital 1991-1998/9



The costs of care for tuberculosis patients increased between 1991 and 1995 on the female medical ward, from 12.6% to 24.4% of total ward costs (Table 6.8). HIV-attributable tuberculosis peaked at 12.4% of ward costs in 1995, up from a level of 1.2% in 1991. On the male medical ward, costs were consistently higher and peaked at 38.5% of total ward costs in 1997 – a figure that reflected both a higher average length of stay (see also Figure 6 and section 6.3.3) and more cases, compared to both previous years and the female ward. In 1997, HIV-attributable tuberculosis accounted for an estimated 21.9% of ward costs (Table 6.8; Figures 3 and 4).

Tuberculosis care costs, both total and HIV-attributable, fell on the female and male medical wards after 1995 and 1997 respectively. The fall was largest (51% and 50% for all tuberculosis and HIV-attributable tuberculosis respectively) on the male medical ward, compared to decreases of 31% and 22% for the female ward. In 1998/9, HIV-attributable tuberculosis

Figure 3: Estimated cost impact of HIV-attributable tuberculosis and non-tuberculosis AIDS on the adult female medical ward in Hlabisa Hospital, 1991-1998/9

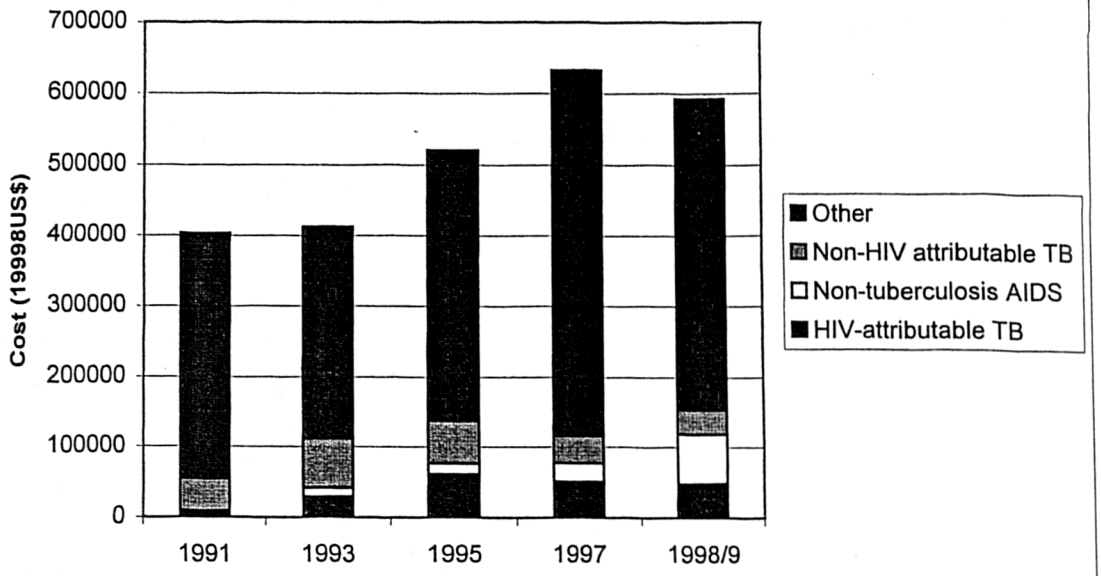


Figure 4: Estimated cost impact of HIV-attributable tuberculosis and non-tuberculosis AIDS on the adult male medical ward in Hlabisa Hospital, 1991-1998/9

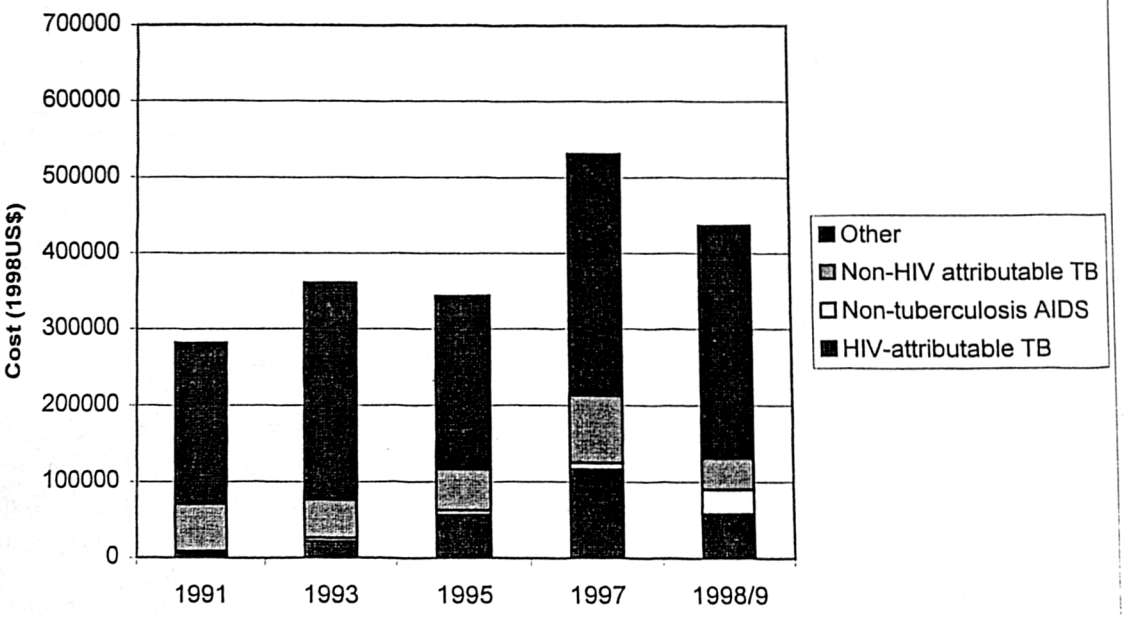


Table 6.8: Costs of care for tuberculosis patients on the adult medical wards in Hlabisa Hospital 1991-1998/9, 1998US$ (% total)

Cost Item	1991		1993		1995		1997		1998/9	
	Female Medical	Male Medical	Female Medical	Male Medical	Female Medical	Male Medical	Female Medical	Male Medical	Female Medical	Male Medical
Medical and nursing staff	23 577 (47)	27 761 (40)	50 663 (51)	32 314 (45)	63 993 (53)	50 832 (46)	36 678 (41)	68 395 (33)	27 774 (33)	33 490 (34)
Overhead costs (e.g. administration, laundry, kitchen)	24 136 (48)	36 753 (53)	43 382 (44)	34 956 (49)	50 474 (42)	51 758 (47)	45 670 (51)	126 106 (62)	46 838 (56)	56 350 (56)
Laboratory tests and x-rays[1]	765 (2)	1 925 (3)	1 621 (2)	2 376 (3)	2 692 (2)	4 421 (4)	3 812 (4)	6 005 (3)	6 115 (7)	7 383 (7)
Buildings and equipment	1 866 (4)	2 361 (3)	3 666 (4)	1 963 (3)	3 710 (3)	3 130 (3)	2 128 (3)	3 957 (2)	2 143 (3)	2 231 (3)
TOTAL, tuberculosis patients	50 344	68 800	99 332	71 609	120 869	110 141	88 648	204 463	82 870	99 454
TOTAL, HIV-attributable tuberculosis	4 783	6 536	29 303	21 125	61 643	56 172	50 441	116 339	47 816	57 384
TOTAL, medical ward as a whole	401 116	279 073	407 326	354 689	494 882	343 417	632 360	530 838	592 644	437 108
Percentage of ward costs accounted for by HIV-attributable tuberculosis (all tuberculosis)	1.2 (12.6)	2.3 (24.7)	7.2 (24.4)	6.0 (20.2)	12.4 (24.4)	16.4 (32.1)	8.0 (14.0)	21.9 (38.5)	8.1 (14.0)	13.1 (22.8)
Number of TB patients	86	217	247	352	316	516	455	702	660	782

[1] drugs excluded because the cost of the drug regimen extends beyond medical ward stay

Table 6.9: Costs of care for non-tuberculosis AIDS patients on the adult medical wards in Hlabisa Hospital 1991-1998, 1998US$ (% total)

Cost Item	1991		1993		1995		1997		1998	
	Female Medical (n=2)	Male Medical (n=3)	Female Medical (n=22)	Male Medical (n=16)	Female Medical (n=28)	Male Medical[2] (n=15)	Female Medical[3] (n=27)	Male Medical[3] (n=16)	Female Medical[4] (n=37)	Male Medical[4] (n=24)
Medical and nursing staff	1 804 (45)	788 (40)	5 903 (51)	1 980 (42)	7 727 (51)	1 790 (43)	3 580 (39)	918 (31)	2 925 (33)	1 377 (31)
Overhead costs (e.g. administration, laundry, kitchen)	1 934 (48)	1 043 (53)	5 170 (41)	2 205 (47)	6 156 (41)	1 947 (46)	4 817 (52)	1 746 (58)	4 907 (56)	2 323 (53)
Laboratory tests, drugs and x-rays	158 (4)	72 (4)	405 (3)	387 (8)	789 (5)	362 (9)	594 (6)	280 (9)	759 (9)	604 (14)
Buildings and equipment	150 (4)	67 (3)	437 (4)	124 (3)	451 (3)	111 (3)	211 (2)	54 (2)	226 (3)	92 (2)
TOTAL, non-TB AIDS patients	4 046	1 970	11 915	4 696	15 123	4 210	9 202	2 998	8 817	4 396
Average Cost	2 023	657	542	294	540	281	341	187	238	183
Average length of stay	69	26	15.6	9.9	15.9	9.7	10.4	6.7	8.6	6.4
TOTAL, medical ward as a whole[1]	403 293	281 180	412 409	360 307	520 994	238 688	220 036	182 838	74 397	60 627
% of ward costs accounted for by non-TB AIDS patients	1.0	0.7	2.9	1.3	2.6	1.8	4.2	1.6	11.9	7.3

[1] total different to that in Table 6.8 because drug costs included

[2] costs are for first 8 months of 1995 only

[3] costs are for the first 4 months of 1997 only

[4] costs are for March 4th to May 6th only and based on data from 625 consecutive admissions, all of whom were tested for HIV

accounted for 8.1% and 13.1% of total female and male ward costs, respectively.

6.3.2 Total costs of non-tuberculosis AIDS cases

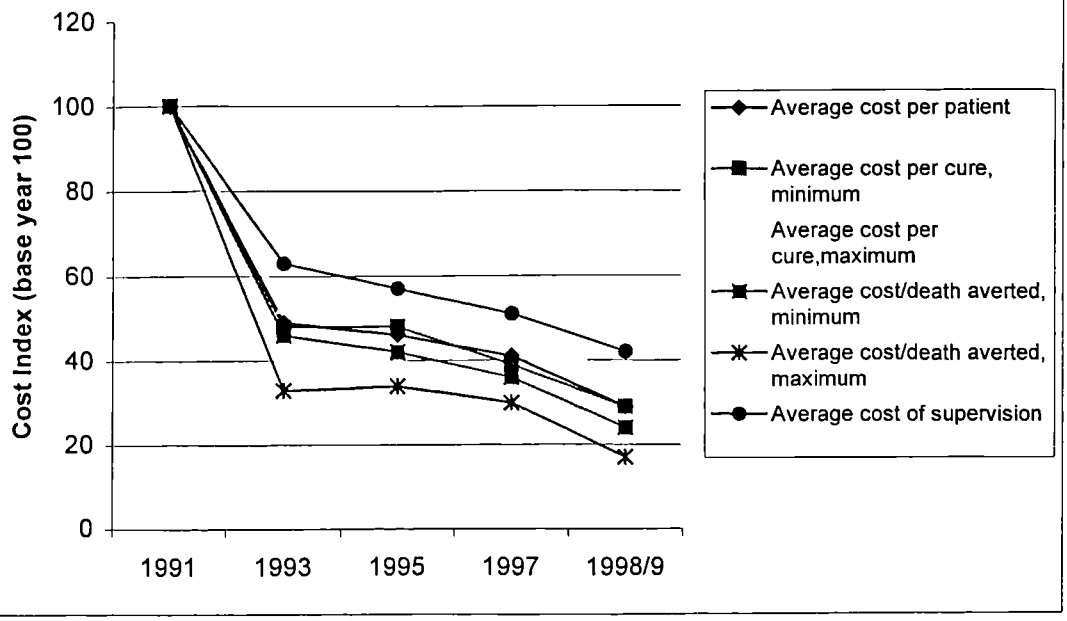
Five non-tuberculosis AIDS cases were identified to have been admitted to the adult medical wards in 1991, equivalent to 0.3% of total medical admissions. This number rose year-on-year and over the two-month period studied in 1998, 37 female and 24 male patients with non-tuberculosis AIDS were admitted to these wards. These figures were equivalent to 10.9% and 8.5% respectively of total admissions to these wards.

The cost of providing care for these patients grew steadily over time, and both total and average costs were consistently higher on the female medical ward (Table 6.9). In 1991, costs for non-TB AIDS patients accounted for only 1% and 0.7% of total costs on the adult female and male medical wards respectively. By 1998, total costs were higher than those estimated for HIV-attributable tuberculosis on the female medical ward (11.9% of total female medical ward costs for non-TB AIDS vs. 8.1% for HIV-attributable tuberculosis). Costs increased less on the male medical ward and remained lower than the costs associated with HIV-attributable tuberculosis (7.3% of total adult male medical ward costs for non-TB AIDS patients, compared to a figure of 13.1% for HIV-attributable tuberculosis).

6.3.3 Trends in average cost per patient, length of stay and the cost-effectiveness of tuberculosis care

The average cost of care for tuberculosis patients fell persistently 1991-1998/9, and by 1998/9 was 29% of the 1991 level (Table 6.10, Figure 5).

Figure 5: Trends in the average cost and cost-effectiveness of tuberculosis care in Hlabisa 1991-1998/9



The largest reduction – of 51% - was between 1991 and 1993. Between 1993 and 1997 there was relative stability, with average cost falling only 8%. A more substantial decline (12%) occurred between 1997 and 1998/9.

The average cost of organising community-based supervision of treatment after discharge, and actual supervision following discharge, also fell continuously. The largest fall (37%) was between 1991 and 1993, but there was a further 21% decline between 1993 and 1998/9.

Table 6.10: Trends in costs (1998US$), average length of stay (days) and efficiency of tuberculosis care 1991-1998/9 [95% CI used in sensitivity analyses]

Indicator	1991	1993	1995	1997	1998/9	% decrease 1991-1998/9
Hospital ALOS*	80.8 [72.6, 89.0]	30.6 [28.4, 32.8]	30.2 [27.8, 32.6]	23.4 [20.3, 26.6]	17.7 [15.6, 19.9]	78
TB ward ALOS	66.0 [58.7, 73.2]	21.8 [19.8, 23.8]	21.0 [18.0, 23.2]	14.4 [10.6, 18.2]	13.3 [10.4, 16.2]	80
Male Medical Ward ALOS	12.7 [10.3, 15.0]	7.2 [5.9, 8.4]	7.5 [6.5, 8.5]	11.1 [8.3, 13.8]	4.8 [3.8, 5.7]	63
Female Medical Ward ALOS	19.4 [15.5, 23.2]	11.7 [10.2, 13.1]	11.5 [9.3, 13.7]	5.9 [4.4, 7.5]	4.6 [3.7, 5.5]	76
Average Cost of Supervision	65	41	37	33	27	68
Average Cost/Patient	1 796	884	834	737	529	71
Average cost/patient cured	2 332 to 2 897	1 113 to 1 524	1 112 to 1 604	921 to 1 474	687 to 998	66-71
Cost/death averted	3 044 to 5 267	1 403 to 1 733	1 264 to 1 774	1 110 to 1 568	735 to 912	76-83

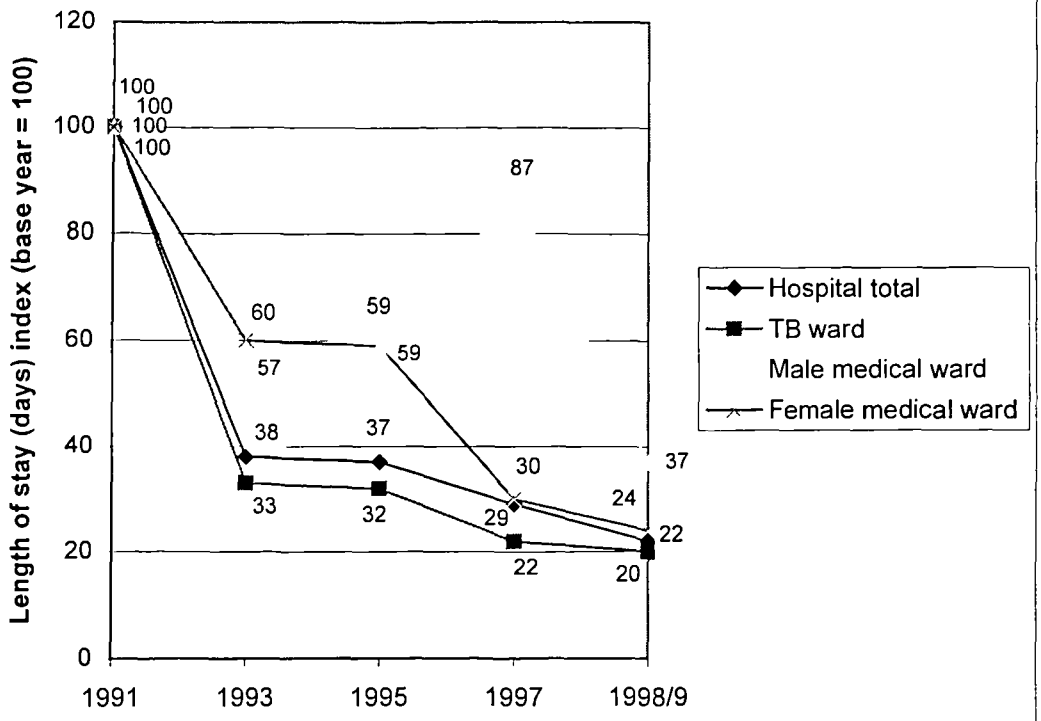
*ALOS = Average length of stay in days

The trend in the cost per patient cured and death averted (Figure 5 and Table 6.10), the best measures available of the efficiency of the programme, was generally downwards, though using the lower estimates of cures and deaths averted, cost-effectiveness worsened between 1993 and 1995. By 1998/9, and depending on the measure of effectiveness used, cost-effectiveness improved by between 66% and 83% compared to its level in 1991.

There was variation in the costs of staff allocated to the wards to which tuberculosis patients were admitted and changes in total hospital overhead costs (Table 6.7). However, most of the changes in the average cost of care, and total costs on the medical wards, reflected trends in average

length of stay – for example the peak in costs on the male medical ward in 1997 mirrored the peak in length of stay (Figure 6; Table 6.10 row 4).

Figure 6: Trends in length of stay for tuberculosis patients in Hlabisa hospital 1991-1998/9



Despite a 376% increase in caseload, the total number of patient days for tuberculosis patients increased by only 5% 1991-1998/9 (calculated from average length of hospital stay data in Table 6.10 and numbers of patients in each year), reflecting a 78% fall in the average length of stay in hospital[24]. The length of stay declined by 76% and 63% on the female and male medical wards respectively. The one exception to the downward trend was the large increase in length of stay on the male medical ward in 1997, which was mirrored by the total cost of care for tuberculosis patients on this ward[25] (Figure 4).

Length of stay data - central to the costing analysis (see section 6.2.6) - appeared reliable. There was 96% agreement between the main sources of admission and discharge date data (the general and tuberculosis registers) and the sources used to cross-check entries (the tuberculosis and medical ward registers).

[24] It is important to note that bed occupancy figures for the TB ward 1991-8, shown in Figure 7, imply a higher increase of 9.4%. The difference reflects 3 factors. First, the patient day figures that indicate an increase of 5% are based on a sample of patients only. Second, the time periods covered are slightly different. Since length of stay has fallen over time, particularly in 1999, this explains why lower figures were found for April 1st 1998-March 31st 1999, compared to the calender year for 1998. Third, the midnight bed state statistics used for Figure 7 are for the TB ward only, whereas the increase of 5% is based on total beddays (on both the medical and TB wards)

[25] The likely explanation for this is specifically addressed in the Discussion

6.3.4 Trends in costs and outcomes for patients with non-TB AIDS

The average cost of care for non-tuberculosis AIDS patients fell persistently between 1991 and 1998/9 (Table 6.9). However, it was difficult to evaluate the cost-effectiveness of care: unlike tuberculosis, there are no standard treatment outcome measures. There were no clear trends over time in outcomes (Tables 6.11 and 6.12), though it appeared that patients with non-tuberculosis AIDS were more likely than other patients to die during their admission. Their death rate was at least twice that of other types of patient in each year studied.

Table 6.11: Admission outcomes for female patients with non-tuberculosis AIDS 1991-1998 compared with those for all other patients (% total of each type of patient)

Year	Improved		In status quo		Died		Transferred		Other[1]	
	AIDS	Other	AIDS	Other	AIDS	Other	AIDS	Other	AIDS	Other
1991	0 (0)	27 (87)	0 (0)	0 (0)	2 (100)	2 (6.5)	0 (0)	0 (0)	0 (0)	2 (7)
1993	9 (41)	25 (83)	3 (14)	0 (0)	9 (41)	4 (13)	0 (0)	0 (0)	1 (4)	1 (3)
1995	12 (43)	24 (80)	0 (0)	0 (0)	15 (54)	3 (10)	0 (0)	0 (0)	1 (3)	3 (10)
1997	16 (62)	24 (80)	0 (0)	0 (0)	10 (38)	5 (17)	0 (0)	0 (0)	0 (0)	1 (3)
1998	24 (65)	176 (58)	0 (0)	0 (0)	9 (24)	25 (8)	3 (8)	97 (32)	1 (3)	5 (2)
Total, all years	61 (53)	376 (72)	3 (3)	0 (0)	45 (39)	39 (7)	3 (3)	97 (19)	3 (3)	12 (2)

[1]"other" included absconded; no data available
Percentages do not always add to 100 due to rounding errors

Table 6.12: Admission outcomes for male patients with non-tuberculosis AIDS 1991-1998 compared with those for all other patients (% total of each type of patient)

Year	Improved		In status quo		Died		Transferred		Other	
	AIDS	Other	AIDS	Other	AIDS	Other	AIDS	Other	AIDS	Other
1991	0 (0)	25 (78)	0 (0)	0 (0)	1 (33)	4 (13)	0 (0)	0 (0)	2 (67)	3 (9)
1993	11 (69)	29 (91)	3 (19)	0 (0)	2 (13)	2 (6)	0 (0)	0 (0)	0 (0)	1 (3)
1995	11 (69)	28 (90)	0 (0)	0 (0)	3 (20)	3 (10)	0 (0)	0 (0)	1 (7)	0 (0)
1997	5 (36)	25 (81)	0 (0)	0 (0)	8 (57)	6 (19)	0 (0)	0 (0)	1 (7)	0 (0)
1998	10 (42)	128 (49)	0 (0)	0 (0)	11 (46)	25 (10)	2 (8)	98 (38)	1 (4)	9 (3)
Total, all years	37 (51)	238 (61)	3 (4)	0 (0)	25 (35)	41 (11)	2 (3)	98 (25)	5 (7)	13 (3)

6.3.5 Bed occupancy on the tuberculosis and adult medical wards

Bed occupancy on the tuberculosis ward was relatively stable over the period 1988-1998/9, though it has tended to increase gradually (Figure 7). Bed occupancy on the adult medical wards fluctuated more. It was relatively erratic on the male medical ward, peaked in 1997 but remained at high levels in 1998. On the female medical ward, rates fell between 1989 and 1993 but climbed steadily thereafter – to almost 200% in 1998.

Figure 7: Trends in bed occupancy rates on the adult TB and medical wards in Hlabisa Hospital 1989-98

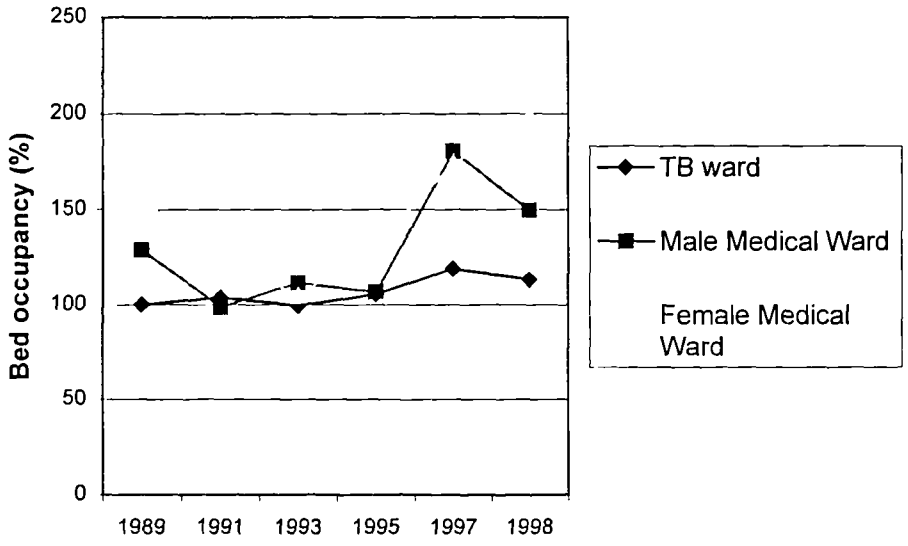


Table 6.13: Estimated average number of HIV-related tuberculosis and non-tuberculosis AIDS patients per day on adult male medical ward 1991-1998/9

Type of admission	1991	1993	1995	1997	1998/9	% change 1991-1998/9
HIV-attributable tuberculosis	0.7	2.1	5.4	12.1	5.9	743
Non-tuberculosis AIDS	0.2	0.4	0.6	0.9	2.4	1 100
All admissions (number of approved beds = 30)	30	33	32	54	45	50

Figure 8: Contribution of HIV-attributable tuberculosis and non-tuberculosis AIDS to bed occupancy on the adult male medical ward, 1991-1998/9

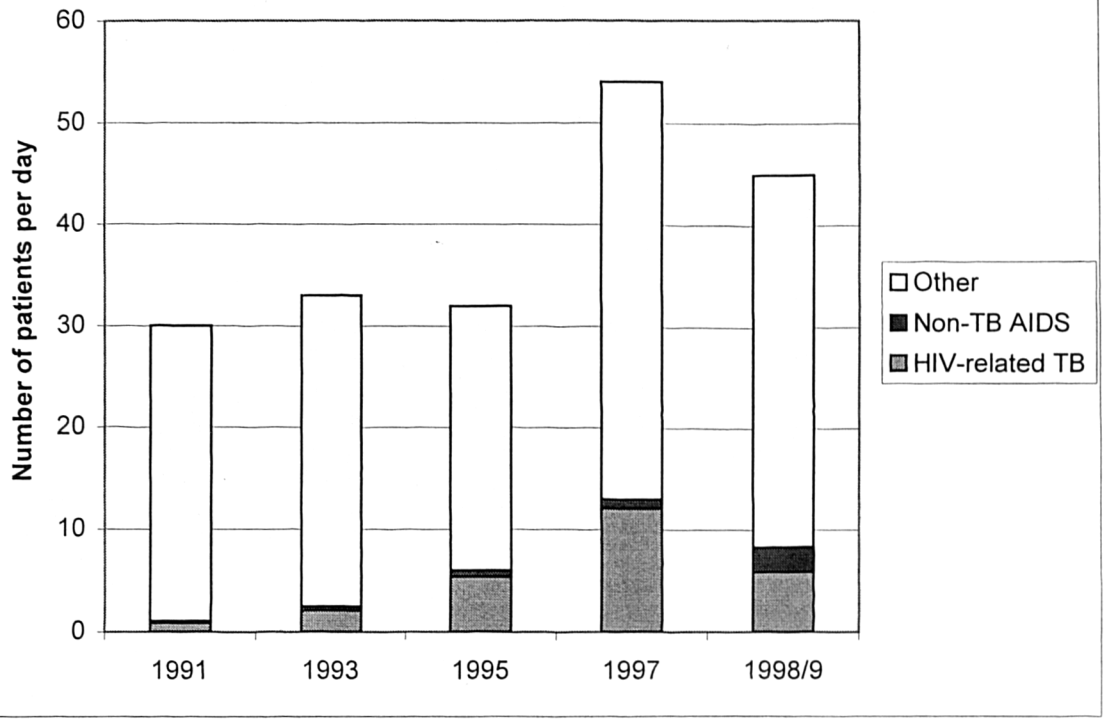
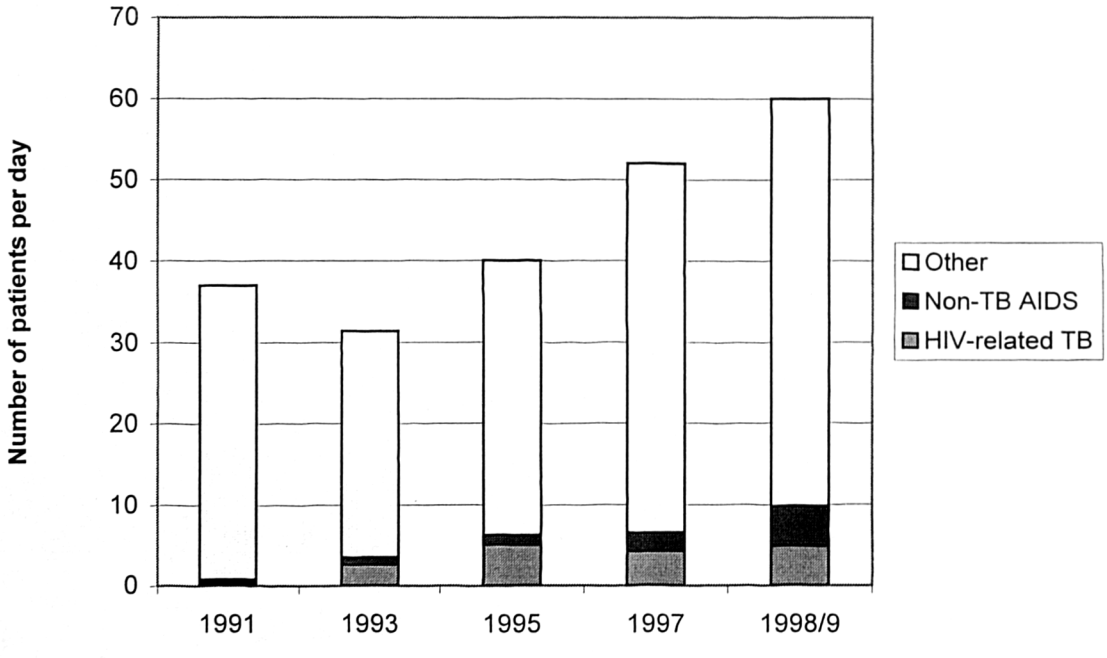


Figure 9: Contribution of tuberculosis and non-tuberculosis clinical AIDS to bed occupancy on the adult female medical ward 1991-1998/9



HIV-related tuberculosis and non-tuberculosis AIDS made a contribution to the rise in bed occupancy rates, but did not explain all of the increase (Table 6.13 and 6.14 and Figures 8 and 9). The rise in the estimated numbers of these patients per day accounted for 48% of the increase in bed occupancy on the male medical ward between 1991 and 1998, and for 39% of the increase on the female medical ward.

Table 6.14: Estimated average number of HIV-related tuberculosis and non-tuberculosis AIDS patients per day on adult female medical ward 1991-1998/9

Type of admission	1991	1993	1995	1997	1998/9	% change 1991-1998/9
HIV-related tuberculosis	0.4	2.3	5	4.2	4.8	1 100
Non-tuberculosis AIDS	0.4	0.9	1.2	2.3	5.0	1 150
All admissions (number of approved beds = 30)	37	31	40	52	60	62

6.3.6 Trends in average length of stay on the adult medical wards

There was no obvious trend in average length of stay on the adult medical wards (Figure 10).

Figure 10: Average length of stay on the adult medical wards in Hlabisa Hospital 1991-1998

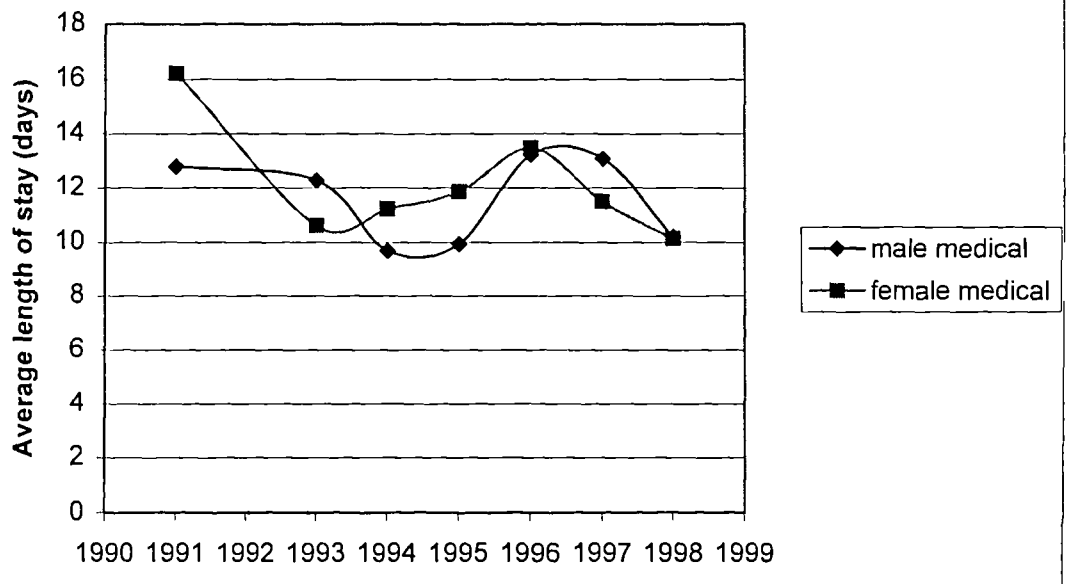


Figure 11: Relationship between number of admissions to female medical ward and bed occupancy rate in Hlabisa Hospital 1991-8

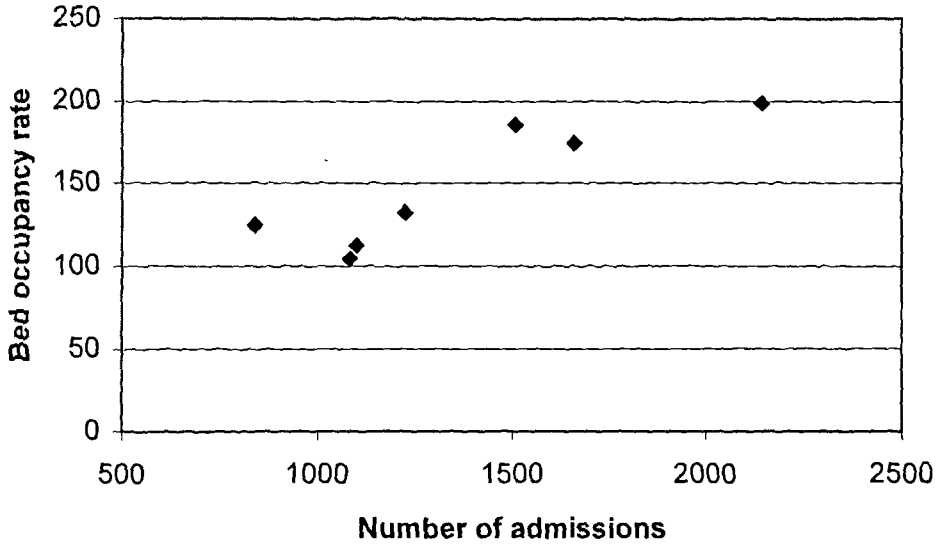


Figure 12: Relationship between number of female medical ward admissions and average length of stay in Hlabisa Hospital 1991-8

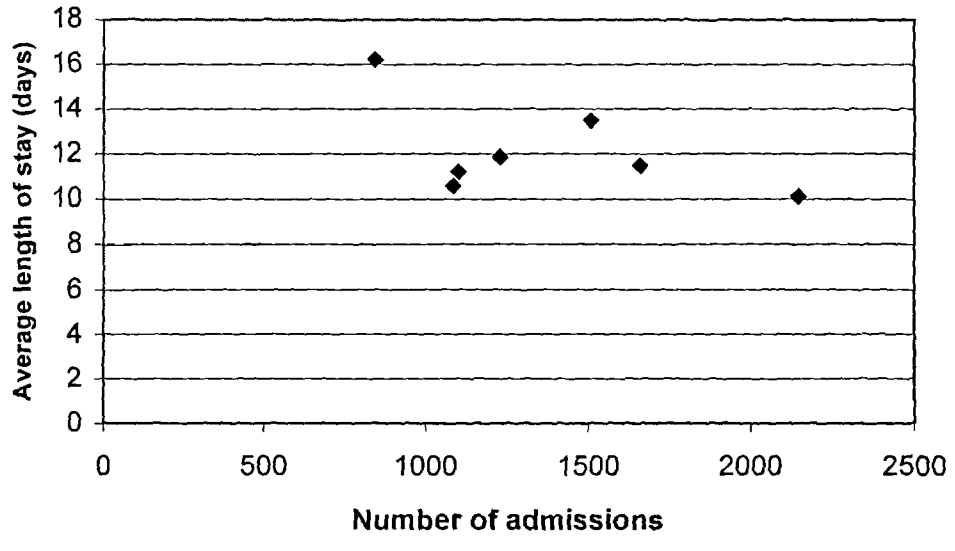


Figure 13: Relationship between the number of admissions to the male medical ward and bed occupancy in Hlabisa Hospital 1991-8

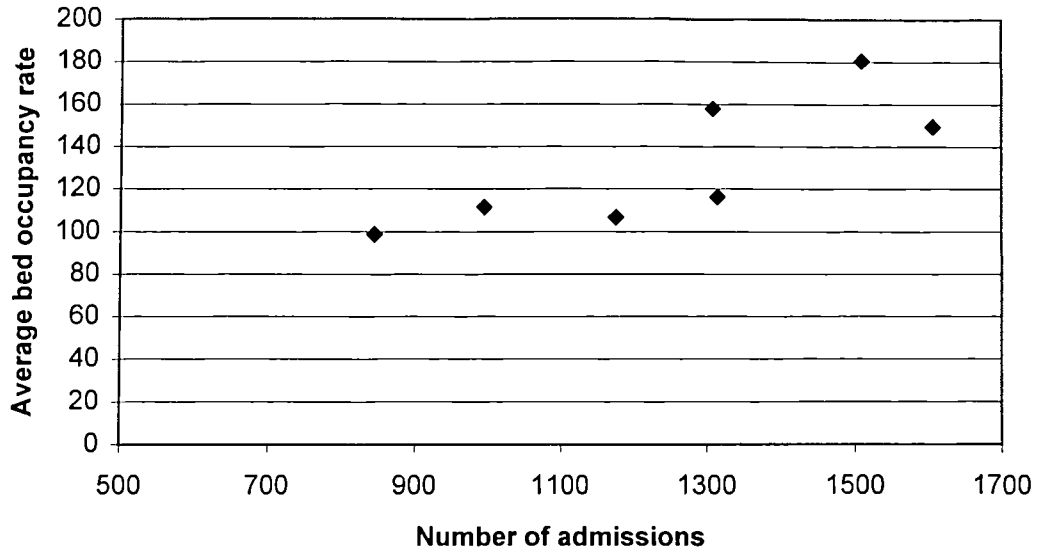
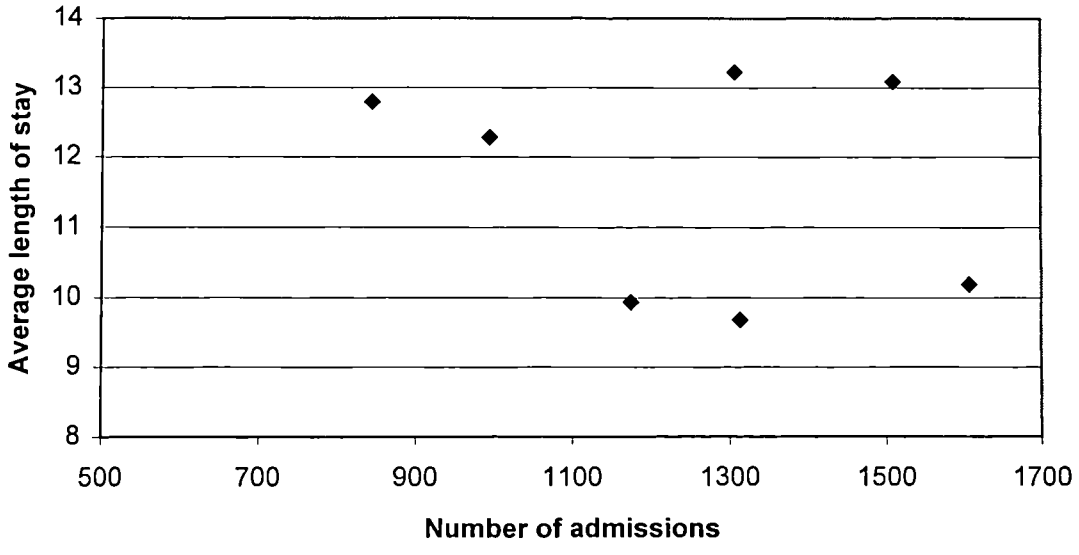


Figure 14: Relationship between number of male medical admissions and average length of stay in Hlabisa Hospital 1991-8



6.3.7 Evidence concerning the extent to which the response to the increase in admissions on the adult medical wards has been reduced average length of stay or increased bed occupancy

As suggested by the trends in average length of stay and bed occupancy, the strongest response to the increase in admissions documented in Chapter 5 was an increase in bed occupancy rates (Figures 11 to 14). The correlation between admissions and the bed occupancy rate was 0.89 on the female medical ward and 0.80 on the male medical ward; both were statistically significant (p=0.007 and p=0.03 respectively). In contrast, the correlation between admissions and average length of stay was –0.54 on the adult female medical ward and –0.26 on the adult male medical ward, with neither figure statistically significant (p=0.21 and p=0.57 respectively).

6.3.8 Sensitivity analyses, HIV-attributable tuberculosis

Sensitivity analyses (Table 6.16, p185) showed that results were not sensitive to the odds ratio used to estimate the number of tuberculosis cases attributable to HIV. In the year with the widest confidence interval, 1995, the range in the costs accounted for by HIV-attributable tuberculosis was 14.5-17.4% of male medical ward costs and 11.1-13.1% of female medical ward costs. Results were more sensitive to length of stay. In combination, using the 95% confidence intervals for both measures, the range in total costs was between 72% lower and 132% higher than the main estimate (Table 6.15). Even with the lowest estimate, costs were considerably larger than those for non-tuberculosis AIDS (Figure 15).

Table 6.15: Sensitivity analysis range in cost results as a percentage of the main estimate

Year	Male medical ward costs	Female medical ward costs	Total hospital costs
1991	80-123	75-119	88-112
1993	76-123	80-119	84-110
1995	78-120	72-125	82-113
1997	72-129	71-132	82-119
1998/9	73-128	73-132	79-124

The sensitivity analysis results for the range in the proportion of ward or total hospital costs accounted for by HIV-attributable tuberculosis are shown in Figure 16.

Figure 15: Comparison of estimated total costs of HIV-attributable tuberculosis and non-tuberculosis AIDS in Hlabisa Hospital 1991-1998/9

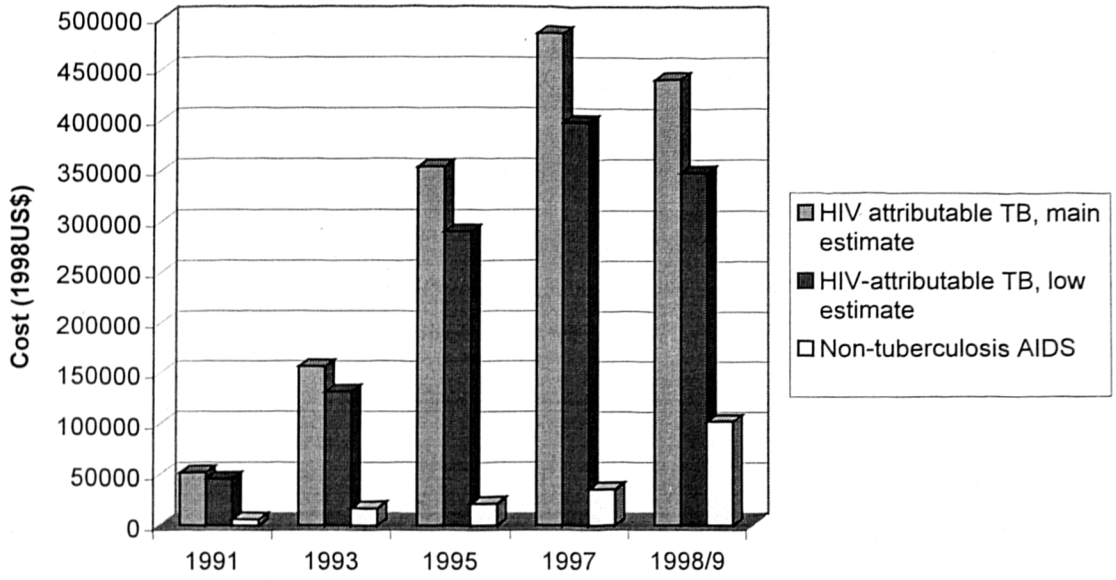


Figure 16: Range in proportion of ward and total hospital costs due to HIV-attributable tuberculosis in sensitivity analyses 1991-1998/9

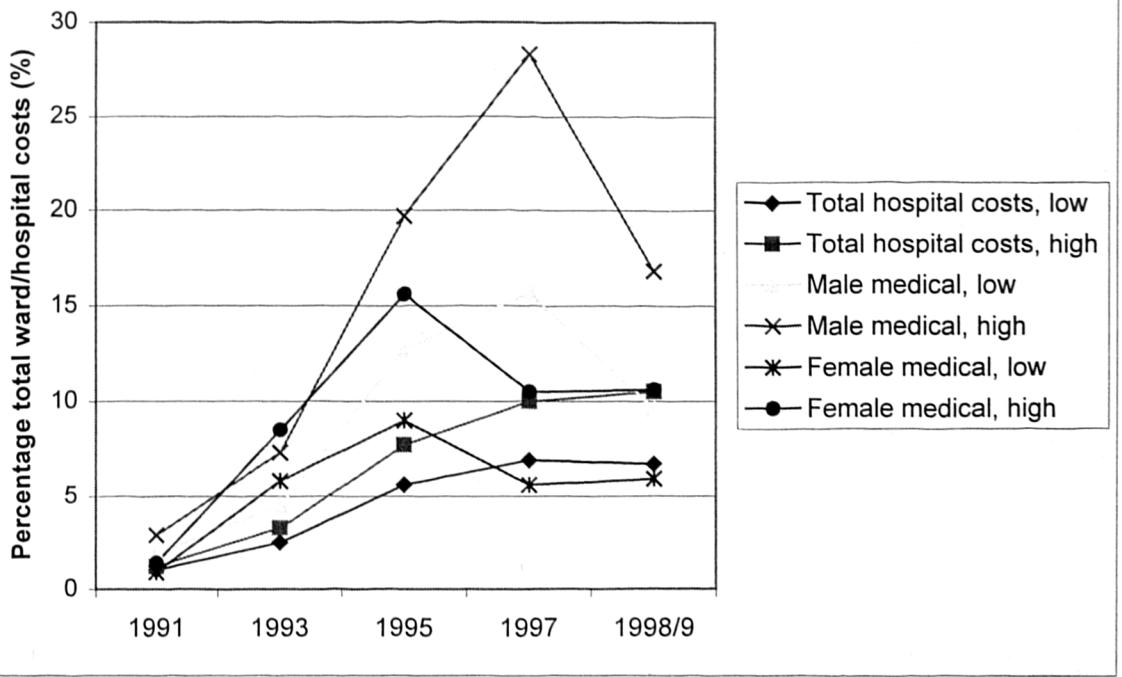


Table 6.16: Sensitivity analyses for costs associated with HIV-attributable tuberculosis (% total ward costs, where relevant)

Type of sensitivity analysis	Cost Item	1991		1993		1995		1997		1998/9	
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate
Range in costs based on 95% confidence intervals for length of stay	Total costs	47 486	55 852	143 706	162 374	327 092	375 005	425 684	549 378	392 871	506 417
	Costs on male medical ward	5 423 (1.9)	7 814 (2.8)	17 530 (4.9)	24 662 (7.0)	49 135 (14.3)	63 560 (18.5)	89 259 (16.8)	143 421 (27.0)	47 098 (10.8)	68 507 (15.7)
	Costs on female medical ward	3 720 (0.9)	5 532 (1.4)	25 694 (6.3)	32 863 (8.1)	49 900 (10.1)	72 338 (14.7)	38 053 (6.0)	63 334 (10.0)	39 329 (6.6)	58 671 (9.9)
Range in costs based on 95% confidence intervals for odds ratios	Total costs	49 590	53 348	142 783	165 186	313 964	375 843	454 053	508 992	390 912	473 319
	Costs on male medical ward	6 270 (2.2)	6 746 (2.4)	19 302 (5.4)	22 330 (6.3)	49 842 (14.5)	59 665 (17.4)	108 810 (20.5)	121 975 (23.0)	50 942 (11.7)	61 681 (14.1)
	Costs on female medical ward	4 589 (1.1)	4 936 (1.2)	26 774 (6.6)	30 974 (7.6)	54 400 (11.1)	65 122 (13.2)	47 176 (7.5)	52 884 (8.4)	42 448 (7.2)	51 396 (8.7)
Range in costs based on 95% confidence intervals for both length of stay and odds ratios combined	Total costs	45 558	57 647	131 304	171 639	290 232	398 326	398 133	575 992	348 763	544 331
	Costs on male medical ward	5 203 (1.9)	8 065 (2.9)	16 017 (4.5)	26 069 (7.3)	43 598 (12.7)	67 513 (19.7)	83 482 (15.7)	150 369 (28.3)	41 810 (9.6)	73 636 (16.8)
	Costs on female medical ward	3 569 (0.9)	5 710 (1.4)	23 476 (5.8)	34 738 (8.5)	44 277 (9.0)	76 837 (15.6)	35 590 (5.6)	66 402 (10.5)	34 913 (5.9)	63 064 (10.6)

6.4 Discussion

6.4.1 Summary of main findings

This study shows that, during the period 1991-1998/9, the HIV/AIDS epidemic has had important – but not always predictable – economic consequences for hospital services in Hlabisa. As might have been expected, HIV-related disease has been accounting for an increasing share of medical ward and tuberculosis service costs, which by 1998/9 were large in the context of hospital services as a whole. There have also been large increases in bed occupancy on the adult medical wards – with rising bed occupancy a much stronger response to rising admissions than the other major possible response of reducing average length of stay. However, impacts have not been of the scale predicted in some modelling exercises and rapid appraisals. In the case of tuberculosis care, upward pressure on costs has been mitigated by a decline in the average length of hospital stay and average cost per patient, reductions that have led – perhaps surprisingly - to an improvement in the cost-effectiveness of care. Bed occupancy on the tuberculosis ward has risen, but increases have been small in relation to the rise in patient numbers.

6.4.1.1 HIV-attributable tuberculosis single most important economic impact

HIV-attributable tuberculosis stands out as the single most important impact on costs. In all years, total costs were estimated to be more than three times higher than those for all patients with an AIDS-defining condition other than tuberculosis combined. Since 1995, HIV-attributable tuberculosis has accounted for more than 50% of total tuberculosis care costs, and by 1998/9 for close to 10% of total hospital costs. It has also consistently been associated with higher costs than non-tuberculosis AIDS on the male medical ward.

6.4.1.2 Costs and bed occupancy rates have not risen in line with increased tuberculosis caseload, and cost-effectiveness has improved

Nonetheless, the costs associated with tuberculosis as a whole have not risen in line with the substantial increase in the number of patients documented in Chapter 5. A close to 400% increase in admissions since 1991 has been associated with only a 40% increase in costs, due to big reductions in the average cost per patient. Similarly large reductions in average length of hospital stay have meant that total patient days for tuberculosis patients – an alternative to numbers of admissions as a measure of demand for hospital care – have risen by less than 10%.

The cost-effectiveness of tuberculosis care has substantially improved, and there have been no major adverse impacts on bed occupancy rates on the adult tuberculosis ward. Bed occupancy has been remarkably stable in the context of the four-fold change in caseload.

6.4.1.3 Cost of AIDS-defining conditions other than TB relatively low to date but important in context of adult medical services

The total cost of caring for patients with non-tuberculosis AIDS has been comparatively low and remains small in relation to the hospital as a whole. However, these costs are important in the context of adult medical services, particularly the female medical ward where costs exceeded those of HIV-attributable tuberculosis in 1998/9. On both wards, they have also contributed to rising bed occupancy rates. These were considerably in excess of 100% on both wards and reached unprecedented levels on the female medical ward in 1998/9.

6.4.2 Interpretation and explanation of results

6.4.2.1 Impacts could have been worse

The impact of HIV-attributable tuberculosis could have been far worse. If the cost per patient had remained at 1991 levels, total costs would have reached 50% of total hospital costs - a level similar to that predicted for HIV-related disease in several models and rapid appraisals (Chapter 3). Bed occupancy rates would have climbed to extremely high levels on the tuberculosis ward at least, and access to care by other patients could have been seriously compromised.

6.4.2.2 The role of supply-side responses

In practice, supply-side innovations and deliberate responses to increased number of patients have avoided this. They have led to a substantial decline in the average length of hospital stay and the closely related average cost of care.

Introduction of a community-based DOTS programme

The largest fall in average length of stay and cost, between 1991 and 1993, was unrelated to the HIV epidemic and did not result from a deliberate effort to reduce costs. It can be explained by the introduction of a community-based directly observed therapy (DOT) programme in mid-1991, which made case management far less hospital dependent. Cost-savings were a secondary (though welcome and important) effect.

Cuts in length of stay in response to pressure on services

The continual reductions since 1993 appear to have resulted from increased and HIV-related pressure on services. To cope with this, patients have been discharged progressively earlier – from both the medical and tuberculosis wards.

The clearest illustration of this is the deliberate change in case management in 1998, which was introduced to cope with the pressure being placed on adult medical services. In the 12 months period since patients have been

discharged as soon as they are considered fit for discharge rather than being kept in hospital for a minimum of 10 days after diagnosis, length of stay fell 8% overall. The biggest impact of this change in strategy appears to have been on the male medical ward. Earlier discharge from the tuberculosis ward appears to have freed up capacity and facilitated earlier transfers from this ward. It has had less impact on the female medical ward, where length of stay was already low in 1997. The difference between the two adult medical wards in this year probably reflects logistical factors. The female medical and tuberculosis wards are part of the same building, while the male tuberculosis ward is in a distinct physical location. In the absence of the special effort to reduce length of stay instigated in 1998, this may have made transfer of patients following diagnosis less efficient.

The change in management also appears to have had a bigger impact the longer it has been in place. In the first three months of 1999, the overall length of stay was 12 days – 5 days less than the average for the period April 1st 1998-March 31st 1999 as a whole (data not shown).

6.4.2.3 The role of increased unit costs and use of admission trends in measuring the impact of HIV/AIDS on health services

The smaller increase in tuberculosis patient days compared with costs reflects an increase in some unit costs (e.g. kitchen; administration) and the fact that some costs are directly related to the number of patients (e.g. drugs; laboratory tests). The small increase compared with admissions shows that admission trends alone may be an inadequate measure of the HIV epidemic's economic impact on health services. However, it does demonstrate the major impact of HIV/AIDS on services: it has meant that a much lower cost approach to tuberculosis care has not resulted in a reduction in the total costs associated with tuberculosis patients.

6.4.2.4 Relationship between effectiveness and costs

Most of the reductions in tuberculosis care costs and length of stay do not appear to have been at the expense of effectiveness, as measured by commonly-used tuberculosis treatment outcome measures. Though in the worst-case scenario (minimum estimated cures and deaths averted per patient treated), effectiveness worsened by between 8% and 15% 1991-7, the effectiveness of treatment has stabilised since 1995, and cost-effectiveness (though not effectiveness) was at its best level of the 8-year period in 1998/9. This is an important achievement, as is the limited change in bed occupancy rates since the emergence of the HIV epidemic.

6.4.2.5 How results compare with modelling exercises

Even so, HIV-related tuberculosis has outweighed – by a considerable margin – the costs associated with patients who meet the WHO expanded surveillance definition of an AIDS case (excluding tuberculosis). This is in contrast to the predictions of an early modelling exercise for South Africa

(Broomberg et al, 1991 and 1996), which suggested that AIDS and not HIV-related tuberculosis would have the most important economic impact on health services. The absolute level of impacts is also smaller – sometimes by a large margin - than the level indicated in rapid appraisals and modelling exercises. For example, one modelling exercise for South Africa in 1991 suggested that HIV/AIDS might account for 64-75% of health sector costs by 2005: Hlabisa data suggest such levels are very unlikely to materialise in practice. Appraisals for other sub-Saharan African countries at a time when their levels of HIV seroprevalence among antenatal women were similar or lower than those in Hlabisa (the early 1990s) suggested that HIV/AIDS might be accounting for 21-50% of health services costs (see Chapter 3). These levels also appear over-estimates, at least in some areas, in the context of Hlabisa data.

6.4.2.6 What else besides TB and AIDS could explain rising bed occupancy?

The combination of non-tuberculosis AIDS cases and HIV-attributable tuberculosis accounted for approximately one fifth of medical ward costs in 1998/9. They have contributed to overcrowded conditions, creating an increasingly difficult environment for provision of patient care. They do not, however, explain all of the increase in bed occupancy rates. The possibility that some of the unexplained increase is due to other types of HIV-related disease – particularly early HIV-related morbidity that could not be identified from retrospective data – is specifically addressed in Chapter 7.

6.4.2.7 Gender differences

The data show that the impact of HIV can differ according to gender. There were a higher number of AIDS cases (excluding tuberculosis) on the female medical ward compared with the male ward, and they accounted for a larger percentage of ward costs – to the extent that they overtook HIV-attributable tuberculosis in cost terms in 1998/9. AIDS patients made a smaller cost impact on the male medical ward, where HIV-attributable tuberculosis remained dominant. This greater importance of non-TB AIDS on the female medical ward could partly reflect the fact that there are more HIV+ women than men in Hlabisa District. The 1996 census data show that, among those aged over 15, women outnumber men by an average ratio of 1.42:1; this reaches 1.67 in the age group 31-35 (Bronwyn Curtis, South African Medical Research Council, written communication, September 27th 1999). HIV seroprevalence may also be higher among women than men in the district. However, while demographic differences and a possibly higher HIV seroprevalence may explain why the *absolute* level of non-TB AIDS is higher on the adult female medical ward, they do not explain why non-TB AIDS is of greater *relative* importance. It is conceivable that these differences may reflect different approaches to care at household level. Men who are seriously ill with HIV-related disease may receive more care at home from their wives/partners or mothers. This care may not be so

available for women, especially if they have already lost their husband or partner to HIV/AIDS.

The differences in the absolute and relative importance of tuberculosis between the male and female medical wards are in line with the fact that, in the absence of the HIV epidemic, the number of reported tuberculosis cases has typically been higher among adult men than women in most parts of the world (Holmes et al, 1998). The rapid rate at which the number of female cases is catching up with the number of male cases – from 29% to 46% of adult cases 1991-1998/9 - may therefore indicate a higher HIV prevalence among women in the district. This would be consistent with the higher number of female patients presenting with non-tuberculosis AIDS-defining conditions.

Irrespective of the explanation, clear differences between men and women illustrate the importance of disaggregating an analysis according to gender rather than focusing only on adult services as a whole.

6.4.3 Study limitations

6.4.3.1 Likely under-estimation of non-tuberculosis AIDS cases

The inability to identify HIV-related impacts other than HIV-attributable tuberculosis and non-TB AIDS is one of several study limitations, most of which illustrate the difficulties that are encountered with retrospective data. The study was limited to particular time periods in the case of non-tuberculosis AIDS. In itself, this limitation should not unduly affect the estimates of the share of costs being accounted for by such patients. A more serious limitation is that reliance on patient case note data to identify cases is likely to result in an under-estimate of their true number. HIV test results were not always available, and doctors do not always document the data required to definitively diagnose a case retrospectively. This probably explains why the estimates of numbers of patients and associated costs in 1998, which were based on comprehensive HIV test results and detailed clinical assessment, were approximately four times the level estimated for 1997 (in previous years the increase was never more than a three-fold increase over a 2 year period and was typically less). The actual cost impact of non-tuberculosis AIDS patients prior to 1998 may therefore have been approximately twice the level estimated. However, this would not alter the fact that they would have remained substantially less than those costs associated with HIV-attributable tuberculosis.

6.4.3.2 Data limitations for estimates of HIV-attributable tuberculosis

The estimates of HIV-attributable tuberculosis costs were constrained by the lack of length of stay data, prior to 1997, for a random sample of TB patients among whom HIV status was known. Similarity in total length of stay for the random sample from 1997, and in medical ward length of stay for a random sample in 1998 (see also Chapter 7), suggests that the assumption of identical length of stay for both HIV+ and HIV- patients is

unlikely to be a major source of error. However, the limited data from elsewhere have tended to indicate longer lengths of stay for HIV+ patients. This suggests that this study may have under-estimated the impact of HIV-attributable tuberculosis in the earlier years studied.

6.4.3.3 Quality of retrospective data and robustness of attributable risk calculations

The close correspondence between key data sources suggested that the retrospective data used to calculate lengths of stay for tuberculosis patients on each ward were of high quality. The HIV-attributable cost estimates also seem reasonably robust. The estimates of the attributable fraction were not sensitive to the odds ratio. In addition, the odds ratios estimated are consistent with the rate ratios calculated from cohort studies comparing the incidence of tuberculosis in HIV+ and HIV- individuals in several African countries (Smith and Moss, 1994). If anything, the odds ratios estimated using Hlabisa data may have led to underestimates of the fraction of HIV+ tuberculosis cases thate were attributable to HIV, since they were generally lower than the rate ratios estimated from these cohort studies. Attributing at least 50% of tuberculosis cases to HIV since 1995, as implied by the odds ratios calculated, is also consistent with a modelling estimate that if HIV prevalence reached 13% of adults in a developing country, tuberculosis rates would double (ibid.).

Using antenatal clinic attendees to estimate exposure to HIV infection in the tuberculosis-negative population could also be criticised. There are several biases involved in estimating HIV infection in the general population from an entirely female, sexually active and fertile population (Boisson et al, 1996). Nevertheless, using antenatal clinic attendees to estimate HIV prevalence rates is standard practice in the absence of acceptable alternatives. Moreover, it is noteworthy that HIV prevalence among adult malaria admissions to Hlabisa hospital in March-April 1998 – which may be a useful marker of prevalence in the community in this non-malaria-immune population – was almost identical to the rate suggested by the antenatal survey conducted in July 1998 (28.6% compared to 29.0% - see Chapter 7 for details).

6.4.4 Generalisability of findings

The generalisability of the results depends on the extent to which Hlabisa is representative in terms of its HIV epidemic, health care seeking behaviour, availability and capacity of hospital services, approach to health care provision, and the type of response strategies implemented. The HIV epidemic is similar to that previously experienced in other African countries, mirrors that of KwaZulu-Natal province as a whole (Chapter 3), and appears similar to that emerging in several other South African provinces – notably the Eastern Cape, Free State, and Mpumalanga (Chapter 2). Utilisation of hospital services appears relatively low (Chapter 3), and Hlabisa may therefore under-estimate increases in demand for care in some other areas. The availability and capacity of services is much

poorer than that of some parts of South Africa – notably Gauteng and the Western Cape (Chapter 2), and major metropolitan areas within KwaZulu-Natal. It is much more representative of services in rural areas, particularly those that were formerly homelands.

One specific area in which Hlabisa is unusual is in its approach to provision of tuberculosis care (though similar approaches are now being piloted and in time may be more widely adopted in other parts of Southern and East Africa). Some of its atypical features – use of a twice a week intermittent drug regimen, and no sputum smear examinations during treatment – do not have a major influence on the costs associated with treatment (see also Chapter 8). The main influence on the costs of tuberculosis care in Hlabisa (and probably elsewhere in South Africa given costs for major inputs to care – notably staff - are unlikely to vary widely) is the length of hospitalisation at treatment outset. This means that in rural parts of South Africa where the conventional approach of hospitalising patients for two months at treatment outset is still practised, the impact of tuberculosis, for any given level of HIV seroprevalence, will be higher than that documented for Hlabisa. On the other hand, in urban areas where tuberculosis is more typically managed on an outpatient basis, the Hlabisa experience will seriously over-estimate the impact of tuberculosis. The approach to care of people with other HIV-related health problems seems most likely to be typical – at least of other community hospitals where only basic drugs are available for opportunistic infections and where there is no access to antiretroviral drugs.

6.4.5 Future implications

6.4.5.1 Within Hlabisa

Within Hlabisa, the immediate priority appears to be finding ways to reduce the severe pressure on the general medical wards. One important question is whether the existing diagnostic strategy for tuberculosis could be changed in such a way that medical ward admission could be avoided. Improved efficiency in case management subsequent to diagnosis has proved an important mechanism for coping with the HIV/TB epidemic to date: improvements in the efficiency of the diagnostic process may be necessary to mitigate its impact in the future. Alternative ways of providing care for non-HIV-related illnesses could also be considered.

There is not much scope for reducing the average length of stay of AIDS patients – these are already relatively short and no longer than average. As the number of patients with AIDS is likely to increase, it would seem advisable to explore how care can be provided outside an inpatient care setting. Evidence from Kenya has suggested that the number of patients with chronic AIDS-related illnesses presenting for care at hospitals may actually start to fall at a certain point in the epidemic (Arthur et al, 1998). Explanations that were suggested were that more care was being provided in the community, and that there might be a perception that hospitals have little to offer such patients. However, this experience will not necessarily

be repeated in South Africa; and if it does, it would imply major care needs at community level.

Even with these sorts of changes, extra resources are likely to be required if the district is to cope with the future impact of the HIV epidemic without progressively worsening bed occupancy rates, doctor and nurse to patient ratios, and reduced access to care for HIV- people. Existing evidence suggests that alternatives to hospital care, such as home-based care, may not be lower cost (Foster, 1996; Hanson et al, 1997) – though clinic-based care would be. It is also likely that additional resources need to be found for tuberculosis case management if programme effectiveness is to be maintained or, ideally, restored to 1993 levels. This is especially the case given that it seems unlikely that there will be a decline in demand for tuberculosis-related care. While demand may conceivably fall for chronic AIDS-related illnesses once there is a perception that health services can offer no cure (in the absence of antiretroviral treatment), tuberculosis is much more likely to be perceived as curable.

The figures for the average cost of care per patient calculated in this study could be used to inform resource allocation to tuberculosis services. More specifically, fieldworker supervision of community-based treatment may be a key area that requires additional input. The fall in the cost/patient for this aspect of care may, in part, be due to the realisation of some economies of scale. Nevertheless, interviews with key programme staff suggest that this element of tuberculosis treatment is very over-stretched. This indicates that, in part, the decline in average cost reflects that fact that not enough resources are being devoted to the supervision of patients once they leave hospital. This element of care is relatively inexpensive and involves only limited staff (3 fieldworkers) and the capital and running costs of 1 vehicle. Strengthening it would not require a large increase in resource allocation, but does require more flexibility in use of funds at local level. If full devolvement of budget management to district level is implemented, this will be feasible.

6.4.5.2 South Africa as a whole

For all of South Africa, this study provides clear empirical evidence that the economic impact of HIV/AIDS on health services is large, and that it is very likely to continue to grow despite the likelihood that supply-side responses will emerge. Finding ways to manage substantial increases in tuberculosis caseloads should be the immediate priority for health services. The community-based model of care used in Hlabisa appears to be worthy of serious consideration wherever lengthy hospital admission is still a key component of case management and a severe HIV/TB epidemic is emerging. It can help to delay the worst effects of increased caseloads and buy time for programme managers to develop and implement other coping strategies. However, other HIV-related impacts are also important and need to be considered too, especially as they have probably been under-estimated in this study (a possibility addressed in Chapter 7).

6.4.5.3 Beyond South Africa

Beyond South Africa, caution is needed in generalising results. The type of health services available, health-seeking behaviour, the relative importance of different diseases, and approach to treatment all vary. The result that may be most generalisable to sub-Saharan Africa as a whole is that tuberculosis is, or has been, the single most important economic impact on health services in countries that have experienced a serious HIV/AIDS epidemic. Three things support this. First, the result is very clear-cut for Hlabisa. Second, the increase in caseload recorded in Hlabisa is similar to that reported by several National Tuberculosis Programmes in Africa. Third, several other African countries (e.g. Malawi, Kenya, Uganda, and Tanzania) have a policy of 2 months of admission for tuberculosis patients at the beginning of treatment, including in urban areas. This indicates that for a given level of HIV-related tuberculosis, the impact would be greater than in Hlabisa, where admissions have been shorter than 60 days since 1993.

6.4.6 Conclusions

Overall, the results presented in this chapter suggest that HIV-attributable tuberculosis stands out as the most important economic impact on hospital services in Hlabisa during the early years of the HIV/AIDS epidemic. Though this has been mitigated by supply-side responses - notably large reductions in average length of stay - this impact is important in the context of the medical wards, the tuberculosis ward, and the hospital as a whole. It is also clear that the impact of AIDS-related morbidity is growing rapidly, is large in the context of medical ward services as a whole, and is particularly significant on the adult female medical ward. The main supply-side response to increased HIV-related morbidity on both adult medical wards appears to have been to allow bed occupancy rates to rise. The most encouraging result is that the overall level of tuberculosis care costs has grown by a fraction of the increase in cases and that the cost-effectiveness of tuberculosis care has improved. However, HIV/AIDS is placing severe pressure on both the adult tuberculosis and medical wards. Extra resources, or strategies that reduce admissions or length of stay, are required to alleviate this - especially as reliance on retrospective data probably leads to under-detection of HIV-related morbidity. A more comprehensive study for 1998, based on prospectively collected data, is covered in Chapter 7.

CHAPTER 7: The economic impact of the HIV epidemic on hospital and clinic services in Hlabisa District in 1998

7.1 Introduction

Chapters 5 and 6 showed that the HIV/AIDS epidemic has had an important economic impact on hospital services in Hlabisa District, South Africa, during the years 1991-1998. It has been associated with a substantial growth in tuberculosis and non-tuberculosis AIDS admissions, which has increased demand for care. In turn, this has put upward pressure on costs, with HIV-related disease accounting for a rising share of medical and tuberculosis ward costs. Furthermore, these costs are large in the context of the hospital as a whole. Supply-side responses have helped to mitigate the impact of HIV-related tuberculosis, and while treatment outcomes are worse than those achieved in 1993, the cost-effectiveness of tuberculosis treatment has improved. However, they have been unable to prevent an increase in bed occupancy rates on the adult medical wards, where there is much more limited scope to reduce average length of stay, and these wards are operating considerably beyond capacity.

The two studies presented in Chapters 5 and 6 were deliberately designed to enable a longitudinal assessment of the HIV/AIDS epidemic's impact on health services. This was important for enabling an existing situation to be set in historical perspective, and for allowing supply-side responses to be detected and their consequences evaluated. In addition, data that show trends over time can be more convincing than cross-sectional data that represent a situation at one point in time only, and are more useful for projecting trends in future. The disadvantage of retrospective longitudinal compared with cross-sectional studies is that they can be much more affected by data limitations – retrospective studies cannot be specially designed to ensure that all relevant information is captured. In the case of the studies presented in the two previous chapters, there were three key constraints. First, the number of AIDS cases detected was likely to be an under-estimate of their true number. Second, it was not possible to capture non-tuberculosis and non-AIDS, but still HIV-related, morbidity – despite the fact that this has been recognised to be important. Third, it was not feasible to assess the impact of HIV/AIDS on outpatient services. In addition, potential differences in nursing workload between patients with HIV-related conditions and those with other types of health problem could not be analysed, which may have meant that the nursing costs calculated for HIV-related disease were either too high or too low.

This chapter concerns a cross-sectional study, based on prospectively collected data, of the economic impact of HIV-related morbidity in 1998, for both hospital and clinic services (Objective 3, Chapter 4)[26]. It builds on the previous two chapters by providing a more comprehensive assessment of the economic impact of HIV on the adult medical wards of Hlabisa hospital than was possible for earlier years, and through presenting data for outpatient

[26] A paper based on this chapter and Chapter 6 has been selected for a keynote oral presentation at the XIII International AIDS conference in Durban, South Africa, on July 12th 2000. The paper is entitled "The economic impact of the HIV/AIDS epidemic on health services in rural South Africa".

services as well as inpatient care. It is structured in five major sections, which are:

- **Methods, adult medical ward study (7.2)**, which describes the approach to data collection and analysis, with particular reference to the costing and epidemiological methods used;
- **Methods, clinic services study (7.3)**, which explains choice of clinics, data collection and data analysis;
- **Results, adult medical ward study (7.4)**, which presents a variety of data according to five main topic areas. The first sub-section reports the number of patients, both overall and for those with an HIV+ test result separately, according to diagnosis; HIV seroprevalence by diagnosis is also presented. The second section covers the average and total costs associated with HIV+ and HIV- patients, in each case both overall and for each major diagnosis. Length of stay data are also included. The third section presents similar data but for the male and female wards separately, to highlight contrasts between them and how an overall analysis can conceal important differences. The fourth sub-section suggests what share of total costs among HIV+ patients can actually be attributed to HIV infection, using HIV prevalence data for different diagnoses and calculated odds ratios. The final section considers to what extent HIV-related morbidity other than that captured in the retrospective analyses (Chapter 6) may explain rising bed occupancy on the medical wards since 1991;
- **Results, outpatient services study (7.5),** which presents data concerning the share of attendances accounted for by patients who fitted the WHO surveillance definition of an AIDS case;
- **Discussion (7.6)**, which suggests explanations for the findings and assesses the importance and implications of the economic impact of HIV-related disease in 1998. Particular attention is paid to the contrasts between the male and female medical wards and possible explanations for them, differences in the magnitude of impacts between inpatient and outpatient services, the degree to which the results suggest retrospective analyses produce under-estimates, the extent to which findings are generalisable, and the ways in which results confirm or contrast with those from earlier studies in Africa. They are also used to analyse the contribution that HIV may have made to the increase in medical ward admissions documented in Chapter 5.

7.2 Methods, adult medical ward study

7.2.1 Recruitment of patients

All admissions to the adult medical wards during the period March 4th to May 6th 1998 were invited to participate in the study. Out of 654 who were eligible, complete data were available for 625. The analysis focuses on these patients. A detailed data collection sheet was used to collect information on sex, age, diagnosis, stage according to the WHO staging system, whether or not a person fitted the WHO surveillance definition for an AIDS case, length of stay, and nursing dependency score on admission (Appendix 4).

7.2.2 Costing

7.2.2.1 Costing of inputs specific to adult medical ward patients

The total costs associated with inputs specific to the male and female adult medical wards were calculated first. The numbers and grades of medical and nursing staff, the size of buildings, and the type of equipment used in 1998 were quantified, and the total costs for each ward established by multiplying quantities by 1998 unit prices. These items were then grouped into the categories "nursing and medical staff" and "buildings and equipment", and a cost per day calculated by dividing total costs by total ward patient days.

A specially designed data collection sheet was used to record the number and type of drugs, laboratory tests and x-rays consumed by each patient. Quantities were then combined with unit prices to calculate the cost of these items for each patient.

7.2.2.2 Costing of inputs not specific to adult medical ward patients, annualisation of capital costs, and sources of data

The methods used to cost inputs not specific to adult medical wards, and to annualise capital costs, were identical to those explained in Chapter 6. To avoid unnecessary repetition here, sections 6.2.5.3 and 6.2.5.4 should be referred to for complete details. Appendix 1 provides a full worked example. The sources of data used were also identical, except that specially designed data collection sheets (see Appendices 4 and 5 and section 6.2.1 in Chapter 6) were also used.

7.2.3 Analysis of clinical and economic data

All data were analysed using the statistical packages SPSS version 8.0 and STATA version 6.0, and the spreadsheet package Microsoft Excel 97. The clinical and demographic variables were those listed in 7.2.1. The economic variables were (a) cost of drugs and investigations (b) cost of medical and nursing care (c) cost of buildings and equipment and (d) cost of overheads. The latter three were computed by multiplying their cost per day (see sections 7.2.2.1 and 7.2.2.2) by each patient's length of stay. For both HIV+ and HIV- patients, data were then used to calculate total and average costs, the breakdown of average cost according to the 4 major economic variables that were defined {i.e. (a) to (d) defined above}, and the average cost and length of stay associated with each major diagnosis.

7.2.4 Analyses involving the epidemiological principles of attributable risk

To assess what share of the costs associated with HIV+ patients could actually be attributed to HIV infection, standard epidemiological methods were employed (Hennekens and Buring, 1997; see also Chapter 4 section

4.4.4). The prevalence of HIV infection for each major diagnosis was calculated. Where this was considerably in excess of the prevalence suggested among the general population by antenatal clinic attendees, odds ratios were calculated.

To calculate odds ratios, data from a July 1998 survey of antenatal clinic attendees were used to estimate the risk of exposure to HIV in the disease-negative population. Odds ratios were then used as a measure of relative risk (RR), and the proportion of HIV+ patients in each diagnostic category whose disease could be attributed to HIV (the attributable risk %, AR%) was calculated as AR% = [{(RR-1)/RR} x 100].

7.2.5 Nursing dependency score

It was recognised that the nursing dependency level of patients varies, but that allocation of nursing costs made the assumption of equal costs (since costs were allocated on the basis that one patient day cost the same for all patients). The impact of HIV-related illness on health services – and nursing staff in particular - could therefore be over or under-estimated if the dependency level of HIV+ patients differs significantly from that of HIV-negative patients. To explore whether or not this was the case, dependency scores were recorded – in consultation with medical ward nurses - for a sample of study patients on each day of their admission, using a categorisation system based on activities of daily living[27] (ADL) and dependence on IV fluids and drugs. They were then used to calculate an average for the admission as a whole. Patients were assigned a score of either 1 (independent, capable of all 4 ADL), 2 (unable to do one ADL), or 3 (unable to do 2 or more ADL independently, fully dependent). Patients were assigned to a lower category than that implied by the ADL score if they were receiving IV fluids or drugs. This scoring system was used because it was straightforward, was judged to reflect a patient's nursing dependency level, and could be collected from retrospective data to allow comparisons with earlier years[28].

7.2.6 Sensitivity analyses

The calculations used to estimate the percentage of morbidity among HIV+ patients that was attributable to HIV infection were subject to one major source of imprecision and one major source of bias. Odds ratios were calculated on the basis of a sample of diseased patients and disease-negative controls; any sample is subject to some imprecision. Second, there is some uncertainty concerning the extent to which antenatal data are an accurate proxy measure of community HIV seroprevalence.
To explore the impact of imprecision in estimation of odds ratios, sensitivity analyses using 95% confidence intervals for odds ratios were undertaken. Six sensitivity analyses were then used to explore the extent to

[27] Defined as walking, dressing, feeding, toileting
[28] the study of dependency level in earlier years was undertaken by another researcher but is referred to in the Discussion.

which results were sensitive to uncertainty in estimation of community HIV seroprevalence. The first two scenarios used the upper and lower limits of the 95% confidence intervals for odds ratios. The 3rd, 4th and 5th used alternative estimates of community HIV prevalence, based on the ratio of antenatal HIV seroprevalence to community seroprevalence documented in seven sites in East and Southern Africa (Carpenter et al, 1997; Gray et al, 1998; Kilian et al, 1999; Fylkenses et al, 1998; Kigadye et al, 1993; Boerma et al, 1998). These consistently suggest that antenatal data under-estimate community seroprevalence; the upper and lower limit in the range (antenatal HIV seroprevalence 52% and 81% respectively of community HIV seroprevalence) and the mean (antenatal HIV seroprevalence 71.5% of community HIV seroprevalence) were used in sensitivity analyses. Finally, the point estimate of the odds ratio for tuberculosis estimated for men using the medical ward and antenatal data from Hlabisa district was low in comparison with estimates of relative risk based on cohort studies, which generally have suggested a relative risk of at least 6. The sixth scenario therefore re-assessed HIV-attributable morbidity by inferring general community prevalence among men from the odds of exposure among tuberculosis patients and the assumption that the odds ratio was 6[29]. This gave an estimated community prevalence for men of 20.3%.

7.3 Methods, clinic services study

7.3.1 Choice of clinics

Three government clinics, a mobile clinic service, and one private clinic were selected for the study of the impact of HIV/AIDS on outpatient services. Two of the nine rural government clinics were chosen at random. One mobile clinic point, one private clinic, and one urban clinic, were chosen purposively. The private clinic was chosen because it was the largest private outpatient service in the district; the urban clinic was chosen because it is the only urban clinic in the district; and the mobile point was judged to be broadly representative of mobile services by the nurse responsible for them.

7.3.2 Data collection and analysis

In the government and mobile clinics, data concerning age, sex, diagnosis, and whether or not the patient fitted the WHO surveillance definition for an AIDS case (see Chapter 2 for full definition), were collected using a standardised questionnaire. The focus was on patients attending for curative care i.e. those attending for preventive services (antenatal clinics and childhood vaccinations) were not considered. In the private clinic, data concerning age, sex, and whether the patient had any signs or symptoms that feature in the WHO surveillance case definition for an AIDS case were collected. Data were collected for at least 300 consecutive attendances at each clinic, in either July or August 1998. The sample size was chosen to

[29] i.e. 6=[(0.604/0.396)/(p2/1-p2)], where p1 = 0.604 (the probability of HIV infection among male TB patients). See Chapter 4 section 4.4. for more detailed explanation of the use of this formula

enable the proportion of patients who fitted the WHO surveillance case definition to be estimated with upper and lower 95% confidence limits within 5% of the mean.

Data were entered and analysed using the spreadsheet package Excel 7.0 and the statistical packages SPSS version 8.0 and STATA version 6.0.

7.4 Results, adult medical ward study

7.4.1 HIV prevalence, overall and by diagnosis

HIV prevalence varied according to both sex and diagnosis (Table 7.1).

Table 7.1: Number of study patients by sex, diagnosis and HIV status, adult medical wards 1998

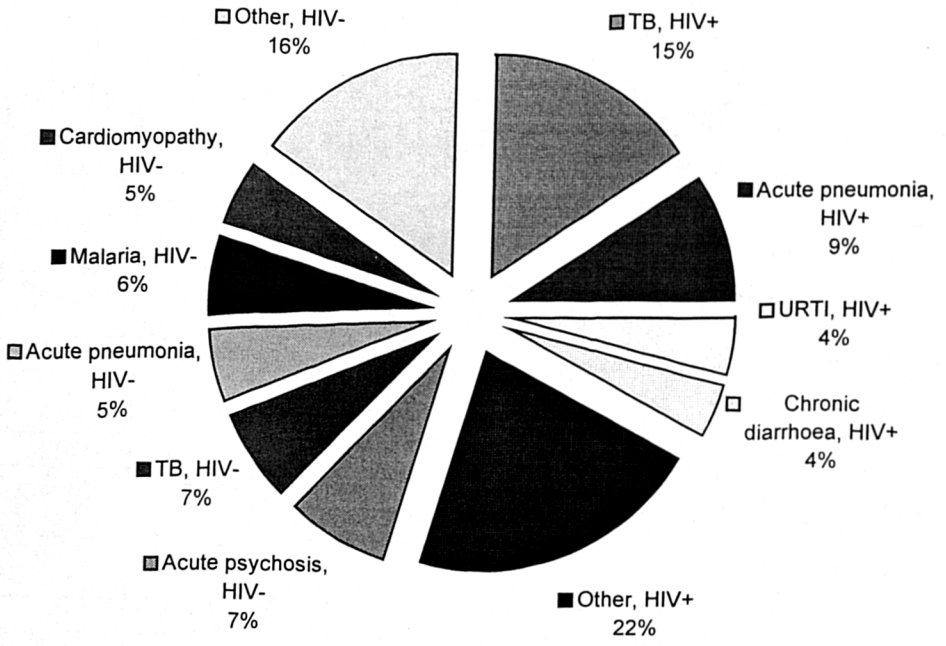
Diagnosis	Male and Female combined		Male		Female	
	Total number	*Total HIV+ (% total)*	*Total number*	*Total HIV+ (% total)*	*Total number*	*Total HIV+ (% total)*
Tuberculosis	187	131 (70)	96	58 (60)	91	73 (80)
Acute pneumonia	92	53 (58)	47	21 (45)	45	32 (71)
Malaria	77	22 (29)	34	8 (24)	43	14 (33)
Upper respiratory tract infection (URTI)	31	23 (74)	15	8 (53)	16	15 (94)
Chronic diarrhoea	26	25 (96)	11	10 (91)	15	15 (100)
Cardio-myopathy/ CCF	26	7 (27)	8	2 (25)	18	5 (28)
Asthma	20	7 (35)	8	2 (25)	12	5 (42)
Acute psychosis	19	4 (22)	11	1 (9)	8	3 (38)
Diabetes mellitus	14	0 (0)	6	0 (0)	8	0 (0)
CVA	14	4 (29)	4	1 (25)	10	3 (30)
Acute diarrhoea	13	5 (38)	2	2 (100)	11	3 (27)
Epilepsy	7	2 (29)	2	1 (50)	5	1 (20)
Other, AIDS	7	7 (100)	3	3 (100)	4	4 (100)
Cryptococcal meningitis	5	5 (100)	1	1 (100)	4	4 (100)
Septicaemia	2	2 (100)	0	0 (0)	2	2 (100)
Kaposi's Sarcoma – disseminated	2	2 (100)	1	1 (100)	1	1 (100)
Other	83	40 (48)	36	16 (44)	47	24 (51)
TOTAL	625	339 (54)	285	135 (47)	340	204 (60)

Overall, HIV prevalence was 54%, but was higher for women than men (60% vs. 47%, p=0.002). Overall and for both men and women separately, HIV prevalence was particularly high among patients diagnosed with tuberculosis, acute pneumonia, upper respiratory tract infections, chronic diarrhoea, cryptococcal meningitis, septicaemia and Kaposi's Sarcoma.

7.4.2 Total and average costs for HIV+ and HIV- patients, overall and by diagnosis and cost item

HIV+ patients accounted for 55% of total adult medical ward costs (Table 7.2 and Figure 1[30]), almost exactly in proportion to their numbers (54% of all patients). Among HIV+ patients, 2 diagnoses – tuberculosis and acute pneumonia - stood out. They accounted for almost 50% of the total costs associated with HIV+ patients. There was a more even distribution among diagnoses in HIV- patients, though tuberculosis and acute pneumonia were the second and fourth leading diagnoses in cost terms.

Figure 1: Total medical ward costs, by diagnosis and HIV status



The breakdown of costs according to cost item was similar for both HIV+ and HIV- patients (Figures 2 and 3). Overheads accounted for over 50% of costs, while nursing and medical staff accounted for 32%. Drugs, investigations, buildings and equipment were comparatively minor costs.

Average costs varied by diagnosis for both HIV+ and HIV- patients (Table 7.2, Figure 4), with HIV+ patients generally associated with higher costs

[30]Figure 1 percentages sum to slightly different totals compared to Table 7.2 due to rounding errors

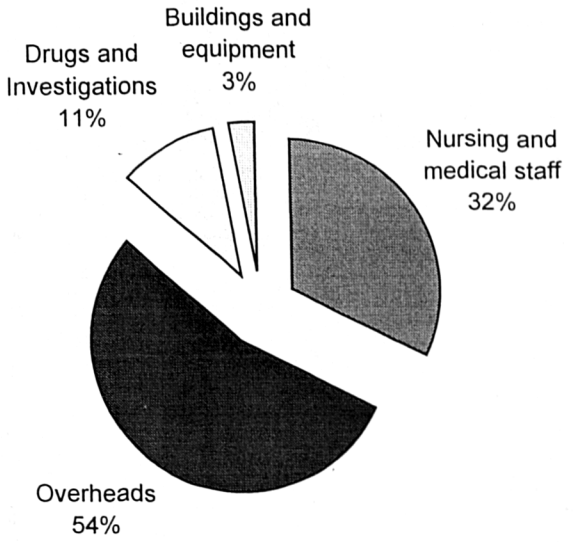
Table 7.2: Average and total cost by diagnosis and HIV status, 1998US$ (% column total unless stated)

Diagnosis	Average cost, HIV+ patients (length of stay)	Average cost, HIV- patients (length of stay)	Number of HIV+ patients	Number of HIV- patients	Total Cost, HIV+ patients	Total cost, HIV- patients
Tuberculosis	160.7 (5.7)	159.3 (5.6)	131 (39)	56 (20)	21 052 (29)	8 921 (14)
Acute pneumonia	243.3 (8.6)	190.7 (6.5)	53 (16)	39 (14)	12 895 (18)	7 437 (12)
Malaria	235.1 (7.6)	144.7 (4.3)	22 (6)	55 (19)	5 172 (7)	7 959 (13)
Upper respiratory tract infection	259.1 (9.5)	301.6 (11.4)	23 (7)	8 (3)	5 959 (8)	2 413 (4)
Chronic diarrhoea	203.6 (7.4)	77.5 (3.0)	25 (7)	1 (0.3)	5 090 (7)	78 (0.1)
Cardiomyopathy/CCF	199.0 (6.9)	331.9 (11.8)	7 (2)	19 (7)	1 393 (2)	6 306 (10)
Asthma	233.1 (8.3)	186.5 (6.2)	7 (2)	13 (5)	1 632 (2)	2 425 (4)
Acute psychosis	1 208.5 (47.8)	676.2 (25.8)	4 (1)	15 (5)	4 834 (7)	10 143 (16)
Diabetes mellitus	N.A.	170.9 (5.9)	0	14 (5)	0	2 393 (4)
CVA	285.1 (9.8)	254.9 (9.4)	4 (1)	10 (3)	1 140 (2)	2 549 (4)
Acute diarrhoea	183.2 (6.6)	136.5 (4.8)	5 (1)	8 (3)	916 (1)	1 092 (2)
Epilepsy	199.9 (6.5)	231.4 (8.2)	2 (0.6)	5 (2)	400 (0.5)	1 157 (2)
Septicaemia	156.4 (5.5)	N.A.	2 (0.6)	0	313 (0.4)	0
Cryptococcal meningitis	211.7 (5.8)	N.A.	5 (1)	0	1 059 (1)	0
Kaposi's Sarcoma – disseminated	280.1 (10.5)	N.A.	2 (0.6)	0	560 (0.7)	0
Other, AIDS	251.8 (9.0)	N.A.	7 (2)	0	1 763 (2)	0
Other[1]	255.7 (8.8)	212.9 (7.4)	40 (12)	43 (15)	10 228 (12)	9 155 (15)
Total, or overall average, as relevant	219.5 (7.8)	217.5 (7.6)	339	286	74 406[2]	62 028[2]
% overall total for both HIV+ and HIV- patients, where relevant	N.A.	N.A.	54.2	45.8	54.5	45.5

[1] includes all diagnoses that, individually, accounted for < 5 admissions (except those that were associated only with HIV+ patients)
[2] sum of totals is not exactly equivalent to totals from analyses for men and women separately due to rounding errors

for any given diagnosis. However, differences were relatively small and only significant for acute pneumonia and malaria, with higher costs

Figure 2: Average cost breakdown for HIV+ adult medical patients, Hlabisa Hospital, 1998



associated with HIV+ patients ($p=0.015$ and $p<0.001$ respectively). Admissions for 2 diseases where HIV prevalence and admission numbers

Figure 3: Average cost breakdown for HIV- adult medical patients, Hlabisa Hospital, 1998

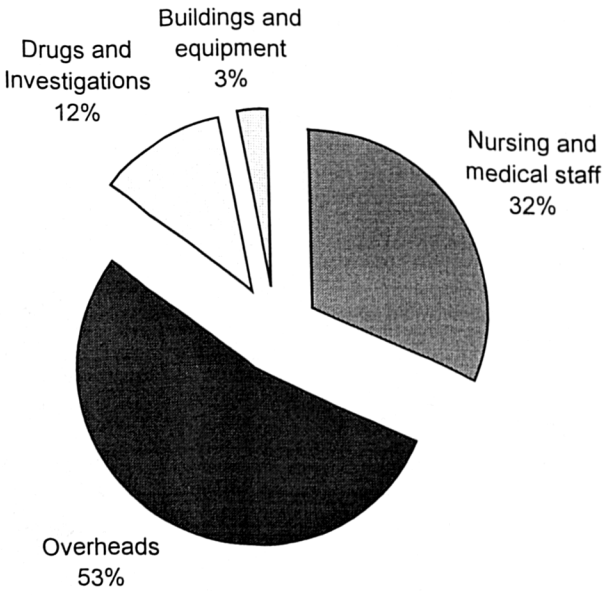
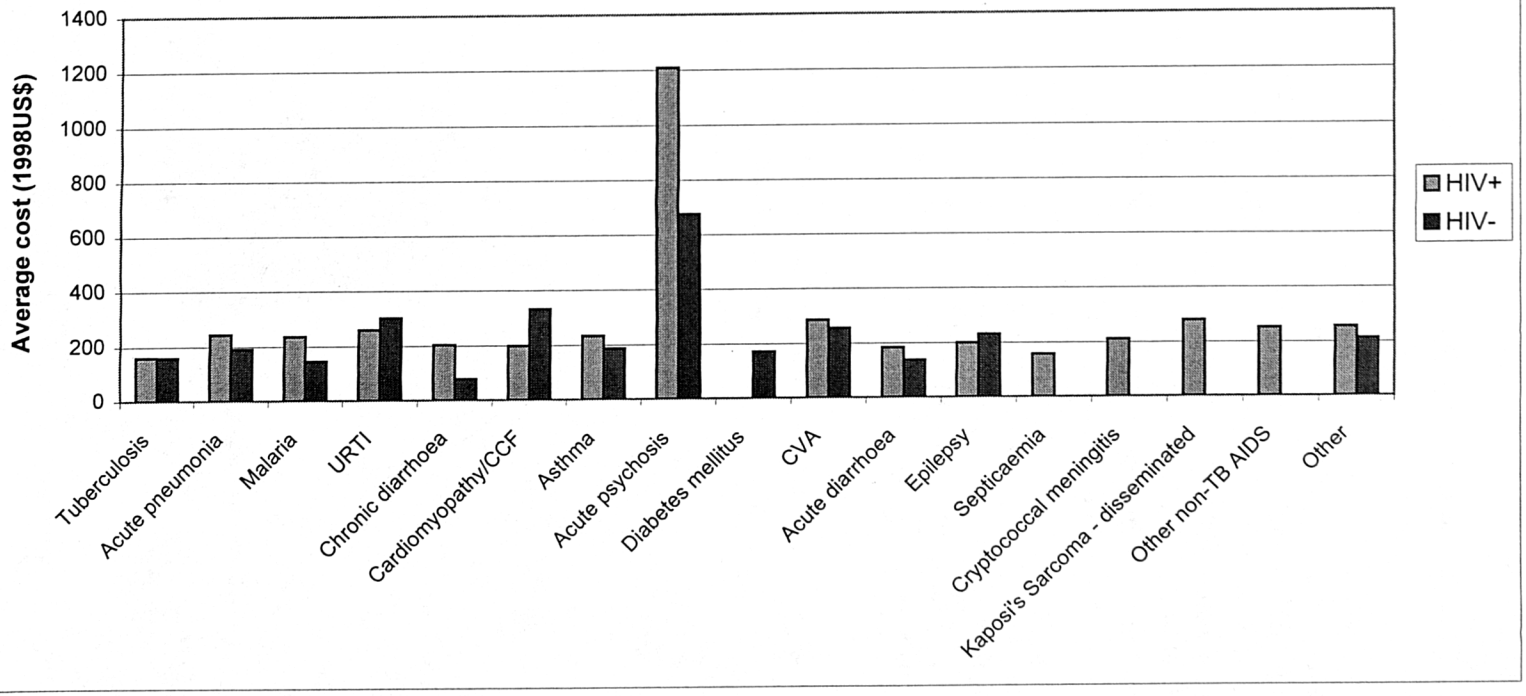


Figure 4: Average cost by diagnosis and HIV status among adult medical admissions to Hlabisa Hospital in 1998

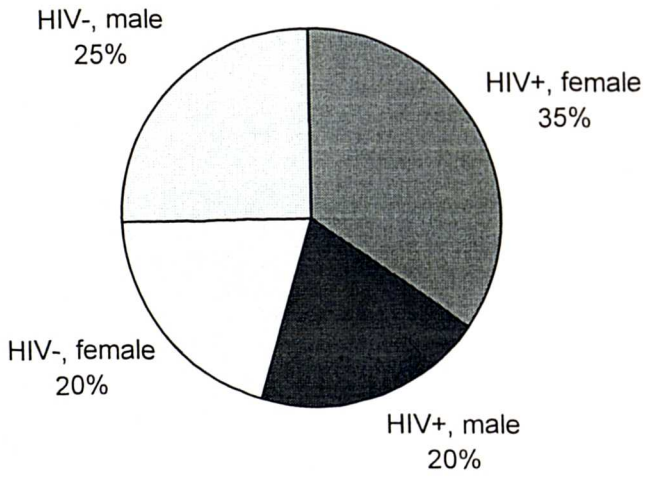


were particularly high – tuberculosis and chronic diarrhoea - were below average costs (Table 7.1). Among HIV+ patients, acute pneumonia was above average cost, in contrast to HIV- patients where this disease was below average cost.

7.4.3 Costs for the male and female medical wards separately

The overall analysis presented in 7.4.2 concealed some striking contrasts between the male and female medical wards. The average cost of care was similar for HIV+ and HIV- patients on each ward and there was no evidence of a difference between them (p=0.234 and p=0.338 for the male and female wards respectively), as in the aggregated analysis (Tables 7.3 and 7.4). However, the absolute costs for HIV+ patients, both overall and for several major diagnoses, were considerably higher on the female ward. Female patients accounted for 64% of the total costs associated with HIV+ patients (Figure 5, Tables 7.3 and 7.4), and the total cost of HIV+ female admissions was 75% higher than that for HIV+ male patients. Costs closely reflected absolute patient numbers, with female and male HIV+ patients accounting for 33% and 22% of total admissions, and 35% and 20% of costs, respectively, over the study period.

Figure 5: Total costs by sex and HIV status, adult medical wards, Hlabisa Hospital, 1998



Diagnoses where total costs for HIV+ female patients were considerably in excess of those for male patients were acute pneumonia, upper respiratory tract infections, cryptococcal meningitis, chronic diarrhoea and "other AIDS" (Figure 6).

Figure 6: Comparison of total costs on adult medical wards by diagnosis and sex, Hlabisa Hospital, 1998

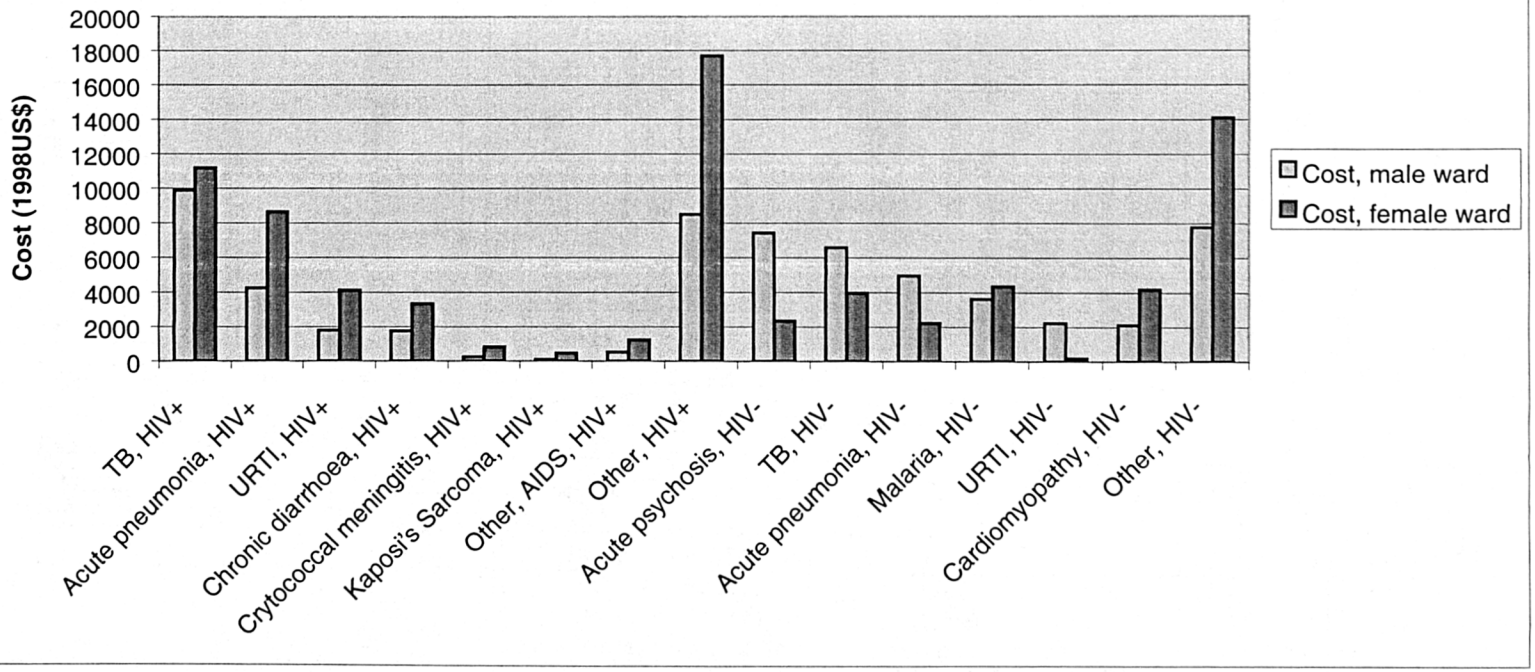


Table 7.3: Average and total cost by diagnosis and HIV status, female medical ward, 1998US$ (% column total, unless stated[31])

Diagnosis	Average cost, HIV+ patients (length of stay)	Average cost, HIV- patients (length of stay)	Number of HIV+ patients	Number of HIV- patients	Total Cost, HIV+ patients	Total cost, HIV- patients
Tuberculosis	153.1 (5.4)	129.5 (4.3)	73 (36)	18 (13)	11 176 (24)	2 331 (9)
Acute pneumonia	270.1 (9.7)	170.8 (5.9)	32 (16)	13 (9)	8 643 (18)	2 220 (8)
Malaria	240.7 (7.6)	149.8 (4.4)	14 (7)	29 (21)	3 370 (7)	4 344 (16)
Upper respiratory tract infection	273.6 (9.9)	193.1 (7.0)	15 (7)	1 (0.7)	4 104 (9)	193 (0.7)
Chronic diarrhoea	221.8 (8.1)	N.A.	15 (7)	0	3 327 (7)	0
Cardiomyopathy/CCF	240.6 (8.2)	321.4 (11.5)	5 (2)	13 (9)	1 203 (3)	4 178 (15)
Asthma	244.2 (8.8)	233.7 (7.9)	5 (2)	7 (5)	1 221 (3)	1 636 (6)
Acute psychosis	1 320.8 (52.0)	553.3 (21.6)	3 (1)	5 (4)	3 962 (8)	2 767 (10)
Diabetes mellitus	N.A.	149 (5.3)	0	8 (6)	0	1 192 (4)
CVA	201.8 (6.0)	240.6 (8.9)	3 (1)	7 (5)	605 (1)	1 684 (6)
Acute diarrhoea	210.4 (7.7)	156.7 (5.6)	3 (1)	8 (6)	631 (1)	1 254 (5)
Epilepsy	289.4 (10.0)	237.6 (8.3)	1 (0.5)	4 (3)	289 (0.6)	950 (3)
Septicaemia	156.5 (5.5)	N.A.	2 (1)	0	313 (0.7)	0
Cryptococcal meningitis	206.3 (5.8)	N.A.	4 (2)	0	825 (2)	0
Kaposi's Sarcoma – disseminated	471.3 (18.0)	N.A.	1 (0.5)	0	471 (1)	0
Other, AIDS	309 (9.0)	N.A.	4 (2)	0	1 236 (3)	0
Other	265.2 (8.8)	192.3 (6.6)	23 (11)	24 (18)	6 097 (13)	4 615 (17)
Total, or overall average, as relevant	233.9 (8.3)	199.7 (6.9)	203	137	47 473	27 364
% overall total for both HIV+ and HIV- patients, where relevant	N.A.	N.A.	59.4	40.6	63.4	36.6

[31] percentages do not always sum to 100, due to rounding errors

Table 7.4: Average and total cost by diagnosis and HIV status, male medical ward, 1998US$ (% column total, unless stated[32])

Diagnosis	Average cost, HIV+ patients (length of stay)	Average cost, HIV- patients (length of stay)	Number of HIV+ patients	Number of HIV- patients	Total Cost, HIV+ patients	Total cost, HIV- patients
Tuberculosis	170.3 (6.1)	173.4 (6.3)	58 (43)	38 (25)	9 877 (37)	6 589 (19)
Acute pneumonia	201.5 (7.0)	191 (6.7)	21 (16)	26 (17)	4 232 (16)	4 966 (14)
Malaria	225.8 (7.4)	139.2 (4.2)	8 (6)	26 (17)	1 806 (7)	3 619 (10)
Upper respiratory tract infection	224.3 (8.6)	317.6 (12.0)	8 (6)	7 (5)	1 794 (7)	2 223 (6)
Chronic diarrhoea	175.9 (6.3)	77.5 (3.0)	10 (7)	1 (0.7)	1 759 (7)	78 (0.2)
Cardiomyopathy/CCF	105.5 (7.0)	352.8 (12.5)	2 (1)	6 (4)	211 (0.8)	2 117 (6)
Asthma	209.8 (7.0)	133.2 (4.2)	2 (1)	6 (4)	420 (2)	799 (2)
Acute psychosis	871.5 (35.0)	743.1 (28.1)	1 (0.7)	10 (7)	872 (3)	7 431 (21)
Diabetes mellitus	N.A.	205.3 (6.7)	0	6 (4)	0	1 232 (4)
CVA	201.8 (21.0)	240.6 (10.7)	1 (0.7)	3 (2)	202 (0.7)	722 (2)
Acute diarrhoea	142.5 (5.0)	N.A.	2 (1)	0	285 (1)	0
Epilepsy	110.3 (3.0)	214.8 (8.0)	1 (0.7)	1 (0.7)	110 (0.4)	215 (0.6)
Septicaemia	N.A.	N.A.	0	0	680 (3)	0
Cryptococcal meningitis	233.6 (8.0)	N.A.	1 (0.7)	0	234 (0.9)	0
Kaposi's Sarcoma – disseminated	88.8 (3.0)	N.A.	1 (0.7)	0	89 (0.3)	0
Other, AIDS	174.9 (4.5)	N.A.	3 (2)	0	525 (2)	0
Other	244.0 (8.7)	236.8 (8.3)	16 (12)	20 (13)	3 904 (14)	4 736 (14)
Total, or overall average, as relevant	195.0 (7.0)	228.5 (8.3)	135	150	27 000	34 727
% overall total for both HIV+ and HIV- patients, where relevant	N.A.	N.A.	47.2	52.8	43.7	56.3

[32] percentages do not always sum to 100, due to rounding errors

HIV+ patients accounted for 63% of total female ward costs compared to 44% of male ward costs (Figures 7 and 8; Tables 7.3 and 7.4).

Figure 7: Total cost by diagnosis and HIV status, female medical ward

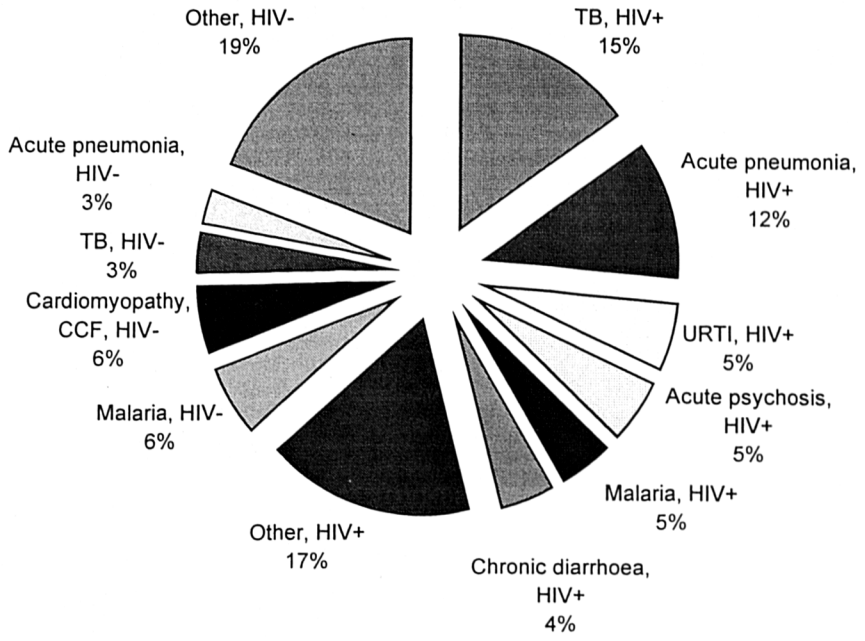
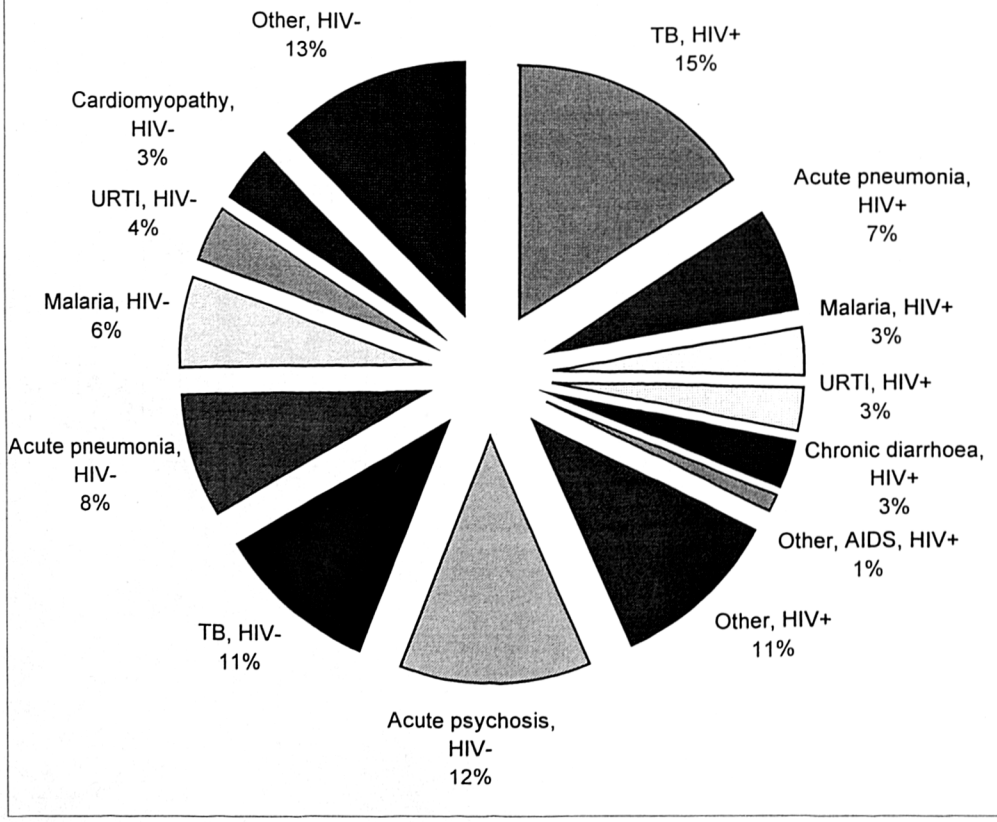


Figure 6: Total cost by diagnosis and HIV status, male medical ward



Tuberculosis among HIV-negative patients was much more important on the male medical ward (11% of total ward costs vs. 3% on the female ward). Overall, acute pneumonia accounted for the same proportion of ward costs, but the share of HIV+ patients was much higher on the female ward (80% of total costs for this disease vs. 47% on the male ward). The cost of upper respiratory tract infections was of comparable magnitude for HIV+ and HIV- patients on the male medical ward (HIV+ patients accounted for 45% of the total costs associated with this diagnosis, compared with 55% for HIV- patients), but there was a striking disparity for the female ward, where HIV+ patients accounted for 96% of the total costs associated with this diagnosis.

7.4.4 HIV attributable costs

7.4.4.1 Diseases where there appeared an excess of HIV+ admissions

There were 4 diagnoses where there appeared to be an excess of HIV+ admissions (i.e. a much higher HIV prevalence than one would expect given the prevalence of HIV infection in antenatal clinic surveys, which was 29% in 1998), and where relatively high sample sizes provided some confidence that the excess was a real one (Table 7.1). These were tuberculosis, acute pneumonia, upper respiratory tract infections, and chronic diarrhoea.

7.4.4.2 Fraction of ward costs that could be attributed to HIV, overall

Overall, odds ratio and attributable risk calculations (Table 7.6) suggested that 205 adult medical admissions could be attributed to HIV. These accounted for 29.5% of total adult medical ward costs (Table 7.6, Figure 9).

Figure 9: Share of adult medical ward costs attributable to HIV, Hlabisa Hospital, 1998

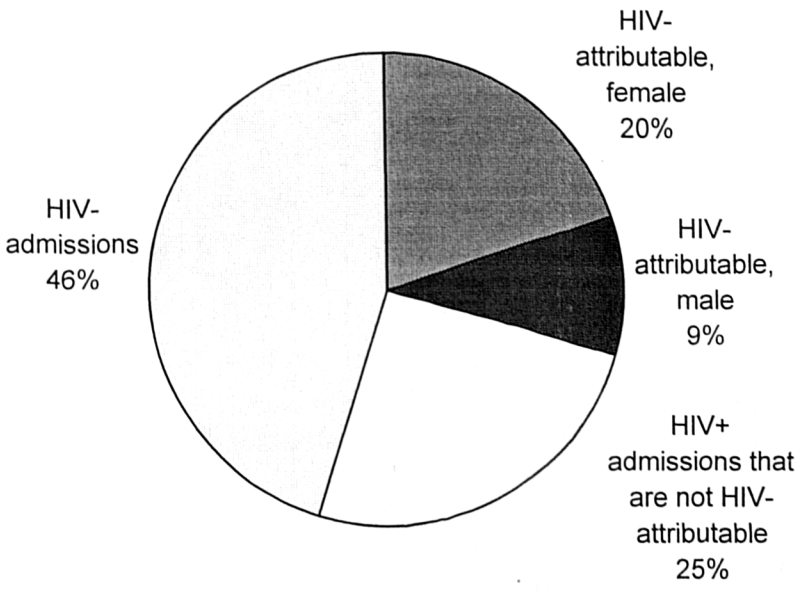


Table 7.5: Calculated odds ratios, and the attributable risk percent for each major disease category

Diagnosis	HIV seroprevalence, % (n = total individuals)			Odds Ratio[1] [95% CI][2]			Attributable Risk Percent , AR% [95%CI]		
	Males	Females	Overall	Males	Females	Overall	Males	Females	Overall
Tuberculosis	60.4 (n=96)	80.2 (n=91)	70.1	3.72 [2.28, 6.07]	9.87 [5.28, 18.48]	5.69 [3.72, 8.72]	73.1 [56.1, 83.5]	89.9 [81, 94.6]	82.5 [73.1, 88.5]
Acute pneumonia	44.7 (n=47)	71.0 (n=45)	57.6	1.97 [1.05, 3.68] p=0.031	5.99 [2.93, 12.2]	3.31 [2.03, 5.40]	49.2 [4.8, 72.8]	83.3 [65.9, 91.8]	69.8 [50.7, 81.5]
URTI	53.3 (n=15)	93.8 (n=16)	74.2	2.78 [0.98, 7.94] p=0.046	36.52 [4.34, 307.33]	7.04 [2.93, 16.71]	64.0 [0, 87.4]	97.3 [77.0, 99.7]	85.8 [65.9, 94.0]
Chronic diarrhoea	90.9 (n=11)	100 (n=15)	96.2	24.34 [3.08, 192.71]	∞ (infinity since all cases were HIV+)	60.86 [8.13, 455.31]	95.9 [67.5, 99.5]	Estimated as 100%	98.4 [87.7, 99.8]

[1] Odds ratio calculated using the HIV seroprevalence figures shown for the 4 diseases, and estimated HIV prevalence in the non-diseased population (see Chapter 4 for full explanation of the calculation of odds ratios). HIV seroprevalence in the non-diseased population estimated based on HIV prevalence among antenatal clinic attendees in 1998 (29%, based on a sample of 340 women; see also Table 6.1 in Chapter 6)

[2] $p<0.001$ unless stated

Table 7.6: Total adult medical ward admissions and costs attributable to HIV-related disease, 1998US$ (% column total)

Diagnosis	Overall, both wards		Female ward		Male ward	
	Estimated number of HIV+ admissions attributable to HIV[1]	Total costs attributable to HIV[2]	Estimated number of HIV+ admissions attributable to HIV[1]	Total HIV-attributable costs[3]	Estimated number of HIV+ admissions attributable to HIV[1]	Total HIV-attributable costs[3]
Tuberculosis (1)	108 (53)	17 258 (43)	66 (50)	10 105 (37)	42 (60)	7 153 (55)
Acute pneumonia (2)	37 (18)	9 308 (23)	27 (20)	7 293 (27)	10 (14)	2 015 (16)
Upper respiratory tract infection (3)	20 (10)	5 226 (13)	15 (11)	4 104 (15)	5 (7)	1 122 (9)
Chronic diarrhoea (4)	25 (12)	5 086 (13)	15 (11)	3 327 (12)	10 (14)	1 759 (14)
Cryptococcal meningitis[4] (5)	5 (2)	1 059 (3)	4 (3)	825 (3)	1 (1)	234 (2)
Kaposi's Sarcoma – disseminated[4] (6)	2 (1)	560 (1)	1 (1)	471 (2)	1 (1)	89 (0.7)
Other, AIDS (7)	7 (3)	1 761 (4)	4 (3)	1 236 (5)	3 (4)	525 (4)
All diagnoses not listed as (1) to (7)	0	0	0	0	0	0
Total HIV-attributable, all diagnoses	205	40 258	132	27 361	73	12 897
Total HIV-attributable as % overall ward total	32.8	29.5	38.8	36.6	25.6	20.9

[1] calculated as number of HIV+ patients with each diagnosis (from Table 7.1) multiplied by the fraction estimated to be attributable to HIV (from Table 7.5)
[2] calculated as female ward total plus male ward total
[3] calculated as average cost for an HIV+ patient multiplied by number of HIV+ admissions estimated to be attributable to HIV (from previous column and Tables 7.2-7.4)
[4] attributed to HIV because they fitted the WHO surveillance definition for an AIDS case, were HIV+, and had a condition typically associated only with HIV+ patients

Figure 10: Share of costs attributable to HIV, by diagnosis, female medical ward in Hlabisa Hospital 1998

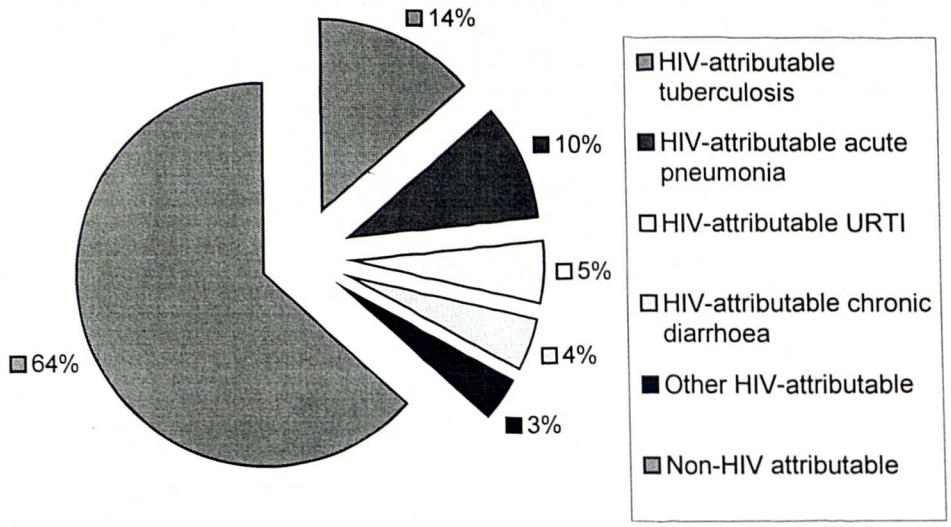
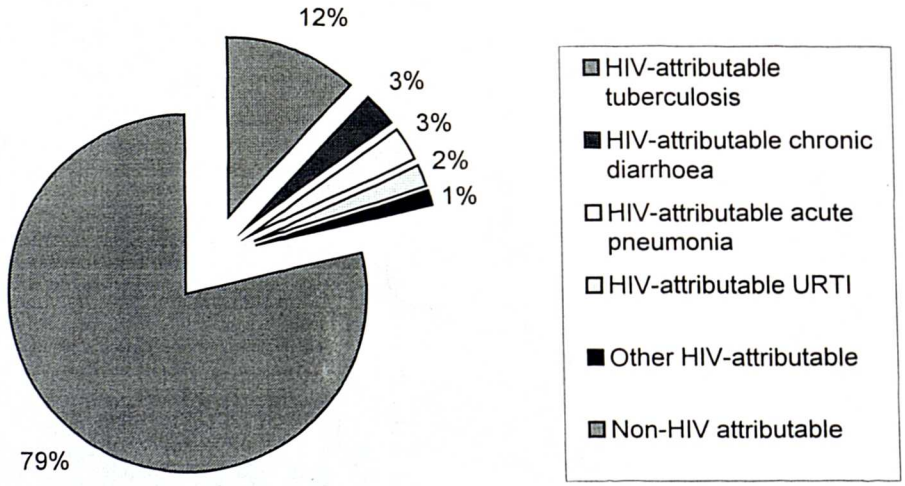


Figure 11: Share of costs attributable to HIV, by diagnosis, male medical ward in Hlabisa Hospital, 1998



Tuberculosis was responsible for the largest single share of HIV-related morbidity – over 50% of admissions attributable to HIV, and 42% of total HIV-attributable costs. The other most important disease was acute pneumonia: together with tuberculosis, this accounted for approximately 70% of total HIV-attributable costs. Upper respiratory tract infections and chronic diarrhoea (13%, and 12% of total HIV-attributable costs, respectively) were the other main diseases in terms of cost and number of admissions.

7.4.4.3 Fraction of admissions and ward costs that could be attributed to HIV, male and female wards separately

In absolute terms, women accounted for 64% (132 vs. 73) of the total number of admissions that could be attributed to HIV (Table 7.6). They accounted for a slightly higher share - 68% - of total HIV-attributable costs, meaning that HIV-attributable costs for female patients were more than twice as high as those for men. In relative terms, there was also a large disparity. HIV-attributable admissions accounted for 37% of total female ward costs (58% of the level accounted for by all HIV+ female patients), compared to 21% (48% of the level accounted for by all HIV+ male patients) of male medical ward costs (Table 7.6, Figures 10 and 11[33]).

Tuberculosis accounted for a much higher share of total HIV-attributable costs on the male medical ward, and acute pneumonia for a higher proportion of costs on the female ward (though in combination these diseases accounted for approximately 70% of HIV-related admissions and costs on both wards). Upper respiratory tract infections were relatively more important on the female medical ward.

7.4.4.4 Dependency Score

The dependency score for diagnoses related to HIV was similar or lower than the average for diagnoses as a whole (Table 7.7). The difference was only significant for tuberculosis, though the absolute difference was small.

Table 7.7: Average dependency score, by diagnosis

Diagnosis	HIV+	HIV-
Tuberculosis	1.2 (n=58, sd = 0.51)	1.0 (n=25, sd = 0.16)
Acute pneumonia	1.0 (n=21, sd = 0.17)	1.1 (n=15, sd = 0.33)
URTI	1.1 (n=10, sd = 0.32)	1.0 (n=3, sd = 0)
Chronic diarrhoea	1.5 (n=14, sd = 0.61)	2.0 (n=1, sd = unestimable)
Non-TB AIDS	1.3 (n=27, sd = 0.60)	N.A.
Overall average, all diagnoses	1.3 (n=151, sd = 0.52)	1.3 (n=130, sd =0.61)

[1] 1=independent, capable of all activities of daily living; 2=unable to do 1 of 4 activities of daily living; 3=unable to do 2 or more activities of daily living (fully dependent); patient moved down 1 category if on IV drugs or fluids

[2] sd = standard deviation

[33] numbers do not exactly correspond in Figure 10 and Table 7.6 due to rounding errors

7.4.4.5 Reassessment of role of HIV-related disease in increased bed occupancy rates

The new data collected within this study permitted a reassessment of the contribution of HIV-related disease to rising bed occupancy rates on the adult medical wards (see also Chapter 6, section 6.3.5: Tables 6.13 and 6.14 and Figures 8 and 9). When HIV-related admissions other than HIV-related tuberculosis and non-tuberculosis AIDS are incorporated in such an analysis, up to 68% and 56% of the increase in bed occupancy between 1991 and 1998/9 on the female and male medical wards respectively may be explained by HIV-related disease (Tables 7.8a and 7.8b). This compares with figures of 39% and 48% when they are not (see Chapter 6).

The new data also showed marked differences between the male and female adult medical wards in terms of the number of patients on each ward per day with HIV-attributable diagnoses other than tuberculosis and non-TB AIDS. These partly reflected longer average lengths of stay for women, but were largely due to higher numbers of admissions. The female:male ratio for HIV-attributable tuberculosis and non-TB AIDS admissions was 1.5:1, but 4.8:1 for other types of HIV-attributable admission.

Table 7.8a: Number of men and women admitted with different HIV-related diagnoses and average length of stay, March 4th-May 6th 1998

Type of Diagnosis	Number of patients		Average length of stay	
	Female	Male	Female	Male
HIV-attributable tuberculosis[2]	66	42	5.4	6.1
Non-tuberculosis AIDS	37	24	8.6	6.4
Other HIV-attributable diagnoses	29	6	11.7	11.0

Table 7.8b: Estimated average number of adult patients with HIV-related conditions per day[1], adult medical wards, 1991 and 1998

Type of Diagnosis	1991		1998/9	
	Female	Male	Female	Male
HIV-attributable tuberculosis[2]	0.4	0.7	4.8 to 5.6	4.0 to 5.9
Non-tuberculosis AIDS	0.4	0.2	5.0	2.4
Other HIV-attributable diagnoses	unestimable	unestimable	5.8	1.0
Total number of patients on ward, all diagnoses (estimated maximum[3] percentage of the increase 1991-1998/9 accounted for by HIV-related disease)	37	30	60 (64-68%)[a]	45 (43-56%)[b]

[1] calculated for HIV-related TB and non-TB AIDS as: {(number of patients with condition x average length of stay)/64}, with totals divided by 64 because 64 days was the length of the study period; for other diagnoses as: [{(total patient days for HIV-attributable admissions – (total for HIV-related TB + total for non-TB AIDS)}/64]. For 1991, numbers for non-TB AIDS and HIV-attributable tuberculosis taken from Chapter 6.

[2] range for 1998 represents estimates from Chapter 6 (in which odds ratio and attributable fraction calculations were done overall rather than for men and women separately, to ensure consistency in approach across the period studied) and estimates from this Chapter, when the analysis was done separately

[3] maximum since only applies if "other HIV-related diagnoses" = 0 in 1991

[a] 64 = {(4.8 + 5.0 + 5.75) – (0.4 + 0.4)}/(60-37); 68 if 5.6 is substituted for 4.8

[b] 43 = {(4.0 + 2.4 + 1.0)) – (0.7 + 0.2)}/(45-30); 56 if 5.9 is substituted for 4.0

7.4.5 Sensitivity analyses

The percentage of HIV+ patients estimated to have disease because of HIV infection for the 3 key diagnoses (tuberculosis, acute pneumonia, upper respiratory tract infections), when different estimates of community HIV seroprevalence are assumed, is shown in Table 7.9. These 3 diagnoses are shown for 2 reasons. First, they were important in terms of numbers of HIV-attributable admissions and costs in the baseline analysis. Second, there was some uncertainty regarding the proportion of admissions with these diagnoses that was attributable to HIV infection. Chronic diarrhoea was not included in the sensitivity analysis because there was a high degree of certainty regarding the proportion of admissions with this diagnosis that could be attributed to HIV.

The results produced in each scenario for the proportion of medical ward costs accounted for by HIV-related disease, overall and for each ward separately, are shown in Table 7.10. HIV-related costs ranged from 16.3-31.7% of total medical ward costs, 7.1-24.5% of male medical ward costs, and 28.6-38.9% of female medical ward costs. Absolute costs were considerably higher for women than men in all scenarios (Figure 12).

Comparing men and women directly in each scenario, men at most accounted for 54% of the costs associated with women. When the highest estimate for male ward costs attributable to HIV was compared with the lowest estimate for female ward costs attributable to HIV, male ward costs were 72% of the female level (scenarios 2 and 4 respectively).

There were only 2 scenarios in which the number of male tuberculosis admissions estimated to be attributable to HIV was greater than the number of tuberculosis admissions identified to be HIV+ and to meet the WHO surveillance definition for an AIDS case[34] (Table 7.11). These were (a) when the upper limit of the confidence interval for odds ratios was used for attributable risk % calculations and (b) when community HIV seroprevalence among men was assumed to be 20.3%. For women, the only scenario that produced an estimate of HIV-attributable tuberculosis cases above the number of patients identified to meet the WHO surveillance criteria was when the upper limit of the confidence interval for odds ratios was used. The relevance of these observations is addressed in the discussion section.

[34] a patient can only be defined as meeting the WHO surveillance definition for an AIDS case when conditions associated with severe HIV-related disease other than TB are present (unlike the expanded WHO surveillance definition – see Chapter 4). The number of patients who fit this definition are likely to be a minimum estimate of the number of admissions attributable to HIV.

Table 7.9 The attributable risk percent (AR%) for three major diagnoses, upper and lower estimates of community HIV seroprevalence and for an alternative estimate of HIV seroprevalence among men specifically

Diagnosis	AR% for men, if community seroprevalence among men is 20.3%	AR%, community HIV seroprevalence 35.9%			AR%, community HIV seroprevalence 56.0%		
		Males	Females	Overall	Males	Females	Overall
Tuberculosis	83.3	63.3	75.3	76.1	16.6	68.6	45.6
Acute pneumonia	68.5	30.7	77.2	58.8	0	48.3	6.3
URTI	77.7	51.0	96.3	80.5	0	91.5	55.7

Table 7.10: Sensitivity analysis results, alternative scenarios

Scenario	Overall percentage of costs accounted for by HIV-related disease, both wards	Overall percentage of costs accounted for by HIV-related disease, male ward (n=number of patients)	Overall percentage of costs accounted for by HIV-related disease, female ward (n = number of patients)
1. Lower limit, 95% CI for odds ratios	Total = 27.0 TB = 11.3 Acute pneumonia = 6.6 URTI = 2.8	Total = 13.8 (n=49) TB = 9.2 Acute pneumonia = 0.6 URTI = 0	Total = 31.9 (n=116) TB = 12.1 Acute pneumonia = 7.6 URTI = 4.4
2. Upper limit, 95% CI for odds ratios	Total = 31.7 TB = 13.7 Acute pneumonia = 7.7 URTI = 4.2	Total = 25.2 (n=85) TB = 13.4 Acute pneumonia = 8.7 URTI = 2.6	Total = 37.9 (n=137) TB = 14.1 Acute pneumonia = 10.5 URTI = 4.4
3. Community HIV seroprevalence = 35.9%	Total = 27.1 TB = 11.8 Acute pneumonia = 5.5 URTI = 3.6	Total = 18.0 (n=62) TB = 10.3 Acute pneumonia = 3.5 URTI = 1.5	Total = 34.9 (n=126) TB = 12.9 Acute pneumonia = 9.0 URTI = 4.4
4. Community HIV seroprevalence = 56.2%	Total = 16.3 TB = 7.1 Acute pneumonia = 0.5 URTI = 2.5	Total = 7.1 (n=25) TB = 2.8 Acute pneumonia = 0 URTI = 0	Total = 28.6 (n=103) TB = 10.2 Acute pneumonia = 5.4 URTI = 4.4
5. Community HIV seroprevalence =40.7%	Total – 25.2 TB = 11.0 Acute pneumonia = 4.6 URTI = 3.4	Total = 15.3 (n=53) TB = 8.9 Acute pneumonia = 1.7 URTI = 1.1	Total = 33.7 (n=122) TB = 12.5 Acute pneumonia = 8.3 URTI = 4.4
6. Community HIV seroprevalence among men = 20.3%	Total = 31.0 TB = 13.4 Acute pneumonia = 7.4 URTI = 4.0	Total = 24.5 (n=83) TB = 13.4 Acute pneumonia = 8.1 URTI = 2.2	N.A.

CI=confidence interval

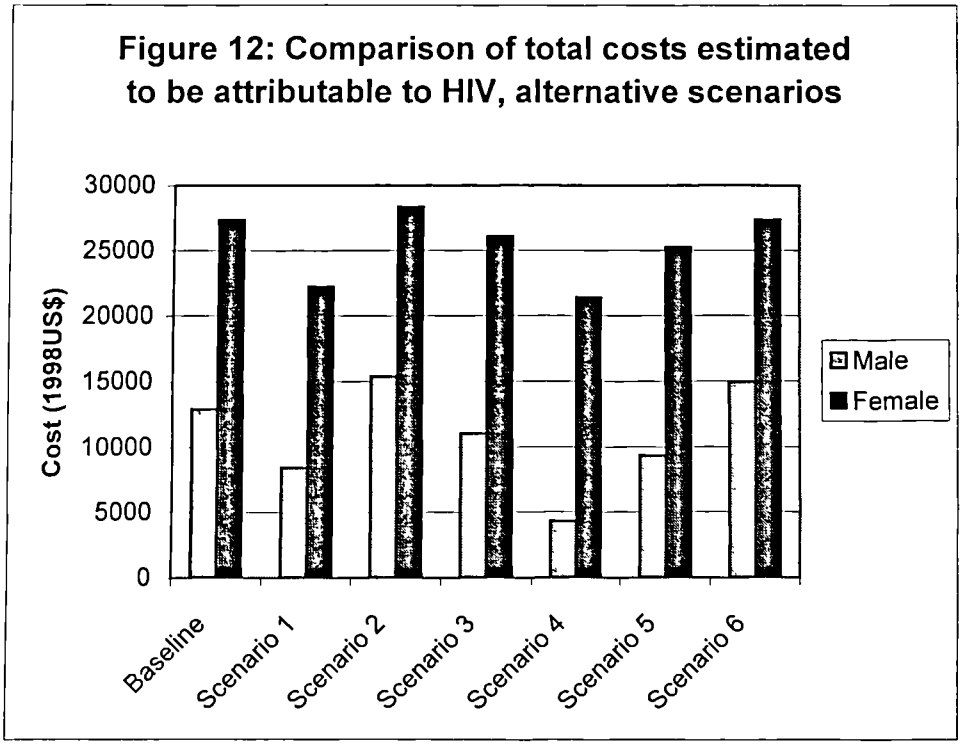


Table 7.11: Number of male admissions estimated to be attributable to HIV infection in alternative scenarios for 3 key diagnoses (number observed to fit WHO surveillance definition of an AIDS case and to have an HIV+ test result)

Scenario	Tuberculosis (n=43)	Acute pneumonia (n=8)	Upper respiratory tract infections (n=1)
1. Lower limit, 95% CI for odds ratios	33	1	0
2. Upper limit, 95% CI for odds ratios	48	15	7
3. Community HIV seroprevalence = 35.9%	37	6	4
4. Community HIV seroprevalence = 56.2%	10	0	0
5. Community HIV seroprevalence =40.7%	32	3	3
6. Community HIV seroprevalence among men = 20.3%	48	14	6

Table 7.12: Number of female admissions estimated to be attributable to HIV infection in alternative scenarios for 3 key diagnoses (number observed to fit WHO surveillance definition of an AIDS case and to have an HIV+ test result)

Scenario	Tuberculosis (n=66)	Acute pneumonia (n=9)	Upper respiratory tract infections (n=6)
1. Lower limit, 95% CI for odds ratios	59	15	12
2. Upper limit, 95% CI for odds ratios	69	29	15
3. Community HIV seroprevalence = 35.9%	65	25	14
4. Community HIV seroprevalence = 56.2%	50	15	14
5. Community HIV seroprevalence =40.7%	61	23	14

When the percentage of male ward costs attributable to HIV was at its highest, the number of patients with an HIV-related diagnosis other than HIV-attributable tuberculosis or non-tuberculosis AIDS per day on the ward was estimated as 1.6 (calculations not shown). The lowest value for women was associated with scenario 4 (community seroprevalence 56%), followed by the lower limit of the confidence interval for odds ratios (scenario 1), when the values were 3.4 and 4.0 respectively.

7.5 Clinic Study

The percentage of patients attending for curative care at clinics who fitted the WHO surveillance definition for an AIDS case was small, and similar in the various types of outpatient service (Table 7.13). The figure ranged from 0.6% in the mobile clinic to 1.2% in the district's one urban government clinic.

Table 7.13: Clinic attendances fitting WHO surveillance definition of an AIDS, 1998

Clinic type	Number of attendances who fitted the WHO surveillance definition for an AIDS case	Percentage of cases who fitted the WHO clinical case definition for an AIDS case [95%CI]
Government, rural (n=614)	4	0.65 [0.01, 0.1.29]
Government, urban (n=338)	4	1.18 [0.03, 2.33]
Government, mobile (n=316)	2	0.63 [0, 1.50]
Private, urban (n=623)	5	0.80 [0.10, 1.50]

7.6 Discussion

7.6.1 Summary of main findings

In Hlabisa District, these cross-sectional studies show that in 1998, when HIV seroprevalence among antenatal clinic attendees had reached 29%, the economic impact of HIV and AIDS on hospital medical services was substantial. Overall, HIV-related disease was responsible for approximately one-third of total medical ward admissions and costs, with tuberculosis the single most important diagnosis. Female medical services appear particularly badly affected, with HIV-related disease associated with considerably higher total costs and accounting for a larger share of overall ward costs compared with male medical services. There were also noticeable gender differences in the relative importance of different diagnoses. Outpatient services appear to be much less affected.

7.6.2 Interpretation of findings

7.6.2.1 How results can be linked with those of previous chapters

The fact that tuberculosis was the single largest impact re-enforces the findings of the studies reported in the two preceding chapters. Furthermore, the detailed and comprehensive nature of the data collected in this cross-sectional study – in particular the availability of HIV test results for a large, representative sample of medical ward admissions – sheds additional light on the data reported in those chapters.

Extent to which HIV-related admissions may explain growth in admissions 1991-1998

In Chapter 5, it was difficult to assess the extent to which the growth in adult medical ward admissions reflected the impact of the HIV/AIDS epidemic. This study found that 39% and 26% of admissions to the female and male medical wards were HIV-related in 1998. Translating these figures into additional demand is complicated by the fact that the number of non-HIV related admissions could have been affected by HIV-related pressure on services. However, they indicate that it is possible that HIV has caused an increase in demand for care of 64% (i.e. 39/61) and 35% (i.e. 26/74) on the female and medical wards respectively. Admissions grew 152% and 90% on these wards 1991-1998 (Chapter 5). HIV and AIDS may therefore account for around 40% of the increase in admissions to each ward 1991-1998.

Extent to which HIV-related morbidity explains rise in bed occupancy

In Chapter 6, a large rise in bed occupancy rates on both adult medical wards was documented. However, only part of this could be explained by HIV-attributable tuberculosis and non-tuberculosis AIDS, and it was noted that it was possible that other HIV-related admissions that could not be identified from available retrospective data might be responsible for some of the unexplained increase. This study demonstrates that HIV-related disease may account for more than half of the growth in bed occupancy, especially on the female medical ward.

Comprehensive assessment of impact of HIV on hospital services

The data reported in this chapter and in Chapter 6 are also complementary. Chapter 6 included an assessment of the costs associated with HIV-attributable tuberculosis in the hospital as a whole, and did not just focus on the medical wards. The cross-sectional study, while limited to the medical ward, produced data concerning HIV-related impacts besides tuberculosis and AIDS. In combination, they permit a comprehensive assessment of the magnitude of the impact of HIV/AIDS on adult hospital services in Hlabisa. The adult medical wards accounted for 20.1% of total hospital costs in 1998 (calculated from data used for the analyses in Chapter 6), so

that HIV-related morbidity as a whole on the medical wards can be estimated to be equivalent to 6% of total hospital costs[35] and non-tuberculosis HIV-related morbidity on these wards equivalent to 3.5%[36]. Chapter 6 showed that HIV-attributable tuberculosis accounted for an estimated 9% of total hospital costs. Overall, this means that HIV-related care for adults was accounting for approximately 12.5% of total hospital costs in 1998. If the impact of HIV on the paediatric medical ward is included, the figure may be close to 20%.

7.6.2.2 Gender differences

The difference between male and female hospital medical services is striking. The excess of female over male HIV-attributable admissions persisted even under extreme sensitivity analysis scenarios, so the difference appears unlikely to be due to chance. It is arguable that the scenarios that are most plausible are those where the number of tuberculosis admissions calculated to be attributable to HIV is at least as large as the number who met the WHO surveillance definition for an AIDS case, were HIV+, and were diagnosed with tuberculosis. For men, these were the scenarios that used the upper limit of the 95% confidence interval for odds ratios and an estimated community HIV prevalence of 20.3%; for women, they were those that used the upper end of the 95% confidence interval, and an estimated community HIV seroprevalence of 35.9%. The scenario in which community seroprevalence is 56% appears implausible: a prevalence of over 50% has not been reported anywhere for any general population, and it seems inconceivable that only 16% of male tuberculosis cases are attributable to HIV given the large increases in caseload that have been observed in recent years (see also Chapters 5 and 6). In the most plausible scenarios, the smallest gap in the share of ward costs accounted for by male and female HIV-attributable admissions is 24.5% vs 34.9%, with absolute costs for women 75% higher than those for men.

One explanation for the absolute difference in admission numbers and costs is that the female population is higher than the male population in Hlabisa, and that this is reflected in a higher total level of HIV-related morbidity. The 1996 census data show that, among those aged over 15, women outnumber men by an average ratio of 1.42:1; this reaches 1.67 in the age group 31-35 (Bronwyn Curtis, South African Medical Research Council, written communication, September 27th 1999). This could explain a large proportion of the differences observed in this study. Nonetheless, it cannot be the only explanation: if it was, the *relative* share of HIV-related morbidity in total morbidity should be the same. The fact that it is not suggests other factors must be important. One possibility is that HIV prevalence is higher among women than men. For most diagnoses, HIV prevalence among female admissions was higher than that of men.

However, other aspects of the data suggest that the differences are not only a reflection of differences in total population size or in the percentage of

[35] i.e. 0.30 x 0.201
[36] i.e.0.06 x 0.58

and women affected by HIV in the district. If this were the case, the ratio of women to men should be consistent for each type of diagnosis – or at least for non-tuberculosis diagnoses (studies in developing countries have typically found that tuberculosis notification rates are higher for adult men than for adult women (Holmes et al, 1998), as also suggested in Hlabisa by the fact that tuberculosis in HIV-negative individuals accounted for 11% of male ward costs but for only 3% of female ward costs). The ratio was the same for TB and non-TB AIDS, at approximately 1.5:1, which is almost exactly in line with the female to male population ratio. However, in the case of "other HIV-related diagnoses", there was a much larger excess of women compared to men – the ratio was 4.8:1. For "other HIV-related diagnoses", two possible explanations could be that HIV+ women are more prone to illnesses such as pneumonia and upper respiratory tract infections; another is that their health care seeking behaviour is different. For example, women may have a greater propensity than HIV+ men to seek care in government hospitals; or men may be more likely to be cared for at home. Further studies are required to understand the relative contribution and relevance of each of these factors.

7.6.2.3 Cost similarities between HIV+ and HIV- patients

It is noticeable that, on the whole, HIV+ and HIV-attributable admissions were not significantly more expensive to treat than HIV- patients. The dependency score results also indicate this would not be altered by adjusting costs for the average nursing dependency level of patients. The 2 exceptions where costs were significantly more for HIV+ patients were malaria and acute pneumonia – it is possible that this may be explained by higher rates of secondary complications, such as Gram-negative bacterial sepsis (especially salmonella).

One explanation for the general similarity in costs is that the HIV- patients now being admitted are, on average, more seriously ill than those who would have been admitted in the past. However, a review of retrospective case note data showed that the average patient dependency score, recorded by nurses at admission, was not significantly different to that in 1998 in either 1991 or 1995 (RA Reid, personal communication). In addition, the fact that patients with HIV-attributable disease cannot account for all of the increase in admissions since 1991 suggests that there has been no general decrease in the number of people admitted to hospital for non-HIV related causes: indeed, the reverse – a general increase in demand - is indicated. In the absence of the availability of anti-retroviral treatment or other expensive drugs for opportunistic infections, HIV/AIDS is therefore unlikely to be associated with a rise in particularly expensive types of admission. The main way in which it will affect costs is through increasing the volume of people requiring care.

7.6.3 Study limitations/methodological issues

7.6.3.1. Estimation of percentage of HIV+ admissions attributable to HIV

The main methodological issue that affected the adult medical ward study was the use of epidemiological techniques to estimate the costs attributable to HIV-related disease. While the methods used are standard ones, it was necessary to estimate the risk of exposure to HIV among disease-negative individuals using HIV seroprevalence data for women attending antenatal clinics (see also Chapter 6). Also, some imprecision in odds ratios is likely given the reliance on a sample of cases (patients) and controls (antenatal clinic attendees) only.

In practice, the results do not appear particularly sensitive to alternative plausible estimates of either the odds ratio or community HIV seroprevalence. Using different estimates of the odds ratio and community HIV seroprevalence, the 2 most plausible alternative scenarios other than the baseline analysis (defined as those in which the number of tuberculosis admissions estimated to be attributable to HIV was at least as high as the number of admissions known to fulfill the WHO surveillance definition for an AIDS case and to have an HIV+ test result) were (a) a scenario in which community HIV seroprevalence among men was assumed to be 20.3% and (b) the upper limit of the 95% confidence interval for odds ratios. Both produced similar results to those of the baseline analysis.

It is also worth commenting that HIV+ and HIV- adults in Hlabisa may be at equal risk of contracting malaria that is serious enough to warrant hospital admission. HIV prevalence among malaria admissions may therefore be an alternative way of estimating its level in the community as a whole. In this study, HIV prevalence was almost identical to the percentage suggested by the antenatal survey conducted in July 1998 (28.6% compared to 29%). The baseline analysis may therefore be based on a fairly accurate estimate of community HIV seroprevalence.

Overall, these considerations suggest that the results are robust, despite methodological limitations.

7.6.3.2 Limitations of retrospective analyses

The study provides evidence that the main limitation of retrospective analyses restricted to HIV-attributable tuberculosis and non-tuberculosis AIDS is that they will under-estimate the impact of HIV-related acute pneumonia and upper respiratory tract infections. The discrepancy was relatively small in the case of the male medical ward, due to the relatively low number of admissions with these diagnoses who did not fit the WHO surveillance definition for an AIDS case. However, on the female medical ward almost 50% of total HIV-related costs were estimated to be associated with patients with either acute pneumonia or upper respiratory tract

infections who did not fit this AIDS definition. In 1991, 1993 and 1995 on both wards, and in 1997 in the case of the male ward, the average length of stay of tuberculosis patients in Hlabisa Hospital was much longer than in 1998 (Chapter 6). In these years, it therefore seems likely that HIV-attributable acute pneumonia and upper respiratory tract infections accounted for a smaller share of total HIV-related costs compared to 1998, and that the impact of HIV/AIDS will not have been under-estimated by a margin as large as 50%. Nevertheless, it is clear that the impacts documented in Chapter 6 – serious as they are – underestimate the impact of HIV/AIDS on medical services.

Three other methodological points are worth highlighting from the medical ward study. One is that it was important to analyse the male and female wards separately – a combined analysis would have concealed important differences between them. Second, the cost analysis illustrates that economic impact assessments restricted to drugs alone (e.g. Armstrong, 1995) will produce major under-estimates of the economic consequences of HIV for health care services. Third, as has been suggested (Buvé, 1997), focusing on the percentage of patients with HIV infection, or the fraction of costs associated with HIV+ admissions, will produce a large over-estimate of the true impact of HIV/AIDS. In this instance, HIV+ patients accounted for 55% of total medical ward costs, while HIV-attributable admissions accounted for 30%. This demonstrates the importance of employing the epidemiological principles of attributable risk (see also Chapters 3 and 4).

The clinic studies show that attendances for severe late-stage HIV illnesses were comparatively low in 1998. Approximately 68% of all clinic visits are for curative care in Hlabisa District, so even in the urban government clinic less than 1% of all attendances fitted the WHO surveillance definition for an AIDS case. However, as with inpatient care, the study's restriction to identification of patients with clinical AIDS may produce a large under-estimate of the actual impact of the HIV epidemic.

7.6.4 Generalisability of findings, including comparisons with other studies

The way in which medical ward care is provided in Hlabisa is probably representative of many rural community hospitals in South Africa. Although the community-based tuberculosis programme is unusual – necessitating care in interpreting the results for the overall impact of HIV-attributable tuberculosis on hospitals (see also Chapter 6) – the impact of tuberculosis on the medical wards specifically is likely to be typical of any area where patients are admitted for diagnostic work-up. This suggests the findings of the adult medical ward study are likely to be generalisable to many other community hospitals located in rural areas where HIV seroprevalence has reached levels similar to that found in Hlabisa. In South Africa, such areas include the rest of rural KwaZulu-Natal, parts of the Eastern Cape and Free State, and Mpumalanga (Chapter 2 and 4).

The argument that the results are generalisable is strengthened by the fact that the similarity in costs between HIV+ and HIV- patients is consistent with data from Kenya and Zaire where the study design was very similar, and with previous studies of medical patients in South Africa (Chapter 3). The finding that tuberculosis is the largest single impact, both on the medical wards and in the context of the hospital as a whole, is consistent with research undertaken in rural Zambia in 1991 (Foster, 1996). It is also noteworthy that the result that 42% of HIV-related disease costs were accounted for by tuberculosis is identical to the figure reported in this Zambian study.

There is a paucity of published clinic data with which this study can be compared. The findings are consistent with a factory clinic study in Tanzania, where 3% of attendances were estimated to be HIV-related between 1991 and 1994 (Kikumbih et al, 1997); and with a 1991 study in Zambia that also found that 3% of clinic attendances had HIV-related disease (Foster, 1996). However, in parts of South Africa where tuberculosis is already a major health problem and where it is largely treated on an outpatient basis, the impact of HIV on clinics may be, or may become, much higher than these figures suggest. One important example of this may be Cape Town: in some clinics, approximately 50% of attendances are for tuberculosis treatment (Edina Sinanovic, Health Economics Unit, University of Cape Town, personal communication).

7.6.5 Future implications

7.6.5.1 Need for additional resources?

This study, like Chapters 5 and 6, suggests that in the early years of the HIV/AIDS epidemic at least, addressing the considerable pressure that the HIV epidemic places on hospital inpatient general medical and tuberculosis services needs to be the first priority for health care managers and planners. There appears to be a strong case for additional resources to be made available to the health sector in areas heavily affected by the HIV epidemic, at least at local district level (it is difficult to extrapolate to secondary and tertiary facilities, where the range of services is different and HIV-related morbidity may be lower in relation to particular service areas/wards or in the context of a facility as a whole). HIV appears to be associated with substantial increases in demand for care, and unless admissions or lengths of stay can be substantially reduced, medical ward and tuberculosis programme capacity in rural community hospitals is or will shortly become too low in the HIV era. This should be carefully considered in health sector and general provincial planning for the next decade at least, though additional studies to inform planning of secondary and tertiary level facilities are also required. Provision of additional resources goes against the present trend in budget allocations to the health sector. However, without additional capacity, the quality of the environment in which patients receive care seems likely to be poor and this may be aggravated by its likely detrimental impact on staff morale.

7.6.5.2 How pressure on services may be reduced without more resources

Changes in health seeking behaviour

There are two major ways in which pressure on services may be reduced without additional resources: changes in health care seeking behaviour, and major improvements in the efficiency with which care is provided.

Though the evidence to date is very limited, recent data from Tanzania and Kenya have suggested that fewer people with chronic HIV-related illnesses may seek hospital care as the epidemic matures (Chapter 3; see also comments in Discussion of Chapter 6). Explanations that were suggested in the Kenya study were that more care was being provided in the community, and that there might be a perception that hospitals have little to offer such patients (Arthur et al, 1998). This experience will not necessarily be repeated in South Africa; and if it is, it would imply major care needs at community level. However, to inform planning, this possibility should be monitored. The clinic and medical ward studies reported in this chapter serve as a valuable baseline, and should be repeated at regular intervals in future.

Guidelines for hospital admission policy

A general strategy for improving efficiency could be to carefully consider what care it is appropriate to provide in hospital, and to develop guidelines or protocols regarding admission policy. More specifically, with TB clearly the major impact in the early years of the epidemic at least, identifying ways to increase the efficiency with which diagnosis and treatment is provided should be the single most important priority.

Changes in diagnostic strategy for tuberculosis

Within Hlabisa, major improvements in the efficiency with which tuberculosis care is provided have already occurred (Chapter 6), and it will be difficult to match these in future. Length of stay by tuberculosis patients, and those with HIV-related disease in general, is already relatively short. Consideration of whether a change in diagnostic strategy for tuberculosis could avoid a large number of admissions may be worthwhile (see also Chapter 6).

Wider consideration of community-based treatment for tuberculosis

Beyond Hlabisa, community DOT programmes for TB are not the norm. Yet with the HIV/TB epidemic likely to be the major HIV-related impact on health services, it is possible that their more widespread use should be actively considered. The community-based DOT model implemented in Hlabisa is, however, innovative and radical in comparison with conventional approaches to tuberculosis care. To be more widely

advocated, its merits – including its possible economic advantages – need to be demonstrated.

The next chapter therefore addresses this issue. It reports a detailed economic evaluation undertaken in 1996, in which the Hlabisa DOT programme was directly compared with the major alternative approaches to tuberculosis treatment that are used in South Africa and sub-Saharan Africa as a whole.

CHAPTER 8: An economic evaluation of the "Hlabisa model" of community-based, directly observed therapy for tuberculosis[37]

8.1 Introduction

Chapters 5-7 have indicated that, during the early years of the HIV/AIDS epidemic at least, tuberculosis has had the single largest economic impact on health services in Hlabisa district. Within Hlabisa and in similarly affected areas of South Africa, this suggests that – especially in the context of constrained budgets – an important priority should be to identify which approaches to tuberculosis diagnosis and treatment are most affordable and cost-effective, and which can be implemented with available health system and community capacity.

Furthermore, tuberculosis is a disease of global significance. There are approximately 2 billion people infected with the tubercle bacillus and 8 million new cases each year - 2.5 million of which result in death (O'Brien, 1994). The only disease that comes close as a cause of death is measles (Murray et al, 1990). Unlike measles, TB is a disease that primarily affects adults - the most economically productive age group. It is estimated that TB accounts for 7% of all avoidable deaths in adults worldwide (ibid) and, in many developing countries - particularly in sub-Saharan Africa - the situation is worsening. This is the consequence of the HIV/AIDS epidemic, increasing poverty, and population growth. The identification of more affordable and cost-effective ways of providing tuberculosis care is therefore of very widespread relevance.

Designing programmes that are both low-cost and effective is not straightforward. Tuberculosis is a difficult disease to treat. Treatment lasts six months even with the shortest drug regimens recommended by the World Health Organization (WHO), and patients must take several tablets a day at least twice a week. Only a handful of tuberculosis control programmes in developing countries have been able to achieve WHO's target of an 85% cure rate. Those that have been successful have relied on either a lengthy period of hospitalisation or a strategy of Directly Observed Therapy (DOT). In Malawi and Tanzania (Davies, 1994), for example, International Union against Tuberculosis and Lung Diseases (IUATLD)-supported programmes have hospitalised patients for the first 2 months of treatment. In the late 1980s, they achieved cure rates of over 90%. More recently, DOT programmes in New York City, Hlabisa District, and

[37] This chapter has been published in three separate formats. The first is a full report including detailed appendices: Floyd K, Wilkinson D and Gilks CF "Community-based, directly observed therapy for tuberculosis: an economic analysis", South African Medical Research Council, Corporate Communications Division, Cape Town, February 1997. The second and third are papers: (1) Floyd K, Wilkinson D and Gilks CF "Comparison of cost effectiveness of directly observed treatment and conventionally delivered treatment for tuberculosis: experience from rural South Africa", BMJ 1997 Vol. 315: 1407-1411 and (2) Wilkinson D, Floyd K and Gilks CF "Costs and cost-effectiveness of alternative tuberculosis management strategies in South Africa – implications for policy" SAMJ 1997 Vol. 87:451-455.

selected parts of China have also reported high cure rates (Friedman, 1995; Wilkinson, 1994; China Tuberculosis Control Collaboration, 1996). WHO now advocates the "DOTS" strategy.

Economic evaluations of these approaches to tuberculosis treatment are scarce (see also Chapter 3). In Malawi, Mozambique and Tanzania, an analysis using data from 1984-1989 showed that short-course regimens delivered with two months hospitalisation at treatment outset were more cost-effective than standard regimens in terms of the cost per case cured and the cost per year of life saved (Murray et al, 1991). The cost per year of life saved by short-course tuberculosis treatment was estimated as US$1-3, suggesting that tuberculosis treatment was one of the most cost-effective health interventions available. In addition, the results suggested that – not surprisingly – ambulatory care would be a lower cost approach to treatment than hospital–based treatment. The cost-effectiveness of the two alternatives could not be compared, since there was no empirical evidence concerning the effectiveness of the ambulatory care alternative. A more recent study in Uganda (Saunderson, 1995) also indicated that a theoretical ambulatory care strategy would be lower cost than the country's conventional reliance on 2 months hospitalisation at treatment outset. Though there was no empirical evidence concerning what effectiveness the ambulatory strategy would achieve in practice, it was argued that it was likely to be the most cost-effective.

As of 1996, there had been no economic evaluations of community-based DOT programmes in Africa. This was despite the fact that community-based approaches have been suggested as one way of coping with the additional care needs generated by the continent's HIV/AIDS epidemic; despite the fact that WHO had begun to advocate the "DOTS" strategy; and, within South Africa, despite the fact that both DOT and use of community-based "treatment supporters" for observation of therapy were included in the Department of Health's tuberculosis treatment guidelines. The lack of such evaluations is not surprising given that community-based DOT programmes were, and remain, rare. In Sub-Saharan Africa in 1996, the only widely-known example of a rural district with a community-based directly observed therapy programme was Hlabisa.

Chapter 6 indicated that this innovative community-based DOT programme, implemented in Hlabisa since mid-1991, has been associated with some major economic benefits. However, this does not demonstrate that it is more affordable and cost-effective than available alternative approaches to care; nor does it prove that it is the strategy that makes best possible use of available health service and community capacity. It is conceivable that other strategies – such as providing the first two months of treatment in hospital and using different drug regimens, or reliance on sanitorium care - could be lower cost, more effective, more cost-effective, or a combination of all three. Even if less cost-effective, they might be sufficiently more effective to indicate that higher costs were worth the extra effectiveness.

This chapter therefore presents a detailed formal economic evaluation of the community-based DOT programme in Hlabisa, comparing it with alternative strategies that are widely used in Africa and with approaches that are recommended in South African Department of Health and international guidelines. It is designed to answer 4 key questions:

- Is the community-based DOT approach more affordable and cost-effective than available alternative approaches to care in Hlabisa district?
- Which approach to tuberculosis treatment is most feasible given existing health services and community capacity in Hlabisa district?
- Are the findings likely to be generalisable to other parts of South Africa and to other countries in sub-Saharan Africa?
- From an economic perspective, should the community-based DOT approach be abandoned in Hlabisa in favour of a better alternative, or should its implementation be seriously considered in other parts of South Africa and in sub-Saharan Africa as a whole?

The chapter is structured in three major sections. These are:

- **Methods (8.2)**, in which the major short-course tuberculosis case management strategies that were chosen for evaluation are described, choice of effectiveness measure is justified, the perspective of the evaluation made clear, the cost data required to enable an evaluation of the costs and cost-effectiveness of alternative management strategies are outlined, and sources of data briefly related. Analysis of cost data and cost-effectiveness calculations are also explained;
- **Results (8.3)**, in which a summary of the average health system and patient costs associated with each of the major components of any tuberculosis management strategy for Hlabisa district are shown, and the average costs and cost-effectiveness of the alternative management strategies when or if applied in Hlabisa are presented. Incremental cost-effectiveness and sensitivity analyses are included; and
- **Discussion (8.4)**, in which the results are summarized and explanations for them suggested, the generalisability of the findings beyond Hlabisa is considered, and implications for the future are suggested.

8.2 Methods

8.2.1 Description of alternative strategies

There are many different ways in which short-course TB case management may be organized. Five strategies were considered relevant for evaluation:

- the community-based DOT (CB-DOT) approach to TB management used in Hlabisa district since 1991;
- the approach to TB management used in Hlabisa district until 1991, which is also similar to the approach currently being implemented in much of South Africa;
- the conventional approach to TB management in much of sub-Saharan Africa, as implemented by the IUATLD and by several national country

programmes, which follows WHO guidelines (WHO, 1993) and involves 2 months hospitalisation at the beginning of treatment;
- the conventional approach to TB case management, involving two months of hospitalisation at treatment outset, plus the application of the South African Department of Health guidelines (South African Department of Health, 1996). In much of South Africa, this conventional approach is widely used. For example, in Mpumalanga, 75% of patients are initially treated in district hospitals or South Africa National Tuberculosis Association (SANTA) hospitals; the average length of stay is 1-2 months (Sawert, 1996a);
- sanitorium care, in which patients are hospitalised for the entire period of treatment but where the intensity of care provided – for example in terms of nurse:patient ratios – is typically much less than that associated with district hospital care.

The major components of any TB case management strategy after diagnosis are broadly similar, and may consist of most, or all, of the following elements:
- drug regimen;
- sputa examination;
- x-rays;
- hospital stay;
- outpatient visits to clinics/community health workers/supervisors/TB ward to collect drugs or for Directly Observed Therapy (DOT);
- supervision of patients/health staff/supervisors of DOT to encourage compliance with treatment; and
- programme management/audit.

Table 8.1 describes each of the alternative approaches that were evaluated in terms of these elements. The focus is on management after diagnosis: among all strategies, there is consensus that diagnosis relies on clinical examination, sputa microscopy and, where available, radiology.

8.2.2 Choice of effectiveness measure, sources of data, and calculation of cure rates

Cure was chosen as the measure of effectiveness. This is WHO's criterion for measuring programme success, and cure rates were available or could be estimated for all evaluated strategies. For the conventional approach to delivery of treatment, cure rates were estimated using outcome data from IUATLD-supported programmes in Tanzania in 1990 (Davies, 1994), and Malawi, 1989-93 (Harries et al, 1996) (Tables 8.2 and 8.3). For the strategy implemented in Hlabisa until 1991, data from a retrospective audit of completion of treatment rates among patients treated in 1990/91 were

Table 8.1: Summary of the major alternative approaches to short-course tuberculosis case management that were evaluated

Strategy	Drug regimen	Sputa examination	X-rays	Hospital stay	No. of outpatient visits for collection of pills or DOT	Supervision of patients or health staff/supervisors of DOT to encourage patient compliance	Programme management/ audit
Hlabisa until 1991	4HRZE + 4HE for adults; 2HRZ + 2HR or 2HRZ + 4HR for children	Patients invited to attend for sputa examination at completion of treatment	None	Initial 4 months of therapy	Once a month to a health clinic for collection of a 1-month supply of pills in the second 4 months of therapy	Not part of the management strategy	Not part of the management strategy
Hlabisa 1991-(Community-based DOT)	6HRZE for adults (both new and retreatment cases); 6HRZ for children (all types of case)	All cases before initiation of treatment	None	Average length of stay 17.5 days	Twice a week to a named supervisor for DOT for 24 weeks	2 fieldworkers organise choosing of named supervisors. 14 trips with vehicle and driver for delivery of patients and supervision of supervisors each month	20% of one Medical Officer's time on managing and auditing the TB programme
Conventional approach plus WHO Treatment Guidelines	2HRZE + 4HR or 2HRZS + 2HR (new cases) or 2HRZES + HRZE + 5HRE (retreatment cases) for adults; 2HRZS + 4HR or 2HRZS + 2HR for children, depending on type of TB.	Smear-positive cases should have their sputa examined at 2, 4 and 6 months for 6-month courses; at 3, 5 and 8 months for the 8-month retreatment course	Suggest 1 at end of treatment is useful	First 2 months for new patients; first 3 months for retreatment patients	At least once a month for monitoring, 3-7 times a week if DOT is being used (7 days in intensive phase of treatment; 3 days a week in continuation phase)	No clear guidance provided about whether or how this should/could be provided	Proper record-keeping/audit seen as essential
Conventional approach plus South African Department of Health Guidelines	2HRZE + 4HR (new cases) or 2HRZES + HRZE + 5HRE for adults (retreatment cases); 2HRZ + 4HR or 2HRZ + 2HR for children, depending on type of TB.	As above plus, for new cases, at 3 months if one sputum specimen still positive at 2 months, and at 5 rather than 4 months; at 2 rather than 3 months for retreatment cases	None after diagnosis	As above	Five times a week in the intensive phase of therapy for all non-hospitalised patients; three to five times a week in the continuation phase of treatment	No clear guidance	As above
Sanitorium care	As above for South African DoH guidelines	As above for South African DoH Guidelines	As above	Throughout treatment	N.A.	N.A.	Part of hospital care

* H=isoniazid; R=rifampicin; Z=pyrazinamide; E=ethambutol; S=streptomycin. Number before letters indicates number of months for which that combination of drugs is given

used. This showed that only 18% of the patients who could be traced had definitely completed treatment. The effectiveness of the community-based DOT approach was based on rigorous programme audit data, shown in Table 8.4 (Wilkinson et al, 1996).

Table 8.2: Treatment outcomes for smear-positive[38] tuberculosis patients in Tanzania

Time period	% cured	% who completed treatment but cure was not confirmed	% for whom treatment failed	% who died while on treatment	% who defaulted from treatment	% who left the district while on treatment
Jan-June 1990	79	3	1	8	4	5

Table 8.3: Treatment outcomes for smear-positive tuberculosis patients in Malawi, 1989-93

Year	% cured	% who completed treatment but cure was not confirmed	% for whom treatment failed	% who died while on treatment	% who defaulted from treatment	% who left the district during treatment
1989	80	0	0	5	2	13
1990	56	8	2	5	12	17
1991	40	3	3	8	33	13
1992	40	7	2	10	29	12
1993	52	7	3	12	16	10

Table 8.4: Treatment outcomes in Hlabisa 1991-4

Time period	% completing treatment	% who died while on treatment	% who defaulted from treatment	% who left the district during treatment	% who completed treatment out of those eligible to complete treatment within the district
1991-4	69.2	7.6	11.9	11.3	85.3

Cure rates (Table 8.5) were calculated in similar but not identical ways, depending on the data available. For the conventional approach, equation (1) was used to calculate the cure rate.

(1) cure rate = [{(% of patients for whom cure was confirmed) + (0.95 x % of patients who completed treatment but for whom cure was not confirmed)} ÷ {100 - (% of patients who died during treatment + % of patients who left the district during treatment)}] x 100

[2] pulmonary TB cases are categorised as smear-positive if laboratory investigation shows their sputa to contain TB bacilli; and as smear-negative if laboratory investigation produces a negative result. The term is not directly relevant to patients with extra-pulmonary forms of TB.

The percentage of patients who completed treatment but for whom cure was not confirmed was multiplied by 0.95 because evidence indicates that 95% of patients who complete treatment will be cured (Wilkinson et al, 1997e).

Table 8.5: Cure rates calculated for alternative management strategies

Management strategy	Source of data	Cure rate achieved
Conventional 2 months hospitalisation plus either WHO or South African Department of Health Guidelines	Tanzania 1990	94.1%
As above	Malawi 1989	97.6%
As above	Malawi 1990	81.5%
As above	Malawi 1991	54.2%
As above	Malawi 1992	59.8%
As above	Malawi 1993	75.2%
Hlabisa 1991-	Hlabisa 1991-4	81.0%
Hlabisa until 1991	Hlabisa 1991	17.1%

For the CB-DOT strategy, the cure rate was calculated using equation (2) below. Equation (1) could not be used because sputa are not examined at the end of treatment to verify cure, and thus there were no data concerning the number of patients for whom cure was confirmed or concerning the number of patients for whom treatment failed. It was therefore necessary to calculate the cure rate by assuming that 95% of those who complete treatment will be cured.

(2) cure rate = [(% of patients who completed treatment x 0.95) ÷ {(100 - (% of patients who died during treatment + % of patients who left the district during treatment)}] x 100

The limited data available concerning the effectiveness of the management strategy in place in Hlabisa until 1991 meant that equation (3) was used to estimate the cure rate.

(3) cure rate = (% of patients who had completed treatment out of those traced x 0.95)

The denominator in equations (1) and (2) excluded (a) all patients who died during treatment and (b) all patients who left the district during treatment. This was because their inclusion would have caused distortions to the analysis, for two main reasons. First, the varying number of patients dying while on treatment in the different places and times from which effectiveness data were available may reflect the varying impact of the HIV epidemic rather than the particular case management strategy being used. Second, the number of patients who leave the district during treatment is probably more a reflection of population mobility than of the case management strategy being used. Inclusion of patients who transferred during treatment would bias the analysis against places where populations are more transient. Excluding patients who fall into either of these categories therefore makes the data more truly comparable.

8.2.3 Perspective of the evaluation

The evaluation was undertaken from a societal perspective i.e. both health system and patient/community costs incurred in case management were assessed. This gives the most complete picture of the costs of different strategies - for example, simply focusing on health system costs may result in very important costs to patients and the community being ignored. Indeed, keeping patient/community costs as low as possible may be the key to achieving high compliance with treatment, and so it was considered critical to assess what these costs were. Moreover, the community is involved in the existing Hlabisa management strategy, and so it was important to consider the costs imposed on non-health workers involved in supervision of treatment.

8.2.4 Costing

8.2.4.1 Type of costs considered

The average costs of each component of care - a day in hospital, a hospital outpatient visit, a clinic visit, a visit to a community health worker, a visit for DOT, different drug regimens, organization and overall supervision of DOT by fieldworkers, overall programme management, an x-ray, and a sputum smear examination – were calculated individually. The focus was on average costs because these are considered most relevant when considering issues of national policy relevance – such as a country's choice of tuberculosis control strategy (BMJ Guidelines, 1996). Costs are reported in 1996US$, using the exchange rate prevailing in May 1996 (US$1=R4.3).

8.2.4.2 Sources of data

Sources of health services cost data in Hlabisa included budget and expenditure files for the hospital and the district as a whole, the district payroll, published drug prices, published pay scales for established positions, vehicle logbooks, laboratory workload records, x-ray department record books, and midnight bed state statistics. They also included face-to-face or telephone interviews with medical equipment company directors, quantity surveying firm employees, architects, medical staff, nursing staff, personnel officers, administrators, drivers, laboratory and x-ray department staff, and fieldworkers. The cost of a day in a sanitorium was based on a figure quoted by a SANTA official (M. Stafford, personal communication, May 22nd 1996).

Patient costs were estimated by administering a structured patient questionnaire (see Appendix 6) to all patients on the TB ward at Hlabisa Hospital in May 1996 who were eligible for treatment outside the hospital i.e. they were not so sick that the only option was to keep them in hospital, and their treatment was therefore to be managed using the community-based DOT strategy. More than 90% of all patients were managed using this approach in 1995. Forty-eight patients were interviewed. This sample size should be large enough to obtain reasonably precise estimates of the

parameters of interest, and represented 6.6% of the total number of patients to be managed in a year and 13.2% of the total being managed at any one point in time (given that treatment lasts 6 months). Patients were asked about the time and travel costs associated with time spent in hospital and with visits to different types of health facility or non-health worker treatment supervisors, average incomes, and any other economic losses (e.g. loss of job) that had been associated with tuberculosis treatment.

Qualitative research results were used to estimate the costs incurred by the community in observing treatment[4]. They suggested that supervision does not involve any cost to supervisors - observing treatment is straightforward, because the patient visits the supervisor there is no time cost, and no inconvenience appears to be incurred. Indeed, it seems that supervisors positively welcome their role in TB management. The time and travel costs incurred by those accompanying a patient when they visit health facilities or supervisors were estimated using the patient survey.

8.2.4.3 Allocation of joint costs

In calculating the average cost of a day in hospital, a hospital outpatient visit, and a sputum smear, some joint costs needed to be allocated. 92.5% of the costs associated with staff not involved in direct patient care were allocated to inpatient care. With the exception of laboratory, medicine and x-ray supply expenditure – items that were costed separately - 92.5% of hospital non-personnel recurrent expenditure was also allocated to inpatient care. This figure was in line with the fraction of total nursing and medical staff costs accounted for by inpatient care. Laboratory staff costs were allocated to sputum smears in proportion to the percentage of the total number of laboratory tests for which they accounted (4.1%). It was also assumed that the cost of a visit by a tuberculosis patient to a community health worker and a health clinic was the same as that for any other patient.

8.2.4.4 How costs were estimated when monetary values were not readily available

The time costs associated with patient visits to health facilities or non-health worker observers of treatment were translated into monetary values using average incomes reported in the patient survey. One hour of time was valued as equivalent to the average income that could have been earned through economically productive work in that time.

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[4] See Coleman R, Wilkinson D, McAdam K. *Voluntary Lay Supervisors of Directly Observed Therapy for Tuberculosis in Africa*, unpublished data available from Professor D. Wilkinson, Head, Department of Rural Health, University of South Australia (Whyalla Campus), Australia.

8.2.4.5 How capital costs were handled

Capital costs, i.e. buildings, vehicles and equipment were annualized using 1996 purchase prices, reasonable assumptions about expected useful life (30 years for buildings, 10 years for equipment, and 5 years for vehicles), and a discount rate of 8%. A discount rate of 8% was chosen because this was the difference between the interest rate paid on government treasury bills in 1996 (quoted by the South African Reserve Bank) and the inflation rate predicted for 1996 at the time of the study.

8.2.4.6 Calculation of the total cost per patient for each strategy

The total cost to manage a patient from diagnosis to completion of treatment was calculated in two steps. First, the average cost of each component of care (e.g. hospital stay; sputum smears) was multiplied by the average quantity of times (as defined by the management strategy) that the cost was incurred per patient (e.g. number of days spent in hospital; number of sputum smear examinations done). Second, the total costs of each individual component were summed.

8.2.5 Cost-effectiveness analysis

The cost-effectiveness of each alternative management strategy was calculated in three steps. First, the cost of managing a patient to treatment completion was calculated. This cost applied to cured patients, and to patients who completed treatment but for whom cure was not confirmed or for whom treatment failed. For patients who did not complete treatment, a minimum and maximum cost were calculated. The minimum cost for a patient not completing treatment was calculated based on the assumption that the earliest point at which default occurs would be at discharge from hospital. The maximum cost for a patient not completing treatment was calculated by making the assumption that only the last hospital/DOT visit (as appropriate given the management strategy) was not made. Second, the cost-effectiveness calculations were based on one of the two equations shown below. Given the effectiveness data available (see section 8.1.2), the first was appropriate for strategies following the WHO Guidelines.

(1) Cost-effectiveness = [{(cost of a cured patient) x (% of patients cured + % of treatment failures + % of patients who completed treatment but whose cure was not confirmed)} + {(minimum/maximum cost of a patient not completing treatment) x (% of patients not completing treatment)}] ÷ cure rate

The second was appropriate for the two management strategies that have actually been applied in Hlabisa.

(2) Cost-effectiveness = [{(cost of a cured patient) x (estimated % of patients cured + estimated percentage of patients who complete treatment but for whom treatment fails)} + {(minimum/maximum cost of a patient not completing treatment) x (% of patients not completing treatment)}] ÷ cure rate

8.2.6 Incremental and sensitivity analysis

Some strategies have achieved higher effectiveness than others in terms of the percentage of patients cured. They were also found to be more expensive, so an incremental analysis was considered worthwhile. Sensitivity analyses were undertaken to assess if results were robust to realistic changes in key parameters.

8.3 Results

8.3.1 Average health system costs for each component of care

The average health system associated with each component of tuberculosis case management in Hlabisa District, in 1996, are shown in Table 8.6.

Table 8.6: Average health system costs for each component of tuberculosis care in Hlabisa District in 1996 (1996US$)

Cost item	Average Cost
Day in hospital (excluding drugs and investigations)	27.8
Hospital outpatient visit (excluding drugs and investigations)	16.7
Health clinic visit (excluding drugs and investigations)	6.4
Community health worker visit	1.6
DOT visit, assuming 1995 pattern of DOT (56.3% use non-health workers, 20.6% use CHWs, 21.4% use health clinics, 1.7% use TB ward)	1.7
Drug regimen[2], Hlabisa until 1991	43.1
Drug regimen, Hlabisa 1991-	30.3
Drug regimen, South African Department of Health Guidelines	41.4
Drug regimen, WHO Guidelines	54.1
Supervision from Hlabisa with one vehicle and 2 fieldworkers[1]	38.9
Management/audit from Hlabisa Hospital, assuming 20% of a Medical Officer's time is devoted to these duties[1]	5.7
X-ray	5.6
Sputum examination	1.5

[1]average cost per patient

[2]drug costs are averages across all categories: adults and children, different patient weights, and different drug regimens for the management approaches which differentiate between new and retreatment cases. Using the average cost makes presentation of the data much clearer.

Average health system costs tended to decrease from the highest level of care (the hospital) to the most basic level of care provided by community health workers (CHWs). Cost differences among drug regimens were relatively small. They ranged from US$30.3 to US$54.1 per patient - a difference that was less than the cost of 1 day in hospital. Supervision of supervisors using a vehicle and fieldworkers was only inexpensive,

equivalent to the cost of 1.4 days in hospital. X-rays, laboratory tests and programme management were relatively minor costs.

8.3.2 Average costs incurred by patients for each component of care

Patient costs associated with different elements of tuberculosis treatment are shown in Table 8.7.

Table 8.7: Average costs incurred by patients for each component of tuberculosis care in Hlabisa District (1996US$)

Cost item	Average Cost
Health clinic visit	2.6
Hospital visit	9.7
DOT visit to hospital TB ward, where TB ward chosen for supervision	1.0
DOT visit to a health clinic, where a health clinic is chosen for supervision	0.7
DOT visit to a CHW, where a CHW is chosen as a 'named supervisor'	0.5
DOT visit to non-health worker, where a non-health worker supervisor is chosen as a 'named supervisor'	0.3
DOT visit, overall (with 56.3% using non-health workers, 21.4% using health clinics, 20.6% using CHWs and 1.7% using the hospital TB ward)	0.4
Day in hospital[1]	4.0

[1]Fees are not charged, so this cost represents only estimated cash income losses

The highest costs were for a visit to, and time spent in, hospital. DOT visits were relatively low-cost, especially if the supervisor was a non-health-worker.

8.3.3 The average cost and cost-effectiveness of the alternative management strategies

The cost breakdown and cost-effectiveness of the five alternative management strategies are covered, in turn, in sub-sections 8.3.3.1-8.3.3.5.

For strategies following either the WHO Guidelines or the South African Department of Health Guidelines, cost breakdowns and the cost-effectiveness analyses are presented for new cases and retreatment cases separately. This is because there are clear differences in their recommended approaches to case management for retreatment and new cases (see Table 8.1), and these have important cost implications. In Hlabisa in 1995, 77.5% of patients were new cases and 22.5% were retreatment cases.

8.3.3.1 Average cost and cost-effectiveness of the Hlabisa CB-DOT model

1. Cost breakdown

The total cost of managing a patient to treatment completion using the Hlabisa CB-DOT model was US$733.8 (Table 8.8). Most of this cost - 87.5% - represented costs borne by the health system. The most significant cost was the hospital stay at treatment outset. This accounted for 76% of total health system costs, 78% of total patient costs, and for 76% of management costs overall. The next most important cost item was DOT visits, which accounted for 13% of total health system costs, 22% of total patient costs, and for 14% of costs overall. Supervision of supervisors using a vehicle and fieldworkers, at US$38.9, was a relatively small cost, as were drugs and programme management.

Table 8.8: The average cost of case management per patient, Hlabisa CB-DOT model (1996US$)

Health system costs

Cost item	Cost (% total)
17.5 days in hospital	486.5 (76)
Drugs	30.3 (5)
48 visits for DOT (average cost assuming 56.3% are managed by non-health workers, 20.6% by CHWs, 1.7% at the hospital TB ward and 21.4% at health clinics, as in 1995)	81.6 (13)
Supervision with 1 vehicle and 2 fieldworkers	38.9 (6)
Management/audit	5.7 (1)
Total	643.0

Patient costs

Cost item	Cost (% total)
17.5 days in hospital	70.0 (78)
48 visits for DOT	19.2 (22)
Total	89.2

Total costs

Cost item	Cost (% total)
Health system costs	642.2 (88)
Patient costs	89.2 (12)
Total	732.2

2. Cost-effectiveness

The cost-effectiveness of the Hlabisa CB-DOT model ranged from US$880.8 to US$903.6 per patient cured (Table 8.9).

Table 8.9: Cost-effectiveness of the Hlabisa CB-DOT model (1996US$)

Cost for a cured patient (% patients in this category)	**Cost for a patient who completed treatment but was not cured (% of patients in this category)**	**Minimum/ Maximum cost[1] for a patient not completing treatment* (% patients in this category)**	**Cure rate**	**Cost/patient cured**
732.2 (81)	732.2 (4.3)	605.9/ 730.3 (14.7)	81%	880.8 to 903.6

[1]The minimum cost assumes a patient defaults immediately after hospital discharge; the maximum cost assumes only the very last drug dose is missed.

3. Cost-savings resulting from utilisation of non-health workers in treatment supervision

Considerable cost-savings were associated with the involvement of lay people in observation of tuberculosis treatment. The cost to the health system of DOT visits using health clinics only would be, on average, US$307.2 per patient, rather than the US$81.6 that applied with the involvement of non-health workers. This represented a saving of US$225.6 per patient, reducing the total cost to the health system of managing a TB patient to treatment completion by 24%. From the patient's point of view, using non-health worker supervisors rather than relying only on clinics reduced the cost of DOT visits from US$124.8 to US$19.2. This was an average cost saving of US$105.6, or 54%, per patient. Overall, using non-health workers reduced the cost of managing a TB patient to treatment completion by 31%.

8.3.3.2 Average cost and cost-effectiveness of the management strategy in place in Hlabisa until 1991

1. Cost breakdown

The cost of managing a patient to completion of treatment using the management strategy in place until mid-1991 was US$3 949.7 (Table 8.10). This is 5.4 times more expensive than the CB-DOT strategy. As with CB-DOT, hospitalisation represented the largest cost item, and all other cost components were comparatively unimportant.

Table 8.10: The average cost of case management per patient, management strategy used until mid-1991

Health system costs

Cost item	Cost (%)
120 days in hospital	3 336.0 (97)
Drugs	43.1 (1)
4 x-rays	22.4 (0.7)
5 sputa for smear-positive cases, average 3 per patient	4.5 (0.1)
4 health clinic visits for adults, 2 for children, average 3.6 per patient	23.0 (0.7)
1 outpatient hospital visit at completion of therapy	16.7 (0.5)
Total	3 445.7

Patient costs

Cost item	Cost (%)
120 days in hospital	480 (95)
4 health clinic visits for adults, 2 for children, average 3.6 per patient	9.4 (2)
Hospital visit at completion of therapy	9.7 (2)
Return visit home after 4 months in hospital	4.9 (1)
Total	504.0

Total costs

Cost item	Cost (%)
Health system costs	3 445.7 (87)
Patient costs	504.0 (13)
Total	3 949.7

2. Cost-effectiveness

The estimated cost-effectiveness of the approach to care used until 1991 was between US$22 631.7 and US$22 965.7 per patient cured (Table 8.11). This made it, at best, 25 times less cost-effective than the CB-DOT management strategy.

Table 8.11: Cost-effectiveness of the approach to tuberculosis case management used in Hlabisa until 1991

Cost for a cured patient (% patients in this category)	Cost for a patient who completed treatment but was not cured (% of patients in this category)	Minimum/maximum cost for a patient not completing treatment (% of patients in this category)	Cure rate	Cost per patient cured
3 949.7 (17.1)	3 949.7 (0.9)	3 852.6 to 3 922.2 (82)	17.1%	US$22 632.0 to US$22 965.8

8.3.3.3 Average cost and cost-effectiveness of the Conventional Approach used in much of sub-Saharan Africa - 2 months hospitalisation plus WHO Guidelines

8.3.3.3.1 New cases

1. Cost breakdown

The total cost of managing a new tuberculosis case to completion of treatment, using the conventional approach and WHO guidelines, was US$2 060.2 (Table 8.12). This was 2.8 times more expensive than the existing Hlabisa CB-DOT management strategy. Once again, the period spent in hospital was the most important cost item, accounting for 94% of health system costs, 89% of patient costs, and 93% of costs overall.

Table 8.12: Cost of conventional approach to case management – 2 months hospitalisation plus WHO guidelines

Health system costs

Cost item	Cost (%)
60 days in hospital	1 668.0 (93)
1 outpatient visit at 4 months for sputa collection for smear-positives, 1 outpatient visit at 6 months for all patients, average 1.56 visits/patient*	26.1 (1)
Drugs	54.1 (3)
4 health clinic visits for monitoring	25.6 (1)
1 X-ray	5.6 (0.3)
6 sputa for smear-positive patients, average 3.3 per patient	5.0 (0.3)
Programme management/audit	5.7 (0.3)
Total	1 790.1

Patient costs

Cost item	Cost (%)
60 days in hospital	240 (88.9)
4 health clinic visits	10.4 (3.8)
1 outpatient visit to hospital for sputa examination for smear-positives at 4 months, 1 outpatient visit for all patients at 6 months for an X-ray, average 1.56 visits/patient	15.1 (5.5)
Return visit home after hospital discharge	4.9 (1.8)
Total	270.1

Total costs

Cost item	Cost (%)
Health system costs	1 790.1 (87)
Patient costs	270.1 (13)
Total	2 060.2

*This assumes that of the new cases, 74.2% are adults, as in Hlabisa in 1995. Of the adults, 75% are smear-positive. Therefore overall, 55.6% of new cases are smear-positive. Hence average of 0.556 x 1 visits for sputa examination at 4 months = 0.56.

2. Cost-effectiveness

The estimated cost-effectiveness of the conventional strategy with WHO guidelines, in a best and worst case scenario (outcomes achieved in Malawi in 1989 and 1991), varied from US$2 108.1 to US$3 773.6 (Table 8.13).

Table 8.13: Cost-effectiveness of the conventional approach for new cases– 2 months hospitalisation plus WHO guidelines

Scenario	Cost for a cured patient (% of patients falling in this category)	Cost for a patient who completes treatment but for whom cure is not confirmed or treatment fails (% of patients in this category)	Minimum/ maximum cost* for a patient who does not complete treatment (% of patients in this category)	Cure rate (%)	Cost/cured patient
Worst case scenario	2 060.2 (50.6)	2 060.2 (7.6)	1 949/ 2 004.8 (41.8)	54.2	3 730.6 to 3 773.6
Best case scenario	2 060.2 (97.6)	2 060.2 (0)	1 949/ 2 004.8 (2.4)	97.6	2 108.1 to 2 109.5

This made the strategy up to 10.5 times more cost-effective than the management strategy in place in Hlabisa until 1991, but, at best, 2.9 times less cost-effective than the CB-DOT strategy.

8.3.3.3.2 Retreatment cases

1. Cost breakdown

The total cost for managing a retreatment patient to treatment completion using the conventional approach and WHO guidelines was, at US$3 065.5, 4.2 times more than the CB-DOT strategy and 78% of the cost of the approach used prior to mid-1991. Hospitalisation was the major cost item. Drugs, though more expensive than those used to treat new cases, accounted for only 4% of total health system costs.

2. Cost-effectiveness

The cost-effectiveness of the conventional approach to treatment, plus WHO guidelines, was US$3 138.0 to US$5 622.4 (Table 8.15). This was a big improvement on the approach used in Hlabisa until 1991. It was, at best, 3.5 times less cost-effective than the existing CB-DOT strategy.

Table 8.14: Average cost of managing a patient to treatment completion, conventional approach plus WHO Guidelines, retreatment cases

Health system costs

Cost item	Average cost (%)
90 days in hospital	2 502 (94)
Drugs	98.3 (4)
1 X-ray	5.6 (0.2)
6 sputa for smear-positive patients, average 4.5 per patient*	6.8 (0.3)
4 health clinic visits for monitoring/collection of pills	25.6 (1)
1 hospital outpatient visit for sputa collection at 5 months for smear-positives, 1 visit for all patients at 8 months for x-ray and sputa examination, average 1.75 visits per patient[1]	29.2 (1)
Programme management/audit	5.7 (0.2)
Total	2 673.2

Patient costs

Cost item	Average cost (%)
90 days in hospital	360 (92)
4 health clinic visits for monitoring/collection of pills	10.4 (3)
2 hospital visits for sputa collection for smear-positives at 5 months, 1 hospital visit for all patients at 8 months for x-ray and, for smear-positives, sputa examination; average 1.75 per patient[1]	17.0 (4)
Return trip home from hospital after hospital discharge	4.9 (1)
Total	392.3

Total costs

Cost item	Average cost (%)
Health system costs	2 673.2 (87)
Patient costs	392.3 (13)
Total	3 065.5

[1]This assumes 75% of retreatment cases are smear-positive, as in Hlabisa in 1995.

Table 8.15: Cost-effectiveness of conventional approach plus WHO Guidelines, retreatment cases

Scenario	Cost for a cured patient (% of patients in this category)	Cost for a patient who completes treatment but for whom cure is not confirmed or treatment fails (% of patients in this category)	Minimum/ Maximum cost* for a patient who does not complete treatment (% of patients in this category)	Cure rate (%)	Cost/cured patient
Worst case scenario	3 065.5 (50.6)	3 065.5 (7.6)	2 947.3/ 3 022 (41.8)	54.2	5 564.7 to 5 622.4
Best case scenario	3 065.5 (97.6)	3 065.5 (0)	2 947.3/ 3 022.1 (2.4)	97.6	3 138.0 to 3 139.8

8.3.3.4 Average cost and cost-effectiveness of case management: Conventional approach of 2 months hospitalisation, plus South African Department of Health Guidelines

8.3.3.4.1 New cases

1. Cost breakdown

The total cost of managing a patient to treatment completion using the conventional approach and South African Department of Health Guidelines was US$2 087.9 (Table 8.16). As with the other management strategies, hospitalisation was the most important cost component, accounting for 92% of health system costs, 87% of patient costs, and 91% of costs overall.

Table 8.16: Average cost of managing a patient to treatment completion, conventional approach plus South African Department of Health guidelines, new cases

Health system costs

Cost item	Average cost (%)
60 days in hospital	1 668 (92)
Drugs	28.4 (2)
6 sputa for smear-positives, average 3.3/patient	5.0 (0.3)
50 visits for DOT (three visits per week for the 4 months of treatment spent as an outpatient)	85 (5)
Programme management/audit	5.7 (0.3)
2 outpatient hospital visits for collection of sputa at 5 and 6 months by smear-positive patients, average 1.1/patient	18.4 (1)
Total	1 810.5

Patient costs

Cost item	Average cost (%)
60 days in hospital	240 (87)
50 visits for DOT	20 (8)
2 hospital visits by smear-positives for sputa collection at 5 and 6 months, average 1.1 visits/patient	10.7 (4)
Return trip home from hospital after discharge	4.9 (2)
Total	275.6

Total costs

Cost item	Average cost (%)
Health system costs	1 810.5 (87)
Patient costs	275.6 (13)
Total	2 086.1

2. Cost-effectiveness

Cost-effectiveness ranged from US$2 133.8 to US$3 848.4 per patient cured (Table 8.17). This made the management strategy less cost-effective than the conventional approach with WHO guidelines. At best, it was 2.4 times less cost-effective than the CB-DOT strategy.

Table 8.17: Cost-effectiveness of conventional approach plus South African Department of Health Guidelines, new cases

Scenario	Cost for a cured patient (% of patients in this category)	Cost for a patient who completes treatment but for whom cure is not confirmed or treatment fails (% of patients in this category)	Minimum/ maximum cost* for a patient who does not complete treatment (% of patients in this category)	Cure rate (%)	Cost/cured patient
Worst case scenario	2 086.1 (50.6)	2 086.1 (7.6)	1 938.1/2 085.5 (41.8)	54.2	3 734.8 to 3 848.4
Best case scenario	2 086.1 (97.6)	2 086.1 (0)	1 938.1/2 085.5 (2.4)	97.6	2 133.8 to 2 137.4

8.3.3.4.2 Retreatment cases

1. Cost breakdown

The cost of managing a retreatment case to treatment completion with the conventional approach plus South African Department of Health Guidelines was US$2 220. This made it 3 times more expensive than the current Hlabisa management strategy, 56% of the cost of the management strategy in place in Hlabisa until 1991, and 72% of the cost of the WHO recommended strategy for retreatment patients. As for the other management strategies, hospitalisation was the most important cost component.

2. Cost-effectiveness

The cost-effectiveness of care for retreatment cases using the conventional approach plus the South African Department of Health Guidelines ranged from US$2 268.4 to US$4 092.4 (Table 8.19). It was more cost-effective than the management strategy that would be used if WHO Guidelines were followed, and much more cost-effective than the strategy in place until 1991. It was, at best, 2.5 times less cost-effective than the CB-DOT approach.

Table 8.18: Cost of managing a retreatment case to treatment completion, conventional approach plus South African Department of Health Guidelines

Health system costs

Cost item	Average cost (%)
60 days in hospital	1 668 (87)
Drugs	86.3 (5)
6 sputa for smear-positive patients, average 4.5 per patient	6.8 (0.4)
78 visits for DOT (last 6 months of treatment, three times per week), assuming pattern of supervisor choice in Hlabisa in 1995	132.6 (6.9)
Programme management/audit	5.7 (0.3)
2 outpatient visits for collection of sputa at 7 and 8 months for smear-positive patients, average 1.5 visits per patient	25.1 (1)
Total	1 924.5

Patient costs

Cost item	Average cost (%)
60 days in hospital	240.0 (82)
78 visits for DOT	31.2 (12)
2 hospital outpatient visits for sputa examination for smear-positives, average 1.5 visits/patient	19.4 (5)
Return trip home from hospital after discharge	4.9 (2)
Total	295.5

Total costs

Cost item	Average cost (%)
Health system costs	1 924.5 (87)
Patient costs	295.5 (13)
Total	2 220

2. Cost-effectiveness

Table 8.19: Cost-effectiveness of case management for retreatment patients: Conventional approach plus South African Department of Health Guidelines

Scenario	Cost for a cured patient (% of patients in this category)	Cost for a patient who completes treatment but for whom cure is not confirmed or treatment fails (% of patients in this category)	Minimum/ maximum cost* for a patient who does not complete treatment (% of patients in this category)	Cure rate (%)	Cost/cured patient
Worst case scenario	2 220 (50.6)	2 220 (7.6)	1 966.9/2 215.5 (41.8)	54.2	3 900.7 to 4 092.5
Best case scenario	2 220 (97.6)	2 220 (0)	1 966.9/2 215.5 (2.4)	97.6	2 268.4 to 2 274.5

8.3.3.5 Average cost and cost-effectiveness of case management if patients are hospitalised for the entire treatment period

The final management strategy – hospitalisation for the entire treatment period in a sanitorium – cost US$2 640.5. This was 3.6 times more

1. Cost breakdown

Table 8.20: Cost of managing a patient to treatment completion, sanitorium care

Health system costs

Cost item	Average cost (%)
182 days in hospital for new cases, 240 days for retreatment cases, average 195 days	1 814.0 (97.5)
Drugs	41.4 (2.2)
6 sputa for smear positives, average 4.5 for retreatment cases and 3.3 for new cases, average overall of 3.6/patient	5.4 (0.3)
Total	1 860.5

Patient costs

Cost item	Average cost (%)
195 days in hospital	780 (100)
Total	780

Total costs

Cost item	Average cost (%)
Health system costs	1 860.5 (70.5)
Patient costs	780 (29.5)
Total	2 640.5

expensive than the CB-DOT strategy. Not surprisingly for a management approach that relies on hospitalisation for the entire period of treatment, the cost of hospital stay outweighed all other costs.

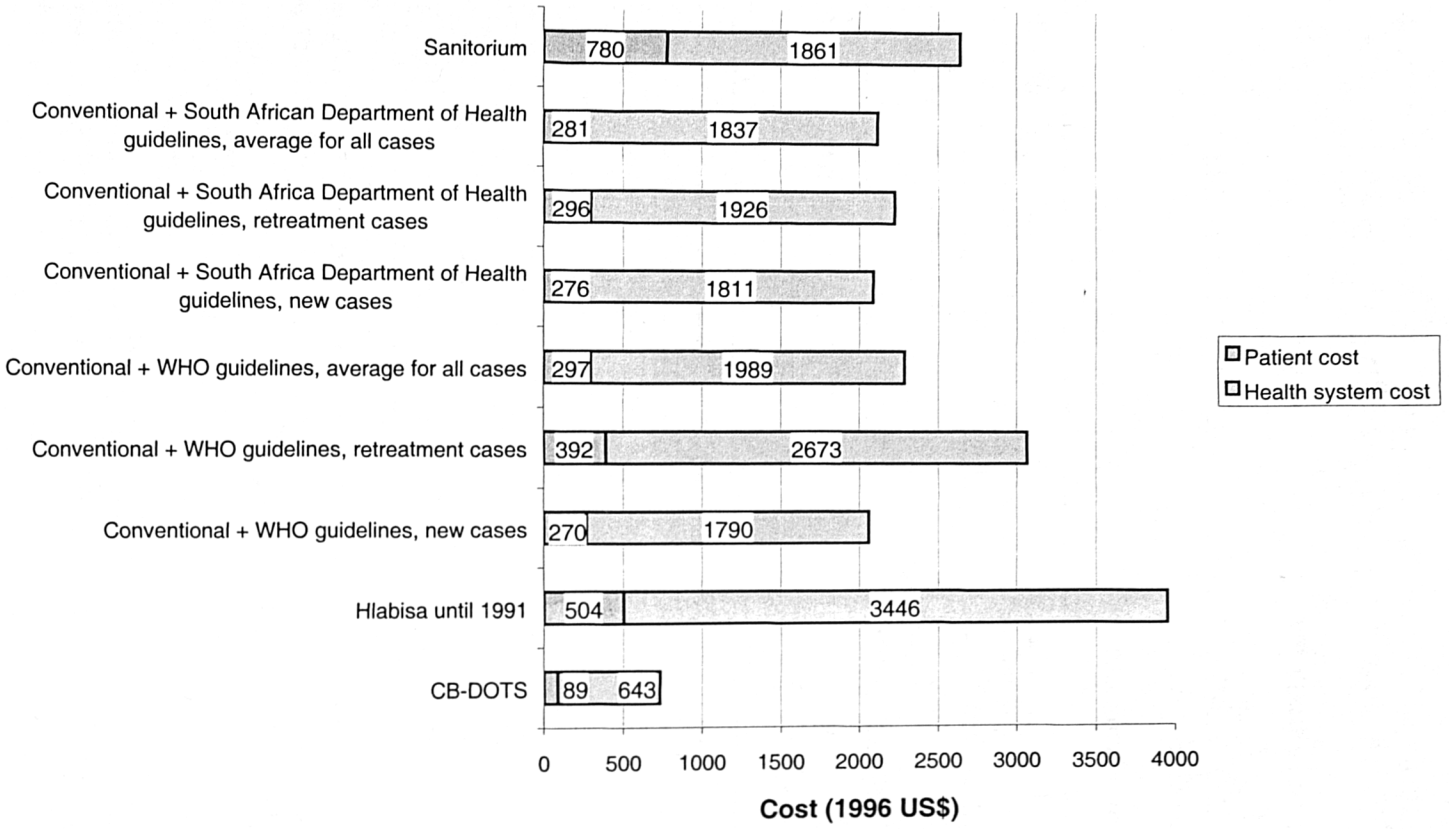
2. Cost-effectiveness

The cost-effectiveness of this approach, assuming all patients would complete treatment and that 95% of these would actually be cured, was US$2 779.5 per patient.

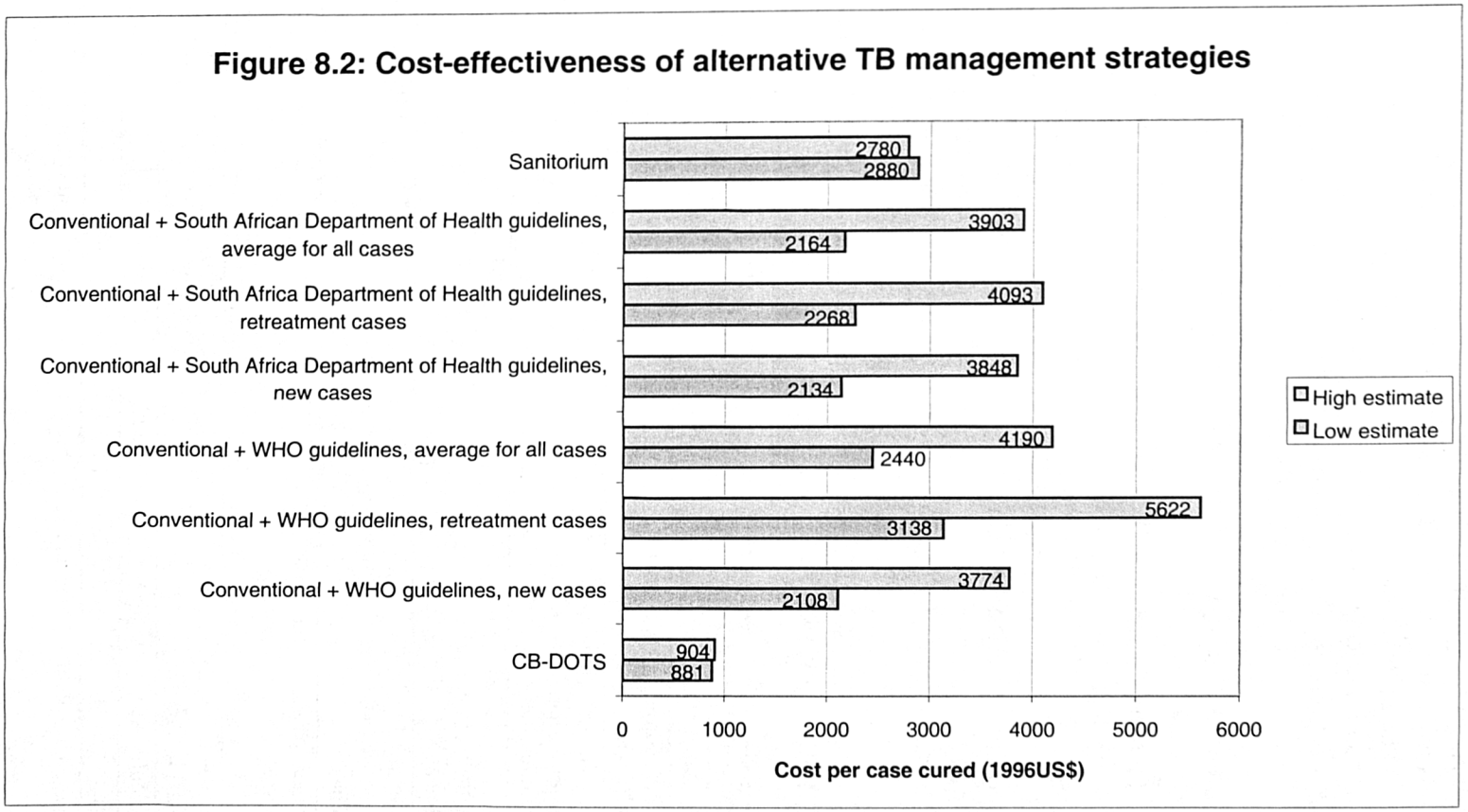
8.3.4 Summary of the average costs and cost-effectiveness of the alternative management strategies

The costs and cost-effectiveness of the different management strategies, when applied in Hlabisa, are summarized in Figures 8.1 and 8.2.

Figure 8.1: Summary of average cost of alternative approaches to TB case management in Hlabisa District in 1996



Average cost per patient for Department of Health and WHO Guidelines based on 22.5% and 77.5% being retreatment and new patients respectively, as in Hlabisa in 1995



Average cost effectiveness for Department of Health and WHO Guidelines based on 22.5% and 77.5% of patients being retreatment and new patients respectively, as in Hlabisa in 1995

8.3.5 Incremental cost-effectiveness analysis

Strategies which have followed the WHO Guidelines and involved hospitalisation for the intensive phase of treatment have achieved treatment cure rates as high as 97.6%. This is a higher cure rate than that achieved with the existing Hlabisa model of CB-DOT, but the strategy was also found to be higher cost. An incremental cost-effectiveness analysis showed that the additional cost per case cured, in this best-case scenario, was US$8 096.7 i.e. [{(2 108.1 x 97.6) - (US880.8 x 81)} ÷ 16.6 = US$8096.7].

8.3.6 Sensitivity analysis: the cost of a day in hospital

The cost results showed that the most important influence on the total costs of every management strategy was the cost of a day in hospital. To assess the consequences of much lower hospital costs for the ranking of alternative strategies, the costs of each management strategy were reworked using the figure of US$9.3, which was quoted by a SANTA official as the cost per day for sanitorium care in 1996 (M. Stafford, personal communication, May 22nd 1996). The results are shown in Table 8.21.

Table 8.21: Average cost of alternative management strategies if the cost of a day in hospital is US$9.3

Management strategy	Health system	Patient cost	Total cost
Hlabisa model of CB-DOT	319.3	89.2	408.5
New cases, conventional approach plus WHO Guidelines	680.1	270.1	950.2
New cases, conventional approach plus South African Department of Health Guidelines	700.5	275.6	976.1
Average for all cases, conventional approach plus South African Department of Health Guidelines	726.2	280.1	1006.3
Average* for all cases, conventional approach plus WHO Guidelines	753.9	297.6	1 051.5
Retreatment cases, conventional approach plus South African Department of Health Guidelines	814.5	295.5	1 110
Retreatment cases, conventional approach plus WHO Guidelines	1 008.2	392.3	1 400.5
Hlabisa until 1991	1 225.7	504	1 729.7
Sanitorium care	1 860.5	780	2 640.5

*Assumes 77.5% are new cases and 22.5% are retreatment cases, as in Hlabisa in 1995

The analysis showed that while the costs of all the management strategies were reduced when this figure is used, their rankings stayed the same. The existing Hlabisa CB-DOT model remained the cheapest and most cost-effective alternative, at worst 1.9 times more cost-effective and 2.3 times

cheaper than the next best alternative (WHO Guidelines with 2 months in hospital for new cases).

Table 8.22: Summary of the cost-effectiveness of alternative strategies if the cost of a day in hospital is US$9.3

Management strategy	Minimum cost per cured patient	Maximum cost per cured patient
Hlabisa 1991-	481.4	504.0
Hlabisa until 1991	9 649.6	9 983.3
New cases, WHO Guidelines	970.8	1 710.4
Retreatment cases, WHO Guidelines	1 433.9	2 550.4
Average* for all cases, WHO Guidelines	1 075.0	1899.4
New cases, South African Department of Health Guidelines	996.5	1 800.5
Retreatment cases, South African Department of Health Guidelines	1 131.1	2 044.5
Average for all cases, South African Department of Health Guidelines	1026.8	1855.4
Hospitalisation for entire treatment period	2 779.5	2 779.5

* Assumes 77.5% are new cases and 22.5% are retreatment cases, as in Hlabisa in 1995.

8.3.7 Implementability within existing infrastructural capacity

The CB-DOT strategy was the only practical approach to tuberculosis treatment with the existing infrastructural capacity of 56 beds (Table 8.23). In 1990 all strategies except the Hlabisa until 1991 approach, and the approach relying on hospitalisation for the entire period of treatment, could be implemented. Since 1993 the rising caseload has meant that the existing approach was the only strategy which it was feasible to implement. It is also likely that it was the only feasible strategy with the available health care staff complement.

Table 8.23: Number of beds required with alternative management strategies in comparison with bed availability in Hlabisa District

Management strategy (average length of stay in days)	Number of beds available for TB patients in Hlabisa Hospital	Number of beds required given 1990 caseload (25 patients per month)	Number of beds required given 1993 caseload (65 patients per month)	Number of beds required given 1996 caseload (80 patients per month)
Hlabisa 1991- (17.5)	56	15	38	47
Hlabisa until 1991 (120)	56	100	260	320
WHO Guidelines, Average for new and retreatment cases (66.75)	56	56	145	178
South African Department of Health Guidelines, average for new and retreatment cases (60)	56	50	130	160
Hospitalisation for entire period of treatment (195)	56	163	423	520

8.4 Discussion

8.4.1 Summary of overall findings

The results show that community-based directly observed therapy for tuberculosis is an attractive economic option in Hlabisa. From the perspective of both health services and patients, it is considerably more affordable than the major alternative approaches to care that have traditionally been used elsewhere in rural South Africa and in several sub-Saharan Africa countries. It is also comparatively cost-effective, and is the only strategy that can be implemented within existing resource constraints.

8.4.2 Reasons why the Hlabisa CB-DOT model is low-cost

The CB-DOT model is low cost for three reasons. First, the hospitalisation period is much shorter than it is with the other management strategies. Hospitalisation was easily the most important influence on the total costs of any management strategy, for both health services and patients. Second, the management strategy benefits from community involvement in the supervision of therapy. This reduces health system costs by 26% and patient costs by 53% in comparison with a management strategy relying solely on health clinics for supervision of DOT. Third, the use of vehicles and fieldworkers to supervise observers of treatment and follow up

absconders is a cheap substitute for supervision in hospital. At US$38.9 per patient, its cost was equivalent to 1.4 days in hospital. The costs of all other aspects of the alternative management strategies - sputa examinations, x-rays, drugs, management/audit - were comparatively minor and had little influence on the costs of alternative strategies. From an economic perspective, different approaches to these aspects of care are therefore unimportant.

8.4.3 Possible explanations for the effectiveness of the CB-DOT model

The data also provide some explanation for the effectiveness of the CB-DOT model. The strategy substantially reduces the time and travel costs associated with accessing treatment, making it far easier for patients to comply with treatment. The fact that patients using non-health worker supervisors incurred time costs only - with no cash expenditure - may be very important in an area where there is much reliance on subsistence activities and where opportunities to earn cash income are limited. Other important factors may include the use of regular supervision of supervisors by fieldworkers, and the co-operation of the community.

8.4.4 How generalisable are the findings?

The results are important for health managers within Hlabisa, because they justify the existing management approach and indicate how further improvements might be made. The crucial issue beyond Hlabisa is whether the results would hold in other places, both within South Africa and in other countries, and whether they are even relevant in certain contexts. Would the cost picture be different? Would the effectiveness of the Hlabisa approach be different? Would the strategies evaluated here even be appropriate? Is there any evidence that the Hlabisa model is feasible elsewhere?

8.4.4.1 Factors which could change the relative costs of alternative strategies

1. Absolute and relative costs of inputs: hospitalisation vs DOT plus supervision of supervisors with vehicle

The management strategies which have been proven to be effective have involved either (a) a lengthy period of hospitalisation or (b) a much shorter hospitalisation period combined with DOT and supervision of supervisors using fieldworkers and vehicles. The results showed that the second option is clearly much cheaper in Hlabisa, but in other contexts it is possible that hospitalisation could be a preferable option, at least from the health system's perspective. Hospital care might be provided with fewer inputs, and hence be cheaper; or the cost of the major input in hospital care - staff - could be much lower in some places relative to the cost of vehicles and fuel.

Within South Africa, it is unlikely that staff costs or the standard of care provided vary enough to change the absolute and relative costs of inputs to any great extent. The lowest cost per day reported in a wide-ranging rapid appraisal of hospital care costs for TB patients in South Africa in 1996 (Sawert, 1996b) was US$10 but was typically over US$25. Even when the figure of US$9.3 for a day in hospital was used in the sensitivity analysis, the rankings of the alternative strategies remained the same. It is also likely that the absolute and relative costs of inputs would be similar in other middle income countries. For example, in Thailand a 1991 study assessed the cost/day in hospital to be US$23.8; given an average inflation rate of 3.7% 1981-91 (World Bank World Development Report, 1993), this would be approximately US$28.6 in 1996. In 1998, the cost/day was estimated as US$24.3 in a district hospital in Botswana (Moalosi G, Economist, Ministry of Health, personal communication September 1st 1999). Both figures are very similar to those calculated for Hlabisa. In countries with higher average incomes, a Hlabisa-type strategy is likely to be relatively even more low-cost and cost-effective, because the cost of hospitalisation would probably be higher than it is in South Africa.

It is in poorer countries that both the absolute and relative cost of inputs might be different enough to affect the findings. Here, the cost of supervision using fieldworkers and vehicles may be similar to the levels documented for Hlabisa – the cost of vehicles and fuel does not vary much among countries. At the same time, the cost of hospitalisation may be substantially reduced, because the cost of the major input - staff - is so much less.

Data from Malawi – one of the poorest countries in the world - make it possible to explore whether this scenario is likely. Research published in 1995 found that the average cost of a day in hospital for a TB patient was US$2.09 (Sawert, 1996). This means that 60 days in hospital would cost US $125.4 per patient. On the assumption that health clinic visits, community health worker visits, fieldworker and driver costs would also be 13.3 times less than Hlabisa levels, but that vehicle and fuel costs would be the same, 17.5 days in hospital, 48 visits for DOT, and fieldworker supervision would cost US$64.3 (36.6 + 6.1 + 21.6).

2. Population density

Population density will also affect the cost of supervision of supervisors with a vehicle, since the less densely populated the district/region/country, the greater the distance that will have to be covered to ensure effective supervision. In Hlabisa district, population density is approximately 67/sq km. In other places, populations can be more scattered. In Tanzania, for example, population density averages just 26.7/sq km (UNDP, 1997). In several other countries – such as Malawi where the figure was 93.5 in 1991 - population density is greater. Even with the Tanzanian figure of 26.7, 2.5 times less than the Hlabisa figure, the cost of supervision, if it increased by 2.5 in proportion, would still only be US $97.3 using Hlabisa costs. If

supervision costs were increased by 2.5 for even the most pessimistic scenario presented for Malawi costs above, the Hlabisa CB-DOT model would remain cheaper than the strategy of 2 months' hospitalisation. In some districts, though, with very sparsely scattered populations, it is clearly possible that supervision would become extremely costly for the health system. For example, in regions dominated by nomadic populations, population density can fall as low as 1-2 persons/sq km. This needs to be borne in mind when appraising the appropriateness of the Hlabisa CB-DOT model.

3. Access to health facilities

A third factor that will affect costs is access to health facilities. This does not affect the costs to the health system - the costs of a day in hospital, a health clinic visit, an outpatient visit, supervision of supervisors with a vehicle, etc., are not affected by the distribution of health facilities. However, it does affect the costs incurred by patients. Indeed, it has been commented that "in the rural areas of Tanzania, and in many other developing countries, smear-positive patients have to be hospitalised for the intensive 2-month phase, not because they are so sick, but simply because there is no other way to ensure regular drug intake in areas where a patient has to walk 20 or 30 km to get to health care" (Davies, 1994). Where a health clinic is more than a day's walk away, time and travel costs will exceed the cost of a day in hospital and make DOT from health facilities too costly for the patient. However, if non-health workers are used in supervision of treatment, a strategy of intermittent (whether twice or three times weekly) outpatient DOT is always going to remain cheaper for the patient than a management strategy relying on 2 months of hospitalisation. This is because patients will be able to choose someone who makes supervision of treatment convenient.

4. Non-health worker input

The cost of non-health worker input in supervision was valued at zero in this evaluation, but it is possible that elsewhere it might be necessary for the health system to pay such supervisors. Even so, with the most pessimistic scenario presented above for Malawi, US$61.1 could be paid per patient for supervision before the CB-DOT strategy became more costly than the alternative of 60 days in hospital.

8.4.4.2 Factors that could change the relative effectiveness of alternative strategies

Just as the costs of different management strategies may change from one location to another, so may their effectiveness vary.

1. Community willingness to participate in supervision

The current Hlabisa management strategy uses many non-health workers in the community to supervise therapy, and patients supervised by them have among the best treatment outcomes. How replicable this is elsewhere is unclear. Possible concerns are that non-health workers might not respond is such a supportive way everywhere, and that supervisors might sell the drugs that they are given responsibility for.

2. Population transience/mobility

CB-DOT as organized in Hlabisa also depends on patients having a fairly stable place of residence. Without this, patients could not identify a supervisor who would be available throughout 24 weeks of treatment, and overall supervision of supervisors would become difficult or impossible to manage if supervisors had to be changed during treatment. Where populations are highly mobile, therefore, CB-DOT may not be very effective and a more practical option could be greater reliance on hospitalisation.

3. Availability of leadership/effective management

It has been suggested that the Hlabisa TB programme benefits from especially strong and motivated leadership and management. Whether this has really been the key to its success is debatable. The initiator of the programme no longer plays an active role in its management - this is the responsibility of a fairly junior doctor. It may be true that starting up such a programme does require strong leadership and special skills - for example the capacity to innovate, to advocate a new idea and convince others of its promise when it is not yet tested or proven to work, and to develop appropriate evaluation methods. It may also be the case that setting up such a programme elsewhere may require special assistance, orientation and training - expertise that might have to be 'bought-in'. Such inputs may not be so crucial once the programme has been shown to work elsewhere, and once it is actually under way (off the ground, as it were) and working.

Early results from the neighbouring district of Nkandla in KwaZulu-Natal provide evidence that, within rural South Africa, the approach may be successfully transferred without major training inputs or external support. In 1995, this district had a completion of treatment rate identical to that estimated for Hlabisa until mid-1991. Following a half-day discussion with the medical superintendent of Hlabisa Hospital, who explained the CB-DOT model since 1991, a similar programme was implemented. This has had considerable early success (G. Dean, personal communication, May 22nd 1996). Emerging evidence from a series of WHO-funded community-DOT pilot projects also suggest that CB-DOT has the potential to work well in rural Kenya and Uganda (Maher et al, 1999).

4. Possible biases in effectiveness data used

The outcome data that were used to estimate the effectiveness of the conventional strategy came from Malawi and Tanzania. Though biased in that the outcomes achieved in South Africa are unlikely to be the same, they covered a range wide enough to illustrate a best and worst-case scenario. The results therefore appear robust to plausible variation in the effectiveness of the conventional approach.

8.4.4.3 Implementation capacity

Hospital capacity in Hlabisa is typical of that available in many parts of South Africa (Chapters 2 and 4), and it seems likely that many African hospitals are operating close to or beyond full bed occupancy levels. This suggests that in many other parts of the country and beyond, the results are generalisable.

8.4.5 Are the strategies evaluated relevant in all contexts?

Apart from the issues of whether the costs and effectiveness of alternative strategies might change from one place to another, it is important to consider whether the management approaches evaluated are actually the relevant ones to consider in certain contexts. The strategies discussed have been developed and applied in rural settings. They may not be appropriate in urban locations if high compliance with treatment is being achieved without either DOT or extensive hospitalisation. Certainly hospitalisation would appear to be unnecessary, since patients should have relatively good access to formal health services. In neighbouring Botswana, approximately 90% of patients are managed on an entirely ambulatory care basis – even in rural areas (Moeti T, Ministry of Health, personal communication, November 4th 1997). However, this appears to have been made feasible by a primary care clinic network that is much more extensive than that typically found in developing countries (ibid.).

If DOT is required to achieve high compliance, the finding that still remains of potential relevance is the reduction in costs realised through involving the community in supervision and using fieldworkers to supervise supervisors. It may be that this remains a very cost-effective way of implementing DOT, from the perspective of both the health system and the patient, in urban areas as well as rural ones. Preliminary results from an economic evaluation undertaken in 1998 indicate that this is the case in a community-DOT programme that has been implemented in Guguletu District, a peri-urban area of Cape Town (Maher et al, 1999).

8.4.6 Other considerations besides economic factors

There are factors besides the economic issues that are the focus of this chapter that are also important and need to be considered in choosing a

tuberculosis management strategy. WHO has set a target of an 85% cure rate, and it may be thought that only strategies that have demonstrated ability to achieve this should be considered. On the other hand, the conventional strategies that have sometimes achieved this target have not been able to maintain this level of success with escalating tuberculosis caseloads (e.g. the Malawi and Tanzania programmes). The Hlabisa CB-DOT model is currently performing better than the Malawi programme; and some districts in Malawi and Tanzania are, out of necessity, beginning to experiment with community-based DOT care. In addition, as the incremental cost-effectiveness analysis demonstrated, additional effectiveness comes at a very high cost.

8.4.7 Conclusions

This evaluation suggests that the Hlabisa model of CB-DOT should be seriously considered elsewhere, both in South Africa and beyond. There is some evidence that this is already occurring: for example, publication of research concerning the programme does appear to have had some influence on the design of pilot WHO research projects; and the district's approach to tuberculosis care is now well known in South Africa.

The CB-DOT approach appears especially relevant in the context of the HIV/AIDS epidemic. It can help health systems to cope with rising caseloads; and in the context of extremely constrained budgets, it is the strategy that the health system can most easily afford. For planners and programme managers also concerned about patient welfare and increasing compliance and cure rates, it is a strategy that appears to have the additional benefit of imposing the lowest costs on patients. However, the advantages of the approach – especially for patients – are due in large part of the extensive use of non-health workers. This needs to be considered acceptable if the Hlabisa model is to be more widely employed.

Generally, if costs are to be kept as low as possible, the clear message for South Africa – and probably beyond - is that hospitalisation should be kept to a minimum. This means that it may be worth reconsidering the South African Department of Health recommendations that retreatment patients be hospitalised for the intensive period of treatment, and to consider supervising them closely as outpatients instead.

CHAPTER 9: An economic appraisal of antiretroviral therapy for the prevention of mother-child HIV transmission

9.1 Introduction

Chapters 5-7 have focused on the economic impact of the HIV epidemic on health services. Chapter 8 presented a detailed economic evaluation of alternative approaches to the delivery of tuberculosis treatment – a key issue given the strong evidence from Chapters 5-7 that the single largest economic HIV-related impact on health services is a substantial increase in the tuberculosis caseload. All 4 chapters were therefore concerned with the care needs generated by the HIV epidemic and how they might be managed. The knowledge generated by these studies is important for improving understanding of the economic consequences of HIV/AIDS for health services, for guiding the development of response strategies, and for suggesting that wider use of innovative community-based approaches to care may help health systems to cope with the HIV/TB epidemic.

Nonetheless, the most exciting and still rapidly evolving developments in the treatment and prevention of HIV/AIDS in the last 3-4 years have (arguably) been in the field of anti-retroviral therapy. In developed countries, combination drug therapies that cost thousands of dollars per person per year have revolutionised treatment for many patients, turning HIV into a chronic condition that may be lived with for many years. In developing countries, use of these new drugs in the care of HIV+ people is far beyond the financial reach of most individuals and many governments – especially in Africa where the total cost of making treatment available to all eligible patients would exceed total health expenditure and, in places, GNP (Chapter 3). In addition, treatment is highly demanding of patients and require sophisticated technical infrastructure for monitoring purposes. For these as well as cost reasons, extensive use of anti-retroviral drugs for treatment of HIV+ people is unlikely to be viable in the near future.

There is, however, one area in which anti-retroviral treatment is being seriously considered for widespread use in developing countries. In 1994, clinical trials (protocol ACTG076) in the USA and France reported that treatment of HIV+ pregnant women with the anti-retroviral drug zidovudine (ZDV), combined with the exclusion of breast-feeding, could reduce the risk of maternal-child transmission of HIV by 67%, from 25.5% to 8.3%. With the number of HIV+ women eligible for treatment much lower than the total number of HIV+ people, and with treatment required for a short period only, this promised to be a potentially viable preventive strategy. This became more likely with the release of results from a CDC-sponsored trial in Thailand. This found that a shorter (approximately 1 month) ZDV regimen - both lower cost and easier to provide in developing countries where many women present for care too late for complete use of the 076 protocol – reduced transmission by 51%. The most recent major research result from developed countries is that caesarian sections can

substantially reduce the risk of transmission (European Mode of Delivery Collaboration, 1999). In combination with anti-retroviral treatment, they can reduce maternal-child HIV transmission to negligible levels. In developing countries, the most recent landmark findings come from a trial of nevirapine – another antiretroviral drug - in Uganda; and the release of the efficacy results from UNAIDS-supported trials of three short-course combination (ZDV plus lamivudine) regimens. Given as a single self-administered dose during labour followed by a single neonatal dose to the infant within 72 hours of birth, and therefore a far less complex treatment than other regimens, nevirapine reduced transmission by 47% at age 14-16 weeks compared to a control group given ZDV only (Guay et al, 1999). With the short-course combination regimens, transmission has been reported as 8.6%-17.7%, compared to 17.2% in the placebo group (Report of Technical Group Meeting, WHO/UNAIDS, Geneva, 1999).

Three key economic questions should be considered when establishing policy on providing anti-retroviral treatment for pregnant women. First, is such treatment affordable? Second, is treatment likely to be cost-effective in comparison with alternative ways in which scarce resources could be used? Third, do health services have the capacity – in terms of both human and physical resources – to make implementation practical?

To date, few published economic analyses have addressed these questions in developing countries (Chapter 3). The first, in 1996, modelled the cost-effectiveness of a short-course zidovudine (shorter than 076) regimen for sub-Saharan Africa as a whole (Mansergh et al, 1996). No country-specific assessments were included and most key parameters (including efficacy) had to be estimated or drawn from a mixture of countries. A 1998 study used aggregated data from four urban African sites where clinical trials of short-course combination regimens were underway to estimate cost-effectiveness, also for sub-Saharan Africa as a whole (Marseille et al, 1998). Again, many parameters had to be estimated in the absence of empirical evidence. Most recently, the cost-effectiveness of several strategies has been assessed for South Africa, with some strategies suggested to be cost-saving (Soderlund et al, 1999); and for nevirapine compared to other antiretroviral strategies (Marseille et al, 1999).

This chapter concerns the affordability, cost-effectiveness, and capacity to implement an anti-retroviral intervention in the rural setting of Hlabisa District. It is based on an analysis published in 1998; and on 2 subsequent publications (one in 1999, one in 2000)[39]. Although such analyses can become rapidly outdated, they are included in this thesis for several reasons. One is that the number of economic analyses is still small. A second is that the studies published to date have adopted different methodological approaches: they may therefore be complementary. Third,

[39] Wilkinson D, Floyd K and Gilks CF (1) "Antiretroviral drugs as a public health intervention for pregnant HIV-infected women in South Africa: an issue of cost-effectiveness and capacity" AIDS 1998; 12:1675-1682; (2) "A national programme to reduce mother-child transmission is potentially cost-saving in South Africa" (South African Medical Research Council, April 1999); and (3) "Wilkinson D, Floyd K and Gilks CF "National and provincial estimates of the cost and cost-effectiveness of antiretroviral therapy to prevent maternal to child HIV transmission". South African Medical Journal, 2000 (in press). The chapter focuses on the economic analysis that the present author was responsible for in these publications.

if studies draw similar conclusions despite variation in methodology, this can increase confidence in them; if they differ, they can highlight where particularly careful analysis or new empirical data are important. Fourth, studies in South Africa are particularly relevant given the country accounts for approximately 11% of the global burden of paediatric HIV infection.

The studies from Hlabisa also have some specific merits. When published, the 1998 study was the first country-specific analysis and the first to use empirical data from a single area for most model parameters. At the time of writing, it remains the only study focused on a rural area. The study's value also lies in being the only analysis to date that has assessed both affordability and implementation capacity from the viewpoint of a typical district. Other analyses have been much more general, and none of the others explicitly assessed the capacity to implement an intervention given available human resources. Meanwhile, inclusion of revisions to the 1998 study analysis for changes in key costs and new availability of efficacy data – in addition to the original analysis – and inclusion of the 1999 study (which incorporated the efficacy evidence from the Thailand trial and estimates of averted care costs due to prevention of paediatric HIV infections) illustrate the importance of updating analyses even over relatively short time-periods when a field is rapidly evolving. Hlabisa – with its very high rates of HIV seroprevalence among pregnant women - is also the type of area where pilot implementation has been suggested to be most relevant. Finally, the chapter can be adapted to assess future interventions, such as nevirapine.

The chapter is structured in three sections. These are:

- **Methods** (9.2), which describes the alternative strategies that were evaluated and explains the measure of effectiveness chosen, how effectiveness was estimated, how cost and cost-effectiveness analysis was undertaken, and how resource requirements were appraised;
- **Results** (9.3), which reports the estimated effectiveness, cost and affordability, cost-effectiveness, and capacity requirements associated with different anti-retroviral interventions. Sensitivity and incremental cost-effectiveness analyses are included; and
- **Discussion** (9.4), which considers the implications of the results, study limitations, the generalisability of the findings with particular reference to other studies, and how the recent nevirapine trial results affect both the results and their interpretation.

9.2 Methods

9.2.1 Description of intervention scenarios considered

Six intervention scenarios were considered (Table 9.1). These cover the major options to prevent maternal-child HIV transmission that were available and whose efficacy was demonstrated or could be extrapolated between 1995 and the end of 1998. There is debate concerning whether or not exclusion of breast-feeding should be recommended in developing

countries. For this reason, exclusion of breast-feeding was included in one of the short-course regimen scenarios but not in any of the longer course regimen scenarios. This is because short-courses are most likely to be practical in developing countries, where many women do not present for antenatal care prior to 34 weeks gestation.

The extent to which services are strengthened prior to implementation of anti-retroviral interventions may have a major influence on their effectiveness. The major requirements for a successful intervention, their current status in Hlabisa, and what strengthening is likely to be required are explained in Table 9.2.

9.2.2 Costing

9.2.2.1 Costs of the intervention

Costing focused on incremental costs i.e. the costs required to add an antiretroviral intervention to existing health services, and were assessed from the perspective of the health system. Each intervention component was calculated individually. Drug costs were based on 1997 market prices, except for the shorter Thai regimen, where both 1997 costs and the costs that applied after a major reduction in prices in 1998 were considered. With no strengthening of health services, it was assumed that an antiretroviral intervention would not increase the costs associated with nurses and counsellors. With strengthened capacity, the extra number of nurses and counsellors required was quantified through interviews with the district AIDS team. It was assumed that women would be pre-test counselled in a groups but individually post-test counselled at each antenatal clinic and after delivery. The extra number of midwives required to deliver more women in hospital or clinics was estimated through discussions with the nursing manager of the maternity service. Quantities were then multiplied by the unit cost for each type of staff in 1997.

Training costs per nurse were calculated using recent data from Hlabisa, and health promotion costs for the district as a whole were extrapolated from a 1997 sexually transmitted disease intervention. Follow-up costs for the child assumed HIV ELISA tests at age 15-18 months, and clinic visits scheduled to coincide with standard under-6 year clinic visits. The costs of HIV testing were based on existing quotes. It was assumed that one extra laboratory technician would be needed to supervise and help with on-site rapid HIV testing. Formula feed costs per infant were based on government tender prices (G. Gray, Perinatal HIV Research Unit, personal communication). Costs are reported in 1997US$, converted at the exchange rate prevailing when the cost data were collected (US$1=R4.7).

9.2.2.2 Possible cost-savings from averted paediatric HIV-related care

HIV-infected children are likely to be associated with higher health care costs compared to uninfected children, due to higher morbidity. Antiretroviral interventions that prevent paediatric HIV infections will

Table 9.1 Antiretroviral intervention scenarios considered

Intervention Scenario	Drug Regimen	HIV counselling and testing	Exclusion of breast-feeding	Efforts made to enhance implementation capacity[1]	Eligible women
ACTG076	ACTG076 protocol: 3-5 months of oral zidovudine (ZDV) 5 times daily; intrapartum intravenous ZDV; 6-weeks neonatal oral ZDV	Essential	No	No	Women presenting prior to 34 weeks gestation
ACTG076 plus	As above	Essential	No	Yes	As above
Thai	Short-course ZDV, or "Thai" regimen	Essential	No	No	Women presenting prior to 36 weeks gestation
Thai plus	As above for "Thai"	Essential	No	Yes	As above for "Thai"
Thai plus formula	As above for "Thai"	Essential	Yes	Yes	As above for "Thai"
Combination regimen (lamivudine plus ZDV)	ZDV 300mg twice daily plus lamivudine 150mg twice daily for the mother from 36 weeks gestation for 4 weeks ZDV 300mg every 3 hours and lamivudine 150mg every 12 hours during labour; ZDV 300mg twice daily and lamivudine 150mg twice daily to the mother for 1 week post-partum; ZDV 4mg/kg twice daily and lamivudine 2mg/kg twice daily to the infant for 1 week	Essential	No	Yes	As above for "Thai"

[1] "Yes" indicates that the strengthening requirements, identified in Table 9.2, are included

Table 9.2: Strengthening of health services required for successful implementation of antiretroviral therapy in Hlabisa

Requirement	Status in Hlabisa in 1997/8	Strengthening required
1. Pregnant women access antenatal care, and the first visit is as early as possible	95% of pregnant women receive antenatal care, but 10% make first visit after 34 weeks	Health promotion to encourage early antenatal care, staff training, possibly need new clinics, possibly need extra staff for the extra workload
2. Women counselled for HIV test and about anti-retroviral therapy	None counselled routinely, some HIV education given. Only 50% of clinics have a dedicated HIVcounsellor	Training for nurses in HIV counselling, recruit new staff for busy clinics to deal with extra work
3. Women tested for HIV receive result	17% of hospital inpatients receive results. Administrative delays due to centralised HIV testing (in Durban, 300km away)	On-site single rapid HIV testing, with confirmation of positive results by ELISA; new laboratory staff to cope with extra workload
4. Women adherent to anti-retrovirals	No evidence for anti-retrovirals, but only 49% of women treated for syphilis do not complete treatment. Access to care and drug supply may be problems	Intensive, on-going counselling; careful tracking of defaulters; improved drug supply; more staff and training
5. Women deliver in clinic or hospital to receive intra-partum anti-retrovirals	83% deliver in clinic or hospital; a 24 hour maternity service is only available in 50% of clinics	Extra staff and allowances to enable night duty, staff training, possibly new clinics, extra maternity beds and nursery cots
6. Reduce risk from breast-feeding	86% breastfeed and 60% do so for 12-24 months; risk of stigma associated with bottle-feeding	Selective avoidance of breast-feeding if considered safe and consistent with national guidelines
7. Paediatric follow-up to enhance adherence, monitor progress, and determine HIV status	No routine follow-up	Incorporate follow-up into routine under 6-year clinic visits; HIV ELISA at 15-18 months

therefore avert some health care costs[40]. However, there were no published data on lifetime paediatric care costs in a developing country at the time the analyses included in this chapter were originally done[41]. To explore the possible impact of cost-savings, a low and high estimate of the lifetime costs associated with HIV-related paediatric care was made. The high estimate was based on two assumptions:

- in any given cohort of HIV-infected children, 10% would die per year, and 10% of total lifetime costs would be incurred in each year (following Mansergh et al, 1996); and
- lifetime care costs would be approximately 150% per capita GNP – the average in a recent multi-country study for adults (Shepard et al, 1996).

These assumptions, together with a discount rate of 3% (to be consistent with the rate used for DALY calculations – see 9.1.5 below), were used to calculate the present value of averted care costs per infected child.

The low estimate was based on the assumption that 10 outpatient visits and 4 district hospital admissions would be associated with paediatric HIV-related health problems, over a lifetime. This was justified on the basis that in a 1996 cross-sectional study (Yeung et al, 1998), the mean annual number of admissions and outpatient visits among HIV+ admissions was 2 and 5 respectively; since most children were discharged well, this number was likely to be higher over a lifetime. The costs of a day on the paediatric ward and an outpatient visit were calculated using cost data collected in Hlabisa in 1997 (some of which were used in the study reported in Chapter 6) and multiplied by the average length of stay in the Yeung et al study. To be conservative, no overhead staff costs were included – it was assumed that extra HIV-related admissions would not necessarily require an increase in their numbers. The cost of drugs and investigations was also excluded - no data were available on these and studies among adults indicated they form a small share of total costs (see also Chapters 6 and 7).

9.2.3 Measure of effectiveness

Two measures of effectiveness were chosen. The first was the number of paediatric HIV infections averted, compared with a no intervention scenario. The main effectiveness measure was the DALY (disability-adjusted life year) - this enables comparisons with cost-effectiveness ratios that have been estimated for a wide range of other health interventions.

9.2.4 Estimation of intervention effectiveness in terms of infections averted

The main parameters used to model the effectiveness of each intervention, the estimates made for them, and the evidence on which the parameter values were based, are shown in Table 9.3.

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[40] In developed countries, these appear sufficient to make antiretroviral interventions to prevent paediatric HIV infection cost-saving (see Chapter 3)

[41] data on care costs from Johannesburg have since been used in a published study (Soderlund et al, 1999)

Table 9.3: Key parameters used to estimate effectiveness, and the evidence on which they were based

Parameter	Estimate	Evidence/assumptions on which estimate based
HIV mother-child vertical transmission rate (VTR)	1) no intervention: 30% 2) ACTG076 protocol: 15% with no strengthening of capacity to increase compliance (50% reduction, 75% of the level achieved in ACTG076); 12.5% (58% reduction, 86.6% of the level achieved in ACTG076) with strengthening of health services, including health promotion 3) Thai regimen: 18.6% with no strengthening of capacity and no formula feeding (11.4% reduction, 75% of the level achieved in the Thai trial); 16.8% with strengthened health services capacity but no formula feeding (13.2% reduction, 86.6% of the level achieved in the Thai trial); 14.7% with strengthened capacity and formula feeding 4) 12% for short-course combination regimen – (60% reduction in VTR[42])	1) Dunn et al, 1992 2) 67% reduction in VTR in ACTG076 trial, from 25.5% to 8.3%, but incomplete compliance and prolonged breast-feeding (eliminated in the trial) would reduce effectiveness in Hlabisa 3) CDC Thailand trial: 14.7% VTR with breastfeeding excluded (51% reduction in transmission) 4) assumption that combination will be more effective than ZDV monotherapy used in Thai trial
Annual number of women who become pregnant in Hlabisa	8421	Health service records for 1997
HIV seroprevalence, ANC[1] attendees	26%	Antenatal survey in Hlabisa in 1997
% pregnant women who do not attend for ANC[1]	1) 5% in absence of any special health promotion efforts 2) 2.5% with health promotion	1) Community survey in Hlabisa and health service records; 2) estimate
% of pregnant women who attend for ANC[1] too late to be eligible for care	1) 10% of women for ACTG076 regimen if no health promotion efforts made; 2.5% if special health promotion efforts made 2) 0% for Thai and short-course combination regimen	1) As above 2) Assumption – regimen is short so all late bookers should be eligible
% of pregnant women accepting HIV testing, receiving test results, and receiving full intervention	1) 35% with no strengthening of health services capacity (approximately midway between 17% and 49% - see column 3); 2) 75% if health services strengthened, including availability of rapid testing, with ACTG076 regimen; 3) 80% with strengthened capacity and Thai or combination regimens	Research in Hlabisa has shown: 90% of TB patients accept testing; as few as 17% of patietns may receive HIV results without the availability of rapid testing; 49% of women tested for syphilis receive results and complete treatment; 80% patients received test results when rapid testing was available. Thai regimen and combination regimen shorter and simpler than ACT076 - should encourage higher acceptance and compliance

[1]ANC = antenatal care

[42] recent evidence (August 1999) suggests that this is a reasonable estimate – in the 6 week efficacy analysis of the trials of this regimen, the VTR was 8.6%, a 71% reduction compared to 30%: if adjusted downwards to 86.6% of this level, as for the other regimens, this gives a value of 62% (Technical Working Group, WHO/UNAIDS Secretariat, August 10-11 1999)

9.2.5 Estimation of DALYs gained

The number of infections averted was converted into DALYs gained using the standard formula for DALY calculations (Murray et al, 1994). The values chosen for the three key parameters that can be varied in calculations were:

- a discount rate of 3% (since this has been used in most other cost/DALY cost-effectiveness analyses, principally those undertaken as background to the 1993 World Bank World Development Report);
- a life expectancy in the absence of infection of 69 years (the average for South Africa in 1997);and
- a disability weighting of 1 for each year of life gained (standard practice in DALY calculations for DALYs gained through prevented mortality).

9.2.6 Sensitivity and incremental cost-effectiveness analyses

Sensitivity analyses were conducted to explore what effect lower drug costs, shorter life expectancy, a different discount rate, and reduced effectiveness would have on the results. These parameters were chosen because:

- pharmaceutical companies have appeared increasingly willing to substantially cut drug costs, some drug patents (e.g. ZDV) are due to expire soon which should lead to reductions in costs, and drug costs were a key or major influence on total intervention costs;
- recent evidence indicates that life expectancy in the HIV era may fall by as much as 20 years in the most badly affected countries, of which South Africa is now one (World Bank, 1997);
- difficulties in implementation may mean that effectiveness in practice is below the levels estimated; and
- differences of opinion exist on what discount rate should be used, and with many years being gained in the relatively distant future, the discount rate may make a large difference to the results.

9.3 Results

9.3.1 Intervention effectiveness, alternative scenarios

9.3.1.1. No intervention

With 8421 women in the district becoming pregnant each year, an HIV seroprevalence of 26% and a 30% vertical transmission rate, 657 paediatric HIV infections would result with no intervention.

9.3.1.2 Scenario 1: ACTG076 protocol, no enhanced capacity

In scenario 1, 33 infections would result among the 421 women not attending for care, and 62 among the 800 women attending too late to receive the intervention. Of the remaining 7200 women, 1872 would be HIV+ and 655 (35% of the 7200) would accept testing, receive results, and fully comply with treatment. This would be associated with 98 paediatric HIV infections. Among the 65% of the 7200 women attending early enough to be eligible for the intervention, but not receiving it, 365 paediatric infections would result. In total, 558 paediatric HIV infections would occur, a reduction of 99 compared with no intervention.

9.3.1.3 Scenario 2: ACTG076 protocol, enhanced capacity

In scenario 2, the women (n=421) not attending for care would be associated with 33 paediatric HIV infections. Among the 95% (n=8000) of women accessing care, 2080 would be HIV+ and, of these, 1560 (75%) would accept testing, receive their results, and accept the intervention. They would be associated with 195 paediatric HIV infections. Among the remaining 25% not receiving the intervention, 156 paediatric infections would result. Compared with no intervention, 384 infections would occur, a reduction of 273 infections compared to no intervention.

9.3.1.4 Scenario 3: Thai protocol, no enhanced capacity

With the Thai regimen but no enhanced capacity, 33 infections would result among the 421 women not attending for care. Among the 2080 HIV+ women attending for care, 135 infections would result among those receiving treatment (n=728, 35% of 2080), and 406 among those attending for care but not receiving treatment (n=1352, 65% of 2080). This would be a total of 574, a reduction of 83 compared with the no intervention scenario.

9.3.1.5 Scenario 4: Thai protocol, enhanced capacity

The Thai protocol with enhanced capacity was associated with 16 paediatric HIV infections among those HIV+ women not attending for care (n=55, 2.5% of the estimated 2189 HIV+ pregnant women in the district). 287 infections would occur among the HIV+ women receiving treatment (n=1707, 80% of the 2134 HIV+ pregnant women attending for care), and 128 among the 427 women (20% of 2134) attending for care but not receiving treatment. This was a total of 431, a reduction of 226 compared with the no intervention scenario.

9.3.1.6 Scenario 5: Thai protocol, enhanced capacity plus formula feeding

With the Thai protocol including formula feeding, the number of infections among the HIV+ women either not attending for care or not receiving treatment would be as for Scenario 4 (16 and 128 respectively). However,

among the 1708 women receiving the intervention, only 251 infections would result, due to higher efficacy. Overall, 395 infections would result, a reduction of 262 compared to no intervention

9.3.1.7 Scenario 6: Short-course combination regimen plus enhanced capacity

With the short-course combination regimen, the number of paediatric HIV infections among the HIV+ women either not attending for care or not receiving treatment would be as for Scenario 4 (16 and 128 respectively). However, among the 1708 women receiving the intervention, only 205 infections would result, due to higher efficacy. Overall, 349 infections would result, a reduction of 308 compared to no intervention.

9.3.2 Costs

9.3.2.1 Unit costs, individual intervention components

The cost of the individual components that make up an antiretroviral intervention are shown in Table 9.4. The ACTG076 regimen was considerably more expensive than the other regimens, with the Thai short-course regimen the lowest cost both before and after its price was cut.

Table 9.4: Unit costs, different intervention components (US$1997)

Cost item	Unit cost
ACTG076 zidoduvine drug regimen, 1997	857
Thai short-course regimen, 1997	136
Thai short-course regimen, after 1998 cut in drug prices	50
Short-course ZDV+lamivudine regimen	340
Single Rapid HIV test	2.7
Double ELISA HIV test	2.7
Single ELISA HIV test	1.4
1 professional nurse/midwife (annual cost)	10 674
1 laboratory technician (annual cost)	12 766
Training (per nurse)	319
Health promotion (per district)	4 255
Formula feeds (per infant, for 4 months)	52

9.3.2.2 Total costs and affordability

The total costs estimated to be associated with each intervention scenario varied from US$51 499 for the Thai regimen with no enhanced capacity and 1998 drug prices, to US$1.5 million for the ACTG076 regimen with enhanced health service capacity (Table 9.5). Drugs were consistently the single most important cost, accounting for over 75% of costs except for the Thai regimen with enhanced capacity. With the ACTG076 regimen and no increased capacity, drugs would account for 97% of total costs. The other important costs were counsellors and, in the one strategy where it was included, formula feeds. Making rapid testing available was comparatively low cost (less than 10% of total intervention costs). Total costs were large

Table 9.5: Incremental cost and affordability of alternative interventions, 1997 US$

Cost Component	Scenario 1: ACTG076, no enhanced capacity	Scenario 2: ACTG076 plus enhanced capacity	Scenario 3: Thai regimen, no enhanced capacity	Scenario 4: Thai regimen plus enhanced capacity	Scenario 5: Thai regimen plus enhanced capacity plus formula feeding	Scenario 6: Short-course combination regimen, enhanced capacity
Drugs[1] (cost after 1998 price cut)	561 335	1 336 920	99 008 (36 400)	232 288 (85 400)	232 288 (85 400)	580 720
HIV ELISA tests[2] for pregnant women	12 514	5 616	13 904	5 765	5 765	5 765
HIV Rapid Tests[3]	N.A.	21 600	N.A.	22 167	22 167	22 167
HIV tests for infants born to HIV+ mothers[4]	1 044	2 438	1 195	2 764	2 718	2 658
8 extra counsellors	N.A.	85 392	N.A.	85 392	85 392	85 392
1 extra laboratory technician	N.A.	12 766	N.A.	12 766	12 766	12 766
4 extra midwives	N.A.	42 696	N.A.	42 696	42 696	42 696
Training of nurses	N.A.	7 660	N.A.	7 660	7 660	7 660
Health promotion	N.A.	4 255	N.A.	4 255	4 255	4 255
Formula feeds	N.A.	N.A.	N.A.	N.A.	88 816	N.A.
Total	574 893	1 519 343	114 107 (51 499)	415 753 (268 865)	504 423 (357 635)	764 079
Total cost as % total district budget (US$5.3 million)	11	29	2 (1)	8 (5)	10 (7)	14

[1] Number of drug regimens required = 655, 1560, 728, 1708, 1708, and 1708 in Scenarios 1-6 respectively

[2] Number of HIV ELISA tests required = 7200 single and 1872 confirmatory tests in Scenario 1, 2080 confirmatory double ELISA tests in Scenario 2, 8000 single and 2080 confirmatory tests in Scenario 3, 2135 confirmatory double ELISA tests in Scenarios 4-6

[3] Number of rapid HIV tests required = 8000 in Scenario 2, 8210 in Scenarios 4-6

[4] Number of HIV tests required = 655 single and 98 double ELISA tests in Scenario 1, 1560 single and 195 double ELISA tests in Scenario 2, 728 single and 135 double ELISA tests in Scenario 3, 1708 single and 287 double ELISA tests in Scenario 4, 1708 single and 251 double ELISA tests in Scenario 5, 1708 single and 205 confirmatory tests in Scenario 6

in relation to available financial resources for all but one scenario, at 8-29% of the total district budget. The one exception was use of the Thai regimen with no enhanced capacity, which would account for an estimated 1-2% of the district budget.

9.3.3 Cost-effectiveness

9.3.3.1 Baseline analysis

The Thai regimen, in any of the three scenarios considered for its use, was the most cost-effective in the baseline analysis (Table 9.6). It cost US$43-60/DALY before drug prices were reduced, and US$19-43 afterwards. The ACTG076 regimen was the least cost-effective (US$181/DALY), and short-course combination therapy was of middling cost-effectiveness (US$78/DALY).

9.3.3.2 Potential cost-savings

Cost-savings ranged from US$604 to US$3943 per case averted (Table 9.7). With the high cost estimate, this would mean that all scenarios except those using the ACTG076 regimen would be cost-saving. With the low-cost estimate, none would be cost-saving, but the cost/DALY would be reduced by US$19 (i.e. 604/32) in each case. This would mean that the Thai regimen, in all scenarios, would cost less than US$50/DALY.

9.3.4 Additional capacity required to implement the intervention

As indicated in Table 9.5, it was estimated that 8 extra counsellors, 4 extra midwives, and 1 extra laboratory technician would be required to facilitate the implementation of the intervention.

9.3.5 Sensitivity analyses

The Thai regimen was almost always the most cost-effective option in sensitivity analyses (Table 9.8). The best-case scenario was the only one in which the short-course combination regimen appeared more cost-effective than the Thai regimen. Analyses also showed that large reductions in drug costs would make an important impact on cost/DALY results, reducing all intervention scenarios to less than US$50/DALY and making the Thai intervention with no enhanced capacity cost-saving. Use of a higher discount rate (6%) exactly doubles the cost/DALY for each scenario, since the number of DALYs gained per infection averted is exactly halved (from 32 to 16 years). Use of a 0% discount rate substantially improved cost-effectiveness, with all scenarios except those involving the ACTG076 regimen and short-course combination treatment plus enhanced capacity falling to US$30/DALY or less. With life expectancy reduced to 49 years and the discount rate remaining at 3%, the results were barely affected: this reflects the fact that the years between 50 and 69 are very heavily discounted, adding only 4 DALYs per infection averted. If 25% fewer infections are averted by each intervention, the cost/DALY remained at

Table 9.6: Cost-effectiveness of alternative strategies (cost after 1998 price cut), assuming no care cost savings

Intervention Scenario	Total Cost	Total Infections Prevented	Total DALYS gained[1]	Cost/HIV infection prevented	Cost/DALY gained
ACTG076, no enhanced capacity (1)	574 893	99	3 168	5 807	181
ACTG076 plus enhanced capacity (2)	1 519 343	273	8 636	5 565	176
Thai regimen, no enhanced capacity (3)	114 107 (51 499)	83	2 656	1 374 (620)	43 (19)
Thai regimen, enhanced capacity (4)	415 753 (268 865)	226	7 232	1 839 (1 189)	57 (37)
Thai regimen, plus enhanced capacity and formula feeding (5)	504 423 (357 634)	262	8 384	1 925 (1365)	60 (43)
Short-course combination treatment plus enhanced capacity (6)	764 069	308	9 856	2 481	78

[1] Number of DALYs gained per infection averted, with discount rate of 3% and life expectancy of 69 years, =32

Table 9.7: High and low estimates of HIV-related paediatric care costs per child, Hlabisa District (1997US$)

Estimate	Cost of clinic visits	Cost of hospital admissions	Total	Total, present value
Low estimate	130*	558**	688	604
High estimate	N.A.	N.A.	4 500	3 943

*calculated as 10 x the average cost of a visit (US$13)

** calculated as 8.2 (average length of stay in hospital) x 4 (estimated number of visits) x 17 (average cost/day on paediatric ward in 1997)

Table 9.8: Cost/DALY results in sensitivity analyses (after 1998 cost reduction, where relevant)

Intervention Scenario	25% fewer infections averted	Drug costs are 10% of their 1997 level	Discount rate 6%[1]	Discount rate 0%[1]	Life expectancy 49 years, discount rate 3%[1]	Worst-case scenario (25% less infections averted, discount rate 6%, life expectancy 49 years[1])	Best-case scenario (effectiveness at level estimated, discount rate 0%, life expectancy 69 years, drug costs 10% 1997 level)
ACTG076, no enhanced capacity (1)	242	22	362	90	207	484	11*
ACTG076 plus enhanced capacity (2)	232	37	352	87	199	464	18*
Thai regimen, no enhanced capacity (3)	57* (26*)	*9***	86* (38)*	20* (10)*	49* (22)*	115* (52)*	*4***
Thai regimen plus enhanced capacity (4)	77* (50*)	29*	114* (74)*	29* (19)*	65* (42)*	153* (99)*	14*
Thai regimen, enhanced capacity, formula feeding (5)	80* (57*)	35*	120* (86)*	30* (20)*	68* (49)*	160* (114)*	17*
Short-course combination regimen, enhanced capacity (6)	103*	24*	156*	40*	89*	207*	12*

[1] DALYs gained per infection averted: 16 at discount rate of 6% and life expectancy of 69 years; 64 at discount rate of 0% and life expectancy of 69 years; 16 if discount rate is 6% and life expectancy is 49 years; 28 if discount rate is 3% and life expectancy is 49 years

* cost-saving with high cost estimate; ** cost-saving with low cost estimate

around or less than US$100 for all scenarios except those involving the ACTG076 regimen. In the best and worst-case scenarios explored, the cost/DALY ranged from US$4-207 for the short-course regimens, and from US$11-484 for the ACTG076 long regimen.

9.3.6 Incremental cost-effectiveness analyses

The baseline analysis suggested that some intervention strategies were both higher cost and more effective than other alternatives. The short-course combination regimen dominated the ACTG076 regimen, being estimated to be both lower cost and more effective (in implementation though not absolute efficacy in a trial setting). However, while more effective than the scenarios using the Thai regimen, it was more expensive. The intervention in which the Thai regimen was used with enhanced capacity was also both more effective and higher cost than the scenario in which no health service strengthening was assumed; the same applied for the addition of formula feeding to the Thai regimen, in comparison with strengthened capacity alone. Incremental cost-effectiveness analyses were therefore relevant, to explore how much more this extra effectiveness cost (Table 9.9).

Table 9.9: Incremental cost-effectiveness analyses

Comparison	Incremental Cost/DALY[1]
Thai with enhanced capacity vs. Thai with no enhanced capacity	48-66
Thai with enhanced capacity plus formula feeding vs. Thai with enhanced capacity	77
Short-course combination treatment vs. Thai with no enhanced capacity	90-99
Short-course combination treatment vs. Thai with enhanced capacity	133-189
Short-course combination treatment vs. Thai with enhanced capacity and formula feeding	176-276

[1] ranges reflect values at Thai regimen drug costs in 1997 and 1998 respectively

The results showed that the incremental cost/DALY for strengthening capacity to implement the Thai regimen was relatively low in the context of the average cost-effectiveness ratios (Table 9.6), at US$48-66; addition of formula feed was not much more, at US$77. Incremental cost-effectiveness ratios were much higher for implementation of the short-course combination regimen, at US$133-276.

9.4 Discussion

9.4.1 General summary of findings

This appraisal indicates that, at least until mid-1999, the Thai regimen of short-course ZDV treatment - with or without formula feeding, and with or without strengthened health services capacity – was the most affordable and cost-effective antiretroviral intervention available to developing

countries. However, with either formula feeding or strengthened capacity – which would be required to realise the full effectiveness potential of the intervention – affordability in Hlabisa district may be questioned. Given stagnant budgets and substantial increases in demand for care related to HIV/AIDS (Chapters 5-7), and devolved budgeting to district management teams, there must be some doubt as to whether health service managers would choose to spend 5% or more of their resources on antiretroviral treatment for pregnant women. The ACTG076 regimen, which has become the standard of care in developed countries, is much less cost-effective and appears unaffordable in a typical rural South African health district (at 11-29% of the district budget) unless substantial additional funding is made available from national or provincial level, or by donor agencies. The cost-effectiveness rankings of the strategies are robust in sensitivity analyses, although it is notable that the ACTG076 regimen would become almost as cost-effective as the other alternatives if drug costs were reduced to 10% of their 1997 level.

9.4.2 Explanation of findings

The affordability results reflect 2 main factors: the varying cost of the drug regimens, and whether or not strengthening of health services capacity is undertaken. Without strengthened capacity, drugs dominate the costs of an antiretroviral intervention; with strengthened capacity, the costs of counselling and testing become important – reflecting the fact that this must be provided to all pregnant women in the district and not just those who actually have HIV infection.

The cost-effectiveness results largely reflect the different costs of the alternative drug regimens. These vary much more than the effectiveness achieved by them, while additional capacity achieves additional effectiveness that is broadly in line with its cost. For example, the effectiveness achieved by the four strategies with additional capacity are within 27% of each other, while the cost of the Thai regimen after the 1998 price cut is only 6% of that of the ACTG076 regimen and 15% of that of the short-course combination regimen. This is illustrated by the closeness of the cost-effectiveness results in the sensitivity analysis in which drug costs were assumed to be 10% of their 1997 level.

9.4.3 Implications of results

Can antiretroviral interventions be recommended in cost-effectiveness terms?

Apart from comparing alternative antiretroviral interventions with each other, policy formulation on implementation needs to be informed by an assessment of whether they are cost-effective in comparison with other ways of using scarce health sector resources. Although there are no clear cut-off points at which an intervention may be judged cost-effective, it has been suggested that a cost/DALY of less than US$150 is "attractive" in developing countries, and that a cost/DALY of less than US$50 is "very

attractive" (e.g. see Mills, 1998). Using these benchmarks, all interventions except that using the ACTG076 regimen appear cost-effective in the baseline analysis; since the 1998 cut in drug prices, the Thai regimen is cost-effective in all sensitivity analysis scenarios and highly cost-effective in almost all cases. It was also interesting that the large fall that is predicted to occur in life expectancy has very little impact on these results: a 20 year reduction translated into only 3 fewer DALYs per infection averted.

Cost-effectiveness is worse in some scenarios than the estimates made for certain health interventions – for example, these include childhood immunisation (US$25-75/DALY), STD treatment (US$10 in the baseline analysis in a recent study) and tuberculosis treatment (estimated as US$1-3/DALY in 1991). However, the figures – including those for the ACTG076 regimen - compare favourably with several widely implemented health services, such as malaria treatment (estimated as US$200/DALY in the World Bank's World Development Report, 1993).

When making these cost/DALY comparisons, it is also important to bear in mind that, though widely quoted, cost/DALY figures should not be unquestionably accepted. For example, some figures are based on studies in very low-income countries. These may under-estimate the cost/DALY in middle-income settings, especially if staff costs form a large proportion of total intervention costs. This would make direct comparisons with studies of antiretroviral interventions from middle-income countries such as South Africa unfair. In addition, the costs used in the World Development Report are based on costs in 1993 at the latest; if inflation is allowed for, these are likely to be considerably higher in 1998 (if costs in the health sector have kept pace with general inflation). Other difficulties include the fact that intervention effectiveness will vary among and even within countries.

As an example, the widely cited figure for tuberculosis treatment is based on data from three of the poorest countries in the world – Malawi, Mozambique and Tanzania, where the maximum cost of treatment per patient was estimated as US$217. In South Africa, the economic evaluation in Chapter 8 suggested that the conventional strategy for treatment of tuberculosis – the approach analysed in this three-country study – would cost approximately eight times more than this. This implies that the cost/DALY for conventional tuberculosis treatment must be at least US$24 in South Africa. Moreover, the effectiveness of treatment is generally lower in South Africa than in the model IUATLD (International Union against Tuberculosis and Lung Disease) programmes appraised in Malawi, Mozambique and Tanzania. In 1998, the national "cure" and "successful treatment" rates were 57% and 74% nationally in South Africa, compared to over 90% in the IUATLD programmes. The number of extra years of life gained by curing a case has also fallen dramatically with so many patients being infected with HIV (from around 26 to 2 years). It is therefore even conceivable that, in cost/DALY terms, some antiretroviral

interventions are more cost-effective than tuberculosis treatment in South Africa – one of the most widely accepted of all public health interventions.

Are antiretroviral interventions affordable and is implementation practical?

Even if an intervention is cost-effective, this is not sufficient to recommend implementation. Two other important considerations are affordability and the practicality of implementation given the available supply of key resources.

This appraisal suggests that the ACTG076 regimen is unaffordable without major reductions in drug prices, and that the affordability of any intervention that involves strengthening of health care capacity is questionable. Even if drug costs were reduced to 10% of their 1997 value and if counselling costs were halved through the use of lay person counsellors, implementation of the Thai regimen with enhanced capacity would still account for 3% of the district budget – a not insignificant sum. Nonetheless, the fact that large reductions in drug costs have already occurred does illustrate the importance of regularly re-assessing these interventions. In 1997, they appeared clearly unaffordable; in 1998, they became much more realistic.

It is also not clear how practical implementation is for the strategies involving health service strengthening. This strengthening is required to realise the full effectiveness and public health impact potential of any given drug regimen, but the estimated extra resource requirements of 8 additional nurses, 4 additional midwives, and 1 extra laboratory technician are not insignificant. In Hlabisa at least, it is difficult to recruit (and then retain) both nurses and laboratory staff; this is probably true of many rural areas. Extra allowances or higher salaries might make recruitment and retention easier, but would also increase the costs of the intervention. Alternative strategies – such as use of lay people in counselling – may need to be considered if widespread implementation is to be achieved.

9.4.4 Study limitations

Though appraisals are valuable for gaining early insights into the economics of antiretroviral therapy, it needs to be acknowledged that, at the time the study was originally done, the analysis – and the firmness of the conclusions to be drawn from it - was constrained by several limitations. Most parameters used to appraise each intervention scenario were based on empirical evidence from clinical trials, routine district data and research studies undertaken in Hlabisa. However, it is not straightforward to extrapolate operational effectiveness from clinical trial effectiveness. Also, the costing of counselling and extra midwifery support was based only on estimates of the number of such staff required - it is possible that these were under or over-estimated. Estimation of the care costs that might be associated with paediatric HIV infection is difficult, which is why potential cost-savings were not allowed for in the baseline analysis. Yet cost-savings

cost-savings are an important element in informing decision-making on antiretrovirals for pregnant women, since it is conceivable that they are large enough to make an intervention programme cost-saving. This would be an argument for implementation that it would be difficult to refute.

Some data on paediatric care costs have now been used (Soderlund et al, 1998) in a cost-effectiveness analysis of several options to prevent paediatric HIV infection, and these do suggest that they are large enough to make some scenarios cost-saving. Nonetheless, these are costs from one urban site only and not necessarily representative of other parts of South Africa, still less sub-Saharan Africa as a whole. In poorer countries, care costs will be much lower than in South Africa, while key intervention costs such as drugs, formula feeds and HIV tests are likely to remain much the same.

The general paucity of data for paediatric care costs illustrates that more research would be useful, especially since it is possible that knowledge of these costs will become relevant in the appraisal of other HIV prevention strategies. Ideally, household costs would also be assessed, since taking the perspective of government health services only could be argued to be too narrow. It also highlights the lack of knowledge on the lifetime morbidity and health care utilisation associated with HIV+ children in Africa. Even if costing analyses had not already been undertaken, reasonably accurate cost estimates could have been made if there were good data available on illness episodes, the number of episodes for which formal care is sought, and the type of care that is provided. For example, the cost of a day in hospital, particular types of drugs, the cost of clinic visits etc., are relatively easy to establish, and could have been combined with the number of days in hospital and number of clinic visits to establish lifetime costs. However, these data were not available.

Finally the study was based on data from one site only, meaning that generalisability of results needs careful consideration; and before the results of the nevirapine trial were released.

9.4.5 Generalisability of findings

9.4.5.1 How costs and effects may vary elsewhere, theoretically

Costs

Theoretically, the absolute costs for several major intervention components – drugs, HIV tests, formula feeds - should be similar in most sites. They are supplied internationally and/or local staff costs - which are most likely to vary by country – form a relatively small fraction of their cost. In the intervention scenarios where drug costs dominate – the ACT076 regimen and the short-course combination regimen – the absolute value of total costs is therefore broadly generalisable. The costs that are most likely to vary, and which accounted for an important share of total costs in some scenarios, are counselling and extra midwifery support. These are likely to

broadly reflect average income levels, so that while Hlabisa may be representative of South Africa and other middle-income countries, costs may be considerably higher than those that would apply in many other parts of Sub-Saharan Africa. There are few data on the costs of counselling and testing elsewhere (Chapter 3). This study, at US$85 392 for extra counsellors per year and approximately 8000 counselling sessions, translates into US$10.7 per counselling visit. This is less than the US$18 that has been estimated for one Ugandan site (Mansergh et al, 1996), but higher than the US$7 estimated in another South African study (Kinghorn et al, 1998; also used in Soderlund et al, 1999) and the US$4 that has been estimated in Lusaka, Zambia (Marseille et al, 1998). This implies that the counselling costs may be as much as 73% higher or 63% lower elsewhere. These over- or under-estimates may also apply to laboratory and midwives, health promotion and training. Taken together, these components were important for the scenarios using the Thai regimen with enhanced capacity, and the Thai regimen using both enhanced capacity and formula feeding (57% and 43% of total intervention costs, respectively). This may mean that, elsewhere, cost differences could make cost-effectiveness up to 42% higher or up to 36% lower for these interventions. Even so, cost-effectiveness would be some way below US$150/DALY.

Effects

The generalisability of effectiveness is harder to gauge. It is possible that in countries with generally lower socio-economic development indicators (e.g. literacy rates), this will be reduced to less than the levels estimated in the analysis – for example due to poorer compliance with treatment, lower rates of booking for antenatal care, or greater irregularity in drug supplies. For any given number of pregnant women, the effectiveness of an antiretroviral intervention will be greater, other things being equal, if HIV seroprevalence is higher. This is because HIV counselling and testing costs will be largely similar (some differences will result if more counselling time is given to women who are HIV+, and more confirmatory tests will be required), but the number of women eligible for the intervention will be less. In other words, while the benefits in terms of DALYs gained will be the same per HIV+ women detected, the lower the HIV seroprevalence the more it will cost to detect an HIV+ woman. Hlabisa has a relatively high seroprevalence in relation to some provinces in South Africa; is similar to some other African countries – particularly urban areas, but is higher than the average seroprevalence for Sub-Saharan Africa, which is approximately 15% (Marseille et al, 1998); and is certainly much higher than any country in Asia or Latin America. If HIV seroprevalence were 15%, it seems reasonable to assume that effects, and all costs except those for counselling and testing, would be halved. This would raise the cost/DALY by approximately one-third (to US$56) for the Thai intervention with formula feeding, and by 44% (to US$53) for the Thai intervention with enhanced capacity only. This tends to indicate that the Thai regimen will remain cost-effective even at relatively low levels of HIV seroprevalence.

Affordability and cost-saving potential

The affordability of an antiretroviral intervention in other rural South African districts will be a function of both HIV seroprevalence and the size of district budgets. HIV seroprevalence in other parts of KwaZulu-Natal, and in provinces such as Mpumalanga and Free State, is similar to that in Hlabisa (Chapters 2 and 4); health budgets per capita in these areas are also broadly comparable. In some other parts of the country, the intervention may be relatively more affordable, due to lower prevalence and, especially in the case of Western Cape and Gauteng, larger budgets.

Since South Africa is a relatively high-income country compared to most other parts of Africa, the affordability of widespread implementation of the antiretroviral treatment strategies considered above must be questionable in other parts of the continent. Given an average per capita income approximately five times that of most Sub-Saharan African countries – and almost ten times that of some countries heavily affected by HIV/AIDS (e.g. Tanzania; Uganda; Kenya; Zambia), general implementation of antiretroviral treatment could easily require between one-third and one-half of district resources. This is also less likely to be offset by care cost-savings, which are likely to be much lower than in South Africa.

9.4.5.2 Comparisons with results from other studies

Cost-effectiveness

Study limitations and variation in costs and effects makes comparing results with those of other studies particularly useful. Pre-nevirapine, these are generally consistent with the results presented here, despite different methodologies and sources of parameter estimates. A general modelling study for South Africa, largely based on data from Johannesburg and on clinical trial results, has also suggested that the Thai regimen was the most cost-effective option and the ACTG076 regimen the least cost-effective (Soderlund et al, 1999). This study assessed a different short-course combination regimen to that considered here, so the results are not directly comparable; however, as in this study, it was ranked between the ACTG076 and Thai regimens. Interestingly, this study used data on paediatric care costs; though the additional cost per HIV-infected child compared with an HIV-negative child is not quoted, it appears that cost-savings were much higher than the low estimate used in this study, and sufficient to make the Thai regimen cost-saving if implemented without formula feeding in the baseline scenario. On the other hand, care costs are likely to be higher than those that would apply in Hlabisa and other rural hospitals– they were based on Baragwanath Hospital, a tertiary facility where the average cost/day – at US$57 – is approximately double that in Hlabisa and more than three times the incremental cost used in this study. The cost/year of life saved without formula feeding was similar to the cost/DALY estimated in this study (US$37 compared to US$43), though a different discount rate (5%) was used and DALYs and years of life saved are not exactly comparable. The results are consistent with the 1998

Marseille et al study of three combination regimens in that the cost/DALY figures – at US$60-274/DALY – would place these above the Thai regimen; and with the conclusion that the combination interventions might be cost-effective if large reductions in drug prices were achieved. They are also consistent with a more recent analysis focused on nevirapine, where the analysis suggested that two short-course combination regimens – including the one focused on in this study – were less cost-effective than the Thai regimen.

Affordability

Affordability has only been commented on in one other study (Soderlund et al, 1999) – it is not considered in the two studies for Sub-Saharan Africa as a whole (Marseille et al, 1998; Marseille et al, 1999), which focus on cost-effectiveness only. Soderlund et al observed that, since implementation of the Thai regimen has been estimated to cost approximately 0.5% of the national health budget (Kinghorn, 1998), it appeared affordable. An analysis for the entire country, using the model originally developed for Hlabisa, suggests a very similar figure (see South African MRC website).

A level of 0.5% of total health expenditure does appear affordable. This illustrates, however, that affordability at a broad, national level may be different from affordability at district level. Areas that are particularly well-resourced (e.g. Western Cape; Gauteng) and/or which have a low HIV seroprevalence will be able to afford to implement the Thai regimen. However, districts with average or below average resources, and high seroprevalence, will have more difficulty. This suggests special national subsidies, or earmarked funds, may have to be made available to some districts to make implementation affordable – especially as decentralisation proceeds and budgets become increasingly district-based.

9.4.6 Implications of the recent nevirapine findings

The recent results of the trial of nevirapine in Uganda, and the recently published economic analysis of the results (Marseille et al, 1999), suggest that any policy implications to be drawn from analyses of alternative regimens have been superseded by strong evidence that a nevirapine intervention is now the most affordable and cost-effective option available. Even with very conservative assumptions, the cost/DALY was estimated to be US$5-11; and was much lower cost and more cost-effective than the alternatives considered – including the Thai regimen and two short-course combination regimens – in all sensitivity analyses. This illustrates how important it is to frequently update analyses when a field is rapidly evolving: arguably all analyses – including those published as recently as June 1999 – that did not include nevirapine are now outdated.

It is therefore interesting to explore how the nevirapine results affect the analysis presented here. Nevirapine costs US$4 per mother-child pair. It is given as a single self-administered dose to both mother and child; this makes it very easy to implement and all women giving birth in government

facilities should be eligible for it. It reduced transmission by 47% at 14-16 weeks compared to a placebo group who received zidovudine, making its effectiveness similar to that of both the Thai and short-course regimens. It also appears well tolerated, so that the idea of giving treatment to all women, irrespective of HIV status, has been raised (Marseille et al, 1999). If universal treatment were given, the only costs would be the drug itself, plus training of nurses and health promotion; if only HIV+ women are treated, the counselling and testing costs would apply as well. Extra midwives would not be required, due to self-administration.

Universal treatment in Hlabisa, under these assumptions, would cost US$32 000 for the drugs (for the 95% of women assumed to give birth in government facilities) and US$11 915 for the health promotion and training; a total of US$43 915. With a 47% reduction in transmission in the 26% assumed to be HIV+ (to a VTR of approximately 16%), 366 infections would occur – a reduction of 291 and a gain of 9312 DALYs. This equates to a cost/DALY of US$4.7. Such treatment would cost 0.8% of the district budget. Even if effectiveness were half this level, the cost/DALY would be less than US$10. With counselling and testing included, effectiveness can be assumed to be the same but costs would increase to US$172 769. This would give a cost/DALY of US$19, and cost 3% of the district budget.

9.4.7 Conclusions

Overall, this analysis shows that some antiretroviral interventions to prevent mother-child transmission are probably cost-effective in both Hlabisa and South Africa as a whole, and may be cost-saving. Until recently, the most cost-effective treatment would have been use of the Thai regimen; now the most cost-effective option appears to be use of nevirapine. The analysis also shows that both affordability and the availability of key resources such as staff are important considerations – cost-effectiveness alone is insufficient to recommend implementation. The Thai and nevirapine interventions appear affordable at national level but some districts may need special funding support if it is to be made affordable throughout South Africa. Universal treatment with nevirapine appears affordable at district level. Meanwhile, important gaps in knowledge remain that have been highlighted by this appraisal – notably the paucity of data concerning lifetime morbidity, health care utilisation and costs associated with paediatric HIV infection in Africa.

CHAPTER 10: Overall Discussion

10.1 Introduction

The first 9 chapters of this thesis have all been written around the 2 themes highlighted in its title: the economic impact of the HIV/AIDS epidemic on health services in South Africa, and evaluation of possible ways of responding to this impact.

Chapter 1 started with a very general introduction and overview, while Chapter 2 provided the overall background information required to appreciate the importance of the subject, to understand the terminology used in later chapters, and to evaluate the extent to which results generated from the chosen study site of Hlabisa District could be generalised to other locations. Chapter 3 then provided a detailed review of the literature concerned with economic aspects of the HIV/AIDS epidemic for the period between the discovery of the human immuno-deficiency virus in1984 and the end of 1998. This was designed to set the research reported in this thesis in context, to identify important gaps or limitations in existing literature, and to demonstrate how the research reported in Chapters 5-9 would represent an important and original contribution to knowledge. Having set the general scene and justified the relevance of new research on the economic aspects of the HIV/AIDS epidemic in South Africa, Chapter 4 provided an overview of the goal, objectives and methodology of the research undertaken in Hlabisa between 1996 and 1999. Particular emphasis was given to the choice of Hlabisa District as a study site and the extent to which it is typical of other places in South Africa, sources of data and their reliability, and analysis of cost data. Chapters 5-9 then presented the five distinct but inter-related research studies undertaken in Hlabisa in turn, with the first three focusing on progressively more detailed and sophisticated analyses of the economic impact of HIV/AIDS on the district's health services, and the final two concerned with possible ways in which the district might respond to these impacts.

This chapter is designed as an overall discussion that pulls together the previous 9 chapters and concludes the thesis. This involves doing 8 things in the same chapter:

- briefly reviewing the importance of research concerned with the economic impact of the HIV/AIDS epidemic on health services in South Africa, and of research focused on identifying economically viable ways of responding to this impact;
- highlighting the gaps in knowledge that existed in 1996, why these were important, how the studies undertaken in Hlabisa over the last three years have addressed some of them, and the extent to which other research in the interim has also done this;
- summarising the key results from the research reported in Chapters 5-9 and the main conclusions that can be drawn from them, with especial reference to their generalisability beyond Hlabisa;

- discussing the overall importance of the results and conclusions to be drawn from the Hlabisa research in the context of the previous body of knowledge;
- assessing the main implications of the results and conclusions for health planners and policy-makers in KwaZulu-Natal and for South Africa as a whole;
- suggesting what future research would be relevant;
- stepping back a little to consider some of the general insights gained through undertaking the research; and
- providing some overall conclusions based on Chapters 1-9 and the preceding discussion in Chapter 10.

The chapter is therefore structured in 8 sections, which deal with each of these items in turn.

10.2 A brief review of the importance of research concerned with the economic impact of the HIV/AIDS epidemic on health services in South Africa, and of research focused on identifying economically viable ways of responding to this impact

The most obvious starting point for a justification of the importance of research concerned with the economic impact of the HIV/AIDS epidemic on health services in South Africa is the sheer scale of the epidemic in the country. The basic facts are that in terms of its magnitude and rapidity of spread, South Africa is experiencing one of the most severe HIV epidemics in the world. In 1985, the prevalence of HIV infection was negligible. By 1998, an estimated 13% of the adult population was infected, meaning the country had the fourth highest HIV seroprevalence in the world and ranked second only to India in terms of number of cases. Combined with the usually inevitable progression from infection to disease and death in a relatively short time period, and the concentration of infection among an age group that would normally be expected to make comparatively low use of health services, these figures indicate that there are strong theoretical grounds for believing that HIV/AIDS will substantially increase the existing burden of ill-health and demand for health care. In turn, this may lead to marked changes in the way health services can and do provide care.

Though it seems likely that demand for care will increase and that this will affect the way in which care is provided, the extent to which this will happen in practice is difficult to predict. On the demand side, this reflects limited epidemiological data concerning the natural history of HIV infection, restriction of HIV seroprevalence data to antenatal clinic attendees who are not necessarily representative of the population as a whole, and uncertainty concerning the health care seeking behaviour of those with an HIV-related illness. On the supply side, health services could respond to increased demand for care in several ways, but neither the magnitude nor direction of change is obvious.

The importance of research concerned with the economic impact of the HIV epidemic on health services in South Africa can therefore be justified in 3 steps. First, the epidemic is likely to have a substantial impact on demand for health care and the way health care is provided. Second, the exact nature of this impact is unclear. Third, to improve understanding of the HIV epidemic's impact on health services and to inform the development of appropriate response strategies, research is required.

The justification for research concerned with the identification of economically viable ways for the health sector to cope with the HIV/AIDS epidemic is an extension of the arguments for research on its economic impact on the health sector. Having identified the main ways in which the HIV/AIDS epidemic will affect health services, including which services are particularly affected and what the main causes of increased demand and costs are, research aimed at identifying more affordable and cost-effective ways of managing the major sources of increased demand for care is a logical next step. In South Africa, the importance of doing this is especially clear. Health budgets in the public sector are stagnating or being cut, so that it appears unlikely that additional demand can simply be managed by increasing the total resources available in hospitals and clinics. Therefore, on the assumption that demand for care will increase, new approaches to care that are more affordable and cost-effective than conventional alternatives are likely to be required. For similar reasons, the use of existing resources for strategies aimed at HIV prevention should also be evaluated in terms of both affordability and cost-effectiveness.

10.3 Gaps in knowledge that existed in 1996, why these were important, and how the studies undertaken in Hlabisa over the last three years have addressed some of them

Despite the relevance and importance of research concerned with the economic impact of the HIV/AIDS epidemic, and of research concerned with identifying economically viable ways of coping with this impact, the body of knowledge in both areas was, for developing countries, still limited in 1996. This was in marked contrast to some developed countries – especially the USA, where a large body of research has emerged despite the much smaller scale of the problem. Research in Africa, the continent most seriously affected by the epidemic, was particularly scarce.

10.3.1 Gaps/limitations in existing knowledge of the economic impact of HIV/AIDS on health services in 1996, and their importance

In terms of the economic impact of HIV/AIDS on health services in Africa, many of the published studies that did exist were rapid national-level appraisals. These were based on estimates of the number of AIDS cases in a country, the estimated cost of care per AIDS patient using clinicians' estimates of the morbidity associated with AIDS, and the assumption that all cases would seek care. Such analyses have obvious limitations – they ignore the role of pre-AIDS morbidity, not all cases will seek care, and clinician estimates may be inaccurate.

There were only a handful of published studies reporting detailed empirical data that could give some indication of the economic impact of the epidemic on health services. Several of these had not been primarily designed to address this issue, and the main focus in most instances was on the clinical conditions associated with HIV infection and the prevalence of HIV infection in hospitals. Few reported cost data. The main examples providing relevant data were as follows:

- 2 studies in Zambia, 1 for a rural district in 1991 and 1 of general medical admissions to a teaching hospital in Lusaka in 1992;
- 3 studies in Kenya, 2 of HIV-related morbidity and mortality on the general medical wards at Kenyatta National Hospital in Nairobi in 1988/9 and 1992 respectively, and 1 of tuberculosis admissions to the Infectious Diseases Hospital in Nairobi between 1985 and 1990;
- 2 studies in Uganda, 1 of general medical admissions to a hospital in Kampala in 1992 and 1 of drug consumption by AIDS patients in another Kampala hospital in 1991;
- 1 study in Zaire, of general medical admissions to a tertiary referral hospital in Kinshasa in 1989;
- 1 study in Guinea-Bissau, of general medical admissions to the national referral hospital in 1989/90;
- 1 study in Côte D'Ivoire, of general medical admissions to 2 Abidjan hospitals in 1991; and
- 2 studies in Rwanda, 1 of a cohort of antenatal women and 1 of general medical admissions to the main hospital in Kigali.

Generally, these studies indicated that a large percentage of general medical admissions in tertiary urban African hospitals were HIV+. In the subset of studies that reported cost data (the ones in Zambia, the one in Zaire, the study of tuberculosis patients in Kenya, and the Ugandan study concerned with drug consumption), costs per admission for HIV+ patients were similar to, or higher than, those for HIV- patients. The only study to set the costs of HIV+ admissions in the context of hospital services as a whole and to consider all district services rather than hospitals only was the study in rural Zambia. However, as with all the other studies, this did not attempt to estimate what fraction of HIV+ admissions could actually be attributed to HIV infection. This is despite the fact that, epidemiologically, it is clear that some HIV+ admissions would have occurred in the absence of HIV infection, and that their numbers may be substantial once population seroprevalence is relatively high. Simple reporting of figures for the prevalence of HIV infection will inevitably exaggerate the true impact of the epidemic.

Other studies reporting costs did not relate the total costs associated with HIV/AIDS patients to the total costs associated with health services, thus making it impossible to assess the overall seriousness of the epidemic's impact. Instead, they focused on the costs per admission or per visit for an HIV+ patient, sometimes comparing figures with those for HIV- patients, and sometimes giving a breakdown by stage of infection. The main examples included:

- 3 studies in South Africa, 1 in the country's largest tertiary care facility in Johannesburg for the period 1988-92, and 2 in tertiary facilities in Cape Town;
- 1 study of adult medical admissions in a Rwandan hospital for the period 1988-91; and
- 1 study of paediatric admissions to a tertiary facility in Lilongwe, Malawi, in 1992.

Overall, therefore, the number of studies related to the economic impact of the HIV epidemic was small, and most dated from the late 1980s and early 1990s. Most were cross-sectional in design and did not involve collection of longitudinal data. The vast majority were confined to urban locations, typically capital cities. Most were restricted to general medical wards, to tuberculosis admissions alone, or to HIV+ patients only; and most were also restricted to tertiary hospitals. None used basic epidemiological theory to assess what fraction of HIV+ admissions or attendances could actually be attributed to HIV infection. Further, few placed costs associated with HIV infection in the context of total ward, total hospital, or total district-level health service costs.

Studies from South Africa offered a good illustration of these statements. There were just 3 published studies based on empirical data, all of which were confined to urban tertiary hospitals. The most recent data were from 1992. Each focused on HIV+ general medical admissions or outpatients only. None used the epidemiological principles of attributable risk, and none set the impact of HIV/AIDS in the context of medical services, hospital services or health services as a whole. Other work was confined to 6 modelling exercises undertaken between 1988 and 1991, whose accuracy was unclear; and one rapid appraisal in 1994, the accuracy of which the authors themselves questioned. The way in which health services were responding to the impact of the epidemic had not been studied.

This left several important gaps in knowledge. First, the HIV epidemic is an evolving rather than static phenomenon, so that data from previous years were probably not indicative of the present situation or the recent past. Second, cross-sectional data represent a snapshot picture only of the impact of HIV/AIDS. They cannot say anything about how the epidemic's impact has evolved or about how health services have responded over time – longitudinal data are required to do this. Third, there were no data from rural areas for most developing countries, including South Africa. This was despite the fact that such areas are where a substantial proportion or a majority of the population lives, and even though studies from capital cities may be atypical - especially when undertaken in tertiary hospitals that may be care "magnets" drawing patients from a wide catchment area. Fourth, there were hardly any data from general district or secondary hospitals, or from clinics, even though impacts are likely to be different to those in tertiary facilities. Fifth, for many countries – including South Africa - there were no data that set the impact of HIV/AIDS in the context of hospital services or health services as a whole, making it difficult to assess the

overall seriousness of the epidemic's impact. Sixth, the accuracy of modelling exercises was unclear.

10.3.2 Gaps/limitations in knowledge of economically viable ways of coping with the impact of HIV/AIDS on health services that existed in 1996, and their importance

As for knowledge related to the economic impact of the HIV epidemic on health services, in developing countries there were also gaps in knowledge related to economically viable ways of responding to the HIV/AIDS epidemic in 1996.

Most of the research that had been done in Africa prior to 1996 concerned home-based care or ways to reduce the costs of HIV testing. This represented a rather narrow focus – HIV testing is a relatively minor cost; and home-based care is relevant only to those with chronic AIDS-related illnesses, and not the HIV+ population as a whole. For other aspects of care, the number of studies was tiny. There had been one appraisal of the cost and cost-effectiveness of an entirely ambulatory care strategy for tuberculosis treatment in Uganda; one cost-effectiveness analysis of isoniazid preventive therapy, based on modelling, in South Africa; one study of the cost-savings that could be realised by decentralising tuberculosis treatment from hospitals to health centres in Malawi; and one study of the costs and cost-effectiveness of using ethambutol instead of thiacetozone in tuberculosis treatment in Kenya.

Studies related to HIV prevention were similarly limited. There had been 3 cost-effectiveness analyses of blood screening and one cost-effectiveness analysis of an intervention targeted at commercial sex workers. There had been no studies of alternative ways of providing tuberculosis treatment in South Africa, despite the fact that tuberculosis was already recognised to be one of the most common diseases associated with HIV infection in Africa. There had been no evaluations anywhere considering the strategy of community-based directly observed treatment for tuberculosis, despite the fact that greater community involvement in care had been suggested as one way of enabling health services to cope with the additional care needs generated by the HIV epidemic, and even though WHO was beginning to advocate directly observed treatment as part of the DOTS strategy. There had been no studies of the preventive strategy of antiretroviral treatment for HIV+ pregnant women – not surprising since the first efficacy results were only published in 1994.

10.3.3 How the research undertaken in Hlabisa 1996-9, and reported in Chapters 5-9, addressed some of the important gaps in knowledge existing in 1996

The research undertaken in Hlabisa between 1996 and 1999, and reported in Chapters 5-9, was designed to address some of the gaps in knowledge highlighted above. As a site, Hlabisa is rural. It also has a district hospital typical of those providing the first level of hospital care in South Africa,

and a well-defined catchment population enabling more meaningful extrapolation of results than is possible from urban locations.

In conducting the research on the economic impact of the epidemic on health services, emphasis was placed on collection and analysis of longitudinal data. Data were collected for the period 1991 through to 1998/9, enabling trends over time to be documented for the period when the epidemic first emerged to the recent past when the epidemic was well established – the first time this has been attempted anywhere. The focus on longitudinal data also allowed supply-side responses to the impact of HIV/AIDS to be explored in detail. Emphasis was placed on the use of epidemiological theory in data analysis, in order to assess what fraction of HIV+ admissions and costs could actually be attributed to HIV infection. This is the first time that this type of combined economic and epidemiological analysis has been done when assessing the economic impact of HIV/AIDS on health services. Where feasible, data were collected for clinics. In all cases, sufficient data were collected to allow the economic impact of HIV/AIDS to be set in an overall context – whether in relation to resources used at the level of a ward, the district hospital as a whole, the district as a whole, or clinic services as a whole.

Research concerned with economically viable ways of responding to the impact of the HIV/AIDS epidemic addressed two key areas. First, an economic evaluation of community-based directly observed treatment for tuberculosis was done, comparing the programme that has been implemented in Hlabisa since 1991 with more conventional approaches to care that are widely used in South Africa and sub-Saharan Africa as whole. Second, an economic appraisal of an antiretroviral therapy intervention for prevention of maternal-child HIV transmission.

10.3.4 How other research published 1997-9 has addressed some of the gaps in knowledge that existed in 1996

It is worth highlighting that, as documented in Chapter 3, the limitations or gaps in knowledge that existed for Africa in 1996 were largely the same in 1999.

The main new published work that contributed to knowledge about the economic impact of HIV/AIDS on health services (even if it was not always couched in those terms) has been presented in abstract form only, at the 1998 World AIDS Conference held in Geneva. It includes a study documenting changes in admission patterns in Tanzania, a study suggesting that health services were not being overwhelmed by patients with HIV or AIDS-related illnesses in Côte D'Ivoire, and a study in Kenya that indicated a change in health-seeking behaviour (fewer chronically ill patients using the main referral hospital in Nairobi) combined with a large increase in bed occupancy rates on the adult medical wards between 1992 and 1997.

In terms of strategies to respond to the HIV/AIDS epidemic, a cost-effectiveness analysis of improved STD treatment in Tanzania indicated that this was a highly cost-effective HIV prevention strategy compared with other health interventions. It has also been suggested that isoniazid preventive therapy for tuberculosis may be cost-effective in developing countries. Meanwhile, there have been studies other than those done in Hlabisa that have been concerned with the affordability and cost-effectiveness of antiretroviral treatment to prevent maternal to child HIV transmission. The analysis reported in this thesis may be distinguished (see also Chapter 9) in 2 ways. First, it is the only study to consider affordability, capacity to implement, and cost-effectiveness from the perspective of a broadly typical rural district in a developing country. Second, it was the first study published for South Africa specifically on the subject.

10.4 Summary of key results and main conclusions from the studies reported in Chapters 5-9

10.4.1 Key Results

The key results from the studies concerned with the economic impact of the HIV epidemic in Hlabisa were as follows:

- HIV/AIDS has led to a substantial increase in demand for in-patient hospital care that is large in the context of hospital services as a whole. This increase in demand has principally affected general adult medical wards and tuberculosis services;
- a major HIV-related tuberculosis epidemic stands out clearly as the single most important economic impact on hospital services in the first decade of the epidemic, a consistent finding whether the measure of impact is number of admissions or costs;
- though virtually undetectable in 1991, the impact of severe (AIDS-defining) HIV-related morbidity other than tuberculosis has grown rapidly and had become marked by 1998. Though of smaller importance in the context of the hospital as a whole than HIV-related tuberculosis, it was having a major impact on adult medical services, and in the case of the adult female medical ward costs exceeded those associated with HIV-related tuberculosis by 1998;
- the way in which tuberculosis care is supplied has been affected by the HIV/AIDS epidemic. Average length of stay in hospital by tuberculosis patients, and the average cost of care, have persistently fallen. The trend in cost-effectiveness has not been consistent, but overall has improved, reflecting the fact that the decline in costs outweighs initial worsening and then stabilisation in the effectiveness of tuberculosis treatment. Although the caseload has risen by close to 400%, bed occupancy rates have remained relatively stable on the tuberculosis ward;
- the way in which in-patient adult medical care is being supplied has been affected by the HIV/AIDS epidemic. It is difficult to assess the efficiency of care other than for tuberculosis patients because of

difficulty in measuring outcomes. However, bed occupancy rates have tended to increase in line with admissions– especially on the female medical ward – and by 1998 had reached unprecedented levels far in excess of official ward capacity. Average length of stay has been less affected by the increase in admissions;

- early HIV-related morbidity that could not be detected from routine data was important at hospital in-patient level, especially on the adult female medical ward;
- the total cost of inpatient care for HIV+ patients was much higher than the total cost of inpatient care for HIV-*attributable* admissions;
- the average cost of care for an adult medical HIV+ patient was similar to that for an HIV- patient, largely reflecting similar average lengths of stay;
- there were important gender differences in the economic impact of HIV/AIDS, with female medical services much more seriously affected than male medical services. This could partly, but not entirely, be explained by demographic factors. In particular, there appeared to be an excess of early, non-AIDS but apparently HIV-related morbidity among women; and
- clinics appeared to be much less affected than hospital in-patient services.

The key results from the studies concerned with economically viable ways of responding to the HIV/AIDS epidemic were:

- community-based directly observed treatment for tuberculosis in Hlabisa was much lower cost and more cost-effective than other widely used alternative approaches to care in South Africa and in sub-Saharan Africa, and the only strategy that could be implemented within existing ward capacity; and
- an antiretroviral intervention for HIV+ pregnant women in Hlabisa would have been difficult to afford and not particularly cost-effective in 1997, based on available drug regimens and prices at that time. There were also questionmarks concerning the district's capacity – in terms of human rather than financial resources - to implement such an intervention. By 1999, both the "Thai" regimen of short-course zidovudine and single-dose nevirapine appeared cost-effective, and if nevirapine were to be provided as universal treatment it would make only limited demands on existing human resource capacity. However, in contrast to analyses undertaken from the perspective of the country as a whole, which indicated that an intervention would consume a comparatively small fraction of the national health budget and therefore appeared affordable, analysis for Hlabisa district suggested that an antiretroviral intervention would still consume a large enough share of the district budget to make its affordability debatable without external support.

10.4.2 Generalisability of results

These results are of value even if they only apply to Hlabisa – at the least, they can inform district management and planning within this district.

However, they are more important and valuable to the extent that they provide more generalisable results and lessons – especially if these include potential ways of successfully coping with the HIV/AIDS epidemic. An important question, therefore, is the extent to which results may be extrapolated to other places.

The extent to which Hlabisa is a typical district was discussed at some length in Chapter 4, and this is not the place to revisit the issue in detail. Nevertheless, it is important to highlight some key types of site and area to which the results cannot be readily generalised. It is also important to consider the argument that Hlabisa is too unique to provide generalisable results at all.

10.4.2.1 Generalisability of economic impact results

Where are results probably not generalisable?

Hlabisa is a predominantly rural district where the apex of care is a first level hospital with no specialist facilities, and where services were operating at close to capacity even in the early 1990s. It is also a district where the HIV/AIDS epidemic has rapidly emerged, and where HIV seroprevalence has reached some of the highest levels recorded for South Africa so far. In terms of the economic impact of the epidemic on health services, this suggests the following:

- there must be considerable doubt about the generalisability of results from Hlabisa to urban areas. This is particularly the case where admission for tuberculosis patients is not common practice. Indeed, where this is the case, it is quite likely that the impact of tuberculosis will be the opposite of that in Hlabisa – with a possibly large impact at clinic level and a small impact on hospitals;
- there must be considerable doubt about the generalisability of results from Hlabisa to referral hospitals (which are referred to as "secondary" or "tertiary" hospitals in South Africa – see also Chapter 2); and
- there must be some doubt concerning the generalisability of results related to supply-side responses. In particular, they are unlikely to apply in facilities where there was significant spare capacity before the advent of HIV/AIDS, and where the epidemic is still limited.

In South Africa, this means that, until shown otherwise, results from Hlabisa should not be considered relevant to the major metropolitan areas. These tend to combine both a concentration of secondary and tertiary facilities, and greater availability of health services. They are also unlikely to apply where HIV seroprevalence is still comparatively low – the main example being the Western Cape.

Is Hlabisa too unique for results to be generalised at all?

What of the rest of South Africa? Some have suggested (albeit informally) that Hlabisa is so unique that no generalisation is possible. It is important to consider this argument.

The factors that make Hlabisa atypical are:

- a considerable amount of published research has been generated from Hlabisa – this is very unusual for a rural district in South Africa;
- since 1996, and especially since 1997 when the UK-based Wellcome Trust awarded a major research grant for research in the area of Reproductive and Sexual Health in Hlabisa and planning for HIVNET vaccine trials (funded by NIH) began, there has been considerable research activity in the district;
- most of the doctors employed at the hospital between 1991 and 1998 were British expatriates; and
- Hlabisa benefited from a particularly motivated and research-oriented medical superintendent between 1991 and 1997.

The effect of these factors on the economic impact of HIV/AIDS on health services has probably been limited. Research has meant that health services have been better studied than in other areas, and that Hlabisa has become a well-known name in the world of tuberculosis research in particular. However, research itself has not led to any change in the kind of services available – for example, no new treatments for HIV/AIDS have been made available. It is also questionable how much the general population was aware of this research until the Wellcome and NIH-funded research began in earnest – recruitment of a large number of field staff, building of new (non health-service related) infrastructure, and community consultation has made these very visible. Both of these projects were only just getting off the ground by 1998, and therefore had little opportunity to influence health care provision or health-care seeking behaviour during the period 1991-9.

The idea that the availability of expatriate doctors has induced more demand for health care – the most logical reason for being concerned that this factor would jeopardise the generalisability of research from Hlabisa - is contradicted by the relatively low level of admissions relative to population in 1996 (Chapter 4). In addition, there have been British doctors working in Hlabisa since 1991, so this in itself has been a constant factor in the 1990s and cannot explain the changes documented for the period 1991-9. Furthermore, many districts in South Africa – notably other nearby rural districts in KwaZulu-Natal – employ expatriates.

The medical superintendent factor is important, because this led to a radical and innovative change in tuberculosis treatment strategy in 1991. There is no question that the community-based DOTS strategy was unique in South Africa when introduced and for several years afterwards. As mentioned in Chapter 5, this may partly explain the increase in tuberculosis admissions between 1991 and 1993. It has also facilitated a dramatic supply-side response in terms of a substantial fall in the average length of stay of tuberculosis patients in hospital and no increase in bed occupancy rates on the tuberculosis ward. Where districts still adhere to the more rigid policy of admitting patients for the first 2 months of treatment, cuts in average length of stay in hospital will not have been feasible and bed occupancy

rates may have risen as a consequence. What this means is that the impact of HIV-related tuberculosis may be even higher than that documented for Hlabisa in other rural hospitals. The impact on the adult medical wards is more likely to be typical, however, since no special programmes or innovations have been implemented there.

While tuberculosis is to some extent a special case in Hlabisa, its impact is so dominant that the finding that tuberculosis is the most important single impact is likely to be generalisable. This is supported by the fact that the increase in the tuberculosis caseload is very much in line with national figures for other countries that have experienced an HIV epidemic of similar magnitude. For example, the tuberculosis caseload in Malawi has increased by approximately 400% since the mid-1980s, and similar figures have been reported for Zambia and Botswana.

Where are results most likely to be generalisable?

The above arguments indicate that, though Hlabisa is unusual in some ways, this does not preclude the wider applicability of results from the district. Therefore, it can be argued that results may be broadly generalisable to other rural districts where HIV seroprevalence is high or rapidly rising, where the apex of care is a community hospital, and where services were operating at or close to capacity in the early 1990s. In South Africa, this means a considerable fraction of the country and a large percentage of the population - other rural parts of KwaZulu-Natal, Free State, Mpumalanga and the Eastern Cape in particular. The main caveats are that the size of the increase in the tuberculosis caseload may be slightly lower elsewhere, since no extra demand induced by a community-based care strategy will have occurred; and that the impact of HIV-related tuberculosis may be higher where patients are still admitted for the first 2 months of treatment.

The result that tuberculosis is the most important single economic impact on health services is so clear-cut that it may even be possible to argue that it indicates that HIV-related tuberculosis has also been the most important impact in other African countries that have experienced a serious HIV/AIDS epidemic - at least in the early years of the epidemic. This is particularly the case given that a policy of 2 months of admission for tuberculosis patients is widespread in many other Southern and Eastern African countries, including urban areas. For example, this is true of Uganda, Kenya, Tanzania and Malawi where alternative, more outpatient approaches to care have only recently begun to be explored.

10.4.2.2 Generalisability of results concerned with economically viable ways of responding to the HIV/AIDS epidemic

The generalisability of the affordability and cost-effectiveness of the community-based tuberculosis care programme implemented in Hlabisa since 1991 was discussed at some length in Chapter 8. Here, it is sufficient to note 2 things. First, that the cost (and hence affordability) results for

Hlabisa are likely to be generalisable to many other settings, including very low-income countries. Second, while the generalisability of the effectiveness – and hence cost-effectiveness – of the programme is harder to judge, emerging evidence does suggest that similar community-based approaches can achieve impressive results elsewhere.

The cost results for antiretroviral interventions for HIV+ pregnant women are broadly generalisable to other areas in South Africa with similar HIV seroprevalence levels, though affordability will depend on budget levels. The ranking of the affordability and cost-effectiveness of the alternative strategies is likely to be consistent.

10.4.3 Main Conclusions

If the results from the studies of economic impacts are broadly generalisable to rural areas of South Africa experiencing a serious HIV/AIDS epidemic, they suggest the following major conclusions:

- in developing responses to the impact of the HIV/AIDS epidemic on health services in rural areas where HIV seroprevalence is rising rapidly or has already reached high levels, the first priority should be to identify ways of coping with an increase in the number of tuberculosis patients;
- where hospitals were operating at or close to capacity before the HIV/AIDS epidemic, managers and planners at all levels need to recognise that in-patient medical services are likely to come under severe pressure from both additional tuberculosis admissions and other HIV-related morbidity. Where resources permit, it may be relevant to expand the capacity of these services; otherwise, to avoid compromising the environment in which care is delivered and other factors such as staff morale, more efficient ways of delivering such care need to be found;
- focusing on the economic costs associated with more readily detectable impacts - HIV-attributable tuberculosis admissions and admissions for AIDS-defining conditions other than tuberculosis - will lead to an important under-estimate of the epidemic's impact on hospital services;
- it is important to assess the fraction of HIV+ admissions that can be *attributed* to HIV infection, rather than simply assessing the costs of HIV+ admissions, otherwise the impact of the epidemic may be substantially exaggerated;
- supply-side responses are likely to emerge, and there may be more scope for coping with a rise in tuberculosis caseload through cuts in hospital length of stay than there is for other types of HIV-related admission. Pressure on tuberculosis services may lead to efficiency gains, but the ability to reduce costs may become exhausted and this risk needs to be considered seriously by those responsible for resource allocation to health services. Where it is difficult to reduce admissions or lengths of stay, bed occupancy is likely to rise – and this has been the dominant response to rising general medical ward admissions to date;
- in the absence of the use of anti-retroviral drugs or expensive prophylaxis treatments for opportunistic infections, the main economic impact of the HIV/AIDS epidemic will be through increasing the

volume of patients seeking care, rather than causing an increase in particularly expensive-to-treat patients;
- gender differences should be explicitly considered when measuring the impact of HIV/AIDS and in developing appropriate response strategies; and
- until better data show otherwise, it can be assumed that clinics are less affected than in-patient hospital services by HIV/AIDS.

If the results from the studies concerned with economically viable ways of responding to the HIV/AIDS epidemic are generalisable, they suggest the following major conclusions:
- community-based directly observed treatment for tuberculosis is a strategy worthy of serious consideration in other rural areas, especially in areas that are facing the challenge of a major increase in tuberculosis caseload associated with the HIV epidemic. Even where HIV/AIDS is not a major problem, community-based approaches can save costs and improve the cost-effectiveness of care. These conclusions appear likely to hold beyond South Africa; and
- a nevirapine intervention is the most affordable and cost-effective option for antiretroviral treatment of HIV+ pregnant women, and the most feasible to implement. However, it needs to be recognised that both affordability and cost-effectiveness vary according to the level at which the analysis is done: results at national level may not apply more locally, and vice versa. It is also clear that the economic viability of interventions can change rapidly and conclusions from studies can become rapidly outdated. As a consequence, analyses need to be regularly updated in this rapidly evolving field.

10.5 Overall importance of the results and conclusions to be drawn from the Hlabisa research in the context of the previous body of knowledge

10.5.1 Economic impact studies

There are several reasons why the results and conclusions concerning the economic impact of HIV/AIDS on health services are important in the context of the previous body of knowledge.

In very general terms, there are now more data for South Africa, a country where such data are limited and where more are required given the scale of the epidemic and the uncertainty and difficulties in predicting what impact it will have in practice. More specifically, there are now data from a rural site, which were previously unavailable despite the fact that approximately half of the South African population lives in these areas. In addition, there are now longitudinal data that cover the period from the outset of the epidemic to a time when it became well-established – the first time this has been achieved. If the research is continued in future, it could offer a unique dataset and insight into the effect of the HIV/AIDS epidemic on health services.

In contrast to other studies in South Africa and most studies undertaken elsewhere, the impact of the epidemic has also been related to hospital and health services as a whole. This has allowed the impact of HIV/AIDS in the context of health services as a whole to be illustrated, in turn making it possible to judge how serious an impact the epidemic will have in this wider context. The results suggest that the impact *is* large in the context of health services as a whole.

Through a more comprehensive focus on the hospital services most likely to be affected by HIV/AIDS than undertaken in almost all previous studies (i.e. both tuberculosis wards and general medical wards, rather than only one or the other), and through studying a district where impacts are not distorted by the possibility that certain types of hospital act as care "magnets", it has also been possible to show that HIV-related tuberculosis stands out as *the* major impact. This was not clear from many earlier studies, though it does confirm results from Zambia. This also indicates that an early model for South Africa predicting AIDS rather than HIV-related tuberculosis would have the biggest impact on health services is, in some settings at least, wrong. Consideration of both inpatient hospital care and outpatient clinic care in 1998, through enabling a direct comparison between these 2 levels of care for the same time period, has also suggested that HIV/AIDS affects inpatient care more than clinics. As with the findings for tuberculosis, this confirms earlier results from Monze District in Zambia, which to date is the only other site where data for both hospitals and clinics over the same time period have been reported.

Methodologically, this is the first time that research has used the epidemiological principles of attributable risk in assessing the economic impact of HIV/AIDS on health services; and the results demonstrate that this is important. It has also been shown that collection of useful longitudinal data is feasible in rural South Africa, at in-patient level at least (albeit with considerable time and effort): this has not been demonstrated before. Also not highlighted in previous studies is the possibility of important gender differences - though further research is needed to understand them fully. Finally, a viable methodology for studying the economic impact of HIV/AIDS in rural South Africa has been established, which could be reproduced elsewhere and used to strengthen the present knowledge base.

10.5.2 Evaluation of economically viable ways of coping with the HIV epidemic

In terms of research concerning economically viable ways of coping with the impact of HIV/AIDS on health services, the study of community-based directly observed treatment for tuberculosis has provided the first evidence that this can be comparatively affordable, cost-effective and more feasible to implement than widely used alternative strategies – evidence that, as this is written, is being expanded through a series of WHO-funded pilot projects. The study of antiretroviral interventions for HIV+ women has

contributed evidence to a field where the number of published studies related to economic considerations remains very small.

10.6 Main implications of the results and conclusions for health planners and policy-makers in KwaZulu-Natal and for South Africa as a whole

At a more local level, the research has several practical implications for planners and policy-makers in KwaZulu-Natal. Most of these are covered in the conclusions listed in 10.4.3. However, it is worth re-iterating the following points:

- a major priority should be to identify effective ways of coping with rising tuberculosis caseloads;
- the capacity of medical wards needs to be reevaluated, because traditional levels of provision may be too small in the era of HIV/AIDS unless admissions can be reduced;
- it is worth considering the implementation of community-based care for tuberculosis more widely; and
- if an antiretroviral intervention for HIV+ women is to be implemented, nevirapine appears the most economically viable option, but some districts may find this hard to afford and special funding support may be required from provincial or national level as a consequence.

Meanwhile, the fact that it is possible to monitor some impacts fairly readily indicates that it may be worth expanding some of the research that has been undertaken in Hlabisa to other areas. For example, data concerning trends in different types of hospital admissions could be relatively easily collected and analysed, and though a relatively crude way of measuring impact should identify major changes.

In the absence of special studies (for example, the establishment of special cohorts that are carefully monitored and for whom detailed data are collected and maintained in special databases – as is done in the USA), one of the lessons arising from the research is that more in-depth data collection and analysis requires much pain-staking and time-consuming work. Moreover, in many settings meaningful interpretation may not be possible, either because HIV prevalence data are not routinely collected for key population groups such as tuberculosis patients and antenatal clinic attendees, and/or because HIV tests are not routinely undertaken even when there is clinical suspicion of HIV infection[43]. Identification of early HIV-related morbidity in particular requires both HIV test results for a representative sample of patients and population controls – otherwise it will not be picked up.

For comprehensive and comparatively efficient monitoring of the impact of HIV/AIDS on health services in KwaZulu-Natal in future, this suggests that the best approach is to conduct periodic surveys in "sentinel sites".

[43] both of these make identification of AIDS cases difficult, and assessment of the fraction of HIV+ attendances due to HIV infection impossible at worst and unreliable at best

Unfortunately, such prospective studies will say nothing about impacts that have already occurred: the only way to understand these is to conduct more time-consuming research of the kind now undertaken for Hlabisa.

10.7 What future research work is relevant?

Continuing to study the economic impact of the HIV/AIDS epidemic in future, as indicated above for KwaZulu-Natal, is one type of research that is relevant in future. Ongoing work in Hlabisa is important for building on what is a unique dataset in South Africa; and extension of studies elsewhere is crucial for confirming the extent to which results from this district are generalisable.

Beyond this, there are other topics worthy of research – particularly in relation to ways of coping with the impact of the epidemic. Here, the amount of research remains paltry despite the scale of the need.

Although recognised as a relevant issue, it was not possible to explore the extent to which improving efficiency of non-HIV related services could help to free up capacity for HIV-related care in Hlabisa. It is conceivable that there may be considerable room for improvement – and cost-savings – in other aspects of health care delivery, such as maternity and surgical services, or in general support services not associated with direct patient care. This is a subject that could deserve further study.

Given the impact they are having in developed countries, research considering the feasibility and economic implications of using antiretrovirals may also be relevant in developing countries. Though use of treatments that are the standard of care in developed countries are not financially viable on a wide scale at present, this may change in the next few years. For example, drug prices may fall and/or it may be shown that simpler and cheaper regimens are equally effective. Pilot work to explore what impact use of antiretrovirals may have on demand for health care, and costs of treatment for HIV-related health problems, would help to inform policy decisions on more widespread implementation, if and when this becomes financially viable. More immediately, and as highlighted in Chapters 6 and 7, research concerned with identifying more efficient ways of diagnosing tuberculosis is also relevant. Where people with suspected tuberculosis are routinely admitted to hospital, this generates demand for care on medical wards that are being particularly seriously affected by HIV/AIDS. If such demand could be avoided or reduced, it could help medical services to cope with the impact that HIV/AIDS is having on health services. One study (not reported in this thesis) considering a new algorithm for diagnosis of smear-negative tuberculosis was undertaken in Hlabisa in 1996. This had less impact than anticipated, and other options need to be considered.

As indicated in Chapter 4, the implications of HIV for the supply of staff in the health sector may be serious. This could be related to HIV-related

morbidity and mortality among staff – in the 3 years in which the research in this thesis was undertaken, there were some obvious changes in the health status of several staff, not necessarily but highly likely to be HIV-related. The supply of staff may also be affected by recruitment and retention problems, as working in the health sector, particularly in areas known to have a high HIV seroprevalence, becomes less attractive. As also pointed out in Chapter 4, HIV among staff is an enormously sensitive issue and therefore difficult to research. Studies in future may be facilitated in 2 ways. First, if it is commissioned by a body such as the Provincial or National Department of Health. Second, if the principal researcher employed to do the work is not undertaking other research that might be compromised by the unpopularity of studies on staff-related issues.

10.8 Stepping back a little: a few insights

Stepping back a little, some more general insights were gained from conducting the research in Hlabisa and, at the end of this thesis, it is worth stopping to consider what these were.

10.8.1 Designing the research

In designing a research study, a critical issue – which ironically may become most strongly evident in writing up – is the representativeness of the study site chosen and hence the potential generalisability of results. In health services research, it is unlikely that there is actually a completely "typical" site, which can make consideration of the generalisability of results more challenging than in some other types of research. The main implication of this is that a careful general assessment of district characteristics right at the beginning of a research study, to inform the choice of study site, is very important.

10.8.2 Conducting the research

In conducting the studies in Hlabisa, it also became clear that HIV/AIDS-related health services research in developing countries is particularly challenging. HIV/AIDS is a hugely sensitive subject, especially in relatively recently affected countries – one that many people do not want attention drawn to, and one for which there may be particular suspicion as to the motivation for research. This makes open discussion of studies more difficult, and can make the researcher feel uncomfortable about their work. Working as an expatriate in a developing country on such a topic is an additional complicating factor, especially if that country is South Africa, where the apartheid system has left a strong legacy that can make building trust and "normal" working relationships harder than elsewhere.

Against this background, two things became evident. First, support from the most senior staff not only makes a substantial difference to the feasibility of conducting HIV/AIDS-related health services research: it is essential. Second, building good working relationships with those

employed within the system being researched is crucial. Indeed, in many ways this – and not study design, data collection, analysis, or writing up - was the most difficult challenge in undertaking research on HIV/AIDS in Hlabisa.

10.8.3 Why is there so little published work?

One of the things that was surprising in conducting research in Hlabisa was how much useful data actually existed, even in a rural area of a developing country. Why then is there so little published work on the economic aspects of HIV/AIDS in developing countries, in South Africa specifically, and in rural areas in particular? One reason appears to be the limited number of economists working in the health sector, and even fewer who are willing to spend any amount of time in rural areas. Furthermore, collecting longitudinal data concerning the economic impact of HIV/AIDS on health services is extremely time-consuming given that primary non-computerised data sources must be relied upon, the work is painstaking if a high level of accuracy is to be achieved, and both data collection and entry can be tedious. These factors may dissuade some from even attempting research of this type. In addition, in some cases – notably outpatient services – experience from Hlabisa suggests that data may simply be inadequate for meaningful retrospective analyses. This could have been the conclusion of others in the past, and may explain the focus on in-patient care and cross-sectional data in research studies undertaken to date.

10.8.4 How could similar research be facilitated in future?

Inadequate retrospective data and time-consuming data collection and entry are not inevitable, however. It became clear during the research in Hlabisa that both would be avoidable with a good health information system. For example, if key data (e.g. length of stay on different wards, age, sex, diagnosis) had been entered for all hospital admissions in a computer database, painstaking recording of data from registers and identification of AIDS-related admissions through time-consuming requests for, and review of, casenotes would have been unnecessary. Therefore, one way to facilitate more widespread research and monitoring of the economic consequences of HIV/AIDS for health services would be to strengthen health information systems.

10.8.5 Complementarity of economics and epidemiology

The complementarity that can exist between economics and epidemiology in health sector analyses was also highlighted by the research. This is worth remarking on, because while combining the two disciplines led to much more meaningful analyses than use of one without the other, it is not automatic that economists working within the health sector have training in epidemiology, or vice versa. This also illustrates the value of working in multi-disciplinary teams, without which the relevance of epidemiological theory to the economics analysis in this thesis might not have been

discovered (and without which other analyses relying on clinical input would have been difficult or impossible).

10.8.6 Need for care in generalising the results of cost-effectiveness analyses – the case of the 1993 World Development Report figure of US$1-3/DALY for short-course tuberculosis treatment

During the period in which the research reported in this thesis was undertaken, a senior policy maker in South Africa asked if it was possible to compare the cost-effectiveness of antiretroviral therapies to prevent maternal to child transmission with health interventions already being widely used in the country. The obvious starting point for comparison was tuberculosis treatment, given the availability of considerable cost and outcome data for treatment of this disease in Hlabisa as well as its public health importance. The analysis produced some interesting results, and prompted some follow-up analysis using data from elsewhere in South Africa and from Malawi. The end result, and an indirect outcome of the research in Hlabisa, was to highlight problems with the generalisability of the widely cited cost-effectiveness figure of US$1-3 per DALY for short-course tuberculosis treatment – a figure that is often quoted as if it is a general law applicable to all tuberculosis treatment in developing countries.

The figure of US$1-3/DALY is based on a background study (Murray et al, 1991) for the World Bank's World Development Report of 1993 "Investing in Health" (World Bank, 1993). Since this report's publication, it has often been quoted and used to argue that short-course chemotherapy treatment for smear-positive pulmonary tuberculosis patients is one of the most cost-effective health interventions available (World Bank, 1993; Murray et al, 1991). Policy and planning documents recommending ongoing government and donor support to tuberculosis programmes regularly use the figure as supportive evidence.

There is not space in the main body of this thesis to present the detailed analysis of some of the limits to the generalisability of this US$1-3/DALY figure (though a draft paper is attached for reference). Here, it is sufficient to say that the following factors have an important impact on the cost/DALY for tuberculosis treatment:

- **Variation in costs between and within countries**. The study on which the US$1-3 figure was based was undertaken in Malawi, Tanzania and Mozambique. These are very poor countries where the health system costs associated with tuberculosis treatment are comparatively low. In fact, in the background study for the World Development Report, relatively low cost figures for Tanzania were explained in terms of low public sector salaries (Murray et al, 1991). In wealthier countries such as South Africa, costs are much higher – largely due to higher income levels which increases staff costs, and to a higher standard of care in hospitals (which affects, for example, the size of food and other non-personnel recurrent expenditure costs);
- **Variation in the approach to case management of tuberculosis patients**. Although tuberculosis treatment typically lasts 6-8 months,

there are a variety of approaches available for its provision. These range from entirely out-patient care with no direct observation of treatment, to hospitalisation for the full period of treatment in sanitoria and supervision of every treatment dose by health workers. The range in costs from the lowest to the highest cost can be large;

- **Variation in the effectiveness of treatment**. The effectiveness of tuberculosis treatment in terms of DALYs gained per case case cured is much lower in countries where large numbers of tuberculosis patients are infected with HIV compared to areas where rates of HIV infection are low. Survival among HIV sero-positive tuberculosis patients after successful tuberculosis treatment is approximately 3 years and around 4 DALYs, compared to approximately 21 years and 24 DALYs among HIV-uninfected patients. Accounting for HIV can therefore make a large difference to the effectiveness of tuberculosis treatment when effectiveness is measured in terms of DALYs gained. Furthermore, the US$1-3 figure was based on "model" programmes that were achieving extremely high cure rates by international standards. In many countries, reported cure rates are much lower than in these "model" programmes, so that the DALYs gained per patient treated are also lower, irrespective of the HIV epidemic;
- **The type of patients that are selected for inclusion in a cost-effectiveness analysis.** The background study for the World Bank World Development Report figure focused on new smear-positive pulmonary tuberculosis patients only. In practice, however, tuberculosis programmes do not selectively treat smear-positive pulmonary tuberculosis patients. Smear-negative pulmonary and extra-pulmonary tuberculosis patients typically form a large percentage of a country's tuberculosis caseload. In 1998, for example, they accounted for over 50% of cases in Africa and South East Asia (WHO, 2000). Restricting an analysis to smear-positive pulmonary cases can bias a comparative cost-effectiveness analysis in favour of tuberculosis treatment, because the effectiveness of treatment in terms of deaths averted or DALYs gained per patient treated is much higher for this type of tuberculosis patient[44].

Taken together, the analysis showed that these factors mean that the cost/DALY for tuberculosis treatment can be as low as US$1 per DALY, but that it can also be over US$100. This illustrates the need for care in generalising cost-effectiveness results from one setting to another, for careful scrutiny of the methods used and results produced in any cost-effectiveness study, and for updating results when a new factor such as the HIV/AIDS epidemic becomes important. In this example, comparing cost-effectiveness results for antiretroviral therapy for pregnant women from a South African study with a widely cited cost/DALY figure for tuberculosis treatment from Malawi, Mozambique and Tanzania would suggest that it

[44] smear-positive patients are much more infectious (at least 5 times more infectious according to existing evidence) than other types of tuberculosis case, and therefore the amount of onward transmission that is prevented by their successful treatment is much higher. In the World Bank analysis, 82% of the estimated number of deaths averted per patient treated were due to prevented onward transmission. In addition, the death rate in the absence of treatment is higher for smear-positive cases.

might not be worth investing in the new antiretroviral intervention. Comparing with an analysis of the cost-effectiveness of tuberculosis treatment from within South Africa would suggest that it might be justified.

10.8.7 With hindsight, was there a better research design?

Finally, it is worth reflecting on whether or not there was a better research design. Experience with undertaking planned research in practice and further thinking along the way (including – or perhaps especially - at the writing-up stage) can mean that, with hindsight, a better alternative existed. In this case, the generalisability issue became particularly evident while thinking about the structure for the thesis and in writing the overview of methods used; it would have been better if this issue had been thought about in a more rigorous way at the outset (as pointed out in 10.8.1). Nonetheless, as argued in Chapter 4, useful generalisation from Hlabisa is possible; and the only way to have improved the generalisability of results would have been to have more study sites or to have picked a "more typical" site. Yet there is not one single site that is obviously "more typical" of rural South Africa. Combined with the fact that meaningful analysis of longitudinal data would have been difficult if not impossible elsewhere (given the lack of HIV seroprevalence surveys among tuberculosis patients and antenatal clinic attendees), and limited resources, the detailed case study approach adopted probably was the best alternative available. In future, however, there is no question that such research could be strengthened if there were more resources available for it; if more than one site began to use surveys to routinely monitor the evolution of the HIV/AIDS epidemic; and if specially designed periodic cross-sectional surveys - that in time would build up into a longitudinal data set - began to be implemented in several districts.

10.9 Final Conclusions

This thesis has been concerned with the economic impact of the HIV/AIDS epidemic on health services in rural South Africa, and the identification of affordable and cost-effective ways of responding to this impact. This is an under-researched area given the scale of the epidemic and the scarcity of resources to cope with it; and remains so more than one decade after HIV/AIDS first began to emerge in the country. Indeed, the data presented in this thesis are the only data currently available for a rural area of South Africa.

While many results have been presented and discussed, there are arguably 4 dominant themes worth re-iterating in this penultimate paragraph. In rural areas experiencing a serious HIV/AIDS epidemic, HIV-related tuberculosis is likely to be the single most important economic impact on health services; tuberculosis and adult medical services will be seriously affected, and the impact will be significant in the context of hospital services as a whole; community-based approaches to tuberculosis care have the potential to substantially mitigate the impact of HIV-related tuberculosis on health

services while also reducing the costs incurred by patients in accessing care; and there are now antiretroviral interventions for the prevention of mother-child HIV transmission that appear affordable and cost-effective.

These conclusions are based on data from one detailed case study, albeit with careful consideration of generalisability. More research is required to confirm the truth of these conclusions and/or to give greater confidence in their generalisabilty; and, more importantly, to further inform health systems' response to the epidemic.

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APPENDICES

APPENDIX 1: Illustration of costing methodology, with especial reference to allocation of overhead costs

Introduction

This appendix is designed to illustrate how the costing analyses in Chapters 6 and 7 were undertaken. It shows how costs were allocated between outpatient and inpatient services, how x-rays were costed (since unlike for drugs and laboratory tests, there were no standard quoted costs for these), and how all overhead costs were quantified and allocated to the appropriate cost centre. It then shows how the total costs of care for particular patients groups were established – overall, for specific types of costs, and in relation to ward costs as a whole. This is done using data for tuberculosis patients in 1995 as an example (since this was the most important type of patient for which these analyses were undertaken). 1995 is chosen for illustration as this represented the mid-point of the longitudinal analyses; the appendix would be overlong if all years were shown.

1. Allocation of costs between inpatient and outpatient care

Table 1: Average number of doctors and different types of nurse working in Hlabisa Hospital in 1995, by location

Ward	Pupil nurse	Nursing auxilliary	Enrolled nurse	Professional nurse	Doctor[1]	Total cost
Male surgical	5.8	4.6	6.1	0.4		
Male medical	2.3	3.8	6.3	1	0.6	697 295.7 (6.6% total)
Female medical	7.2	6.3	10.6	1.1	0.6	1 160 443.3 (10.9% total)
Female surgical	5.5	5.8	5.2	0.8		
Tuberculosis	5	8.7	9.3	1	0.3	1 049 702.9 (9.9%)
Paediatrics	6.9	8	10.6	1.1		
Intensive care unit	2.1	5.7	4.8	4.8		
Maternity	1.8	4.9	5.1	13.2		
Operating Theatre	3.5	1.4	4.4	4.6		
Out-patient Department (OPD)	5.4	7.6	6.4	5.3	2	1 510 938.6
Total inpatient	40.1	49.2	62.4	28	5.5	9 099 179
Total overall	45.5	56.8	68.8	33.3	7.5	10 610 117.6

[1] data not collected for all wards as this information was not required

Total annual cost of staff involved in direct outpatient care =
(2 x 188 028) + (5.3 x 71 284) + (6.4 x 47 666) + (7.6 x 36 191) +
(5.4 x 32 771) =
1 510 938.6

Total annual cost of nursing staff allocated to direct inpatient care = (40.1 x 32 771) + (49.2 x 36 191) + (62.4 x 47 666) + (28 x 71284) = 8 065 025

Total annual cost of doctors allocated to direct inpatient care = 5.5 x 188 028 = 1 034 154

Total annual cost of doctors and nurses involved in direct inpatient care = 9 099 179

Inpatient costs as % total inpatient and outpatient costs = 85.8%

2. Building area (floor space)

Cost centre	Floor area (square metres)
TB ward	600 (15.5%)
Male medical	250 (6.5%)
Male surgical	250
Female medical	400 (10.3%)
Female surgical and ICU	250
Paediatrics including laboratory	408
Maternity	400
OPD including X-ray and pharmacy	600 (15.5%)
Administration	500 (12.9%)
Kitchen	110 (2.8%)
Laundry	100 (2.6%)
Total	3 868

3. X-ray department costs

Staff = 1 senior radiographer (69 828), 1 radiographer (69 252), 2 darkroom assistants (55 128 for both, 27564 each) = 194 208

X-ray equipment to purchase new = 430 303.3, annualized value (annualization factor = 6.7101) = 64 127.7

Supplies = 28 776

Buildings = 2 041.3

Number of x-rays = 7 324

Average cost = 39.5

4. Allocation of overhead costs, 1995

Cost Centre	Staff NB: 22% addition to personnel costs for benefits such as pensions, medical funds (unit cost in 1998)	Non-personnel recurrent expenditure (cumulative inflation 1995-98 = 25.2%)	Total to allocate to inpatient care and/or wards (allocation criteria)	Cost/day
1. Administration	2 senior operators (3552) 3 operators (2122) 14 administration clerks (2844) 15 senior administration clerks (4287) 4 telecom operators (3015) 2 registry clerks (2498) 4 typists (2306) 1 senior personnel officer (3967) 1 personnel officer (2709) 2 administration officers (6728) 1 senior administration officer (6728) 1 chief administration clerk (5440) 1 medical superintendent (25273) 1chief matron (11945) TOTAL = 213 389 per month = **2 560 668 per year** **x1.22 = 3 124 015**	regional council levies = 2 321 subsistence = 16 521 freight charges = 4 448 telephone/fax = 104 672 tv licence/radio networks = 17 379 postage = 1 939 printing = 1 214 stationery = 62 502 publications = 858 contractual services = 305 radio and intercom systems = 2 518 **TOTAL =214 677** Total in 1998 terms = 268 776 Building costs (500 sq m, 2138/sqm, life expectancy 30 years, discount rate 8%) = **94 956.4** Maintenance (see 7) = 186 273.9	{3 124 015 + 268 776 + 94 956.4 + 186 273.9} x 0.858 = **3 152 310.3** (share of costs of staff involved in direct care accounted for by inpatient services)	**Cost/day =** 3 152 310.3/158 046 **= 19.9**
2. Other staff related		Maintenance allowance for staff = 333 private motor transport = 16 510 telephone allowance for staff = 4 221 training courses/seminars = 885 uniforms and protective clothing = 162 194 regional service council levies = 16 390 Total = 200 533 Total in 1998 terms = 251 067.3	Total to TB ward = 0.099 x 251 067.3 = 24 855.7 Total to Female medical ward = 0.109 x 251 067.3 = 27 366.3 Total to Male medical ward = 0.066 x 251 067.3 = 16 570.4 (share of costs of staff involved in direct care accounted for by each ward – see table 1 p359)	**Cost/day TB ward =** 24 855.7/28 245 **= 0.9** **Cost/day Female medical ward =** 27 366.3/14 521 = **1.9** **Cost/day Male medical ward =** 16 570.4/11 673.8 = **1.4** **Average overall = 1.3**

3. Cleaning	32 cleaner "I" (2166) **831 744 per year** **x1.22 = 1 014 728**	Cleansing agents = 74 301 **Total in 1998 terms = 93 024.9**	Total to inpatient care = 0.858 x (93 024.9 + 1 014 728) = 950 452 (as for administration)	**Cost/day =** 950 452/158 046 **= 6.0**
4. Domestic	1 housekeeping supervisor (2714) 13 household aids "II" (2079) 3 seamstresses (2017) **= 429 504 per year** **x1.22 = 523 995**	Bedding, linen and needlework = 53 604 Total = 53 604 **Total in 1998 terms = 67 112.2**	591 107.2 All allocated to inpatient care	**Cost/day =** 591 107.2/158 046 **= 3.7**
5. Kitchen	18 food services aids "I" (2198) 1 food services supervisor (2714) **507 336 per year** **x1.22** **= 618 950**	Catering = 1 234 045 **Total in 1998 terms = 1 545 024.3** Building cost = 110 sqm, 2138 per sqm, annualized using life expectancy 30 years and discount rate of 8% = **20 890** Equipment cost = **12 654.5** (assumed life expectancy 10 years) Maintenance (see 7.) = 40 431.6	2 237 950.4 (all allocated to inpatient care)	**Cost/day =** 2 237 950.4/158 046 **= 14.2**
6. Laundry	20 laundry supervisors (3010) **722 400 per year** **x 1.22** **= 881 328**	Building cost = 100 sqm = annualized cost = 18 991.3 Equipment cost = 146 700, annualized cost = 27 565.2 Maintenance = 37 543.6 (see 7.)	965 428.1 (all allocated to inpatient care)	**Cost/day =** 965 428.1/158 046 **= 6.1**
7. Maintenance	2 groundsman II (2173) 5 tradesman AIDS (2522) 29 groundsman (2173) 1 artisan, group A (3205) 1 senior artisan A (7719) 2 labourers (1914) **1 136 700 per year** **x1.22 for pensions/medical benefits etc.** **=1 386 774**	Building material = 36 825 Maintenance material and parts = 7 465 Painting material = 1 405 Total = 45 695 **Total in 1998 terms = 57 210.1**	Total = 1 443 984.1 12.9% to administration = 186 273.9 15.5% to OPD = 223 817.5 2.8% to kitchen = 40 431.6 2.6% to laundry = 37 543.6 15.5% to TB ward = 223 817.5 10.3% to female medical ward = 148 730.4 6.5% to male medical ward = 93 859 (floor area see p360)	**Cost/day TB ward =** 223 817.5/28 245 **= 7.9** **Cost/day Male medical ward =** 93 859/11 673.8 **= 8.0** **Cost/day female medical ward =** 148 730.4/14 521 **= 10.2**
8. Transport	18 drivers (2305) **497 880 per year** **x 1.22** **= 607 414**	Fuel = 36 563 Total = 36 563 Total in 1998 terms = 45 776.9 Vehicles = 305 393.6 (annualized cost of 6 vehicles, assuming life expectancy 5 years)	Total = 958 584.5 x 0.858 = 822 465.5 (as for administration)	**Cost/day =** 822 465.5/158 046 **= 5.2**

(X-ray – costed separately)		Supplies = 4 067 Total = 4 067		
(Surgical wards, Operating theatre, paediatrics: ignored)		(Chemicals and gas = 22 380 Surgical implanted prosthesis = 992 Medical gas = 274 803 Baby napkins = 110 361 Total =408 536)		
9. Security	15 security guards (2252) **405 360 per year** **x1.22** **= 494 539.2**		494 539.2 x 0.858 = 424 314.6 (as for administration)	**Cost/day =** 424 314.6/158 046 **2.7**
10. Miscellaneous	1 general assistant (1914) 1 porter (1939) 1 health therapist (4414) **99 204 per year** **x1.22** **= 121 029**	Provisions = 615 196 Disposable paper products = 242 319 Patients clothing = 1 012 Electronic material = 48 527 Coal = 262 534 Packing material = 2 114 Other consumable items = 129 153 (artificial aids = 13 387) internment requirements = 6771 (human blood = 188 178) other medical consumables = 375 495 surcharges = 1 054 SA bureau of standards = 1 025 Sanitation/sewerage = 1 656 Water and electricity = 3 751 Farm and garden requisites = 7 982 Total = 1 698 589 **Total in 1998 terms = 2 126 633.4**	2 247 662.4 x 0.858 = 1 928 494.4 2	**Cost/day =** 1 928 494.4/158 046 **= 12.2**

COST OF ADULT TB CASES 1995

TOTAL COSTS

(a) Costs for staff involved in direct patient care

(i) Medical Staff costs on T-ward = (0.3 x 188 028) = 56 408.4 = US$10 200.4

68.38% of patient days on T-ward in 1995 were for adults: therefore ***medical staff costs to be allocated to adult tb patients = US$6 975***

(ii) Nursing staff on T-ward = 1 professional nurse; 9.3 enrolled nurses; 8.7 nursing auxilliaries; and 5 pupil nurses

Cost of these staff = (1 x 71 284) + (9.3 x 47 666) + (8.7 x 36 191) + (5 x 32 771) = 993 294.5

Nursing staff costs to be allocated to adult patients = 679 214.8 = US$122 823.6

Total staff costs for adult tb patients on tuberculosis ward = US$129 798.6 x 1.22 =US$158 354.3

Total staff costs for adult tb patients on tuberculosis ward = US$158 354.3

(iii) Medical staff costs on male medical ward = 0.6 x 188 028 = 112 816.8

(iv) Nursing staff on male medical ward = 1 professional nurses, 6.3 enrolled nurses, 3.8 nursing auxilliaries and 2.3 pupil nurses

Nursing staff costs on male medical ward = (1 x 71 284) + (6.3 x 47 666) + (3.8 x 36 191) + (2.3 x 32 771) = 584 478.9

Total staff costs on male medical ward = 697 295.7 x 1.22 = 850 700.8 = US$153 833.8

Patient days for male tb patients on male medical ward = 3 857.4
Patient days for male medical ward in total = 11 673.8

Share of staff costs on male medical ward to be allocated to tb patients = (3 857.4 ÷ 11 673.8) x 153 833.8 = US$50 831.6

Staff costs for tb patients on male medical ward = US$50 831.6

(v) Number of medical staff working on female medical ward = 0.6

Medical staff costs on female medical ward = 0.6 x 188 028 = 112 816.8 = US$20 400.9

(vi) Nursing staff working on female medical ward = 1.1 professional nurses, 10.6 enrolled nurses, 6.3 nursing auxilliaries, 7.2 pupil nurses

Nursing staff costs on female medical ward = (1.1 x 71 284) + (10.6 x 47 666) + (6.3 x 36 191) + (7.2 x 32 771) = 1 047 626.5 = US$189 444.2

(vii) Total cost of staff working on female medical ward = US$209 845.1 x 1.22 = US$256 011.0

Patient days for tb patients on female medical ward = 3 629.7

Total patient days on female medical ward = 14 521.1

Staff costs on female medical ward to be allocated to tb patients = (3 629.7 ÷ 14 521.1) x 256 011.0 = US$63 992.6

Staff costs for tb patients on female medical ward = US$63 992.6

(b) Administration

cost/day = R19.9; patient days for adult TB patients = 30.18 x 832 = 25 109.8
cost = 499 684.2
= US$90 359.0

(c) Kitchen

cost/day = R14.2; patient days for adult TB patients = 25 109.8
cost = 356 559.2
= US$64 477.2

(d) Maintenance

i) cost/day = R8 on male medical ward, patient days = 3 857.4, total cost = 30 859.2 = US$5 580.3
ii) cost/day = R10.2 on female medical, patient days = 3 629.7,
total cost = 37 022.9 = US$6 694.9
iii) R7.9 on t-ward; patient days for adult TB patients = 17 622.7
total cost = 139 219.3 = US$25 175.3

Total overall = US$37 450.5

(e) Laundry

cost/day = R6.1; patient days for adult TB patients = 25 109.8
cost = 153 169.8
= US$27 698.0

(f) Cleaning

cost/day = R6; patient days for adult TB patients = 25 109.8
cost = 150 658.8
= US$27 243.9

(g) Other

cost/day = R19.9; patient days for adult TB patients = 25 109.8
cost = 499 685.0
= US$90 359.0

(h) Drug Costs

Cost for drug regimen = US$36.4

Total number of tb patients = 832

Total cost for drugs = US$30 284.8

(i) Lab Tests

Total number of patients = 832

Estimated total number of smears for male patients = 515 x {(0.57 x 0.9) + (0.57 x 0.1 x 2) + (0.194 x 2)} = 522.7 (based on 1 for 90% of smear-positive patients, 2 for 10% of smear-positive patients, 2 for smear-negative patients)

Total cost of sputum smears for male patients = 7.85 x 522.7 = 4 103.2 = US$742

Estimated total number of smears for female patients = 317 x {(0.519 x 0.9) + (0.519 x 0.1 x 2) + (0.19 x 2)} = 301.4 (based on 1 for 90% of smear-positive patients, 2 for 10% of smear-positive patients, 2 for smear-negative patients)

Total cost of sputum smears for female patients = 7.85 x 301.4 = 2 366 = US$427.8

Total cost of sputum smears = US$1 169.8

(j) X-Rays

Estimated total number of X-rays = 832
Cost for an x-ray = 39.5

Total cost for x-rays = 32 864 = US$5 942.9

(k) Building and equipment costs

Total building costs for male medical ward = 534 500, annualized cost = 47 478.2
(based on 250 sq m for male medical ward at 2 138 rands per sqm)
share of male medical ward costs to be allocated to tuberculosis patients = 47 478.2 x (3 857.4 ÷ 11 673.8) = 15 688.3 = US$2 836.9
annualized equipment costs = US$293.5
Cost of tb patients on male medical ward = US$3 130.4

Total building costs for female medical ward = 400 x 2 138 = 855 200, annualized cost = 75 965
share of female medical ward costs to be allocated to tuberculosis patients = 75 965 x (3 629.7 ÷ 14 521.1) = R18 988.2 = US$3 433.7
annualized equipment costs = US$276.2
Cost of tb patients on female medical ward = US$3 709.9

Cost of TB ward buildings = 600 x 2 138 = 1 282 800, annualized cost = 113 947.7
Share to be allocated to adult patients = 0.6838 x 113 947.7 = 77 917.4 = US$14 090
Annualized equipment costs = 17 622.7 x 0.0761 = 1 341.1
Cost of TB ward buildings for adult patients = US$15 431

(l) Supervision Costs

Number of days vehicle used for tb = 14 x per month = 168 per year
Average number of kilometres travelled per trip = 251.2
Cost per km for all costs = 1.6
Total cost for vehicle/fuel/maintenance = 1.6 x 251.2 x 168 = 67 522.6
Total cost for driver (70% of one driver's time) = 19 363.6
Total cost for fieldworkers (2) = 59 160
Total cost for vehicle/fuel/maintenance/driver/fieldworkers = 146 046.2
Total number of adults supervised on DOT = 645
Total number of children supervised on DOT = 72
Total cost of supervision to be allocated to adult tb patients = 645/717 x 146 046.2 = 131 380.5
Total cost of supervision for adult tb patients = 131 380.5 = US$23 757.8

TB Cases as a % of Male Medical Ward Costs (excluding costs for drugs)

(i) Total Male Medical Ward Costs

(a) **Total cost for staff on male medical ward =** US$153 833.8

(b) Administration

cost/day = R19.9; patient days for adult male medical patients = 11 673.8

cost = 232 308.6
= US$42 008.8

(c) Kitchen

cost/day = R14.2; patient days for adult male medical patients = 11 673.8
cost = 165 768
= US$29 976

(d) Maintenance

i) cost/day = R8 on male medical ward, patient days = 11 673.8, total cost = 93 390.4 **= US$16 888**

(e) Laundry

cost/day = R6.1; patient days for adult male medical patients = 11 673.8
cost = 71 210.2
= US$12 877.1

(f) Cleaning

cost/day = R6; patient days for adult male medical patients = 11 673.8
cost = 70 042.8
= US$12 666

(g) Other

cost/day = R20; patient days for adult male medical patients = 11 673.8
cost = 233 476
= US$42 219.9

(h) Total cost for lab tests and x-rays on male medical ward = US$23 473.1

(i) Total cost for male medical ward buildings and equipment = US$9 473.9

Total costs for male medical ward = US$343 416.6

(ii) Cost for tb patients on male medical ward

(a) Staff costs for tb patients on male medical ward = **US$50 831.6**

(b) Total cost for administration = 19.9 x 3 857.4 = 76 762.3 = **US$13 881.1**

(c) Total cost for kitchen = 14.2 x 3 857.4 = 54 775.1 = **US$9 905.1**

(d) Total cost for maintenance = 8 x 3 857.4 = 30 859.2 = **US$5 580.3**

(e) Total cost for laundry = 6.1 x 3 857.4 = 23 530.1 = **US$4 255.0**

(f) Total cost for cleaning = 6 x 3 857.4 = 23 144.4 = **US$4 185.2**

(g) Total cost for miscellaneous = 20 x 3 857.4 = 77 148 = **US$13 950.8**

(h) Total cost for lab tests and x-rays for TB patients on male medical ward = US$4 420.6

(i) Total cost for male medical ward buildings and equipment = US$3 130.4

Total costs for male medical ward = US$110 140.1

% of total male medical ward costs accounted for by tb patients = 110 140.1 ÷ 343 416.6

= 32.1

TB Cases as a % of Female Medical Ward Costs (excluding costs for drugs)

(i) female medical ward costs as a whole

(a) Total female medical ward staff costs = US$256 011

Total patient days on female medical ward = 14 521.1

(b) Total cost for administration = 19.9 x 14 521.1 = 288 969.9
= US$52 255

(c) Total cost for kitchen = 14.2 x 14 521.1 = 206 199.6 = **US$37 287.5**

(d) Total cost for maintenance = 10.2 x 14 521.1 = 148 115.2
= US$26 783.9

(e) Total cost for laundry = 6.1 x 14 521.1 = 88 578.7 **= US$16 017.8**

(f) Total cost for cleaning = 6 x 14 521.1 = 87 126.6 = **US$15 755.3**

(g) Total cost for miscellaneous = 20.5 x 14 521.1 = 297 682.6
= US$53 830.5

(h) Total cost for lab tests and x-rays on female medical ward = 122 162.1 =
US$22 098.8

(i) Total cost for female medical ward buildings and equipment = US$14 841.9

Total costs for female medical ward = US$494 881.7

(ii) Cost for tb patients on female medical ward

(a) Staff costs = **US$63 993**

(b) Total cost for administration = 19.9 x 3 629.7 = 72 231.0
= US$13 061.7

(c) Total cost for kitchen = 14.2 x 3 629.7 = 51 541.7 = **US$9 320.4**

(d) Total cost for maintenance = 10.2 x 3 629.7 = 37 022.9 **= US$6 694.9**

(e) Total cost for laundry = 6.1 x 3 629.7 = 22 141.2 **= US$4 003.8**

(f) Total cost for cleaning = 6 x 3 629.7 = 21 778.2 = **US$3 938.2**

(g) Total cost for miscellaneous = 20.5 x 3 629.7 = 74 408.9
= US$13 455.5

(h) Total cost for lab tests and x-rays for TB patients on female medical ward = US$2 692.1

(i) Total cost for female medical ward buildings and equipment= US$3709.9

Total = 120 869.5

% of total female medical ward costs accounted for by tb patients = 120 869.5 ÷ 494 881.7 = 24.4

APPENDIX 2: Form used to collect length of stay data for tuberculosis patients 1991-1998/9 (Chapter 6)

TB register number	Hospital inpatient number	Year	Name	Age	Sex	Date admitted hospital	Date admitted TB ward	Date discharged from hospital

APPENDIX 3: From used to collect data for non-tuberculosis AIDS patients (Chapter 6)

Hospital in-patient number:

Year: (circle as appropriate)

1991 1993 1995 1997

Male/Female

Date admitted medical ward:

Date discharged medical ward:

Drugs consumed:

Laboratory tests done:

No. of x-rays: 1 2 3

Outcome: Cured Improved In status quo Died Other

APPENDIX 4: 1998 MEDICAL WARD STUDY DATA CAPTURE FORM

SURNAME:_____

FORENAME:_____

IP No._____

OP No._____

STUDY No._____

AGE:_____ Barcode:

SEX (M/F):_____

DATE OF ADMISSION:___/___/___ (date of admission to hospital)

WARD (where patient was admitted to, from OPD **C** **Hsurg** Hmed **S** **ICU**
Other_____

If patient initially admitted to ICU or other ward state date of transfer to medical ward: ___/___/___ and length of stay_____

If patient transferred to ICU or other ward during admission note date of transfer ___/___/___ length of stay _____and outcome_____

PREVIOUS HOSPITAL ADMISSION: Yes / No

MAIN PRESENTING SYNDROME: (Please ring)
Respiratory, Cardiac, Endocrine, Psychiatric, Gastroenteric, Neurological, Musculoskeletal, Other (state)_____ _____

DEPENDENCY SCORE: (ADL)
(on admission)
1 Fully ambulant and self caring, requires no help with activities of daily living
2 Requires some help with ADL or on iv fluids or iv antibioics
3 Fully dependent, requires help with all ADL

Serum sample stored in lab: YES / NO

CCD: **Major**: W D F **Minor**: C P Z T S L **CCD Fulfilled**: Yes / No

STAGING: ONE_____ TWO_____ THREE_____ FOUR_____
(based on WHO system)

FINAL DIAGNOSES: [ ] [ ] [ ] [ ] [ ] [ ] OTHER
DIAGNOSES:_____
(codes) (uncodable)

DATE OF DISCHARGE /DEATH___/___/___
(include transfers to T ward)

LENGTH OF STAY_____

DISCHARGE OUTCOME: ALIVE: Improved (symptoms relieved, pathological process halted, specific therapy started)
ISQ (unchanged)
Deteriorated
Absconded
Transferred, state destination_____
Discharged with the expectation to die at home within a month
DIED

DISCHARGE PLAN: Hlabisa Hospital Other Hospital
(state)_____
Local Health Clinic No discharge plan

APPENDIX 5: Form used for collection of drug, laboratory and x-ray data, 1998 adult medical ward study (Chapter 8)

Recording from for Drugs, Laboratory tests and x-rays

To be attached to main data capture form

Hospital inpatient number =

Study number =

1. Drugs

Drug and dosage	Number of doses given

2. Laboratory Tests

Laboratory test	Number of times test done

3. X-rays

Number of x-rays =

APPENDIX 6: Patient Questionnaire used in evaluation of alternative approaches to tuberculosis treatment (Chapter 8)

Name of patient: **Male/Female:** **Age:**

1. Where do you live?

2. When you came to hospital, did you travel by bus, by taxi, or did you walk?

3. How much did you pay for your journey to hospital (*one-way*)?

4. Did anyone come with you to hospital, or did you come on your own?

5. Approximately how long did it take you to get to the hospital? (*Include time spent walking to place from where bus/taxi was taken, if a bus/taxi was used, as well as the time actually spent on the bus/taxi.)*

6. What is the name of the health clinic nearest to where you live?

7. To get to this health clinic, would you take the bus, a taxi, or would you walk?

8. If you use a bus/taxi, how much would it cost you to get to the health clinic? (*Include cost of going there and return journey.)*

9. How long would it take you to get to the health clinic, both there and back? (*Include time spent walking to place from where bus/taxi was taken, if a bus/taxi was used, as well as the time actually spent on the bus/taxi.)*

10. Is there a Community Health Worker close to where you live?

11. How long would it take you to get to the Community Health Worker (both there and back)?

To be asked when supervisor is decided upon:

12. Who is to be your named supervisor?

13. How long does it take you to visit this named supervisor *(both there and back)*?