EFFICIENCY IN THE HOSPITAL SECTOR: A STUDY OF ELECTIVE SURGERY IN SPAIN

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ABSTRACT

This thesis provides a comprehensive assessment of the reasons for the differences in hospital utilisation.

The research starts with a quantitative analysis of the reasons for the differences in the length of stay and inpatient costs for elective surgery. Both these topics are central to efficiency and value for money in the hospital sector. Subsequently, a qualitative component is introduced involving a questionnaire answered by surgeons.

A comprehensive statistical model is developed by using 1991 data from a number of hospitals in Spain. The model includes a large set of control variables: health status indicators, hospitalization-related variables, hospital and doctors characteristics and regional supply.

Using a large data set, the analysis confirms many hypotheses concerning the reasons for the variations in the length of stay and inpatient costs. Longer stays were estimated for a) patients with more severe Diagnoses Related Groups; b) comorbidity or multiple diagnoses; c) complications after the operation; d) patients over 65 year old; e) admitted through the emergency room or referred by the Internal Medicine Department; f) admitted to hospital on a Friday or a Saturday and discharged on a Monday; g) living in an area with a relative large supply of surgeons, beds per specialty and resident surgeons. In contrast, patients who were admitted to a hospital with a high turnover rate, a high percentage of operations and a high number of total hospital beds experience shorter lengths of stay. Higher costs were estimated for patients with a) longer lengths of stay; b) longer operating theatre minutes; c) admitted through the emergency room; d) and in areas with a high number of surgeons. In contrast, hospitals with a high number of beds per specialty and a high number of total hospital beds experience lower hospital costs.

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Chapter 1

Introduction

The rising costs of hospital operation have in recent years gained ever increasing public attention. Although the absolute increase in costs of the hospital sector has diminished in recent years, an increasingly large proportion of gross national product is involved. Within the framework of macroeconomic considerations, this development has led the government to desire a greater degree of cost containment policies in the hospital sector.

The appropriateness of health care intervention and hospital care in particular is becoming a central issue for health care providers and policy-makers alike. Research in geographic variations in practice patterns has shown large differences in hospital length of stay and the cost per inpatient stay. Since these variations cannot be fully explained by differences in the health status of the population or the supply of providers, they lead us to ask whether patients in some hospitals receive more care and in other hospitals less care than should be provided. In fact, the issue is not only to consider whether the volume of care is too high or too low, but, more importantly, to determine the extent to which patients receive care that is "right" for the moment.

Variability in the length of stay and different components of inpatient costs for elective surgery is a continuing pattern that occurs both between countries and within countries. The within country variation largely reflect the influence of local circumstances in terms of the levels of bed provision, the organisation of care at the hospital level and the availability of community services, as well as the independent effect of differences in clinical practice styles which are a product of the considerable clinical autonomy that exists. This suggests that as long as clinical decision making affords scope for individual judgement and choice, some variation in the management of surgical patients will form a continuing feature of health care.

The Ministry of Health and the local hospital authorities can make recommendations for cost containment measures and can also try to limit the doctor's freedom by the resources that they make available, but the ultimate decision about each case are made by the individual doctor. Given that the doctor rather than his patient who generally makes the decisions that determine the use of medical services, many improvements in health service efficiency will occur if doctors begin to ask the right types of questions and are provided with appropriate decision-making information and tools.

In deciding whether a patient should be treated in hospital and, if so, how long he/she should remain there, neither the patient nor doctor face a charge reflecting the costs that would be incurred by the health services. A knowledge of appropriate marginal cost estimates may therefore encourage doctors to use facilities more efficiently.

The fact that significant differences in medical practice do exist indicate, that there is room for improved medical and economic efficiency. We should achieve greater benefit from existing resources.

One of the most important reasons for this research is our lack of knowledge of the factors and processes that influence hospital utilisation patterns in Spain. This ignorance extends to the behaviour of individual hospitals, which is surprising given their central role in the delivery of care and the detailed data routinely collected on activities.

Health researchers, planners and policy makers believe that there is too much overemphasis of acute hospital care in the health care delivery system. It has been argued that too many people are admitted to a hospital and that many of the patients are kept longer than necessary in those institutions. Long lengths of stay are said to result in higher risks for iatrogenic diseases, possible traumas among young children, higher risks for drugs, etc. However, the most frequently mentioned source of concern related to excessive hospital length of stay consists of the costs of providing unnecessary hospital care.

It is also unlikely that health care variations are solely due to variation in patient characteristics which require different magnitudes of hospital care. Hospitals with a higher length of stay and costs probably experience higher degrees of overutilisation and inefficiency in the delivery of health care. Moreover, there is a large body of literature which explains part of the variation in length of hospital stay and hospital costs in terms of hospital organisational patterns, physician characteristics, availability of health care resources, etc. However, most studies usually look at one or few variables at a time and often do not control for case mix.

This research presents a statistical analysis of the determinants of the length of stay and inpatient costs for a number of the quantitatively more important Diagnoses Related Groups (DRGs) in elective surgery. The data used permit some exploration of the role of differences in health status indicators, hospitalization-related variables, hospital and doctor characteristics and regional supply variable in the explanation of differences in the length of stay and inpatient costs. Despite the substantial interest in the determinants of variations in the length of stay and costs, the literature based on Europe data is very limited.

In this research, two of the efficiency measures of hospital utilisation have been chosen: the duration of hospitalization following admission and the different components of inpatient costs. An important argument for this choice is that in general, also outside of Spain, the length of hospitalisation and the hospital costs have been least studied. A second argument is the social relevance of differences in the length of hospital stay and costs.

This research will focus on the preoperative, postoperative and the total length of stay and total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient of a set of elective surgical DRGs. The separation in the preoperative, postoperative and the total length of stay restricts the study to surgical cases only. However, the separation will allow for a better test of the formulated hypotheses.

We include most types of variables which have been found or hypothesised to have some effect on the duration of hospital stays and costs. We expect to obtain a more accurate picture of what variables do and what variables do not have a significant effect on the length of stay and cost.

Health status is one of the most important factors determine demand for health care. However, the existing large differences with respect to standardized output measures (length of stay and inpatient costs) between hospitals and surgeons, which cannot be explained by differences in the health status, lead us to think that hospital utilisation may in fact be inappropriate or unnecessary. Whatever, the causes of this, it is important to determine which hospitals deviate from the usual pattern. In this research we shall investigate the different factors which determine these variations.

In economic terms, the development of resources may be regarded as inefficient to the extent that a given outcome may be achieved at less cost. For example, reducing stays and costs for inpatient admission may not affect the outcome achieved for individual patients, but nevertheless may lead to considerable savings in terms of the health care resources required in their treatment, and is therefore more efficient. To the extent that such savings enable larger number of patients to be treated with a given level of resources (hospital beds, doctors, nurses, etc), the effectiveness of the health care system is increased. The appropriateness of resource use are thus central to the promotion of good quality, cost-effective care.

1.1 Structure of the Research

Chapter 2 contains a brief description of the Spanish National Health Service and a short discussion on the recommendations of the Abril Report, which places in context this research.

In Chapter 3 a survey of empirical literature on the hospital utilisation with the patient as the unit of analysis is presented.

In Chapter 4 a survey of empirical literature on hospital costing methodologies is reviewed.

In Chapter 5 we explain the sources and the construction of the main data sets used and the methodology in this research.

In Chapter 6 the hypotheses will be tested using the length of stay (preoperative, postoperative and the total length of stay) as the dependent variables. The health status indicators, hospitalisation related variables, hospital and doctor characteristic and regional supply variable are analysed for specific elective surgical DRGs as the explanatory variables. The statistical technique multiple regression stepwise analysis proves us with the correct tool to analysis the data.

In Chapter 7 the hypotheses will be tested using the different components of inpatient costs (total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient) as the dependent variables. The health status indicators, hospitalisation related variables, hospital and doctor characteristics and regional supply variable are analysed for specific elective surgical DRGs as the explanatory variables. We use the same statistical technique as in chapter 6 to analyse the data.

In Chapter 8 we analyse the questionnaire sent to surgeons in twenty different hospitals.

The research concludes with a summary of the most significant results and points to some policy implications.

Chapter 2
The Spanish Health Care System

2.1 Introduction

The Spanish health care system has been characterised by universal coverage, financed mainly from general taxation, public ownership and the control of service provision. Important administrative reforms in the 1980s enlarged autonomous regions entities and giving them greater responsibility. This administrative change was an important prerequisite for further decentralisation of the responsibility of health care activities.

This chapter describes the Spanish health system and goes on to consider some of the reforms and remaining problems in 1980s and the most important reforms in the 1990s. Finally, future developments are discussed.

2.2 Historical Developments

There are three historical periods in the Spanish Health Service. The first period (1942-1963) covers the long period of the Franco regime, with the growing importance of the Social Security model. The contemporary Spanish health care system started after the civil war period with the creation of the Compulsory Sickness Insurance (SOE) in 1942. Funds for the programme came mostly from compulsory premiums paid by employers (75 per cent) and workers, and were managed by the government. Prevention and health promotion were explicitly not included. The SOE, which had been designed for industrial workers, grew during the following twenty years to cover a large proportion of the population, around 50 per cent in 1963.

In the second period (1963-1978), the government decided to establish a more comprehensive model with the social security reform. That model increased the rate of population coverage to 84 per cent particularly following the 1972 reform[1].

The third period (1978-1996), is characterised by the commitment to health reforms reflected in the 1986 enactment of the General Health Law (GHL) with the creation of the Spanish National Health System, as a universal service, formed by the 17 Regional Health Services of the autonomous communities. The need for health care reform was necessary as early as 1978 and incremental steps in increasing population coverage and restructuring the system began. However, the reform legislation and more dramatic steps for changes in the health sector were not taken until the 1980s.

2.3 The Spanish Health Care System

Health care in Spain is generally considered to be a public responsibility. Almost the entire health care sector is financed, planned, and operated by public authorities. Hospital services and primary health care are provided by salaried employees. Alongside the hospital system is an extensive network of outpatient centres. While they depend on the hospitals they are responsible for the provision of outpatient care.

The Spanish Parliament approves the budget on an annual basis. Then it is allocated to the autonomous communities with devolved health services and to INSALUD for those autonomous communities whose health services are centrally managed. The allocation of money is done on a per capita basis. In 1994, a political agreement was achieved to ensure equity in system financing and budget allocation. A ceiling for public expenditure and annual increase as a percentage of GDP was agreed for the period 1994-1997.

The providers are divided into public services (hospital and primary health care) and private hospitals. The third-party payers include the state and private insurer.

2.4 Relationship Between the Population and Providers

Most health care services are provided free of charge by central National Health System (INSALUD) and the seven autonomous Regions. All hospital and primary health care centre services are free at the point of use. Co-payment exist only for pharmaceuticals prescribed in the primary health care centres. Hospital in-patients do not have to pay for pharmaceuticals. All citizens with permanent residence in Spain are entitled to the National Health Service.

2.4.1 Primary health care

The distinctive feature of the health system is the large role of doctors salaried by the State, many of them under civil service terms of services, even in primary care. The country is in a process of transition. Under the old system, still covering about 40 per cent of the population, both general practitioners and ambulatory specialists work in 2.5 hour shifts and are paid on the basis of the number of family cards allocated to them. Consequently, this leads to very short consultations, and doctors provide little more than prescriptions, referrals to specialists and sickness certificates, while nurses undertake clerical work. Thus the services is seriously depersonalised with patients being extremely dissatisfied. Under the new system, health centres which aim to provide not just curative but also preventive services, are gradually replacing the older curative ambulatory centres. From 1984, primary health care has been increasingly based on full-time, primary health care teams consisting of GPs, paediatricians and nurses in the public health centres which serve a defined geographical area. The trained family doctors are paid whole-time salaries and work one of two shifts (8 am to 3 pm or 2 pm to 9 pm) and the nurses are heavily engaged in health promotion. Patients are allowed to choose both their General Practitioner and health centres within a given health zone, yet each doctor has a ceiling on the number of patients on his/her list. The extent to which this has been developed varies considerably by region.

It was hoped that the new system would reduce prescribing but it has had little effect in this respect, though it has reduced waiting time for patients, nearly halved the rate of referral to specialists and increased the time patients spend with their doctors from an average of 3.1 minutes to 5.4 minutes. The General Practitioners are meant to act as gatekeepers for the health system but in practice still tend to respond to patients' requests, and if they do not, the patient just goes to the emergency room of the hospital. There has been insufficient development of health plans by the primary health teams which suggests that their work is still primarily of a curative and not preventive nature.

2.4.2 Hospital care

All hospital services are concentrated towards the main urban centres. There is an excessive and inappropriate use of hospital beds, as care in the community is very poorly developed in most part of the country. Part of the problem is the lack of specialised facilities for the elderly with the result that the acute hospitals are looking after those who cannot afford private nursing home care. The shortage of beds leads to a problem of waiting lists and up to a two year delay for admission for some elective surgery (e.g., Lens Procedures) and long waiting time for outpatient departments visits. In the attempt to bypass the waiting lists, 50 to 60 per cent of patient come to hospital through the emergency departments. In emergency cases, the patient can turn directly to the hospital for treatment. One in every three people go to the hospital emergency services each year, 80 per cent go on their own initiative and only 30 per cent of these are considered to be real emergency cases. The problems of the waiting list are also due to the fact that most hospital operating rooms are only open from 8am to 2pm, because doctors do not work in the evenings and there are no incentives for doctors to reduce the average length of stay. This exacerbates the waiting list problems. There is a relative lack of anaethesiologists, dentists and psychiatrists as there are not enough openings for the training of students in these fields through the residential training programme, while there is an oversupply of other types of specialists.

Day surgery is hardly developed in public hospitals, however, in the Basque Country, day surgery and domiciliary hospital care cases have increased dramatically over the past few years.

As the hospitals lack a separate accounting system, there is no data for assessing or comparing their efficiency in the use of resources. Indeed, throughout the health system, there is a shortage of reliable data for assessing efficiency.

Cases of fraud in public hospitals are by no means unknown, for example, such as "Kick backs" for equipment purchases and unethical practices or as the deliberate extension of waiting lists to divert patients to private practice.

Since 1995 in some pilot health centres, patients can choose their specialists. Patients cannot choose to which public hospital they are admitted.

2.4.3 Community care

Provision for long term care and for the elderly does not have a strong history in Spain. Resources for geriatric and rehabilitation care are largely underdeveloped, however, many older small public and private hospitals have been transformed into being for used the chronic sick and terminally ill or convalescent patients. Many public tuberculosis hospitals have been converted into long stay beds and a few into homes for the elderly.

The main problems affecting the community care sector can be summarised in: the continuing separation of health and social services, resulting in duplication, wastage and unco-ordination; and a general lack of resources, both in infrastructure and personnel. Spain benefits from a tradition of strong family support mechanisms.

2.4.4 The supply of high technology

Doctors decide about the use of medical technology in both private practice and hospitals, though the National Health System makes capital decisions centrally: there are plans to give hospital more freedom to purchase medical equipment from their own budgets. However, when public facilities are unable to buy it, the private sector does so and offers it under contract to public patients. This stimulates patient demand for its use.

2.5 Relationships Between the Population and Third-Party Payers

The coverage of health insurance has been steadily expanded during the 1980s from 85.5 per cent of the population in 1982 to 98.9 per cent in 1989. In 1984 the self-employed (about 3 million persons) were brought into insurance. In 1987 unemployed persons over the age of 26 living with families with entitlement were brought into the scheme. In 1989 coverage was further extended to bring the total up to nearly 99 per cent of the population including the 4.5 per cent of the population covered by the scheme for public servants

(Mutual companies) and the 0.9 per cent covered through social assistance. Those excluded are mainly the wealthy and illegal immigrants.

The Spanish health system is mainly publicly financed (78.2 per cent in 1995). The remainder 21.8 per cent is mostly financed direct by patients but also from private insurance schemes.

The Spanish health care is dominated by a compulsory national health system funded by a mix of general taxation (almost 83 per cent) and social insurance contributions (17 per cent) in 1996. The system has gradually changed from one based on social security contributions to one based primarily on general taxation. This gradual change to tax finance is definitely motivated by a desire to increase equity in the burden of payments.

Private insurance has grown significantly over the last decade. In 1991, private health sector expenditure comprised 1.56 per cent of GDP and was estimated to be around 1.78 per cent in 1994[2]. While in 1980 only approximately 3 per cent of the population had some sort of voluntary insurance, by 1993 this percentage had reached 8 per cent, when we include civil servants the total is 12.5 per cent which represent about 5 million people. About the 12.5 per cent of the population with private insurance, 29 per cent of those with high incomes report that their usual source of care is a private doctor or clinic. Visits to specialists are 40 per cent of total visits in the case of the richest 10 per cent of the population and only 20 per cent for the poorest 10 per cent. Public expenditure, defined to include compulsory insurance contributions, is used to buy 16 per cent of services from the private sector. Opting out of public health care is not permitted, except for civil servants who are given the choice of public (INSALUD) or private (MUFACE) coverage. As many as two-thirds of those covered opt for the private insurer. In recent years there has been considerable debate about adopting such a scheme for the entire Spanish population.

Private insurance is tax-deductible by 15 per cent, however, co-payment for drugs can not be deducted.

2.6 Pharmaceutical Care

Pharmaceutical care is provided by independent private pharmacists. Those at work and their dependents have to pay 40 per cent of the total cost of the prescription outside hospital: pensioners, the handicapped, invalids, victims of adulterated cooking oil and cases of accidents at work are exempted and the chronic sick pay only 10 per cent of the cost, up to a maximum of 439 pesetas per prescription. Since December 1995 this reduced contribution has also been extended to AIDS patients. Patient contributions as a proportion of drug costs have fallen from 19 per cent in 1981 to 8.8 per cent in 1995. This is partly attributable to fraud - for example the use of pensioners' prescriptions by younger people who are not entitled to free drugs.

All users of civil servants' mutual companies pay 30 per cent of pharmaceutical costs.

2.7 Relationships Between Third-Party Payers and Providers

While budgets are established annually by central government for public expenditure on health services, these have been regularly overspent and sooner or latter the government writes off the deficit. The annual budgets established are regarded as far too low within the service.

In Spain, under the law, there is a population-based criterion for distributing money between regions. In practice, agreement on the levels of funding is reached taking into consideration the historical level of spending within a given region, simple capitation (non-adjusted) and political negotiation between the autonomous communities and the central government and this leads to quite substantial differences between regions. While decentralisation has perhaps allowed for increased health sector efficiency through bringing the decisions closer to the population and making authorities increasingly able to structure the system according to the health needs of the population, it has also allowed for significant differences between regions, both in the financing and the provision of health care, thus questioning equity within the Spanish health system.

Most health service providers in Spain are salaried public employees working in institutions owned by the public government.

2.7.1 Reimbursement of primary health care providers

In primary health care, the General Practitioners still working under the old system model are paid according to capitation. Under the new system, the General Practitioners receive a salary plus a capitation component. They work in large clinics in cities and large towns. A twenty-four hour service seven days a week is provided at clinics or more often at hospitals to cover emergencies. Doctors in health centres have no performance-related pay and have been known to receive payments for prescribing particular drugs.

Dental care is provided by private dentists paid on a fee-for-service basis. The dentistry in the public sector consists only for extractions and reconstruction surgery following accidents.

2.7.2 Reimbursement of hospitals

About two-thirds of the hospitals in Spain are in the public sector. Hospitals are given budgets by the autonomous regions or INSALUD out of which they pay the salaries of their doctors and other personnel. They are expected to plan and manage their hospitals within these budgetary limits. The budgets are set mainly on an historical basis, typically with increases for expected rises in pay and prices and for planned improvement in services. Employees in the hospitals, including doctors, are salaried. Doctors in public hospitals cannot have private patients, but they are allowed to work part-time in the private sector. Since 1987, they have been given incentives to work full-time in the public sector. Salaries are set nationally in negotiations between the Government and the trade unions. However, the basic problem for Spain is that the services lack the incentive to be efficient: budgets can be exceeded and efficient working can lead to a lower budget or a higher workload without any extra money, while inefficiency is rewarded by a quiet life. Moreover, local managers are faced with line budgets and obtaining virement involves slow and complex procedures. On top of this the essential information tools to manage hospitals are lacking, such as accountancy and often even inventories and reliable statistics on beds or hospital workers. The whole service operates within the rigid regulations of the civil service and this even tends to apply to the autonomous regions. Employees have their contracts with the governments for which they work, not with their respective health units. This severely limits local managements' control over their staff. Purchasing and contracting procedures are rigid and inefficient.

The government has established since 1992 a "business plan" under which hospital budgets would be tied to service objectives; each hospital would determine its consumption, organisation and services and instruments would be developed to evaluate each hospitals' technical quality. Therefore, linking activity with resource allocation have been incorporated to various degrees within different autonomous communities and INSALUD with the consequent change of methods for hospital payment. In the INSALUD and some autonomous communities the new methods are:

- per process: for those simple procedures that are not carried out in conjunction with other services. These procedures have the same price in all hospitals.

- prospective payment based on an activity unit which groups together all hospital activity. The activity units use to determine prospective payment levels in Spain is the UPA (weighted health care unit). The hospital receives a fixed amount in order to guarantee economic stability which covers both the fixed and personnel costs.

Some regional initiatives have been undertaken in an attempt to link resources allocation to activity. Catalonia has run a series of pilot studies to examine the possibilities of using a cost per case payment method for hospitals using Diagnoses Related Groups (DRGs). The Basque Country has developed a method of hospital payment using Patient Management Categories (PMCs).

In order to reduce the waiting lists, monetary incentives has been offered for surgeons performing operations in the afternoon as most operating theatres are only open from 8am to 2pm. They are required to do four operations in a session.

2.7.3 Paying for pharmaceuticals

In 1993, pharmaceutical expenditure including "over the counter drugs" was 1.3 per cent of the Gross Domestic Product (GDP) and 18.2 per cent of health care expenditure - the third highest in the European Community[3].

Although pharmacists are independent entrepreneurs, they are under public control. The Ministry of Health decides the number and location of pharmacies and negotiates with the Pharmacists' Association the percentage. Pharmacists can, with the consent of the doctor, substitute generics, but there is no incentive to do so. Indeed the straight percentage mark up on price gives them a clear disincentive to do so, though patients would gain from lower co-payment.

There is a negative list in existence since 1993.

As patent protection in Spain is not effective until approximately the year 2004, the generic market has not developed and all generics are sold under a variety of brand names.

There is no effective monitoring of the prescribing of individual doctors and there is excessive prescribing of expensive antibiotics.

Legal authorisation for opening new pharmacists have been relaxed by decreasing the restrictions which were based on population and distance criteria.

2.7.4 Private insurance

Contracted private hospitals tend to pay on a uniform rate per day, depending on level of specialisation. This leads to long lengths of stay and high occupancy and concentration of mainly elderly patients, who do not require expensive procedures. However, in some autonomous communities private hospitals are paid by fee for service and recently by process.

2.8 The Control of Pharmaceutical Prices

Prices are calculated on the basis of costs. There are three parameters which the Ministry really considers to set the final price: the expected sales volume, the cost of similar products and the price in other European countries. With these three parameters authorities obtain a view of the potential cost to their budget, and then try to go for the lowest EC price.

The Medical Law of 1990 is concerned not only with safety and efficiency but the rational use of drugs and incorporates the EU requirements. There are, however, considerable delays in handling applications for marketing authorization. There is a strong network for post-marketing drug surveillance. A number of economic evaluations of drugs have been undertaken. A research study identified sixteen such evaluations between 1992-3. Most commonly, there were cost-effectiveness studies but one assessed the effects on quality of life. One was undertaken in conjunction with a control clinical trial[4].

2.9 Cost Containment Measures

The Government have introduced the following cost containment measures in the last years:

- Changes in co-payment/cost-sharing for pharmaceuticals. This measure has been used to reduce demand but it has not been by any means the most important mechanism for cost containment. Exclusion from the coverage of health service can be viewed either as a restriction of supply or as a system of 100 per cent cost-sharing. From July 1993, 892 specialities for minor ailments were withdrawn from the reimbursement list. New pharmaceuticals are no longer automatically included in the list of reimbursed pharmaceuticals.

- Budget ceilings for all expenditure, re-enforced by manpower controls. Prospective global budgets for hospitals have been given on based on past spending, however, in recent years attempts at changing this mechanism of financing hospitals have been made (e.g., developments with Diagnoses Related Groups and Patients Management Categories).

- Alternatives to inpatient care. There is very little day surgery and day hospital. Home nursing is only well developed in the Basque Country.

- Influencing authorising behaviour. Spain introduced a change from capitation payment for primary care doctors to salary. Other ways of influencing prescribing behaviour are to promote the use of generics. In 1995, INSALUD intends to promote generic prescribing under its rational drug use programme. The authorities would like the generic share of the market to rise from 0.5 per cent to 10 per cent, without any "anti-brand" policies, prejudicing quality, or increase in patient co-payment.

- Limiting supply. Controls on the entry to medical education have been established.

- A global agreement between the Spanish pharmaceutical industry association, Farmaindustria, and the health authorities. The pact introduces an annual growth ceiling of 7 per cent for pharmaceutical expenditure (for three years). If sales exceed the ceiling, the companies will pay back to the state the gross profit on sales exceeding the ceiling. Committed Farmaindustria to encourage the use of generic products.

2.10 Government Regulation and Planning

The system is closely planned and regulated by the Spanish government. During the last fifteen years, however, there has been considerable devolution from the centre to the autonomous communities. There are now seven autonomous communities authorities (Catalonia in 1981, Andalusia in 1984, the Basque Country and Valencia in 1987, Galicia and Navarre in 1991 and Canaries in 1994), which have assumed competence in the area of health, out of seventeen. Collectively, these autonomous communities provide health services for approximately 62 per cent of the population of Spain. The autonomous communities plan and manage the health care services within their regions. They are also responsible for assessing the medical needs of their respective populations. The autonomous communities further delegate management functions to smaller local health areas. As a general rule each health area covers a population of no less than 200,000 population and no more than 250,000. These health areas are the basic health administration units in Spain. Each one has the minimum of one general hospital. The health area authorities are responsible for management of health centres and hospitals, for the development of health programmes and for the supply of health care within its defined area. Each area is further divided into basic health zones covering 5,000-25,000 population, which is the territorial unit designated for primary health care, at which level primary care teams operate. The basic health zones are in charge of executing and supplying the services of health education, promotion, prevention, cure and rehabilitation.

Autonomous communities offer a magnificent opportunity to generate initiatives and experiences which favour the evaluation and the dissemination of what has been shown at local level to be successful.

For the rest of the country, which account for 38 per cent of the population, the administrative body is the INSALUD, created in 1978 and dependent on the Central Administration, which is responsible for the delivery of health care. The duties of the INSALUD include:

- general co-ordination of all parties, public and private, involved in health care;
- pharmaceutical and prescription policy;
- purchase of expensive and durable medical equipment;
- capital and operational budgets for hospitals;
- general health care finance.

It appears that the policy of the central government is to decentralise the 10 remaining autonomous communities in order to remove as many layers of management and bureaucracy as possible.

Health planning is difficult in view of the substantial delegation of responsibilities to the autonomous regions, but the central Ministry did prepare its fifth National Health Plan in 1993. This is based on coordination with Regional Health Ministries. Priorities have been established in three categories. For health promotion the emphasis is on tobacco, exercise, alcohol abuse, nutrition. In the environment the emphasis is on biological, physical, chemical and work-related risks. In the health system the emphasis is placed on public health, primary care, maternity and infant care, oral hygiene and rehabilitation. Spain is also carrying forward the "Health for All" strategy through the "Health Cities" programme which involves over 30 municipal authorities.

Human resource planning occurs only through restrictions on the number of internist and residents taken from the pool of medical students each year. However, it is up to each University to determine how many students it will admit each year.

2.11 The Growth and Performance of the Spanish Health Care System

As a proportion of national wealth, as measured by the Gross Domestic Product (GDP) at market price, total health expenditure grew appreciably from 1.5 per cent in 1960 to 7.6 per cent in 1995, of which 6.0 per cent was public expenditure[5]. Total and public expenditure on health care as a percentage of the GDP is shown in table 2.1.

Table 2.1
Total and Public expenditure on health care as a percentage of the GDP

	1960	1970	1980	1990	1993	1994	1995
Total % of GDP	1.5	3.7	5.7	6.9	7.3	7.3	7.6
Public % of GDP	0.9	2.4	4.5	5.4	5.7	5.7	6.0

Source: OECD Health Data.

Spain experienced the second highest rate of growth in health spending in relation to GDP over the period 1960 to 1991. Yet despite the increase, Spain continued to remain one of the smallest spenders on health care among major industrialised countries, both in relation to the population and to the national wealth.

The health of Spanish population fairs quite well when we compare with other countries. Over the past decades there has been a great improvement in some health indicators[6], for example:

- life expectancy at birth was one of the highest for developed nations, reaching 80.5 years for females and 73.4 for males in 1990 (European average: 79.5 for females and 72.8 for males);

- infant mortality rate which fell from 44/1,000 in 1960 to 26/1,000 in 1970 and 7.6/1,000 live births in 1993;

- of European countries, Spain has the fifth lowest percentage of low-weight births, 5.0 per cent in 1990;

- the maternity mortality rate in Spain is the fourth lowest of the European Union countries with 4.76 deaths/100,000 births for the period 1985-88;

- the general mortality rate in 1992 was 8.7/1,000.

The most important group of causes of death in Spain comprises diseases of the circulatory system, which account for 46 per cent of deaths. The second major group is malignant neoplasms which cause 21 per cent of deaths in 1985. Three other important causes are: diseases of the respiratory system (9 per cent); diseases of the digestive system (5 per cent) and accidents and trauma (5 per cent).

The ratio of doctors to population (4.1/1,000 in 1993) is among the highest in Europe, while the ratio of nurses (4.3/1,000 in 1993) is low compare with other countries in the European Union[7].

The number of hospital beds, which include: acute, nursing home and psychiatric beds, (5.0/1,000 in 1991) has decreased since 1984 (5.6/1,000). Spain has the lowest ratio of hospital beds to population, the lowest ratio of admissions (10.0/1,000 in 1993) and among the highest length of hospital stay (9.1/1,000 in 1993) for acute care in the OECD countries[8].

2.11.1 The public's perception of their health services

Increasing expectations are widely held to be a driving force behind calls for increased health expenditure. Research on public opinion survey on health services has been carried out in some countries of the European Union in 1992.

Only a third of the Spanish people think their health services are of good quality. Moreover, the majority of people think that the health services are inefficient (72 per cent) after Italy, Greece and Portugal. About a third of people think that the health service will be less good in the future. Half of the population were willing to pay more in higher taxes for health services and most of the population are again that the government should provide everyone with only essential health services such as care for serious diseases and encourage people to provide for themselves in other respects[9].

2.11.2 Participation

The General Health Law emphasized the importance of community participation by Health Councils for each area. However, these committees lack direct responsibility for health care expenditure and the consumer associations are not representative of the community. It is unclear to what extent they have been developed in the different autonomous communities.

2.11.3 Research

In Spain 1 per cent of the budget is used for research. There are two main administering agencies. The first, coordinated by the Education Ministry, tends to finance fundamental research especially in molecular biology, immunology, genetics and bioengineering: it is also responsible for research on pharmaceuticals and sport. The second, the Health Research Fund, uses social security funds under the Ministry of Health to finance biomedical and clinical research and, more recently, public health and health services research. Most of the funds are channelled through the Carlos III Health Institute. Health services research and clinical epidemiology are currently the priorities for the Ministry in the promotion of research, for which centres have recently been approved, but there is only limited evaluation of clinical practice and economic evaluation methods are seldom used. More recently, the Research Fund for Social Security (FISS) started to finance health service research.

2.12 Health Care Reforms and Remaining Problems in the 1980s

The ultimate goal of the General Health Law, enacted in 1986, was to establish the basis for the future development of the National Health Service (NHS), which would cover the whole population without distinction; change the financing mechanisms of the system; changing the basis from being one primarily structured on social security contributions to one based on general taxation; the General Health Law provided the legal mandate for the decentralisation of health care management and administration to the autonomous regions, with the creation of 17 regional health services within a National Health System; legislative support for the primary health care reforms; and the establishment of a supra-regional health council to co-ordinate policy and planning between the different regional health services. The National Health Service required the integration of the old health delivery structure so that a more coordinated and even distribution of care will ensue.

General cost-containment measures, therefore, were accompanied by specific initiatives. It was generally believed that it would be possible to reduce hospital costs by strengthening the primary care sector.

The health care reforms undertaken by Spain in the 1980s must be judged according to the degree to which they have met a set of criteria or policy objectives for health care. The reforms improved equity and coverage. However, the reforms did not apply microeconomic efficiency (enforcement of global budgets which create incentives to eliminate waste, the expansion of community-base care where cost effective, and system efficiencies such as management information system).

2.12.1 Remaining problems in the reform

Spain has the highest ratio of doctors to population of all industrialised countries and over half the doctors are specialists. There are estimated to be 12 per cent of doctors unemployed or under-employed. The excess of doctors can be explained by the lack of medical resource planning and by the late introduction of 'numerus clausus'. The ratio of nurses is among the lowest in the European Union with about one nurse per doctor compared with Ireland and the United Kingdom which have more than three nurses per doctor. The teaching in general practice is well-developed. There is an effective selection system for entry to specialist training which takes three to four years in hospitals approved for this purpose.

Doctors in Spain occupy most of the managerial positions. Training in health service management has grown over the last fifteen years but around ten per cent of present managers have had no training at all and another roughly 40 per cent have had less than 300 hours of training. The level of pay offered makes it difficult to employ good managers from the private sector in view of the scale of resources they are intended to control. Moreover, all managers in hospitals and other public health institutions are appointed mainly because of their affiliation with the political party in Government and not because of their competence or qualifications. While the doctor managers tend to keep an eye on medical activity, they pay much less attention to nursing and administrative matters. There is an excessive use of medical specialists, high technology equipment and of drugs. Hospitals in the NHS in Spain work on a fixed budget. A major concern is thus to keep spending within their total budget. There is little financial incentive to adopt short stay and to reduce the cost per case, because they are likely to lead to greater total costs and a possible budget overspend if they result in a greater throughput of patients. These budgetary consequences of increasing efficiency are referred to as the 'efficiency trap'. There have thus been relatively few financial pressures or incentives on managers and clinicians in the NHS to achieve important budgetary constraints on activity through a reduction in length of stay and cost per case. There is a chronic history of the over-spending of budgets and the absence of effective financial control.

There is a lack of the information systems needed for efficient management (data on costs and full information on inputs, inventories and detailed data on the utilisation of services). There is a need to develop a standard of normal costs for various diagnoses, to facilitate comparisons of efficiency between hospitals and departments and to support budgeting.

The centralisation of controls on staff and purchasing decisions, the enforcement of line budgets, the lack of performance-related pay and all the rigid bureaucratic rules of civil service organisations still remain after the reform.

2.13 Some Major Reforms of the 1990s

2.13.1 The Abril Report

Health policy has been attracting increasing public attention during recent years in Spain. In July 1991, the Abril Report (Abril was the chairman of the Committee), commissioned by the Parliament, and produced by the "Committee for the Analysis and Evaluation of the National Health System", was published. The Committee made 64 recommendations and identified two basic sources of inefficiency in the health system: excessive demand triggered by a zero-price policy; and, the inefficiency of public health care providers[10]. The report formally takes its references from some of the reforms from other European countries (e.g., Netherlands, United Kingdom and Sweden).

The Report envisaged that the health services would continue to be financed mainly by taxation but the report did not favour a reduction in the role of social security contributions in the financing. It was also argued that charges for drugs and hospital emergency services should be increased to control trivial demand with arrangements to protect the poor. Additional revenue would also be obtained from hotel services and training activities. Further long term hospital beds and additional community care services for the elderly would be provided so that existing acute beds could be used more efficiently. Waiting lists would be reduced by contracting services with private providers. Emergency services would be provided in the health services to take the load off the hospitals.

The Report faced strong opposition, as it proposed, among other measures, a larger economic contribution from the beneficiaries. Co-payment for drugs, has been the largest single issue debated in the media. The Commission recommended to introduce nominal charges for certain basic services, including extending the 40% co-insurance payments for pharmaceuticals administered to pensioners while compensating them through higher pensions.

The report envisaged that there would be a clear definition of basic services and there would need to be explicit decision to add any further services. Every new technology would be assessed for its technical and economic efficiency. If a decision to exclude new services were taken, they would have to be paid for by patients. It was envisaged that for all services patients would be given statements showing what they cost.

The report advocated greater autonomy for health units, an increase in competition for the provision of care and a decentralization of administration in order to allow for greater budgetary rigour. It is difficult to forecast how far the Abril proposals will be implemented. Nevertheless, the most political fashionable feature is the differentiation between purchasers and providers, and the creation of some type of self-governing structure for hospitals.

The report is based to a considerable extent on the British reform but also has important differences. The main similarity is that health areas, broadly corresponding to the British districts, would contract services from the public and private sectors. Their role is to be purchasers rather than providers, buying on the basis of price, quality and patient satisfaction. But this would be applied to primary care as well as secondary care. There would be tight budgets for each health unit, tied to clearly defined objectives: management information would be improved. Moreover all the public health units contracted would become autonomous public enterprises, so that new employees would not be civil servants. While conditions of service for existing staff would remain with some modification, there would be complete freedom for the health areas to pay new staff on a different basis. The aim would be to have more flexible, performance-related contracts for health service employees. Any profit earned from contracts could be given as extra remuneration for staff.

One issue is whether the proposed changes in financing although reducing costs per case will lead to a rapid escalation of total health care costs, as a result of an increased number of patients being treated. However, the "Abril report" leaves many questions unanswered[11].

Although the Abril Report was not explicitly accepted by the government, some of the underlying ideas, such as linking activity with resources allocation, were adopted in 1992 by the main health care agency, INSALUD. But the public hospitals have not been made autonomous. The government promised not to implement the recommendations concerning drug charges for pensioners and has postponed decisions on most of the other recommendations.

Catalonia and the Basque Country have already been taking some steps to create competition (a provider market):

- by separating the purchasing and provision of hospital care,
- by trying to improve management and the information system in the public sector,
- by giving more autonomy to the hospitals and the primary health care centres,
- by trying to introduce more flexible performance-related contracts for health service employees.

2.13.2 Priority setting and technology assessment

In February 1994, a working group of the Interterritorial Committee, which coordinates the regional health services of Spain, proposed a basic package of care to be provided under the National Health Service. It developed criteria for excluding services - the lack of sufficient evidence of clinical effectiveness, no proven impact on life expectancy or increase in patient self-reliance or diminution of patient distress. On this basis it recommended the exclusion of in vitro fertilisation, sex change intervention, aesthetic surgery, psychoanalysis, hypnosis and spa treatment. In the case of new treatments, the criteria proposed for inclusion were clinical effectiveness, the absence of cost-effective alternatives and the availability of technology and health professionals to provide the treatment[12].

The Government has established an agency in charge of the clinical and financial evaluation of new technologies and the use of drugs prior to inclusion in the NHS. Technology Assessment programmes exist at local level. The Catalan Office for Health Technology Assessment was established in 1991 within the Department of Health of the Autonomous Region of Catalonia. This agency has so far evaluated some 20 technologies (equipment, procedures and health programmes). Evaluations are primarily concerned with safety, impact on health care organizations, ethical implications and clinical efficiency. Primary research is undertaken or sponsored, but comprehensive literature reviews are also used. Economic evaluations are sometimes carried out, or simply the cost per unit of output. The office is also involved in the process of the purchasing decisions on expensive equipment and in defining reimbursement systems for technology. A similar agency has been set up recently within the Department of Health of the Basque Government.

2.14 The Future

The Spanish government has to realise that if they are to be successful in improving the health of Spaniards, they will achieve this objective only through the preservation of the fundamental principles of the Spanish health care system; adequate funding; effective management of the system; and local democratic regulator. Moreover, cost containment is likely to remain an important issue during the late 1990s.

2.14.1 Doctors

Key elements of the strategy are aimed at reducing medical school enrolment and postgraduate medical training positions, as well as at supporting the development and implementations of national clinical guidelines. Moreover, the different regions and INSALUD have to agree to establish global, regional and individual doctor budgets and, where possible, to replace the method of payment to doctors. The aim should be for specialists to be appointed and paid for giving their whole time to the National Health Service and salaries need to be supplemented by incentive payments to encourage productivity and cut down waiting lists.

The government has to focus on the development of clinical and practice guidelines aimed at improving the appropriateness and quality of care. Cost-effectiveness is an important factor which should be considered in the development of such guidelines. While still in its infanticy in Spain, this aspect of quality assurance should be develop in partnership where appropriate.

2.14.2 Hospital

An ageing population and funding constraints are likely to require reducing the number of acute-care beds in favour of more long-term care beds and alternative community-based care. It is by no means clear that constructing more hospitals is a high priority. Moreover more hospitals will lead to higher running costs. It would seem wiser to first ensure that existing hospitals are used appropriately and efficiently and to stimulate the full development of cheaper substitutes to inpatient care.

Hospitals have to be made dependent on the contracts placed with them. Encouraging hospitals compete for custom keeps them on their toes. They have to be able to try and respond quickly to the demands made on them and they have to find out what patients really want and make their hospitals more use friendly. Inevitably it takes time for all hospitals to make the transition from being staff dominated to becoming more consumer conscious.

Hospitals need substantial autonomy and power to be managed under a trust status. Bringing authority down to the hospital level and giving managers much more power to manage, are important steps to enable hospitals to become patient centred.

2.14.3 Community care

Community care under-funding is a really serious problem. The figures show that there is an increase in hospital expenditure in the last years. Authorities do not spend what is really needed on home care. While hospital care is free, people have to pay in a nursing home or residential home where relatives would have to pay the fees. This is a critical area to reform so that people can have a choice between home care, sheltered housing or subsidised care in some type of institution without their relatives being forced to pay. A new source of funding is needed with dedication to the long term care for elderly people.

2.14.4 Pharmaceuticals and new technologies

The pharmaceutical costs are the fastest rising component of national health care expenditure. Measures should be taken into determining the extent of overuse of medication, prescribing practices of doctors and cost-effectiveness of pharmaceuticals. As we have mention above, assessment offices have been established, however, the rather modest level of funding afforded to these agencies has limited their scope.

2.14.5 Training in health service management

There is an urgent need to foster and develop training for health service managers and information systems in their widest sense so that local managements can be given the authority and freedom to use resources efficiently at the local level. What will be required in the long run, is a major delegation of responsibility and freedom from the restraints of civil service bureaucracies.

2.14.6 Health services research

Health service research needs to be strengthened. If health service costs are to be controlled in the long run, there needs to be a major expansion in the economic evaluation of clinical practice (particularly on new technologies and the use of drugs), leading to the development of medical profiles. We need to set up a research disseminated service.

It is absolutely necessary for the new Agency for Technology Assessment which reviews new treatments and informing purchasers to work in parallel with similar agencies in other countries. International comparative information should be shared. There are very wide variations in the extent to which Gps refer patients to hospital and what is done for them and how long they are kept in hospitals for the same condition. Waiting lists could be eradicated if hospitals were always used appropriately. But it is difficult for individual doctors to know what is and what is not appropriate. What is needed are clear guidelines based on hard data about what improves the outcome for the patient.

But what is more important is a fundamental reassessment of medical knowledge. This could, in the long run, lead to significant savings and indicate clear priorities for the future. One of the main problems is the lack of information about which services and treatments and what resources used within these treatments are effective and which are not. In view of resource limitations, effectiveness is a crucial principle. With further knowledge of the costs and clinical effectiveness, more reliable systems of outcomes measurement and disease management can be developed.

Chapter 3

Variations in Hospital Utilisation

3.1 Introduction

In view of the large proportion of health care expenditures devoted to hospital care, it is not surprising that during the last two decades many studies have been published which investigate the determinants of hospital utilization. The first objective of this study is to examine which factors affect the consumption of medical care by individuals in general and their use of hospital facilities in particular.

It has frequently been observed that there exist large differences with respect to standardized output measures (length of stay, costs per case) between hospitals which can not been explained by differences in the health status of their patient population. Some studies have found that large proportions of hospital utilization may in fact be judged unnecessary. Whatever the underlying causes of this may be for example, doctor's inexperience, cautiousness, carelessness, obsolete knowledge, financial motives, unavailability of alternative care etc. In such a situation it is obviously important to evaluate the efficiency of care delivery by hospitals and doctors.

3.2 Variations in the Utilisation of Health Services

The literature on geographical variations in the utilisation of health services is very wide[13]. There is substantial evidence of significant geographic variations in the use of medical services. Early studies reported differences among small areas (counties or hospital service areas), but recent studies have shown impressive differences between large areas (states or regions) as well[14]. These differences, moreover, do not appear to be explicable in terms of the needs or characteristics of the populations served or, at least, such explanations have not been found.

3.2.1 International Health Care Variations

The pattern of hospitals use and doctors'services during the past two decades in U.S. Canada, and Europe, has revealed wide variations. Studies have showed consistently higher rates of use with shorter length of stay in the US than in other countries, finding generally attributed to differences in the health care system.

Pearson et al., (1968)[15] studied hospital discharge rates and length of stay controlling for sex and case mix and found wide differences in use between three regional areas in the US, Sweden, England and Wales. He demonstrated much higher rates in hospital discharges in Sweden and the US than in England and Wales. However there were longer durations of stay in England and Wales.

Andersen et al., (1970)[16] found that Swedish adult inpatients are estimated to spend on average 7.3 days more in the hospital than the Americans.

A study by Jonsson and Neuhauser in (1975)[17] found that the American doctor orders three times as many tests to decide upon a simple elective surgical diagnosis as does a comparable Swedish doctor. One of the possible explanations is that the American surgeons do more testing because they are more discriminating in deciding to operate. Unfortunately, this is not consistent with the fact that the operation rate per 1,000 population is 18 per cent lower in Sweden relative to the United States for inguinal hernia, and 25 per cent lower for cholecystectomies and prostatectomies. The Swedish patients have the same age and diagnosis specific mortality rates as their American counterparts, so that the additional utilization of ancillary services observed in American hospitals may not be medically necessary.

Bunker's (1970) studies[18] show that the difference in rate of surgery between the UK and the USA is associated positively with a difference in per capita number of surgeons. A similar relationship has been shown for counties in Kansas[19], and for USA census areas[20]. Wennberg and Gittelsohn (1973)[21] in their Vermont study found the supply of surgeons to be positively correlated with surgical rates for nearly all of the surgeries they studied.

Vayda compared surgical rates in Canada and England and Wales. He found that surgical rates in Canada were 1.8 times greater for men and 1.6 times greater for women than in England and Wales. The age standardised and sex specific rates for particular operations were two or more times higher in Canada than in England and Wales. Vayda pointed out that the key factors were the more conservative treatment styles in England and Wales, the greater availability of surgeons and beds in Canada, and the impact of financial incentive to operate in Canada. Differences in disease prevalence, as measured by mortality rates, were not found to be important[22].

The importance of supply as a determinant of utilisation was also highlighted in an analysis by McPherson and colleagues of variations in the use of in England and Wales, Canada and the US[23]. However Vayda and Bunker as well as McPherson argued that the US fee-for-service system provided an incentive for surgeons to operate. This incentive is lacking in England and Wales where surgeons are constrained by fixed budgets and the availability of beds.

Evans (1974)[24] using Canadian data, he showed that doctors appear to have a strong effect on utilization that it often overwhelms the other variables. This effect lends support to a supply-creates-demand hypothesis.

While the rates are generally lower in the UK and Norway than in USA, the range of variation within the UK and Norway appears to be of the same order of magnitude as seen in the USA comparing[25]. Cross national comparisons also reveal significant differences. Hysterectomy is performed nearly 3 times more often in the US than in England and Wales, and prostatectomy 2.5 times as frequently[26]. Rates vary widely within other countries as well. Among 56 small rural areas in Manitoba, reported a 2.7 overall variation in surgical rates, with a high of 4.2 times for cataract removal[27]. Wide variations in surgical utilization have been demonstrated in the UK, Norway, and Canada[28].

3.2.2 Small Area Health Care Variations

One of the most widely documented and least understood health care phenomena is

3the substantial variation in hospital and physician care utilization rates per capita across small market areas[29]. Differences in overall surgical rates, as measured by high-low ratios, are commonly more than twofold across areas, but for some procedures, such as tonsillectomies, the differences are much greater.

From the beginning, geographic variation has been regarded as evidence of unnecessary surgery. The early studies focused on surgical operations, and either stated or implied that the differences in use resulted from overuse in the high rate areas[30].

In one of the earliest modern studies, Lewis compared utilization of six common surgical procedures among 11 health planning regions in the state of Kansas in 1969[31]. Variations in use ranged from 2.3 times for inguinal hernia to 3.8 times for appendectomy. He noted a correlation of surgical rates with the number of hospital beds and the number of surgeons.

Wennberg and Gittelsohn (1973)[32] studied variation in performance of the same six operations plus some others among 13 hospital service areas in Vermont in 1973. Differences ranged from a factor of 1.7 for herniorrhaphy to 11.6 times for tonsillectomy. Significant variations have been found even when large areas (States or parts of large States) were used as the unit of analysis[33]. Studying a large number of medical and surgical procedures in Medicare enrollees in 1981, they found, for example, that the rates of performance on hip arthroplasty varied by 11.4 times, carotid endarterectomy by 4 times, and herniorrhaphy by 1.4 times.

In more recent years extensive variations for total surgery and between specific procedures have been documented between nations[34], neighbouring communities within the United States and Canada[35], geographically separated but apparently homogenous members of insurance plans[36].

Wennberg and Gittlesohn (1982)[37] found in a review of small area variations the importance of supply factors in accounting for variations but this was not a complete explanation of all the variations that existed. The key factor was the judgements and preferences of doctors.

Research to date has claimed that these variations cannot be accounted for by variations in medical needs, socioeconomic characteristics, or supply availability[38]. It seems that variations come to be regarded as undesirable or arbitrary, not only because many patients are being exposed to unnecessary surgical risks but also because it is a substantial unnecessary cost[39].

Several of the reported variations could result from statistical problems of sampling. However, consistency of variations over time in one region and the findings from multiple studies that certain operations display wide variations in use wherever studies are undertaken, provide abundant evidence that most variations are real[40]. Moreover, no evidence was found in these studies that residents differed in their propensity to develop appendicitis, haemorrhoids, hernia etc.

3.3 Variations in Hospital Utilisation: Length of Stay and Hospital Costs

The first aspect of hospital utilisation, is the length of stay. Reduction in length of stay has occurred across all age groups and for most surgical procedures and diagnoses in the last years. However, there are questions at to the extent to which length of stay varies between hospitals, the causes of these variations, and their implications for resource use.

A hospital stay is defined by admission and discharge. As soon as a patient is admitted into a hospital a more or less continuous decision process is started with respect to the treatment and eventually discharge of the patient. The length of the patient's hospital stay is used often as an indicator of the quality and efficiency of care in short-term hospitals. It is an output variable that can be easily obtained and measured objectively from the hospital record and, can reflect the appropriateness and economy of care received in the hospital. Moreover length of stay, more directly than other output indices, has definite implications for cost containment, since the bed day is usually one of the most costly hospital item during short-term hospitalization.

This aspect appears to have drawn most of the attention of researchers concerned with analysing the use of hospital facilities, probably because data on this subject are readily available as it is routinely registered by the hospital themselves. The determinants of length of stay have been studied from two different approaches: population-based and institutional-based analysis. In the population-based analysis, the denominator used to determine the level of resource use within a health service area is the resident population. The institutional approach uses as the denominator the total number of discharges from a hospital[41]. Some studies have looked at variations in average length of stay across hospitals .

The second aspect of hospital utilisation, is the different components of hospital costs (e.g., cost per case). This is relatively difficult measured, and attempts to control, for example, diagnostic tests or length of stay can affect the magnitude of cost per case. Excessive length of stay and number of tests are two central issues in the public debate about rising hospital costs. Excessive use of tests and procedures is a source of concern not only because it is costly but because it is unnecessary. This would include those interventions which are ineffectual, inappropriate, or over-used in the sense that they could be provided less expensively. Inappropriate services include treatments which are too risky in the sense that the probable risk exceeds the probable benefit or using a type or care which is effective for a different condition to the one with which the patient is presenting. Estimates of unnecessary services range from 30 per cent to 60 per cent of health spending in Canada[42] and inappropriate services are estimated to be 30 per cent of health care in the United States. It has even been suggested that reduction of unnecessary or excessive amounts of care could raise the general health status of the population by decreasing the likelihood of iatrogenic complications.

A study showed that patients discharged one day after hernia or varicose vein surgery did as well as those discharged after six days[43]. Variations in many parameters of acute hospital service use have been the focus of much managerial study in the 1980s manifested by the development of performance indicators. Performance indicators use routine statistics such as measures of staffing, bed supply, length of stay, waiting lists and waiting times for treatment to compare the performance of the health authorities. Underlying the development of such indicators of efficiency in the health service is an assumption that measures of throughput and activities (that is, cost per case) can be used to assess the quality and efficiency of care. There are in principle, four levels at which an analysis of hospital utilization can be performed: the patient, the specialist, the hospital, and some regional level. Studies which employ the hospital as the unit of analysis are mainly concerned with estimating input-output relations[44] and typically do not control for population characteristics of the hospital service areas. This is partly due to the fact that population characteristics do not play an important role in hospital production functions. Since decisions about admission and discharge are, taken at the patient level and are primarily affected by patient characteristics like diagnosis and age, it seems that an analysis at this level is most appropriate. Therefore, we shall employ the individual as the unit of analysis in the present study.

3.4 Factors Contributing to Variations in Hospital Utilisation

From the beginning, the causes of variations have been an object of active speculation. A common assumption has been that variations indicate overutilization in high use areas[45]. Clearly, the reverse hypothesis is equally plausible, differences could also result from underuse in the low-rate areas. In recent years an astonishing variety of hypotheses has been subjected to study in the search for evidence of variations in hospital utilization.

The first question is whether variations in hospital utilization result from differences in the incidence of specific diseases. Most investigators have assumed that they do not, but the subject has not been studied adequately. Circumstantial evidence, such as extensive variations between adjacent regions with apparently similar populations, as well as the mobility and heterogeneity of the population in the US, suggests that it is unlikely that variations are due to differences of this kind between high-and low-use areas[46]. In one study to assess the relationship between a specific disease and utilization, Roos et al., (1977)[47] found no relationship between tonsillectomy rates and rates of respiratory infection.

Our research builds on the extensive literature that has analyzed determinants of hospital use. Most of this research, focuses as variation in hospital use across types of individuals or across types of hospitals.

The research on small area variation in hospital use was pioneered by Wennberg and Gittelsohn (1973)[48], who have identified large differences in hospital use across small health service areas in Vermont, Maine, Massachusetts, and Rhode Island.

We will consider briefly some of the potential explanatory variables that have been investigated.

- Consumer/ Patient characteristics;
- Hospital characteristics;
- Doctor characteristics;
- Supply factor; and
- Health care system characteristics.

3.4.1 Consumer/ Patient Characteristics

The health status of a patient is, of course, one of the most important determinants of demand for medical care in general and for demand for hospital care in particular. Van Vliet (1988)2[49] found that length of hospital stay is determined to a large extent by health status indicators. Moreover, health status is likely to be correlated with other characteristics of the patient and also with hospital and physician characteristics in the case of hospitalization. The following health indicators are used for hospitalised patients: urgency of admission and mortality per diagnosis[50], variables for primary, and existence of secondary diagnosis[51], number of diagnoses[52], and severity of illness[53]. For a given diagnosis, the severity of an illness can vary for a variety of reasons and this might influence length of stay and cost per case. Thomas and Ashcraft (1991) found that the patient's severity of illness is positively associated with charges and length of stay[54]. Some authors found a relation between severity of illness and length of stay[55]. Harris (1975)[56] found that illness type had no direct impact on patterns of use within 56 counties in New York.

One measure of the existence of illness used is the severity of cases that are admitted to hospitals. One might thus expect that the more complex the case mix the more resources would be used as compared to cases admitted which were less severe. Merchaoui, Fekih and Sfar (1992) found that complications have influence on the length of stay[57]. The attempt to account for case mix is usually through controlling for diagnostic groupings, surgical procedure, and age.

Feldstein (1967)[58] demonstrated that approximately one third of the observed interhospital variation in cost per case is due to case mix differences, but Feldstein and Schuttinga (1977)[59] also pointed out that it is not clear whether any particular hospital has a relatively high average cost per case because it treats a case mix that is inherently expensive or because it treats a more ordinary case mix in a costly way.

Horn and Schumacher (1979)[60] studied 45 Maryland hospitals and they found that case mix explains 82 per cent of the variation in average cost per case. Watts and Klastorin (1980)[61], using a 1976 sample of 315 short term general US hospitals, compared the ability of various measures of case mix to explain the variation in average cost per case across hospitals and they found that in no case did the proportion of explained variation rise above 70 per cent. Schumacher et al., (1979) reported that case mix complexity is a highly significant predictor of cost per case[62]. Shachtman et al., (1986)[63] found in his study, case mix to have a positive effect on length of stay.

Severity is difficult to measure directly so instead it is considered that the source of a patient, that is whether he is admitted as an emergency case or from a waiting list, reflects a difference in severity. Dividing the patients into these two groups would be expected to reduce the range of severity within each and it can be argued that as all emergency cases require immediate treatment they are all of equal severity. Litwin, Kahn and Reccius (1993) found that patients who are more ill at admission remain in hospital longer after a prostatectomy. However, they not receive more intensive care during their stays. Duration and not intensity appears to be the primary determinant of higher hospital charges for patients undergoing prostate surgery who have comorbidity and complicated conditions than for patients without these conditions[64]. Accordingly differences between emergency and waiting list cases have been studied by Aldred (1973)[65]. When differences in mortality rates between emergency and non emergency cases in the same diagnostic group are studied the mortality rate is clearly higher for emergency cases confirming that these are more serious.

Differences in severity, expressed as differences between emergency and waiting list cases have an influence on length of stay. Cairns and Munro (1992) found that emergency admissions have longer lengths of stay than waiting list admissions[66]. Morgan (1988)[67] pointed out in his study in Britain that severity of cases treated cannot be entirely excluded, but there was no evidence of the concentration of these conditions in the longest stay districts. Invariably, these indicators were found to have strong impact on the expected direction on hospital utilization. In the studies by Gustafson (1968) and Anderson and Steinberg (1985)[68] information on hospitalizations in the past is used to predict length of stay and readmissions respectively.

Lave and Leinhardt (1976) found that individual who enter as emergency patients do not have higher costs per day, while urgent patients are slightly less expensive[69].

Discharge status, might also be viewed as an indicator of health status and is found to have negative and positive impacts respectively on length of stay[70].

Less obviously, the length of stay of a patient is affected by whether he/she is discharged or dies in hospital. Since the death of a patient occurs against the efforts of the medical staff, the exact time at which death occurs might be expected to be a high variable giving a randomising effect on length of stay. Patients who have died in the hospital are sometimes reported to have shorter stays[71]than patients who are discharged to their home, but others report longer length of stay for patients who died in the hospital[72].

It appears to be the case, that patient age and sex are known to be significant in influencing hospital utilization. Since age is by far the most important predictor of incidence of illness, age structure differences among populations would be expected to bear a strong positive relation to health care utilization. Ro (1973); Posner and Lin (1975); Arnould et al., (1984); Morgan (1988); Goldfarb et al., (1980); Burns and Wholey (1991) and Cairns and Munro (1992)[73] have suggested that age has a positive effect in the length of stay.

Among small area studies in New England age structure has not been generally been found useful in explaining variations in utilization. Indeed, the effect of age is sometimes inversely related to expenditures. For example, among 13 Vermont areas the percent of population 65 years of age and older is negatively correlated with reimbursements under the Medicare program[74]. Griffiths, Walters and Acheson (1979), however, report no significant effect of age on postoperative stays for inguinal herniorrhaphy[75]. Kurt and Kominski (1988) analysed inpatient charges for 1984 and also found that charges do not influence age[76]. Schumacher et al., (1979) however found that patient age is a significant predictor of cost per case[77]. Fernow et al., (1978)[78] analysed length of stay for patients discharged from three London teaching hospitals and they found that although age was a significant variable in patients with hernia and gall stones, it had relatively little practical effect on length of stay.

Health status differences also could result in higher length of stays for females[79]. However, the study for males may be relatively shorter if males put more pressure on doctors to let them get back to work, as some researchers have suggested. Bombardier et al., (1977) and Doyle et al., (1977) found a longer length of stay among males[80].

When considering hospitalization-related variables (eg. weekday of admission) Lave and Leinhardt (1976); Berki (1984); Cannoodt (1981)[81] found that patients admitted on a Friday or Saturday have longer stays than other patients. This might be attributable to hospital organisational characteristics, since hardly any medical treatment takes place at the weekend. Cannoodt and Knickman (1984); Van Vliet (1988); Udvarhelyi et al., (1992)[82] found that longer stays were estimated for patients admitted just before the weekend, discharged just after the weekend.

Westert (1992) found a positive effect on Monday discharge for three of the four selected procedures studied[83]. Much of the literature of the 1960's suggested that better discharge and admission planning could reduce the length of stay. One such suggestion was to eliminate elective admissions on weekends or a Friday. This was supported by McCorkle (1970) and Gustafson (1969)[84], who found a positive effect of the day of admission on preoperative and total length of stay.

Social economic variables commonly employed in empirical studies concerned with medical care utilisation are: income, education, family size, employment status, occupation and marital status. Little agreement with regard to the estimated effects of these variables on length of stay can be found in the literature. Income plays a crucial role. Knickman and Foltz (1985); Bombardier et al., (1977)[85] found statistically significant, positive income elasticities for the length of stay. Epstein et al., (1990) found that hospitalized patients of lower socioeconomic status (income, occupation, and education) have longer stays and probably require more resources[86]. Ro (1969)[87] found a negative effect of income on the length of stay. Westert (1992) reports that patients with a high economic and social cultural occupational status remain just as long in hospital on average for comparative medical diagnoses and the associated surgical procedures as patients with a lower economic and social cultural status[88].

Van Vliet (1988) reports further that persons with private first or second class insurance (higher socio-economic status) have a shorter length of hospital stay and higher additional costs than those with a lower class insurance[89]. Education can be seen as representing more or less the same notion as income. Higher educated people in general have more medical knowledge and might therefore communicate more easily with a physician. Education is also found to be negatively correlated with length of stay[90]. A non significant effect of educational level was found by Knickman and Foltz (1985); Bombardier et al., (1977)[91], while Ro (1969)[92] estimated a positive effect on length on stay.

The social conditions of the population and especially the presence of deprivation, are regarded as increasing patients' needs for hospital services, due both to their greater morbidity and their unfavourable home circumstances (poor housing conditions, living alone etc). These effects are thus concentrated among elderly patients[93]. This suggests that although the social circumstances of patients may have contributed to the observed variations in length of stay between hospitals, this is unlikely to account for the consistent differences in length of stay among all age groups. The employment status could also be a proxy for health status or time costs. In some studies unemployment is indeed found to be correlated with longer length of stay[94]. The existence of a supportive home environment for recuperation could reduce the need for hospital stay. It could be expected that variables such as family size, being married or not living alone, have a negative impact on at least length of stay. Pauly (1980) found no evidence for a negative impact of family size[95]. Knickman and Foltz (1985) found no evidence with respect to being married[96]. Unmarried persons and those living alone is found by Ro (1969); Boaz (1979) and Lave and Leinhardt (1976)[97] to be positive as it relates to length of stay.

Eastaugh (1980)[98] pointed out that the distance from the patients' home to the hospital on preoperative length of stay has a positive impact. While Berki et al., (1984) and Arnould et al., (1984)[99] also confirmed that the distance from the patient's residence to the hospital was positively and significantly associated with length of stay. Lave and Leinhardts (1976)[100] found that single patients exhibit relatively longer lengths of stay.

Population density or the degree of urbanisation has a positive impact on the length of stay in some studies, revealing the urban vs. rural location to be an important determinant[101].

3.4.2 Hospital Characteristics

Hospital characteristics are often used as explanatory variables for hospital utilization once a patient is admitted. These include the following: hospital size (in terms of available beds, specialists and other personnel), teaching status, occupancy rate.

Laboratory turnaround time is estimated by Eastaugh (1980)[102] to have positive impacts on both the preoperative length of stay and the total length of stay for three common elective surgical procedures. Querido (1963); Gertman and Buchner (1969) and Restuccia and Holloway (1976) reported bottlenecks in laboratory and X-ray departments'[103].

Griffiths, Walter and Acheson (1979)[104] pointed out that the determinants of variations in the length of post operative stay for inguinal hernia repair: the mean post operative stay was similar for consultants at any one of the eight hospitals studied but was significantly different for consultants who operated at more than one hospital.

The characteristics of the hospital appear to exercise a greater influence in determining mean post operative stay than the individual consultant. Hospital size was measured by the average number of beds over the hospitals in the Region. A high number of beds is found to have a positive effect on length of stay[105]. This is generally viewed as reflecting the effects of the level of pressure on beds in raising or lowering thresholds for discharge, as well as influencing the efficiency of organisation at the hospital level. Feldstein (1965)[106] found 12 per cent of stay variations could be explained by hospital size. He pointed out that larger hospitals will have lower throughput and rates as a reflection of longer length of stay.

Patients in larger hospitals are reported to experience longer stay[107] and a smaller probability of being readmitted within 60 days following their discharge[108]. Van Vliet's (1988)[109] study in the Duch health care system pointed out that the size of the hospital does not affect length of stay. Westert (1992) pointed out that the size of the hospital is not related to the length of stay[110].

Similarly, the availability of appropriate facilities and staffing for day case surgery encourages the substitution of day case for impatient care. The ratio of housestaff to beds per hospital is found to be positively associated with average length of stay in the hospital-based study by Robinson and Luft (1985)[111].

There are some reasons for expecting teaching hospitals to have longer overall mean stays and higher cost per case when compared with non-teaching hospitals: a) the patient load in terms of case mix is more severe in teaching hospitals; b) the education process causes longer stays[112] and c) scientific research performed by medical specialists mainly in University hospitals may cause patients to be discharged later than is strictly necessary. Becker and Steinwald (1981)[113] found that case complexity is indeed higher in teaching hospitals and in hospitals with medical school affiliations.

Little evidence is found to support hypotheses b) and c) only Boaz (1979) and Robinson and Luft (1985)[114] concluded that there were positive effects on length of stay of the hospital's teaching status and medical school affiliation respectively. Butler (1995) suggested in his study that medical school affiliation has a positive effect, and General Nurse training a negative effect, on average cost per case[115]. Non significant impact is reported by Becker and Sloan (1983); Cannoodt (1981); Dowd et al., (1986); Jones (1985) and Van Vliet (1988)[116]. Lave and Leinhardt (1976)[117] concluded that the major reason why length of stay is high in the urban teaching hospitals they studied is that residents, because of their lack of experience, order more tests and increase the length of stay. Eastaugh (1979)[118] observed in teaching hospitals a more extensive use of diagnostic testing and greater use of drugs and medical and surgical supplies is also noted by Garg et al., (1982)[119].

It is a well recognized fact that the average charge per case in teaching hospitals, particularly university teaching hospitals, is higher than in community hospitals[120]. Although it is part of conventional wisdom that teaching hospitals admit more complex cases and severely ill patients than non-teaching hospitals, the degree to which case mix complexity in teaching hospitals accounts for their relatively high level of average costs remains unclear[121].

Garber et al., (1984)[122] found that case mix differences across 12 DRGs accounted for most of the cost differential between patients on the teaching versus nonteaching service of a university hospital. Frick et al., (1985)[123] indicated in their study that the case mix differences that exist between teaching and non-teaching hospitals explain only one fourth of the higher average cost per case of teaching hospitals.

Several studies have showed that medical education activities generate additional charges to patients even when case mix is held constant[124]. This greater expense has been attributed partially to inefficiencies of operation and the practice of passing on the costs of research and teaching to patients. The result is that DRGs will not account for the major differences in the costs of treatment among patients due to severity of illness[125]. These issues have led to efforts to identify that portion of higher teaching hospital costs that is due to graduate medical education programmes as opposed to patient case mix and severity of illness differences. Cameron (1985)[126] found that university teaching hospitals were 33 per cent more costly than non-teaching hospitals with respect to direct hospital costs after adjustment for differences in case mix using diagnosis related groups. This study found major teaching hospitals to be 18 per cent and minor teaching hospitals 9 per cent more costly than non-teaching hospitals. Cameron pointed out that these cost differentials were due primarily to the greater intensity of services provided in teaching settings rather than to the cost per unit of service.

The fact that all teaching hospitals treat a substantial portion of routine hospitalizations at average cost that are generally higher than the treatment of similar cases at non-teaching hospitals raises the question of whether teaching hospitals are being appropriately used.

The occupancy rate of a hospital is often interpreted as a measure of risk aversion or as an indicator of inefficient organisation: hospitals with high occupancy rates experience organisational problems in the diagnostic, treatment and/or discharge phase resulting in longer mean stay[127]. There is a positive association between occupancy rate and the length of stay. However, for occupancy rate at admission time was found in be positively associated[128], negatively associated[129] and non significant[130], for occupancy rate at discharge time was lengthened[131].

Revans (1972)[132] argues further that hospital efficiency reflects the fact that communication is likely to be worse in larger hospitals. Decreasing staff efficiency, and poor communications in particular, are likely to raise cost per case by increasing patients' average duration of stay.

Barbaro et al., (1977) and Becker et al., (1980)[133] pointed out that length of stay is affected more by overall coordination and management between hospital departments such as admission, nursing service, operating room, laboratory, and x-ray. Griffiths et al., (1979)[134] suggested that change in hospital organisation can have an affect on the length of stay.

3.4.3 Doctor Characteristics

With recent increasing interest in efficiency in the health care sector, it has quickly become apparent that, because major resource decisions are taken by individual doctors who are not necessarily aware of the cost consequences, efficiency concerns must impinge on clinical decision-making. This has in itself led to an increased questioning of the basis of such decision-making and the accompanying outcomes. The now substantial evidence on medical practice variations has furthered such questioning.

Inevitably attempts to control costs and to reduce practice variations have run into conflict with notions of clinical freedom. The professional uncertainty hypothesis' is often mentioned as an explanation for differences in hospital use. Uncertainty with respect to effective medical behaviour leads to large variations in length of stay. To explain the unknown sources of variation, Wennberg, Barnes and Zubkoff (1982); Wennberg (1987); Mulley (1990); Evans (1990) and Mooney and Ryan (1993)[135] propose that the observed patterns of use are principally determined by differences in clinical judgment on the appropriateness of treatment. A physician's set of beliefs about the efficacy and appropriateness of alternative forms of care has been called the physician's practice style[136].

Variations in practice style are troublesome for policy-makers because they suggest that some surgical risks as well as expenditure levels are unnecessarily high. Allevi et al., (1992) found that total and preoperative length of stay were influenced by the number of instrumental exams (constrastographic, endoscopy, echographic)[137].

Little information is available on the characteristics of the doctors who treat hospitalized patients. Only the age or years since graduation of the attending physician and his specialty are considered. Age did not have a significant impact on length of stay in the study by Lave and Leinhardt (1976)[138]. Studies by Payne, et al., (1984) and Sanazaro and Worth (1985) draw the conclusion that the age of the specialist is positively related to the length of hospital stay[139]. A higher level of specialization was found to be related with shorter stays[140] whereas no significant relation was found for obstetrical admissions[141].

It is therefore likely that the age of the doctor relates positively to his hospital utilization patterns eg. more admissions and longer length of stay. This hypothesis is supported by Rosenblatt and Moscovice (1984)[142] who found the age of the physician, scope and pressure of his out-patient practice to be positively related with the hospitalization rate.

Eastaugh (1979)[143] pointed out that the duration of stay and number of tests per patient are likely to be affected by the educational background of the surgeon.

The degree of specialisation of the doctor and the length of patients' hospitalisation has a negative relation: more specialised doctors choose on average a shorter stay[144].

The style of individual clinicians has been identified by Wennberg et al., (1987)[145] as being of central importance in explaining the large variations in hospital admission rates for conditions whose management is surrounded by considerable medical uncertainty.

These variations in practice style also have implications for the length of patients' hospital stay. They include differences in the extent to which preoperative tests and investigations are conducted on an inpatient basis, general norms regarding the appropriate length and management of the postoperative period, as well as the effects of different surgical techniques and types of anaesthesia which have made a major contribution to the overall decline in length of stay[146].

3.4.4 Supply Factor

The characteristics of local health systems that can be considered potential causes of regional differences in hospital use are the number of hospital beds per capita available in the community, the number of doctors per capita, the number of General Practitioners and the availability of nursing home beds in the community. Hartman and Watts (1978) found a positive effect on the statewide number of surgeons or other specialists per capita on statewide average length of stay[147]. Deacon et al., (1979) showed that a higher ratio of doctors per 1,000 Medicare enrollees result in a somewhat shorter average length of stay[148].

A relatively large number of hospital beds per 1,000 population in the Region would reduce the pressure on the physician to cut down on length of stay and, therefore, would have a positive effect on length of stay. Morgan et al., (1987)[149] pointed out that the Region with consistently long length of stay (Mersey) having the most beds per 1,000 population and the Region with consistently shorter stays (Oxford) having the fewest beds per 1,000 population. The supply of acute hospital beds and medical manpower are important factors explaining variation in the length of stay.

Generous supplies of hospital beds in particular have been cited as having a positive influence on utilization, a phenomenon often termed Roemer's Law[150]. Harris' study[151] clarify the controversy surrounding Roemer's thesis, at least in urbanized areas. Harris showed in his study that supply can create its own demand rather than that demand leads to congruent levels of supply. To supply additional beds to areas with current high demand (utilization) in an attempt to satisfy the unmet need in these areas is thus seen to be a futile exercise.

Additional beds will always lead to additional use, and health care expenditures will continue to rise. It seems that to base hospital construction priorities primarily on past use and current demand is hopeless since areas will never have enough beds. This showed the expected pattern in non-teaching districts of a relatively plentiful supply of beds, and hence less pressure on their use, being associated with a lower throughput and greater length of stay[152].

Feldstein (1967)[153] observed the relationship between bed availability and use and he found the length of stay in the NHS in UK to have a high elasticity to bed availability. Van Vliet (1988)[154] noted longer stays in the Duch health care system for patients living in a region with a relatively large supply of hospital beds. Knickman and Foltz (1982)[155] in their study between New York and Los Angeles noted a positive effect of a large number of acute care hospital beds on the length of stay.

Morgan et al., (1987)[156] emphasises in this study in Britain comparing three surgical procedures, that the supply of beds and medical manpower are important factors in explaining variations between Districts on the length of stay.

The fact that General Practitioners provide alternatives for hospital treatment, can be seen as a substitute for hospital care and thus their regional densities can be expected to be negatively related to length of hospital stay. Knickman and Foltz (1985) found a negative impact on length of hospital stay[157] and a positive effect on the preoperative as well as the postoperative length of stay was found in the Cannoodt (1981) study and Cannoodt and Knickman (1984)[158].

Another supply factor influencing the length of hospital stay is the availability of alternative residential facilities and community services. In particular, the opportunity to discharge patients requiring continued nursing care to convalescent hospitals and units has a direct effect in determining need for an acute hospital bed. Ro (1969) measures the availability of substitutes for inpatient care by the existence of a hospital based outpatient clinic and an organised home care program and finds both variables to have a significant negative effect on the length of stay[159]. Patients discharged to a home health agency would require fewer days of postoperative stay, and are therefore expected to have shorter length of stay[160]. Cannoodt (1981); Cannoodt and Knickman (1984) found that patients discharged to long-term care facilities have longer a postoperative length of stay[161].

3.4.5 Health Care System Characteristics

Differences in methods of organising and financing health services appear to be important in explaining some of these variations.

In the group practice Health Maintenance Organisations (HMOs), paying physicians by salary appears to be related to lower levels of use and to lower costs[162]. However, Arnould et al., (1984)[163] found no evidence that HMOs have an effect on the length of stay. They also found surprisingly, gross costs were significantly lower for HMO patients only in the case of appendectomies, suggesting that increases in some other resources cost or high variability aiming doctors' practice patterns occurred with hysterectomies.

In order to develop hypotheses concerning the relative strengths of provider responses to different payment policies, it is useful to consider the nature of the incentives associated with each payment system. Since the model of hospital decision making has been developed extensively in the work of Ellias and McGuire (1986)[164], we will briefly summarize the incentives contained in each payment system.

Under a prospective per diem system, a price independent of actual costs is set for each inpatient day. If the per diem rate is set above the marginal cost of a day of care, the hospital will earn net revenues for each additional day of care provided and will therefore have a financial incentive to extend the length of stay. We expect that the length of stay will be longer under per diem prospective payment systems. Under a per case prospective payment system, a fixed payment often based on diagnostic grouping (DRGs) is made for each discharge. Under this payment system, a hospital's net revenues are reduced for each day of care provided by an amount equal to the marginal cost of a day of care. Hospitals can therefore earn profits by reducing the length of stay below average. Per case prospective payment systems contain strong incentives for hospitals to reduce length of stay.

The response to payment arrangements may also differ across types of institutions. Hospitals in which net revenues are relatively more important may respond more strongly to incentives to reduce the length of stay[165]. Hence, for-profit hospitals and hospitals under financial pressure are expected to be more responsive to incentives. The revenues of public hospitals are completely different and the incentives can also be different. This is particularly true if their budgets are fixed in any given year and administrators are held accountable for deficits.

A number of studies have examined the effect of state prospective per case payment systems. The experiments in New Jersey and Maryland have received the most attention. Rosko and Broyles (1986)[166] examined the initial impact of the implementation of DRG-based per case prospective payment in New Jersey. Using the hospital as the unit of observation, they found that relative to a per diem prospective payment system, lengths of stay in hospitals being paid under the DRGs fell by 3.4 percent, while costs per admission fell by 4.4 percent. Salkever, Steinwachs, and Rupp (1986)[167] examined the Maryland experience with a modified per case prospective per service system. Using the hospital as the unit of observation, they found that the method of payment had little differential effect except in those cases where additional penalties were levied on hospitals that had previously been found to be high-cost providers. In those cases they found significant reductions in both the costs and the length of stay. They also reported that in non-teaching hospitals, the length of stay was lower on hospitals under the case-based payment than under the per service system.

Lave and Frank (1990)[168] studied the effect of different payment methods on the length of stay of Medicaid patients. They found that per case payment systems and negotiated contracts lead to significant decreases in the length of stay for medical, surgical, and psychiatric groups. Prospective per diem with limits in most cases leads to decreases in the length of stay.

Publicly owned hospitals are more responsive to payment system incentives than are other hospitals. Eastaugh (1980) and Cannoodt and Knickman (1984) indicate the significantly longer stays in government hospitals versus private hospitals[169]. The latter authors also indicate differences between profit and non-profit hospitals[170]. Overall, the research to date consistently shows a significant response to per case prospective payment for all patients.

A variety of recent proposals rely heavily on market forces as a means of controlling hospital cost inflation. Robinson and Luft (1985)[171] analyzed the impact of market structure on average hospital costs, measured in terms of both cost per patient and cost per patient day. They found that hospitals in more competitive environments exhibited significantly higher costs of production than those in less competitive environments. Sloan and Valvona (1986)[172] found that competitive influence had no effect in length of stay.

Van Vliet (1988)[173] found in the Dutch health care system that the drop in average length of hospital stay from 1983 to 1984, which was probably prompted by the introduction of hospital budgeting, was at least in part a real drop and was not entirely caused by a decrease in the relative severity of the case mix of hospitalized patients (the latter being suggested by the simultaneous increase in the hospitalization rate).

A second influence is the extent to which care, particularly surgery, is provided on an outpatient rather than inpatient basis. Outpatient surgery has notably increased in recent years, accounting for 18 per cent of all surgery in the US in 1985 and 28 per cent of all surgery in Canada in 1983-1984[174]. It seems that differences in the health care system play a fundamental role in clinical behaviour and medical judgement.

3.5 Conclusion

Health status indicator has a positive effect on length of stay and hospital costs. The consistent finding relates to the strong positive impact of regional hospital bed supply on both length of stay and cost per case. This consistency is found in both macro-studies and in micro-studies.

Hospital size in terms of beds or medical staff positively affects length of stay as does the day of admission, patients admitted on a Friday or a Saturday experience significantly longer stays.

The age of the attending physician or the number of years since his graduation both act as proxies for the quality of his service, appear to affect hospital utilization positively. Social economic variables such as income and education play only a minor role in explaining hospital utilization.

Teaching status and occupancy rates are mixed while utilization review appears to have only small negative effects on overall hospital utilization.

In summary, the studies reviewed above provide a fair amount of empirical evidence about the influence of a number of physician and hospital characteristics on costs and length of stay. Morgan (1988)[175] emphasises in his study in Britain that supply variables and differences in the organisational and clinical practices of individual hospitals and doctors are important sources of these variations.

Underlying the concern that some patients are spending unnecessarily long periods in hospital question the appropriateness of resource use. Assuming that a shorter length of stay has no detrimental effects on patients, this is generally seen as economically desirable, since it will reduce the cost per case of hospital treatment. If this is associated with a stable admission rate and reduction in beds, it will also serve to reduce total hospital costs. However, if the reduction in the length of stay is accompanied by increased numbers of admissions and a higher throughput, greater demands will be placed on hospital resources, in terms of the medical and nursing staff, theatre time and other facilities. This more intensive use of hospital beds will generally increase total costs[176].

Reducing the length of stay, although producing a more efficient use of hospital beds, may therefore have major financial implications for a centrally funded health service such as the National Health Service if accompanied by a greater throughput of patients.

Individual clinician decisions would be improved if the responsible doctors were more aware of the high opportunity costs of longer durations of stay and the low marginal financial costs of substituting more cases for longer stays. Implicit in this analysis is that to require more days of stay for producing the same product is inappropriate or wasteful behaviour, unnecessary in the sense that the marginal benefits of more days of hospitalization are minimal.

Chapter 4

Hospital Costing Methodologies

4.1 Introduction

The financial constraints in health service funding inevitably lead to attempts at measuring relative efficiency in health services, or more specifically in the hospital. It is clear that as a result of the set of perverse financial arrangements which surround hospitals, one could expect that the system in its entirety to be inefficient. But it is also becoming increasingly recognized that some parts of the system seem to behave in a less efficient way than others. The considerable variation which can be observed in the performance of comparable hospitals may indicate that such variations cannot be justified by the single notion of hospital uniqueness. Therefore, some mechanisms for comparing efficiency are required.

At present, in the health services, decisions about admitting and discharging patients and about selecting treatments are taken in relative ignorance of their cost consequences. The lack of data about the exact cost of patient care and the cost of any procedure is not required by this system which relies upon the clinician to use wisely the resources available and to treat all patients regardless of cost. The purpose of producing detailed costing figures is to provide a sound financial basis for the distribution of resources, and also to show the purpose for which these resource have been used.

Appropriate information about the cost of what has been done will help to decide how much money is needed by the hospital to support its current level of work. Cost for this purpose should be assessed not only in financial terms, but also in terms of the material resources consumed, measured in units of time and physical consumption. Financial cost must ultimately be linked to these physical factors.

The long term aim of any procedure for cost analysis is to forge a link between cost incurred and the benefit received by the patient (health). However, health is a multidimensional concept and one that is extraordinarily difficult to measure, even in principle, let alone in practice when one considers all the limitations of available hospital statistics.

If a comprehensive and rational assessment of the justification of expenditure is to be provided, a comparison of costs, backed by a link with benefit and accompanied by an explanation of changes and variations must be the long term aim of any system of financial assessment for hospitals.

The objective of this chapter is to draw on economic theory about production and costs and a growing literature about hospital costing mainly in Britain and USA.

4.2 Production Function

Almost all production function studies in Britain, like their USA counterparts, have almost all been directed at the hospital sector. Viewing the hospital as an organization of departments producing a multiplicity of services, some of which are direct medical patient care, some ancillary services, and some hotel type services, the fundamental conceptual question is not one of time dimensionality nor what should be measured. The basic issue is the purpose for which the measure of output is required.

A hospital product function can be defined as the minimum amount of any one input required to produce a given output, given the level of other inputs. But because the real aim of the hospital is to treat individual patients, these are really only intermediate outputs. In an ideal hospital, what would be costed is the final output of hospitals which is, among other things, the improvement in health brought about by hospital services. Empirical work in this area is, however, still in its infancy[177] and as we have pointed out research has had to fall back on measures of throughput as a proxy for output (cases treated, inpatient days).

Due to the difficulty of measuring the ultimate output of health services, the improvement in patient health[178], we consider here the alternative measures of what is sometimes termed intermediate output used in estimating hospital cost structures. Definitions of output have demonstrated the prevalence of multiple and sometimes conflicting concepts[179]. Health economists generally have employed intermediate outputs (patient days, admissions and so on) as proxy measures of final output in studies of hospital costs, productivity and efficiency. The need to define and measure hospital output, therefore, has been of secondary importance to the main research objectives of investigating inter hospital cost variations. Of course, this leaves open the question of the relationship between the quality of intermediate services and their cost. In the absence of measures of outcome, this is a matter that must be left to the judgement of decision-makers.

A production function for acute hospitals can be a useful tool for studying several practical problems optimum input proportions, and the measurement of productive efficiency.

4.2.1 Methodological aspects of production function studies

The choice of unit for output measures varies in different studies: Feldstein (1967) in UK; Evans and Walker (1972) in Canada use cost per case as a dependent variable, while Lave and Lave (1970) in USA use cost per week[180]. More specific criticism has been levelled at the use of the case as the unit of output particularly in those studies in which no adjustments are made for the differing case mix, complexity or severity of illness, in which no distinction is made between those cases terminated by discharge or death[181]. It seems that the analysis of cost per case with some account taken of differences in the type of cases treated is likely to explain more of the variation in hospital costs than cost per week or per day, for example an extra day of recuperation at the end of the treatment is unlikely to have any substantial effect on the health of the patient and so its contribution to output will be small.

The first major British application was by Feldstein (1967)[182]. He was not primarily interested in estimating specialty costs, but he did highlight the importance of taking the case mix of a hospital into account when attempting inter hospital cost comparisons by examining the financial consequences of changes in length of stay or increasing the intensity of bed use. However, it was not possible in Feldstein's study to address the problem of variations in case severity for the same condition (not all patients admitted for surgery are equally ill). With a small number of case mix categories one runs the risk of overlooking some of the inter-hospital variations in case mix[183].

4.2.2 Factor substitution and allocative efficiency

A major issue of interest is that of factor substitution. How are inputs combined in a process? Are they substitutes one for the other, or do they complement each other? If they are substitute, do considerations of allocative efficiency suggest that some substitution away from doctors towards nurses would be desirable? Feldstein's study pointed out that "too much is being spent on nurses, catering and other supplies and not enough on doctors, drugs and dressings"[184]. However, there are some studies that are markedly different from those Feldstein's conclusions. The possibilities for substitution may be constrained technically or by social conventions or regulations. But it is highly likely that there will be some such possibilities.

4.2.3 Technical efficiency

Another issue of interest addressed by the production function literature is the question of technical efficiency. What is the level of technical efficiency between different hospitals? Feldstein investigated the issue using the residuals of the production function as a measure of technical efficiency. Thus a hospital with a residual equal to zero was said to be of average technical efficiency, whilst hospitals with residuals which were greater or smaller than zero were said to be of above average or below average in technical efficiency[185]. However, it provides no information on the absolute level of technical efficiency and it implicitly assumes all cross-sample variation in the error term is due to variations in efficiency[186].

4.3 Research into Hospital Cost Methodologies

Interest at the policy level has been concerned with such questions as the ideal length of stay for inpatient cases, expenditure minimising the use of beds (normally defined in terms of beds as a proxy of capacity and patient days or cases), the possibility of identifying hospitals that are more or less efficient than others, the effects on the cost of differences in the kind of function performed, etc. It seems that there are many problems in relation to these questions. Hospitals are far from being homogeneous. The quality of their treatment varies with the groups of their patients age, as well as the mix of type of case.

The need to develop an accounting system for output costing was the main focus of all the studies in the 60's, 70's and 80's for example those by Feldstein, Abel-Smith, disease costing by Babson and Russell and more recently, some with different output measures such as costs by specialty, patient costing by FIP and the development of the Diagnosis Related Groups (DRGs) system in the United States and Europe[187].

It appears that two different approaches have been taken in hospital costing:

1. Econometric / Empirical Statistical Methods
2. Cost Accounting Methods.

The first relies on submitting large samples of hospitals (usually using Hospital Costing Return data) to statistical analysis in the hope of finding evidence of systematic relationships between costs, and the variables that are postulated to affect costs. As regressors, these studies use fairly indiscriminately all variables for which a causal relationship to hospital costs is hypothesized and data are available:
- the capacity (bed size) of the hospital;
- global indicators of hospital activity such as case flow rate, - average occupancy rate or average length of stay;
- case mix, mostly measured by the proportion of patients in various diagnostic categories defined by a more or less detailed classification code;
- the wage level of hospital employees;
- dummy variables for teaching status, the existence of a nurses' training program and ownership type;
- indicators of hospital facilities and services;
- characteristics of the market for inpatient services like the regional income level, doctor density and hospital bed density. Given the heterogeneity of these explanatory variables there is no accepted theory on the structure of the true functional relationship to costs.

The second relies mainly on cost accountancy in individual hospitals and usually takes the form of extensions to, or improvements upon, the techniques of the Hospital Costing Returns often follow careful work-study of hospital activities.

4.3.1 The econometric approach methodology

This method applies econometric models based on classical economic theory with a pre-conceived structure of patient costs. They use statistical techniques of regression analysis on substantial samples of hospitals to estimate the quantitative effect of various variables on costs.

4.3.1.1 Cost function studies

Hospital cost functions have long since been a popular topic amongst health economists in Britain and USA. For a review of the literature see Berki (1972); Mann and Yett (1968); Cowing et al., (1983) in USA; Breyer (1987); Wagstaff (1989) in UK[188].

The literature on hospital cost functions associated with the intermediate output approach, is, therefore, dominated by the search for a variable output measure normally based upon either a service mix or case mix valuation. The literature is generally not concerned with the effect of hospitalisation upon health status[189]. Tatchell (1983) pointed out that the approach to case mix relies upon the existence of competitive supply-side forces[190]. It seems that such an approach suits the USA, but is unlikely to be suitable for public service systems. The alternative intermediate production approach is to standardise hospital output with respect to case mix data. This aims to associate diagnostic characteristics with cost variations.

In recent years, considerable work have been undertaken in this field, One of the most relevant studies is by Barer (1982)[191]. In his study he argued that the nature of hospital sector production necessitates at least two levels of dimensions of standardization for cross section analyses, one to account for inter hospital variation in activity mix, the other to standardize for patient mix variance within those activities directly related to patient care.

Grannemann, Brown and Pauly (1986) in their multiple-output analysis for estimating the cost of inpatient and outpatient services in USA hospitals, pointed out that their approach to cost function was to separate the cost of a discharge (or admission) from the cost of a day[192]. In effect, they view each hospital stay as consisting of a) a quantity of medical services associated with the admission or discharge per se (laboratory tests, other ancillary services, surgical services) plus b) daily services (including routine nursing and hotel services) associated with the amount of time spent in the hospital. There are therefore two outputs representing inpatient care number of discharges and number of days care. The advantage of this approach over the usual approach of simply using patient days as the measure of hospital output provided to inpatients is that it helps avoid distortions in the cost function that could arise from differences across hospitals in average length of stay.

Chernichovsky and Zmora (1986) suggested a hedonic prices approach to estimate the cost of hospital services[193]. The approach is then applied to Israel data in order to a) measure the relative costs of basic services rendered by hospitals, b) suggest a price index for these services, c) measure the effect of hospital characteristics on cost and its determinants across hospitals, and d) test how the cost of specific hospitals deviates from predicted averages.

Vitaliano (1987) studied economies of scale from data of New York State hospitals, and he used beds as the measure of size, and thus the proxy for size-related output[194].

Whynes and Walker (1995) compared the results of a detailed costing study with reduced list costing and econometric estimation. They concluded, first, that use of a reduced list is likely to generate substantial research economies only at the expense of inaccuracy. Second, crude costing, based upon average costs of the specialty, is acceptable when the frame of reference is the aggregate. Such crude costing, however, is vulnerable to bias when specific sub-samples of patients are to be considered. Finally, total costs are predictable from a restricted list of cost and event variables, and with a high degree of accuracy[195].

4.3.1.2 Methodological aspects of cost function studies

The cost function studies by Feldstein (1967) and Hurst (1977) both employed the second of Feldstein's approaches to measuring hospital output, namely treating the vector of case mix proportions as a regressor[196]. However, Culyer et al., (1978) have employed the information theory approach proposed by Evans and Walker (1972)[197]. This provides a measure of hospital output based on the number of cases treated adjusted for the complexity of the hospital's caseload (low complexity if it can be treated in any hospital and high complexity if it can be treated in only one or two hospitals).

In the choice of model the majority of studies in the cost function literature have focused on the average cost function, though some authors have opted for the total cost function. There is a lack of consensus about the appropriate specification of a cost function for health care. However, the absence of incentives to minimize costs means cost functions need to be interpreted as "behavioural" rather than technical[198]. It has been suggested that the organization is set up to protect the doctor from behaving as an economic man. Harris (1977) suggested that performance in this sector may not be adequately judged in the economist's traditional manner[199]. This, of course, makes it difficult to assess performance in the hospital sector.

Mann and Yett (1968) have suggested that a hospital's average costs may depend not only on its volume of output, but also on the rate at which its output is produced[200]. Some studies include beds, caseflow, bed occupancy rate and length of stay all as independent variables. The justification for including beds in the cost function is that it is a proxy for capacity. Wagstaff (1989) pointed out that if beds are viewed as a proxy for the rate at which output is produced, the simultaneous inclusion of beds and caseflow may be justified[201].

4.3.1.3 Short-run average and marginal costs

The concept of marginal cost is that the cost of an additional unit is essential if we are to determine the optimal quantity to produce. But this raises question of whether hospitals tend to produce to the left of the minimum point of their short-run average cost curve so that marginal cost is less than average cost? Marginal cost can be estimated either on a cost per case basis or on a cost per patient day basis. Feldstein (1967) estimated various types of marginal cost from his total cost equation[202]. He found estimates of marginal cost on a per case basis equivalent to 21% of the average cost per case (in the case when only the stock of beds is fixed) and 12% of the average cost per case (when the occupancy rate is also fixed). Marginal costs on a per patient day basis equivalent to 54% of the average cost figure (in the case where both length of stay and the occupancy rate can change) and 74% of the average cost figure (in the case where only length of stay can change).

Hurst (1977) also estimated marginal costs for British hospitals[203]. He used an average cost function rather than total cost function. Hurst estimated the cost of an additional patient day as the equivalent of 50 % of the average cost per patient day in acute hospitals.

4.3.1.4 Economies of scale

The approach to estimate economies of scale in hospitals has been to use equations relating cost per case to case mix and the stock of beds. The stock of beds is seen as a measure of capacity, and the partial relationship between cost per case and the stock of beds is viewed as evidence about the extent of economies of scale. The existence of economies of scale has been investigated in several studies. Feldstein (1967) has shown that there are economies of scale between 310 or 900 beds depending of how the statistical results are interpreted[204]. Culyer et al., (1978) found economies of scale reaching a minimum at 430 beds[205] (both of them in UK); Evans (1971) and Evans and Walker (1972) (in Canada) found no economics of scale[206]; Lave and Lave (1970) and Lave, Lave and Silverman (1972) (in USA), also found no evidence of significant economies of scale[207]. On the other hand, Jenkins 1980 found evidence of diseconomies of scale as hospital size increased[208]. Berki (1972) in a sarcastic approach said that economies of scale "depending on the methodologies and definitions used, economies of scale exist, may exist, may not exist, or do not exist, but in any case, according to theory, they ought to exist"[209].

4.3.1.5 Effects of case mix on hospital costs

The case mix problem has been handled in rather ingenious ways in a number of studies in the USA, for example, Thompson et al., (1975); Luke (1979); and Watts and Klastorin (1980), but in general the models used have not been formally related to economic theory and thus are rather arbitrary in terms of the variables included and the specifications assumed[210]. A fundamental criticism of these studies is that little use has been made of the economic theory of a multiproduct firm and the related cost structures. Since hospitals provide both inpatient and outpatient service in a variety of heterogenous dimensions, it would appear that the concept of a multiproduct firm would provide a useful framework for analysing hospital costs, especially the case mix dimension[211].

Previous studies dealing with this issue fall into different groups studies that relate some measure of case mix to total hospital costs such as Lave and Lave (1970), Evans (1971), Evans and Walker (1972), Lave, Lave and Silverman (1972), Thompson et al., (1975), Luke (1979)[212]; and studies which aggregate the various hospital services provided into a single scalar index of hospital output such as Jenkins (1980)[213]. Cowing (1983) pointed out that considerable ingenuity has been displayed in the technical procedures used to derive case mix measures[214].

With the respect to case mix, two related issues are important: first, how best to measure or capture case mix differences across hospitals, and second, how case mix variation affects hospital costs. Several studies in USA such as Lave, Lave and Silverman (1972), Luke (1979), Watts and Klastorin (1980), have attempt to assess some of these issues[215]. The aggregation techniques that have been evaluated include principal components or factor analysis, cluster analysis and the aggregation of services based on similar costs. The use of alternative hospital service classification systems have also been evaluated. With respect to the importance of case mix effects, a large number of studies such as Lave, Lave and Silverman (1972), Feldstein and Schuttinga (1977), Goodisman and Trompeter (1979), Luke (1979), Watts and Klastorin (1980), have used a variety of methods for adjusting inter hospital differences in case mix in order to examine how such variation affects hospital costs[216].

In British studies, Feldstein (1967) found that 27.5% of the sample variation in cost per case could be explained by variations in the case mix vector, but that only 2.1% of variation in cost per patient day could be attributed to case mix variations[217]. It seems that the importance of case mix variations was underestimated by Feldstein[218]. More reasonable results were obtained by Hurst (1977) using a small number of case mix categories[219]. These results were used by Culyer and Maynard (1981) in their estimates of the hospital costs associated with treating patients with duodenal ulcers by surgery[220].

4.3.1.6 Economic efficiency

Cost functions may also be useful in investigating the total efficiency of health care in hospitals. It seems to be of some interest to try to break down economic inefficiency into its two components. What proportion of observed inefficiency is due to allocative inefficiency and what proportion due to technical inefficiency?

Feldstein (1967) developed an index of hospital costliness based on the residuals of his basic cost function. Costliness is defined as the ratio of actual cost per case for the hospital in question to the cost per case that would be expected if its cost per case in each of the case mix categories were the same as the national average[221]. Wagstaff (1989) pointed out that Feldstein confounds inefficiency with random influences outside the hospital's control[222].

4.3.2 The empirical statistical methodology

It is only more recently, that these models have been developed which concentrate on estimating specialty costs. Wagstaff (1989) pointed out that, none of these studies, however, are based on the economic theory of cost function and instead focus on cost equations[223].

The model developed by Coverdale et al., (1980) was the first type which gave more detailed estimates of treatment, overhead, and hotel cost by specialty[224]. Since hotel and treatment costs may vary between different type of patient, they decided to desegregate the representation of patients according to the clinical specialty under which they are treated.

However, the cost of treating patients in some specialties may be similar, so the specialties were grouped according to similar treatment costs. The size of each component is estimated using regression on historical hospital cost and activity data. Ashford, Bailey and Butts (1981) comparing the model by Coverdale et al., (1980)[225] and Ashford and Butts (1979)[226], found that the latter is more parsimonious in terms of parameters, is applicable to a wider range of type of hospital and fits the available empirical data somewhat better than either version of the former[227]. However, a more recent model developed by Bailey and Ashford (1984) has attempted to draw these separate statistical approaches together[228]. In what was referred to as the component model, because some elements of cost were defined as patient-dependent whereas others remained linked with resource provision, total costs were divided into twelve subgroups, such as medical and nursing staff, domestic cleaning, etc, for each of which an appropriate model structure, derived from a data base of over 1500 hospitals, was generated. Specialties were organised into seven groups because it was reasoned that the relative proportions of treatment, hotel, and overhead costs varied between specialties and that to desegregate by specialty group to allow for this would more adequately explain variations in cost.

Both regression model approaches are attempting to achieve the same objective, a detailed analysis of specialty costs, but in fundamentally different ways. One assigns importance to available resources as prime determinators of costs, the other relates expenditure more closely to patient throughput. Ashford and Cumming (1991) in their last publication argued that statistical costing has many advantages over cost accounting in the present state of the NHS and is capable of filling an important gap in the information currently available[229]. They also pointed out that the Department of Health, in its definition of performance indicators based upon the post 1987 Korner data sets appears to give little emphasis to the presentation of costs in specific functional categories per unit of service in sufficient detail to be useful for local management purposes. They went on to say that the use of statistical techniques enables the costs per inpatient spell within a given specialty to be assessed on a rational and consistent basis.

4.3.3 The cost accounting methods

Cost accounting is recognised as the principal means for an organisation to plan and control a multiproduct. Therefore, one aspect of cost accounting is the accumulation of performance information at the product level.

Basically there are three approaches to hospital cost accounting. These are, responsibility costing and two mutually exclusive types of product line cost accounting full costing and differential costing.

Additionally, product line accounting utilises three basic types of cost accounting systems for cost accumulation. The aim of cost accumulation is to define the object and purpose of costing. We use the process costing (specialty, ward, department), the job-order costing (patient, disease, clinician), and a combination of both methods. The most basic method, process costing, involves averaging the accumulated costs according to a specific cost centre's process and dividing costs by volume to arrive at a unit cost per item (a case, an intermediate product, eg. radiology) for all products generated by the specific process. Process costing utilises explicit general assumptions to allocate costs to a department level input per case. The process method is time and volume dependent, and each cost centre completes the specific process and the system attaches a unit cost to the patient/case.

A more complex form of cost accounting is job-order costing. Job-order costing is most appropriate for service products that vary considerably from order to order. Job costing treats each product or case as unique and assigns all costs to a specific individual case[230].

The third cost accounting technique is a combination of job-order and process costing methods. Some items might be sufficiently costed with process costing, such as taking the average costs of routine nursing care in treating some cases, but other items are more unique and subject to job-order costing[231]. Thus job costing attempts to collect accurate actual costs, whilst process costing averages total costs amongst group.

Responsibility costing establishes aggregate costs or average costs related to departments and thus has the most general product definition. Responsibility costing traces operating costs to the individual organisational units, which are called responsibility centres[232].

Full costing involves product line analysis by direct costing either though process costing or by the systems of job costing.

Costs at all cost centres are established by direct costing and then through the system of process costing, expenses are accumulated by step-wise allocations from support departments to direct patient service cost centres. The differential cost of the product is normally the sum of its direct costs. The direct costs may be variable or fixed. The full cost of the product is the sum of its direct cost plus a fair share of applicable indirect costs. It seems that under full costing, all hospital expenses, including fixed costs, are apportioned to the individual cases. Under differential costing, only direct costs are allocated. Thus, full costing provides a measure of average cost, and differential costing provides an estimate of the incremental resources needed for additional products, patients.

All the studies mentioned below fall into the general category of cost accounting but not all, by any means, have been carried out by cost accounting[233]. All the studies have tailored costs to particular groups of patients, or particular activities within selected hospitals, by measuring or observing the resources used by these patients or activities.

One of the pioneering studies in hospital costing was the work carried out by Montacute (1962) in UK[234]. He pointed out that departmental costing had contributed to cost-consciousness and had helped to achieved numerous identifiable saving in hospital housekeeping activities.

These appear to be two main sorts of study. The first, is concerned solely with the costs of particular procedures of particular types of patients. The idea is to use local accounting data supplemented by additional collection of data to analyse the cost of treating specific case types. This sort of study includes the work under taken by Babson (1973)[235].

He carried out some experiments in Disease Costing by estimating all the costs incurred by patients undergoing treatment for several conditions, the comparative costs of treating hernias and acute appendicitis in three hospitals in Manchester (UK)[236]. In a cost effectiveness study, Piachaud and Weddell (1972) compared the costs of treating varicose veins by inpatient surgery and outpatient injection and compression in UK[237].

Magee in Cardiff investigated the costs of a cervical screening programme including those costs attributable to patients with a positive cervical smear who needed hospital inpatient treatment[238].

The second type attempts to cost in detail the activities of whole units or even whole hospitals. Examples of the second sort of study include the work taken by Harper (1978), who costed all patients admitted to one surgical ward during a six month period in Scotland[239]. Estimates were made of ward care, dressings, theatre, radiology, pathology, haematology, bacteriology, blood, radiotherapy, physiotherapy, electrocardiography, and pharmacy and resources area overheads.

There is a review of all these studies in an excellent paper by Mason, Perry and Skegg (1974)[240].

An advantage sometimes claimed for the second approach is that it guarantees that costs of individual activities that add up to total costs. All studies agree that some hospital costs can be attributed unambiguously to individual patients, and others (indirect or shared costs) cannot. The differences in the studies are which headings were treated as individual costs, which as shared costs, and which as a combination of the two.

Magee (1976) investigated a specialty costing system based on sampling for an entire general hospital[241]. The advantage of the Magee system, as it was known, over regression models is in the amount of detail provided. There is no need to group specialties prior to analysis, and the results are hospital-specific. But, there are certain disadvantages, notably the validity with which inter hospital comparisons can be made. Such comparisons are bedeviled by the problem of accounting for case mix. There were, for example, large variations in specialty costs reported in the DHSS trials of the Magee system[242]. It is essential that comparisons can be made, without them it is not possible to tell if an individual hospital's costs in a particular area of activity are high or low. Magee suggested that this could be done by establishing national average costs from a cross section of different hospital types to act as a bench mark of comparisons. The problem is that because hospitals vary so much from place to place, there will be too much arbitrariness in apportioning costs over cost centres, with the result that costs will not be compared like for like[243]. Another major problem, however, with the above approach is the lack of flexibility. It can be criticised on the grounds that it is inflexible in that the costing system produces only one kind of information, namely functional. Moreover, it seems that specialty costing is not particularly homogeneous in nature.

Consequently, producing information on the costs of specialties tends to disguise a wide variation in the cost per patient of for example, an orthopaedics specialty would disguise the fact that some patients are treated for minor ailments and receive simple and cheap treatment, while other patients receive a complete course of treatment which is very expensive, such as artificial joint replacements[244]. However, the Korner Report (1982) suggested the implementation of specialty costing for the NHS in the UK[245].

Another example of patient-based costing is the approach carried out under the auspices of the West Midlands Regional Health Authority's Financial Information Project (1984)[246]. They apportionined expenditure to specialties on the basis of cases, inpatient days or available bed days and it proved possible to approximate specialty costs. Using these specialty costs together with data on the number of patient days and cases in each age group/specialty, the Coventry project is taking three wards in a major general hospital and establishing and recording the different resources that a patient consumes during his stay in the hospital. Because they take only a small number of wards and so a small number of patients in the totality of health care, one would think the system has been unduly selective. However, the system has identified workload or activity measure for all departments including operating theatres. Added to is the system analysed nursing and clinical time related to individual patient care.

4.4 Intermediate Approaches to Estimating Hospital Service: Unit Costs

These approaches have been suggested in the eighties by different authors. In Jenkins' (1980) approach for multiproduct cost analysis for Ontario hospitals, he undertook some limited aggregation of the service (but not the case-type) variables[247]. This aggregation is accomplished by regressing the reported costs of individual hospital departments on their service output. Estimated cost parameters (in relation to that of the designated departmental service) are then employed as weights in constructing a departmental output index. Output indices are generated for radiology, laboratory, physical medicine and rehabilitation and newborn nursery and are then employed along with other service variables (number of deliveries, number of patient-days etc.) in the regression of all hospital costs on all hospital services. He views total costs as a linear function of total patient-days, total admissions and capacity as measured by rated patient-days.

Forte (1983) (in UK), as an alternative approach to estimating specialty costs, suggested a model to make the maximum use of existing information and analyses costs in terms of resources used per inpatient day by specialty within a particular hospital[248]. The model has constraints built into it to ensure that all known totals are in accord with the given data. This data consists of three main elements; the routine annual inpatient expenditure analysis by resource input (such as medical staff time, radiography, catering) and by hospital; the annual number of inpatient days in a particular specialty and hospital; and the results, in the first instance, of the Bridgend cost-accounting (Magee specialty costing) survey, which relate resources consumed to the specialty of consumption in a general hospital. The model output represents the cost per inpatient day of a particular resource by specialty and by hospital.

Grosskopk and Valdmanis (1987) in their study in California pointed out that in modelling hospital production or technology, it is difficult to conceptualize (and measure) hospital output[249]. Since they cannot accurately measure health status, they choose instead to measure hospital production as an array of outputs which are assumed to be related to improved health status. They specified a range of outputs rather than a single measure such as admissions of adjusted bed days to better reflect hospital output and allow for variation in input usage for different types of treatments or cases. They specified four separate outputs: acute care, intensive care, surgeries, and ambulatory and emergency care. The first two are measured in inpatient days, surgeries are measured as inpatient and outpatient surgeries, and the last category in terms of visits. Inputs include the number of physicians, full time equivalent employment of non-physician labour, admission and beds as an alternative capital variable.

Breyer (1987) has suggested in his review of the literature on hospital cost functions that the unit "cases" has found more supporters than "patient days" both because of its closer relation to the true output (health improvement) and because length of stay can be easily manipulated[250]. However, he pointed out that these two output categories do not have to be regarded as strict alternatives. Each of them accounts for a different service dimension of a hospital, of which he found it useful to distinguish three:

1. Medical services (admission, diagnosis, surgical therapy, discharge), for which the number of cases is a good representation;
2. Nursing, accommodation and hotel services which are reflected in the number of patient days; and
3. The provision of hospital beds to satisfy an option demand.

In each of these output dimensions, several subgroups of different resource intensity can be distinguished:

- beds by hospital department because a bed in an intensive care unit requires more expensive equipment and more personnel than a bed in other department;
- cases by illness type, for example, diagnostic group;
- patient days by the care needs of a patient.

It seems that all the authors used the same multiple-output analysis for a hospital cost function as an alternative to the previous approaches. These three outputs are the following:
- number of cases;
- number of inpatient days;
- beds.

However, we have to make some restrictive assumptions in order to manage the parameters. Breyer (1987) proposed the following assumptions[251]:

1. The provision of hospital beds is a homogeneous product.
2. Patient days are a homogeneous product.
3. The impact of illness type on total costs can be divided into an indirect influence via length of stay and a direct influence, where the latter amounts to a diagnosis-specific additive constant per case.
4. All other cost determinants bring about only an additive shift of the cost function by a constant amount per case.
5. The age of the patient influences length of stay but not the resource requirements per day.

After accepting all these assumptions, only the three global output measures beds, cases and patient days have to be integrated in the flexible functional form model.

This intermediate approach is basically a compromise between the statistical econometric approaches and the cost accounting approaches considered earlier.

4.5 Progress in Financial Information Systems: Resource Management Initiative

Six hospital sites were selected for demonstration Resource Management Initiative (RMI) projects over the period 1986-1988 in Britain. Resource management in the NHS is not a new concept but its current form has evolved over the last decade. In one sense it can be seen as the latest attempt to make service provision more cost-effective by enabling service providers, particularly doctors but also nurses and para-medicals, to relate their activities to their costs[252]. Whilst the information systems implemented in the demonstration sites generally were quite different, the common factor in each was the identification of costs at patient level and the allocation of these costs to individual patients. This patient-centred approach was recognized as essential for providing to general and clinical managers key financial information required for the resource utilization decision process. This approach has subsequently manifested itself in the guise of information systems known by the generic term case mix management. By late 1991 each of the 280 English acute sites had commenced with the project to some degree or other[253].

It seems that this still begs the question of how far, in practice, it will become possible to classify and weight in resource need terms, the workload of individual clinicians. Clearly at least some of the new resource management projects are intended to experiment in patient costing, and in analysis by DRGs. These are important and promising developments. We discuss these two developments, their potential, and their likely rate of progress.

4.5.1 Patient costing

It seems that the final approach to be considered is one where the cost centre is the individual patient and information is collected about the costs of treating and maintaining every patient[254]. The importance of this approach to costing is not that the manager needs information about the costs of individual patients but that if a file of patient costs is held on computer it would be a simple task for the data to be aggregated in different ways to produce a variety of information. A number of indications could be attached to each patient such as disease classification, specialty, consultant and method of treatment. The computer could then group patients together to produce information.

The total costs attributed to a patient comprise the various individual costs of accommodating, treating and feeding the patient. Consequently separate charges must be recorded against each patient to reflect the cost of performing various events on their behalf. The term event is used to describe a range of activities needed to maintain patients in hospital.
Example are:
a) pathology - tests performed on patients;
b) ward - nursing care performed for patients (nursing dependency);
c) pharmacy - drugs prescribed to patients.

To record total patient costs it is necessary to set predetermined charges for each of the possible events. These would include, for example, a charge per test and a charge per drug. In this way, data will be built up about the total costs of treating different patients.

Information about particular patients or groups of patients can be extracted as desired. It is worth nothing that such systems of patient costing have only become feasible since the revolution in micro-computing which has radically reduced the cost of computing facilities.

The main advantage of patient costing is its accounting basis. In principle, it adopts the approach of job costing, and as in an industrial setting, can provide a powerful management tool. However, it seems that the NHS will be unable or unwilling at the moment to invest large sums in the appropriate capacity of computer hardware and software necessary to develop systems of patient costing.

The conclusion, therefore, is that the best type of costing system is one that records patient costs and which distinguishes between fixed and definitely variable costs[255].

4.5.2 Diagnosis Related Group (DRGs) costing

Interest in the control of hospital costs has led to increased concern about how the costs of medical services are determined in the USA. In the past attempts to associate costs with the hospital's products have not been convincing, because as pointed out before, hospital products are difficult to define. Simple measures of productivity, such as the number of patients admitted or the number of patient days, remain unsatisfactory because of the wide variation in inputs and costs from patient to patient[256]. To address the problem of defining hospital products, a patient classification system that originally separated the patients into diagnosis related groups (DRGs) has been developed by Yale University (USA)[257].

Diagnosis Related Groups (DRGs) are a system for describing the types of patients discharged from acute care hospitals. The current most widely used version of the groups contains 467 classes of patients, each defined in terms of one or more of the following variables, principal diagnosis, surgical procedures, additional diagnoses (comorbidities and complications), age, sex, and discharge disposition. Hence, the profile of services ordered by a doctor is expected to be fairly similar for all patients treated in a given DRG[258].

The development of DRGs was an attempt to operationally define the products of a hospital in terms of groups of patients receiving similar sets of outputs or services (such as laboratory tests, x-rays, nursing care, etc). It divided all principal diagnostic codes into major diagnosis categories. These major categories were then partitioned into subgroups based on the values of variables associated with length of stay as a reasonable proxy for resource use and homogeneous groups were formed with this as the dependent variable, the only utilization measure available at that time. Each product is identified in terms of the treatment plan and set of services expected to be delivered to the patient. For example, a patient hospitalized for acute appendicitis without peritonitis and without comorbidity problems might be expected to consume 12 meals, four days of hotel services, 16 hours of nursing care, 50 minutes of surgery, and so on, it adopts the approach of job costing. Each element would be costed so as to produce in each service-providing department or cost centre the expected costs of this treatment.

Existing departmental costing mechanisms do not permit the doctor to make the connection between the units of service department resources he uses and the way he is treating certain patients with the consequent impossibility of use by managers of the hospital. However, we have to be aware that resources within each DRG are not expected to be identical. The criterion for homogeneity was that grouping of medically similar patients should be statistically stable in terms of use of hospital resources, not that each patient within a DRG should consume the same amount of resources. Horn et al., (1983) has shown that variation in resource use within DRGs can be considerable[259]. It seems that estimates of averages of total costs by DRGs are valuable for making comparisons with other hospitals but not for predicting the cost implications of changing performance. Costs must be structured to reflect how changes affect resource use.

Another important criticism frequently made of the DRG classification approach is that it fails to discriminate between relatively easy and relatively difficult or complex cases, the case severity factor. This will apply especially to patients treated by centres of regional specialties, and departments in teaching hospitals more generally, where it tends to be assumed that the case mix contains an above average proportion of complex of advanced cases[260]. The spread of DRGs as a basis, in the main, for the financing of hospitals in many countries is a new development. However, some of the pioneers who were involved in their development would like to see uses beyond simple financial allocation to hospitals[261]. The major uses should be in cost and quality control with respect to hospital performance. Thus, each hospital has available to it information as to the areas in which its performance is different from that of its peers in the hospital community. If it has the will, this information can be used to improve its performance from both a cost and quality point of view. This should be one of the ultimate goal of DRGs in their internal use in managing hospitals. Quality waste occurs when resources are employed in ways which do not have value to the patient. A surgeon who consumes twice the surgical theatre time as his peers for a given procedure is wasting resources and increasing patient risk. Utilizing a surgical procedure which is inappropriate for the patient constitutes quality waste no matter how efficiently the procedure is performed.

4.6 The Internal Market

The National Health Service has undergone a period of rapid and extensive change, notably with the division of purchasers and providers of health care and the introduction of NHS Trusts. All those involved in the process now need a much closer awareness of how their own units of management operate in financial terms, in order to gain maximum benefit from the new system.

4.6.1 The purchaser/provider interface

The separation between purchasers and providers of health care gives two resource flows which have to be balanced for the service as a whole to keep within its cash limit:

- Purchasers have to ensure that they do not commit themselves to spending more than is received.
- Providers receive virtually all their income from purchasers, and have to ensure that their expenditure does not exceed their income.

The relationship between purchasers and providers is regulated by the use of contracts. There are three types of contract[262]:

* Block contracts involve the purchase, for an annual fee, of access to an agreed range of services. These are particularly appropriate for core services where it is necessary to maintain a level of capacity. However, problems may arise if the actual volume of cases or the mix of cases differs significantly from those predicted when the contracts were entered into. The problems can be overcome by including in the contract indicative levels of usage and how cost increases are to be accommodated.

* Cost and volume contracts pay providers a sum for the provision of a set level of service, usually expressed as a maximum number of treatments, cases or interventions. Once the agreed maximum is reached, additional payment is made on the basis of individual cases. The contract must specify an overall limit on the number of cases it covers so that the purchasers can maintain control over their expenditure, which cannot be done if an open-ended commitment is made to pay for all instances when a treatment is provided.

* Cost per case contracts are used to pay for instances where patients are not covered by either of the other types. The amount of funds is likely to be determined by experience, but there is a danger that it will be minimal with the result that the ability to meet ad hoc requirements will be limited.

4.6.2 Development of Healthcare Resource Groups (HRGs)

The introduction of the NHS and Community Care Act 1990 and the development of contracting for health services had led both purchasers and providers of healthcare to want to respond appropriately to changes in activity levels. Previous guidance required provider units to price their services so that income received matched the net costs incurred.

As the contracting process matures it will be necessary to enhance and develop the Healthcare Resource Groups. The first resource groupings were developed in the United States (as we have mentioned above) as a way of analysing hospital activity. These tools were called Diagnosis Related Groups (DRGs). When the Resource Management Initiative was set up in the country in the mid 1980s a similar tool was needed to analyse resource use within clinical directorates. DRGs were evaluated for this purpose but because clinical practice is significantly different in this country, the detailed design of DRGs was not seen as appropriate for use here[263]. DRGs being deemed unsuitable in the latter context, the National Case Mix Office, established in 1990, was charged with responsibility of developing Healthcare Resource Groups (HRGs). The primary objective of the programme of accounting guidance, under the general heading Costing for Contracting, is rational price-setting by providers. Costs are to be established on a full-cost basis, with no planned cross-subsidization, and prices are to be based on costs. HRGs are, as it were, the building blocks in the costing process, being a nationally recognized method of classifying case mix by categorizing patients into a manageable number of groups which are: clinically similar (homogeneous), expected to consume similar amounts of resource (isoresource). HRGs are centred on the International Classification of Diseases typology.

4.7 Conclusion

An expression of hospital output in terms of the health benefits to individual patients has been so far some way ahead of the management information system available. Present mechanisms for reviewing hospital performance against cost rely heavily on the use of intermediate measure of outputs. However, no matter which approach is adopted in trying to ascertain hospital costs in more detail, all research reveals the complexities of the structure of inpatient costs and the paucity of useful information currently available.

It remains unclear what most specific outputs costs and uncertain how much inefficiency exists. It seems that the form in which financial information is currently assembled for accountancy purposes in the health services at the moment does not lend itself to discussion of medical priorities, because breakdowns of expenditure and costs are generally given for broad categories which are not subdivided in such a way as to be of use in costing particular objectives of the service. The essence of the problem is, therefore, to determine a new basis for subdividing total expenditure on the health service, so that component units of work or activity which are related to specific objectives can be separated and costed.

The creation of the post-reforms "market-place" was assumed the end of the formal Resource Management Initiatives (RMI). Such a view overlooked the fact that the RMI has always been intended to be a means to an end and not an end in itself. The RMI is a multifunction management tool designed specifically to assist in the achievement of a stated goal, that of optimization of health gain and health status, by encouraging the efficient use of resources through planning spending patterns and comparing actual outcome to these plans.

The new contracting environment has actually increased the need for the RMI or an equivalent process. The contracting approach would not long survive without either the RMI or something conceptually similar.

Implementing the HRG programme will prove expensive in the short term but, assuming that it is completed successfully, the next generation of health economists should find treatment costing far simpler than the present one.

Chapter 5

Sources of Data and Methodology

5.1 Introduction

The empirical analysis in this research was mainly based on data from discharge reports, operating theatre books, hospital admission books, medical records, regional hospital statistics, accounting information data system from one of the hospitals under study and a questionnaire. In this chapter a description is given of the construction, from these and other data, of the actual data sets used in the empirical analysis.

The approach adopted to date (this approach will be further explained in chapter 6 and chapter 7) has been to concentrate on the analysis of a small number of relatively clearly defined and homogeneous surgical procedures. The surgical procedures considered in our analysis include: cataract extraction; inguinal herniorrhaphy (hernia repair); perianal & pilonidal procedures; hysterectomy; prostatectomy; cholecystectomy; anal procedures; transurethral prostatectomy; transurethral procedure. These procedures have been selected for several reasons. First, as discretionary procedures, they represent the type of surgery that has been the subject of considerable attention over the past decade, because of the growing evidence of overuse. By discretionary we mean surgeries which can be scheduled in advance; that is, they are not emergency procedures. For all these procedures the surgeon and patient usually have some choice as to whether the operation should be carried out.

The second reason for choosing these procedures is that they are performed frequently. Therefore, when studying data from hospitals, it is more likely that an adequate sample size will be available. In 1991, in the eight hospitals being under studied, 16% of all bed days, where operations were performed, were associated with the specified procedures within the surgical area.

Table 5.1 shows the number of selected hospitals and the percentage of patients who received hospital surgical treatment within the surgical area. The identity of the eight hospitals in the study is not being disclosed here to ensure that confidentiality is preserved. The eight hospitals will therefore be referred to (rather unimaginatively) as Hospital 1 to Hospital 8.

Table 5.1
Selected hospitals and percentage of bed days within the surgical department

HOSPITALS	1	2	3	4	5	6	7	8
GENERAL SURGERY	22%	25%	27%	31%	20%	25%	13%	23%
OPHTHALMOLOGY	63%	46%	54%	72%	21%	23%	45%	36%
GYNAECOLOGY	55%	36%	22%	53%	21%	20%	23%	50%
UROLOGY	80%	36%	32%	45%	29%	9%	33%	18%
SURGICAL AREA	18%	20%	14%	24%	11%	10%	15%	17%

Thirdly, these procedures are considered clean and easily identified, which reduces opportunity for miscoding, so that it is possible to compare precisely the same procedures in most of hospitals. However, to control the case mix, we coded these procedures from the International Classification of Diseases - 9th Revision - Clinical Modification (ICD-9-CM) to Diagnoses Related Groups (DRGs).

The approach adopted to date (this approach will be further explained in chapter 8) is the analysis of the surgeons questionnaires.

This chapter describes the nature of the data prepared for analysis, the sample selection procedure, the statistical analysis, the computer processing of the data and some of the problems faced in obtaining the data.

5.2 Description of Available Hospital Data

Hospital Activity Analysis in Spain does not provide useful data for analysing differences in length of hospital stay (preoperative, postoperative and the total length of stay) and the different components of inpatient costs (total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient) for the nine surgical procedures that are selected for this research. Moreover, there is not an integrated system of hospital information designed specifically for purposes of monitoring and analysis of hospital activity. In general, it can be asserted that Spanish Health Authorities have followed an accountancy approach to a departmental one, which tentatively incorporates some analytical information, but this is mainly for administrative purposes. This has been mostly collected at the aggregate hospital level, and only partly on a specialty-departmental basis.

It seems that the Spanish hospital information system is characterized today by the following features:

1. The fragmentary composition of the statistics available. Six different reports are required to attain a comprehensive view of hospital activity. For instance, with regard to the study of hospital expenditure, three different statistical sources need to be consulted, as with the analysis of hospital indicators of activity, and for data of hospital manpower.

2. The system lacks a goal oriented definition for data collection, (eg. for viewing sources rather than just usages). Up to the present time, far too many indicators of doubtful relevance are requested from the hospital, often without explicit feedback for hospital management.

3. Gaps in the coordination of the information due to the actual process of decentralization of the organisation of health care can also be found.

5.3 Controlling for Case Mix

Controlling for case mix is extremely important when we try to compare patients by hospital. Severity of condition may to some extent be controlled for by the use of DRGs[264].

Comparisons of DRG hospital databases from hospitals have produced important differences in length of stay and cost per case for high volume patients. Measurement of the hospital product has been a field of research of significant strategic importance in improving the efficiency of health services. The use of Diagnostic Related Groups have spread in various European Countries during the past decade, offering new possibilities for obtaining information and for comparing hospital operations, at both national and international levels[265].

The availability of systems for measuring the hospital product, especially DRGs, owing to their great dissemination, makes it possible to obtain more precise information for the comparative study of hospital use.

Two particularly prominent case mix classifications will be discussed: the International Classification of Disease, and Diagnoses Related Group.

5.3.1 International Classification of Diseases (ICD)

The ICD codes, as contained in the Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death published by the World Health Organisation, provide the most detailed disease classification system currently available. The classification was originally developed as a classification of causes of death by a committee of the International Statistical Institute and was adopted by the Institute in 1893[1].

The current version of the Manual contains the ninth revision of the codes-ICD-9. This contains approximately 1,000 categories. The ICD codes provide a mutually exclusive and exhaustive set of possible output categories for a hospital. These are important characteristics for any output classification scheme for they ensure that all units of output produced are captured and that double counting is avoided. There are, however, some limitations associated with this taxonomy. First, it does not include some dimensions of case mix which may be important sources of heterogeneity between cases. These include age, sex and the presence or type of any surgery performed. Further, the dimension of severity (i.e. mild, moderate and severe) is specified only for a few selected diagnoses. As a result, cases falling within any particular ICD code may still be heterogeneous with respect to the treatment received on account of these omitted factors.

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[1]The following historical information has been taken from the Manual containing the eight revision.

A second problem arises because of the large number of output categories which result from this classification. However, the ICD codes provide a comprehensive disease classification system and have formed the basis for several other output classification schemes which have been developed.

5.3.2 Diagnoses Related Groups (DRGs)

Of the various case mix classification scheme which have been developed, the one based on DRGs has gained particular prominence and is perhaps the most well known and widely applied case mix measure[266]. Diagnosis Related Groups are a system for describing the types of patient discharged from acute care hospital. The groups were designed to be clinically coherent in the sense that they are expected to evoke a set of clinical responses which result in a similar pattern of resource use.

The Diagnosis Related Group patient classification system was developed by the Health Systems Management Group at the Yale School of Organization and Management in the late 1960s. The objective for the DRG system is to identify in the acute-care setting a set of case type, each representing a class of patients with similar processes of care and a predictable package of services (product). The original DRGs were constructed using the eighth revision of the ICD, adapted for use in the United States (ICD-8). However, primary diagnosis was not the only characteristic used in constructing the groups. Other attributes finally employed included some or all of the following: secondary diagnosis; primary surgical procedure; secondary surgical procedure; age.

Following the publication of the ninth revision of the ICD (World Health Organisation, 1977), a further revised version of the DRGs was developed. Beginning with a smaller number of 23 Major Diagnostic Categories (MDCs) defined mostly in terms of the organ system affected , the revised version contains a total of 467 DRGs. For most MDCs, the initial split was into two groups based on whether an operating room procedure was or was not performed. In contrast with the derivation of the original DRGs, the revised version embraced discharge status (including death) as a basis for classification and placed more emphasis on clinical judgement relative to statistical criteria in forming the terminal groups.

The original development of the DRGs at Yale University had nothing to do with prospective payment, but was largely motivated by needs of utilisation review and the evaluation of health care in acute care hospitals. From early on, Fetter and Thompson (1981) advocated that DRGs should be used to assess the efficiency and effectiveness of hospitals in providing acute patient care[267]. This is why we decided to convert all of our patients in DRGs as the best method for efficiency purposes.

The sample of 7,053 patients was divided into sub-groups to capture severity of the patients. The case mix used was DRGs version 8.0[2]. The conversion was done from the nine surgical procedures by ICD-9-CM coding system to 23 DGRs after studying the behaviour of DRGs for all the patients and particularly for the same surgical procedures that were used in this research in one hospital in the Valencia Region[268]. The main objective of this part of the research was to test the behaviour of the DRGs in this hospital in the Valencia Region compared with other hospitals in other countries[269]. It was found that the results were the same.

5.4 Data Set and Method of Analysis for Length of Hospital Stay

The empirical analysis in this thesis for length of hospital stay (preoperative, postoperative and the total length of stay) is mainly based on discharge reports, operating theatre books, admission books, medical records and Health Authorities statistical books from 8 hospitals (5 General Hospitals and 3 Teaching Hospitals) in the Valencia Region in Spain.

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[2]The all patient Diagnosis Related Group patient Classification System, version 8.0, was developed by 3M Health Information Systems and the New York State Department of Health.

5.4.1 Data sample and data collection used in this thesis for length of hospital patient stay

The data refers to the whole of 1991 and corresponds to all acute inpatients in 8 hospitals, a total of 7,053, for the above 23 different surgical DRGs.

From the above sources the author was able to obtain information for each of the 7,053 patients on: hospital identification code, patient identification code, primary diagnosis (ICD-9-CM), secondary diagnosis, multiple diagnoses, source of the patient (casualty, outpatient department and internal medicine), complications, age, sex, length of hospital stay (pre-operative, post-operative and total length of stay), weekday of the admission, weekday of the discharge, primary procedure (ICM-9-CM), secondary procedure, multiple procedures and discharge status. From the Health Authorities statistical books the information obtained was on: occupancy rate, turnover rate, number of beds per speciality, teaching hospital, total number of beds, percentage of operations, number of surgeons, number of surgeon residents and number of General Practitioners.

Obtaining the data from the discharge reports, operating theatre books, admission books and medical records for length of stay was a time consuming task. It took between 5 and 10 minutes per inpatient, and, at a conservative estimate, this exercise occupied six months of research time.

It is very important to have in mind that sometimes a big sample of patients is not worth using because of the time and resources used. It was considered that the total inpatients for one year in the eight hospitals was a large enough sample for the research.

Extreme length of stay values indicate multiple pathology and medically complex hospitalizations; patients with a length of stay of more then fifty days[3] were therefore

[3] The limit of fifty days was determined as follows: the mean length of stay of patients plus two times the standard deviation. Patients with a length of stay above this limit were excluded from the analysis. This involved a minimum of 0.3% and a maximum of 2.5% of patients per procedure.

removed from the sample. Such a choice, while arbitrary, is necessary if the experience of a small number of unusual patients is not to obscure the determinants of length of stay for the vast majority[270]. Moreover, using a dependent variable with a large coefficient of variation in a multiple regression analysis may result in unstable regression coefficients and low significance levels of many of the independent variables included in the regression equation. This problem is avoided in this research by selecting relatively homogeneous and frequently occurring surgical DRGs.

Cases where the patient died, which were around 0.3% of the sample, were removed from the data. Those patients admitted through casualty and had the operation the same day were not included, as we considered them real emergency patients and this research focuses only on elective surgery. However, for our surgical procedures, emergency patients are not very common.

5.4.2 Dependent and independent variables used in the research for length of stay

Table 5.2 shows the description of variables in the length of hospital stay data set.

Table 5.2
Description of the different variables for length of stay

Three dependent variables were being used:

Preoperative length of hospital stay (P1)
Postoperative length of hospital stay (P2)
Total length of hospital stay (PT)

Explanatory (Independent) variables:

Health status indicators variables:

comorbidity or multiple diagnoses (=1 if Yes)
complications after the operation (=1 if Yes)

three dummy variables for the age of the patient:
66 to 75 years old
76 years and over
Left out: 1 to 65 years old
sex of the patient (Male=1)

23 dummy variables for the surgical DRGs:
DRG 306 Prostatectomy W CC
DRG 307 Prostatectomy W/O CC
DRG 336 Transurethral Prostatectomy W CC
DRG 337 Transurethral Prostatectomy W/O CC
DRG 310 Transurethral Procedures W CC
DRG 311 Transurethral Procedures W/O CC
DRG 354 Uterine, Adnexa Proc for Non-Ovarian/Adnexal Malignancy W CC
DRG 355 Uterine, Adnexa Proc for Non-Ovarian/Adnexal Malignancy W/O CC
DRG 358 Uterine & Adnexa Proc for Non-Malignancy W CC
DRG 359 Uterine & Adnexa Proc for Non-Malignancy W/O CC
DRG 157 Anal & Stomal Procedures W CC
DRG 158 Anal & Stomal Procedures W/O CC
DRG 159 Hernia Procedures Except Inguinal & Femoral Age >17 W CC
DRG 160 Hernia Procedures Except Inguinal & Femoral Age >17 W/O CC
DRG 161 Inguinal & Femoral Hernia Procedures Age >17 W CC
DRG 162 Inguinal & Femoral Hernia Procedures Age >17 W/O CC
DRG 163 Hernia Procedures Age <18
DRG 195 Total Cholecystectomy W C.D.E. W CC
DRG 196 Total Cholecystectomy W C.D.E. W/O CC
DRG 197 Total Cholecystectomy W/O C.D.E. W CC
DRG 198 Total Cholecystectomy W/O C.D.E. W/O CC
DRG 267 Perianal & Pilonidal Procedures
Left out: DRG 39 Lens Procedures with or without Vitrectomy

Hospitalisation-related variables:

three dummy variables for patients admitted through outpatient departments (waiting list), emergency room and internal medicine:
admitted through emergency room
admitted through internal medicine
Left out: admitted through waiting list
three dummy variables for patients admitted on a Friday, Saturday and other days of the week: admitted on Friday
admitted on Saturday
Left out: admitted other days of the week
patients discharged on a Monday (=1 if Yes)

Hospital and doctor characteristics variables:

occupancy rate
turnover rate or case-flow rate
number of beds per speciality per 1,000 population
patients admitted to Teaching hospital (=1 if Yes)
hospital size in terms of total number of beds per 1,000 population
percentage of operations
number of surgeons per 10,000 population
number of surgeon residents per 10,000 population

Regional supply variables:

number of General Practitioners per 10,000 population

Table 5.3 shows the mean and standard deviation of the dependent and independent variables for length of stay.

Appendix 1 shows the means, standard deviations and number of cases for preoperative, postoperative and the total length of stay for eleven surgical DRGs in the eight hospitals.

Table 5.3
The mean and standard deviation of the dependent and independent variables for length of stay

Variables	Cases	Mean	Std Dev
Sex	7053	1.5090	.5000
Comorbidity	7053	.0505	.2189
Complications	7053	.0622	.2416
Discharge on a Monday	7053	.2083	.4061
Preoperative length of stay	7053	4.3879	5.3251
Postoperative length of stay	7053	7.3637	4.5109
Total length of stay	7053	11.7492	7.6541
Teaching hospital	7053	.4429	.4968
Number of surgeons	7053	.4009	.1356
Number of surgeon residents	7053	.1286	.1444
Number of beds per specialty	7053	75.9522	14.8571
Occupancy rate	7053	.4600	.2499
Turnover rate	7053	2.6225	.7872
Number of GPs	7053	5.3798	.7918
Total hospital beds	7053	2.3183	.8030
Percentage of operations	7053	3.9510	1.8795
Admitted through waiting list	7053	.8352	.3710
Admitted through emergency room	7053	.1428	.3499
Admitted through internal medicine	7053	.0220	.1466
1 to 65 years old	7053	.6027	.4894
66 to 75 years old	7053	.2579	.4375
76 years and over	7053	.1394	.3464

Admitted on other days of the week	7053	.8646	.3422
Admitted on a Friday	7053	.0985	.2981
Admitted on a Saturday	7053	.0369	.1884
DRG 39	7053	.2335	.4231
DRG 306	7053	.0101	.0998
DRG 307	7053	.0515	.2210
DRG 336	7053	.0055	.0742
DRG 337	7053	.0406	.1973
DRG 310	7053	.0089	.0941
DRG 311	7053	.0615	.2403
DRG 354	7053	.0016	.0395
DRG 355	7053	.0163	.1267
DRG 358	7053	.0313	.1742
DRG 359	7053	.1466	.3537
DRG 157	7053	.0014	.0376
DRG 158	7053	.0316	.1750
DRG 159	7053	.0030	.0545
DRG 160	7053	.0123	.1104
DRG 161	7053	.0089	.0941
DRG 162	7053	.0829	.2758
DRG 163	7053	.0129	.1129
DRG 195	7053	.0060	.0769
DRG 196	7053	.0360	.1863
DRG 197	7053	.0257	.1581
DRG 198	7053	.1643	.3706
DRG 267	7053	.0075	.0864

5.5 Data Set and Method of Analysis for the Different Components of Inpatient Costs

The empirical analysis in this research for the different components of inpatient costs (total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient) is mainly based on medical records, the accounting system of one hospital and Health Authorities statistical books from four General hospitals in the Valencia Region of Spain.

5.5.1 Data sample and data collection used in this research for the different components of inpatient costs

The data refers to the whole of 1991 and corresponds to 40% of a random sample of all acute inpatients in four hospitals, a total of 1,222, for the twenty-two different surgical DRGs. Stratified sampling was used because of distinct subgroups (e.g., age and sex) which differ with respect to the feature under study and which are themselves of interest. A random sample was taken from each subgroup to ensure that they are all adequately represented[271].

From the analysis of each patient's medical records, data was obtained on the number and nature of length of inpatient stay, time spent in intensive care, duration of the operation (in minutes), units of blood and all diagnostic requests (e.g., laboratory, x-ray, etc) and all drugs consume. In practice, each patient could have had records in up to a total of twenty event categories. The above data was accordingly recorded for each admission episode for each inpatient. Events were translated into costs using the hospital accounts system developed by Andersen Consulting in one hospital in the Region. From the Health Authorities statistical books we could obtain information on: occupancy rate, turnover rate, number of beds per speciality, total number of beds, percentage of operations, number of surgeons, number of residents and number of General Practitioners.

Obtaining the data from each medical record for the different components of hospital costs was also a time consuming task. It took between 30 and 45 minutes per each inpatient, and, at a conservative estimate, this exercise occupied six months of research time.

For some parameters, such as length of stay and duration of operation, recording from the notes can be accomplished rapidly. In other cases, however, the collation process is time-consuming, requiring considerable amounts of cross-checking, the number of pathologies and drugs requests are cases in point.

5.5.2 Dependent and independent variables used in this research for the different components of inpatient costs

Table 5.4 shows the description of variables for the different components of inpatient costs.

Table 5.4
Description of the variables for the different components of inpatient costs

Four dependent variables were being used:

total cost for each patient
ward cost for each patient
drug cost for each patient
test cost for each patient

Explanatory (Independent) variables:

Health status indicators variables:

comorbidity or multiple diagnoses (=1 if Yes)
complications after the operation (=1 if Yes)
three dummy variables for the age of the patient:
66 to 75 years old
76 years and over
Left out: 1 to 65 years old
sex of the patient (Male=1)

23 dummy variables for the surgical DRGs:
DRG 306 Prostatectomy W CC
DRG 307 Prostatectomy W/O CC
DRG 336 Transurethral Prostatectomy W CC
DRG 337 Transurethral Prostatectomy W/O CC
DRG 310 Transurethral Procedures W CC
DRG 311 Transurethral Procedures W/O CC
DRG 354 Uterine, Adnexa Proc for Non-Ovarian/Adnexal Malignancy W CC
DRG 355 Uterine, Adnexa Proc for Non-Ovarian/Adnexal Malignancy W/O CC
DRG 358 Uterine & Adnexa Proc for Non-Malignancy W CC
DRG 359 Uterine & Adnexa Proc for Non-Malignancy W/O CC
DRG 157 Anal & Stomal Procedures W CC
DRG 158 Anal & Stomal Procedures W/O CC
DRG 159 Hernia Procedures Except Inguinal & Femoral Age >17 W CC
DRG 160 Hernia Procedures Except Inguinal & Femoral Age >17 W/O CC
DRG 161 Inguinal & Femoral Hernia Procedures Age >17 W CC
DRG 162 Inguinal & Femoral Hernia Procedures Age >17 W/O CC

DRG 163 Hernia Procedures Age <18
DRG 195 Total Cholecystectomy W C.D.E. W CC
DRG 196 Total Cholecystectomy W C.D.E. W/O CC
DRG 197 Total Cholecystectomy W/O C.D.E. W CC
DRG 198 Total Cholecystectomy W/O C.D.E. W/O CC

Left out: DRG 39 Lens Procedures with or without Vitrectomy

Hospitalisation-related variables:

preoperative length of stay (P1)
postoperative length of stay (P2)
operating theatre minutes
three dummy variables for patients admitted through outpatient departments (waiting list), emergency room and internal medicine:
admitted through emergency room
admitted through internal medicine
Left out: admitted through waiting list
three dummy variables for patients admitted on a Friday, Saturday and other days of the week: admitted on a Friday
admitted on a Saturday
Left out: admitted other days of the week
patients discharged on a Monday (=1 if Yes)

Hospital and doctor characteristics variables:

occupancy rate.
turnover rate or case-flow rate
number of beds per speciality per 1,000 population
hospital size in terms of total number of beds per 1,000 population
percentage of operations
number of surgeons per 10,000 population
number of surgeon residents per 10,000 population

Regional supply variables:

number of general practitioners per 10,000 population

Table 5.5 shows the mean and standard deviation of the dependent and independent variables for the different components of inpatient costs.

Appendix 2 shows the means, standard deviations and number of cases for total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient for ten surgical DRGs in the four hospitals.

Table 5.5
The mean and standard deviation of the dependent and independent variables for the different components of inpatient costs

Variables	Cases	Mean	Std Dev
Sex	1223	1.5029	.5002
Comorbidity	1223	.0548	.2276
Complications	1223	.0818	.2741
Discharge on a Monday	1223	.2150	.4110
Preoperative length of stay	1223	3.6451	4.5133
Postoperative length of stay	1223	7.1987	4.2450
Total length of stay	1223	10.8414	6.8416
Number of surgeons	1223	.4138	.1370
Number of surgeon residents	1223	.0521	.0741
Number of beds per specialty	1223	73.9141	20.0601
Occupancy rate	1223	.4460	.3152
Turnover rate	1223	2.6643	1.0138
Number of GPs	1223	5.5910	.9276
Total hospital beds	1223	1.8078	.3783
Percentage of operations	1223	5.3333	2.0088
Admitted through waiting list	1223	.8201	.3842
Admitted through emergency room	1223	.1521	.3593
Admitted through internal medicine	1223	.0278	.1645
1 to 65 years old	1223	.6280	.4835
66 to 75 years old	1223	.2371	.4255
76 years and over	1223	.1349	.3418
Admitted on other days of the week	1223	.8880	.3155
Admitted on a Friday	1223	.0613	.2400
Admitted on a Saturday	1223	.0507	.2195
DRG 39	1223	.2118	.4087
DRG 306	1223	.0164	.1269
DRG 307	1223	.0720	.2585
DRG 336	1223	.0114	.1064
DRG 337	1223	.0450	.2073
DRG 310	1223	.0049	.0699

DRG 311	1223	.0139	.1171
DRG 354	1223	.0008	.0286
DRG 355	1223	.0139	.1171
DRG 358	1223	.0319	.1758
DRG 359	1223	.1333	.3400
DRG 157	1223	.0008	.0286
DRG 158	1223	.0760	.2652
DRG 159	1223	.0057	.0755
DRG 160	1223	.0253	.1572
DRG 161	1223	.0196	.1388
DRG 162	1223	.1120	.3155
DRG 163	1223	.0065	.0806
DRG 195	1223	.0082	.0901
DRG 196	1223	.0384	.1923
DRG 197	1223	.0294	.1691
DRG 198	1223	.1226	.3282
Operating theatre minutes	1223	82.7400	37.4526
Total cost for each patient	1223	365465.1308	194207.7031
Ward cost for each patient	1223	207089.5143	142976.3839
Drug cost for each patient	1223	5854.3230	10405.1372
Test cost for each patient	1223	9885.3720	14674.0634

5.5.3. Method used to obtain the different components of inpatient costs

One part of the research focused on quantifying the resources of the hospital used by individual patients. These resources were not only the general hospital services such as electricity, laundry and catering, but also the precise medical, diagnostic and special treatment services provided in various parts of the hospital. One crucial intermediate step necessary in determining both cost per inpatient and cost per unit of service, is to assign to various procedures weighted values, representative of their consumption of resources.

The reality for Spanish hospitals, however, is that information which could be used to relate the use of ancillary services to individual patients is not available. The collection of this information for the specific purpose of this study was not feasible because the exercise would have been too costly, too time consuming and would place excessive demands on participating hospitals.

The objective was not to examine the efficiency of the service department but, rather, to devise a means of describing the financial repercussions of the different types of care required by certain patients. We took in Chapter 4 an overview of the existing and possible alternative means of costing. However, attempts have been made to cost hospitals in Spain with a direct patient costing model and later grouped into DRGs[272].

Therefore, in order to collect this information, the author used the accounting system and related value units (RVUs) of a hospital in the Valencia Region which had decided to employ an outside firm of accountants (Andersen Consulting) to help with the financial aspects of the hospital[273]. This accounting system and related value units were then applied to the other hospitals.

This is the first attempt at producing costings (on a case mix basis) for hospitals in this Region. One reason for the interest in case mix measures is the extent to which variation in the types of case treated in different hospitals accounts for differences in resources use and cost.

The cost modelling, or top-down approach used in this hospital of the Valencia Region is essentially a product line, or case mix cost accounting model with the core objective of costing individual patients grouped into similar classes. The costing process involves the desegregation of the costs from the general ledge level, through the assignment to cost centres, and ultimately to the determination of cost per patient in each patient group. This approach to cost modelling is essentially a four-stage process[274].

The assignment process includes the following phases: Definition of initial cost centres; allocation of costs from support service cost centres to final cost centres; estimation of inpatient fractions for final cost centres; allocation of inpatient costs from final cost centres to patient or patient groups (DRGs). The final phase is the one that presents the greatest difficulties. The decision to assign costs to individual patients or to groups of patients depends basically on the level of detail in the available information.

Each cost centre has responsibility for the production of a specific type of good or service required for patient care or for the functioning of the hospital. These cost centres are of five general types:
(1) Overhead general services cost centres (such as laundry, housekeeping);
(2) Ancillary services cost centres (such as radiology, laboratory);
(3) Hotel and general services cost centres (such as admitting, cashier);
(4) Other cost centres (such as emergency room);
(5) Non-inpatient cost centres (such as outpatient).
Those defined as final cost centres (FCCs) are constructed from the latter four categories. Final cost centres are those cost centres for which methods can be developed to: (1) allocate costs from the overhead cost centres to FCCs; (2) estimate the proportion of costs in FCCs incurred in treating inpatients; and (3) allocate costs from FCCs to patients.

The initial step in the cost-finding process is the allocation of overhead costs to the final cost centres. This is accomplished through a set of initial cost centre allocation statistics' which reflect the relative amount of a given overhead on a cost center's expenses, that can be attributed to each final cost centre. For example, laundry is allocated on the basis of weight, maintenance on the basis of square feet, and so forth.

Finally, the inpatient costs in each FCC are allocated to individual patients, on the basis of some measure of resources consumption or statistics that reflects the relative intensity of the services delivered. That is, for each FCC a patient-related statistic (such as length of stay) is totalled over the whole hospital.

The approach used in the Valencia Region hospital was the relative value units developed in the U.S. The relative value unit is defined as the "weighted measures of resource consumption based on the relative amount of time and materials required to produce a particular service"[275].

To evaluate the intermediate activity costs, such as Laboratory and Radiology, the hospital used the weighted measures for the relative value units of laboratory by DRG from the College of American Pathologists and the weighted measures for the relative value units of radiology by DRG from the Maryland cost study. The allocation of routine costs - physician and nursing costs - does not include the measurement of the different workloads of nurses and physicians related to the patient. Although this would be of interest, there are no satisfactory developments of this kind in this area, and there was no data. In order to assign doctor costs, there is an estimate on the proportion of time dedicated to inpatient activities compared to outpatient ones, with the purpose of separating the resources that were included in the model.

For nursing services, nursing costs by length of stay have been calculated, adjusted in accordance with the hospitalization ward coinciding with the medical service to which the patient was admitted.

It was recognised that it would have been desirable to make some allowance for depreciation and capital replacement, particularly of that equipment specific to individual resource areas, but this is a very time consuming job which would require a very detailed study.

In most of the European experiences, not only is direct assignment to patients not possible, but neither is there any information available about statistical methods that allow the assignment to groups of patients based on calculations practised in each country. Some of the projects chose to assign costs to DRGs based on Relative Value Units developed in the U.S. to assign cost of ancillary services[4].

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[4] From this basis, three countries (France, Ireland and Portugal) have chosen to use a system of RVUs developed in the United States to allocate ancillary services, and a system of weighted days, also developed in the United States to nursing services across patients groups.

Standardization of the definition of a cost centre and the development of relative value units and weighting systems are some of the objectives of general projects under way in Europe and other countries that may constitute an important advancement in this field in the future[276].

The product of unit cost of the relative value unit, multiplied by the individual units of consumption per inpatient (expressed in monetary units) gives the cost per inpatient.

The cost of treatment is broken down into its various components: hotel costs, theatre costs, medical costs, ward costs, overheads, and other treatment expenses. Even though there were large numbers of patients under study, detailed individual information was recorded for all patients in all aspects of care (for drugs, laboratory investigations, blood transfusion, radiology, electrocardiography, etc).

It is, however probable, that the profile of resource consumption by surgical DRGs, for ancillary services will be different in Spain compared with the United States. This is a hypothesis which would need to be tested in some future study. The use of these data in this study is based on the assumption that the application of a common set of allocation weights for the apportionment of final cost centres to the DRG inpatient level will provide some insight into inter-hospital variations in patterns of resources utilisation associated with particular levels of case mix. Hospitals in the Valencia Region are not funded on the basis of patient-based costs, therefore the estimation of relative resource consumption, rather than absolute costs, assumes a higher priority in this study.

It is therefore advisable to be cautious in interpreting the results of the process of DRG cost estimation presented below.

5.6 Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) was employed for the purpose of undertaking the statistical analysis of the data. Statistical techniques were used for different purposes. The mean and standard deviation for length of stay and the different components of inpatient costs were used. The statistical analysis technique stepwise multiple regression, the basic analytical tool utilised in this study, was used for length of stay and the different components of inpatient costs (in Chapter 6 and 7). This technique allows for measuring the direct effects of each independent variables on the dependent variables (length of stay and the different components of inpatient costs), while holding constant the values for all the other independent variables. The classic Student's t Distribution Table is used to calculate which of the regression coefficients are significantly different from zero at the five and one percent significant level.

The regression analysis employs dummy variables to represent best measured by categories, such as admission type. In the case of admission type, for example, the three categories are admitted through waiting list, emergency room and internal medicine. Employing the standard methodology of omitting one of the categories (in this case waiting list is left out), the two dummy variables actually entered measure the differential effects of emergency room and internal medicine admission in comparison with waiting list.

The dummy variables provide a powerful method of data analysis. It is often good practice to choose the most frequent category as the reference category, as we have been doing in this analysis, so that the dummy regression coefficients represent deviations of smaller groups from the largest group[277].

The analysis of the data set for the twenty-three surgical DRGs for length of stay and for the twenty-two surgical DRGs for the different components of inpatient costs consists of two parts: In the first part, for length of stay, a general regression equation is run for preoperative, postoperative and total length of stay. About forty-five other variables are included in the equation with the primary purpose of analysing the significance level and the magnitude of the effect of each of these variables on length of stay after holding constant for the other variables. From the twenty-three surgical DRGs, we selected the eleven common surgical DRGs, and we developed similar preoperative, postoperative and total length of stay regression equations for each of these particular surgical DRGs separately.

In the second part, for the different components of inpatient costs, a general regression equation is run for total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient. About forty-seven other variables are included in the equation also with the primary purpose of analysing the significance level and magnitude of the effect of each of these variables on the different components of inpatient costs after holding constant for the other variables. From the twenty-two surgical DRGs, we selected ten common surgical DRGs, and we developed similar total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient regression equations for each of these particular surgical DRGs separately.

The statistical technique Frequency Distribution was used, this is the analytical tool utilised for the surgeons' questionnaires in Chapter 8.

The survey questionnaire (see Appendix 9) was given to seven hundred surgeons within six surgical specialties (general surgery, ophthalmology, thaumatology, urology, gynaecology and ENT) within twenty hospitals in the Valencia Region. The response time for the questionnaire was about six months and 46% of the surgeons responded. All of the questions were answered and the responses were deemed acceptable for use in this study.

5.7 Computer Processing

The primary purpose with the data collected was to create three system files containing all data considered necessary to conduct the empirical analysis. First, a patient file was created which contained all patient-specific information concerning fourteen variables for the 1991 data, for a sample of twenty-three surgical DRGs. Second, a hospital file was created which contained information concerning nine variables for the 1991 data, on each of the eight general and teaching hospitals in the region. Third, a patient file was created which contained all inpatient-costs information concerning six variables for the 1991 data, for a sample of twenty-two surgical DRGs. The three files, which were created with DBase III Plus, were linked through the number of the hospital and the medical record for each patient.

An individual specific identifier contained in each of the data files made it possible to link the information. Regional information on the availability of medical facilities and other regional variables was merged via the hospital code and the diagnosis code. On the basis of the above described data, three data sets were constructed which were subsequently used to analyse the different aspects of hospital utilisation on which this research focuses.

In order to allocate the different costs to each inpatient a special programme in DBase was developed in collaboration with the Information System Department of the Polytechnic University of Valencia. The programme allocated a unit cost, consisting of x-rays, drugs, laboratory test, blood units, length of stay, etc, to each inpatient. As each inpatient had a different code, it was possible to obtain the total cost for each one.

It was also possible to merge all files into one file with all the information. This file was converted into a SPSS file, which was used as the data base for analysing hospital variations in length of stay (preoperative, postoperative and total length of stay) and the different components of inpatient costs (total cost, ward cost, drug cost and test cost).

At a conservative estimate, feeding this data into the computer occupied three months of research time.

5.8 The Problems of Getting The Right Data

One of the main problems was to wait until all the different managers, consultants, staff in the financing department, etc, in the eight hospitals had received the notification letters from the Regional authorities to collect the data. It took five months for the authorities to send these letters. Further delays were incurred in the collection of data from some of the hospitals. One should also add, that only one hospital provided the information in a file disk. On checking, most of the information on this disk was missing or incorrect which meant having to go through all the discharge records and other sources again.

All the information collected in the hospitals had to be copied in different protocols created for this research. Subsequently, all this information had to be re-introduced in different files of DBase III Plus for processing.

At a conservative estimate, the entire exercise of obtaining the data and then feeding it into the computer, occupied fifteen months of research time.

One should also add that the eight hospitals under study are in different areas of the Valencia Region. The research required the comparison of different districts of the Valencia Region and this involved travelling long distances to get from one to the other.

There were some problems mainly due to incomplete and missing data from the discharge reports; for example, missing date of admission, date of surgical procedure, date of discharge, patient's age, etc. This meant that reference had to be made to the operating theatre and admission books to recover the information that was missing. Further problem presented itself: some of the discharge reports were not available in the different specialties and had to be retrieved from within the medical records.

The main problems data retrieval from the medical records as it related to the different components of hospital costs were that these records were usually in complete disorder. Subsequently the only solution was to examine each medical record in its interaty in order to identify all the laboratory tests, x-rays, theatre time, drugs, etc for the specific procedures.

The distribution of the questionnaires also presented a number of problems: there was no financial support to produce the 700 questionnaires and no help with the distribution to over twenty hospitals in the whole region. Once the questionnaires were completed the researcher had to collect them personally from the different hospitals, and this involved numerous time-consuming trips.

5.8.1 Limitations of the data

We have to keep in mind that sometimes consultants do not write all the procedures in the medical records; for example, some of the information for the different components of hospital costs might be missing. Also some consultants forget to write the discharge report which means some patients are omitted in the system. However, it is difficult to quantify the number of such patients.

The main disadvantage with the data in the field of medical care utilisation, is the omission of information on the health status of individuals - such as general health status, number of sick days or number of longstanding diseases and socio-economic status, like income, education or occupation. This lack of data is, however, of little consequence if one restricts the analysis to hospital utilisation since past utilisation can be used as a proxy for health status while the literature survey presented in Chapter 3 shows that socio-economic status has almost never been estimated to have a substantial impact on demand for hospital care.

5.9 Conclusion

The discharge reports, operating theatre books, admission books, medical records and accounting system have been chosen as the primary data source because they are the best available set of data that includes length of patient stay and the different components of inpatient costs: this data was supplemented with information from the health authorities of the region concerning the characteristics of local health systems.

The survey questionnaire was the second data source because it was also important to obtain some indications of the surgeons' views concerning issues of hospital utilization and efficiency.

The statistical techniques used were: means, standard deviations, stepwise multiple regression and frequency distribution.

Chapter 6

Factors which Determine Preoperative, Postoperative and the Total Length of Hospital Stay

In this chapter an empirical analysis is presented of the length of stay in eight general and teaching hospitals in Spain. The analysis is based on the data described in Chapter 5, and presents a statistical analysis of the determinants of length of stay for a number of twenty-three important Diagnoses Related Groups (DRGs) in Surgery. The purpose of the chapter is to compare the empirical results of each independent variable with the hypothesis formulated and to contrast the effects and significance levels of these independent variables on the preoperative, postoperative and the total length of stay (hereafter referred to as P1, P2 and PT).

The chapter is divided into three parts. The first part focuses on the empirical analysis of all selected surgical DRGs taken together in one general regression equation on all hospitalisations with the preoperative, postoperative and the total length of stay as the dependent variables. In the second part, we shall look at preoperative, postoperative and the total length of stay regression analysis specifically for the most important eleven surgical DRGs. In the third part, we shall look at preoperative, postoperative and total length of stay regression analysis specifically for the eight hospitals for the twenty-three selected surgical DRGs. The chapter ends with a discussion of the findings in light of published empirical evidence.

6.1 Introduction

Variations in length of stay between health care units are often put forward as indicators for the differences in technical efficiency in the delivery of health care[278]. Indeed, length of stay has long been used as a measure of inpatient resource use and hospital performance[279].

Length of stay can vary for many reasons, not all of which are good. Some variability may be indicative of inefficiency. An analysis of the determinants of length of stay may thus provide useful information for assessing and improving the efficiency of the delivery of health care and value for money.

The length of patient stay is defined as the number of nights spent in the hospital. As soon as a patient is admitted, a more or less continuous decision process commences with respect to the treatment (surgical procedure in this case) and planned discharge of the patient. This process is influenced by the patient's medical condition, his reaction to the treatment and the results of the diagnostic tests, as well as the patient, doctor, hospital and health system characteristics.

It appears that three groups of patients have an operation upon admission: 1) those patients admitted to have an operation from the outpatient departments (waiting list); 2) those who are admitted through the emergency room because of an acute health problem that may require immediate attention; and 3) those who are transferred from another specialty.

The first group of patients is by far the largest in surgery and is presented as less severe than other groups. This may lead to shorter stays. Besides that, these patients can be anticipated to be relatively easy because treatment consists of some surgical procedures which are generally accepted, though often informal norms exist as to the appropriate duration of the hospital stay. However, in some of the selected Spanish hospitals there were many patients who were admitted through the emergency room and did not necessarily present an acute health problem (1,007 case were admitted from the emergency room department, 14.3% of the total cases from the sample), but the surgical procedure took place in the same way as for the first group of patients (elective surgery). Most of these kinds of patients remain in the hospital until they have had the surgical procedures. Besides the medical condition upon admission, which may be operationalised by the admission diagnosis supplemented by variables defining the above-mentioned patient categories, it has to be realised that there may exist alternatives to hospitalisation: minor surgical procedures can often be performed on an out-patient basis or in day surgery. In general, the appropriateness of an admission may be doubtful. For example, the hospitalisation of a patient with a certain diagnosis might be thought necessary by one specialist, but not considered so by another specialist with different preferences or with different treatment facilities at his disposal. It follows that the admission diagnosis as such is probably not an objective and sufficient indication of the health condition of patients while, moreover, specialist and hospital characteristics may affect both the choice of the treatment and its duration.

An important decision by the attending specialist, which might be taken in the course of the treatment process, is that of consulting a colleague in the same hospital or even to transfer the treatment of the patient to another colleague. This may occur, for example, when a medical patient is diagnosed as needing surgery or complications arise. Given the initial diagnosis on admission this probably leads to a longer stay.

For the discharge decision, there are two alternatives: a) the patient is discharged home; or b) the patient is transferred to a long term hospital bed or nursing home. The first option is the normal procedure and may be delayed when there is a lack of home-care facilities because the patient in question lives alone, his family is not able to give the necessary care or the general practitioner cannot provide follow-up treatment. The second option is also limited: the present situation means that there is a substantial shortage of long term hospital beds and care in the community is very poorly developed in Spain, so that the patient has to wait until a place in such an institution become available.

As soon as a patient is admitted to a surgical ward in a hospital, it is primarily the specialist who decides about treatment and thus the length of stay. So patient preferences that are not medical can be expected to be of only minor importance.

In relation to the influence of specialists' preferences on the decision underlying the length of stay, Spanish hospital budgets can be exceeded and efficient working can lead to a lower budget or a higher workload without extra money, while inefficiency is rewarded by a quiet life. Therefore, where there are patients waiting for admission, reductions in lengths of stay or the introduction or extension of day surgery place this objective at risk[280]. This may lead to a lack of efficiency and does not create incentives for doctors to shift inpatient to outpatient treatment, and to reduce the length of stay. This may result in a longer length of stay.

6.2 General and Specific Surgical DRGs Regression Equation Formulated with Respect to Preoperative, Postoperative and the Total Length of Patients' Stay

A sample of twenty-three more common surgical DRGs were selected to test the hypothesised effects of a series of variables on the preoperative, postoperative and the total length of stay in the equation. This sample includes data from 7,053 episodes of hospital stay merged with data characterising the eight hospitals. In the second part, a sample of eleven common surgical DRGs was selected from the twenty-three surgical DRGs, to test the hypothesised effects of a series of variables on the preoperative, postoperative and the total length of stay in the DRGs-specific equation.

The purpose of this chapter is to test the effects of certain explanatory variables on the preoperative, postoperative and the total length of stay after controlling as many confounding factors as possible.

The analysis will focus on the preoperative, postoperative and the total length of stay of the surgical procedures. The division into the preoperative, postoperative and total length of stay restricts the study to surgical cases only: thus the results of the study are not necessarily generalizable to non-surgical cases. However, the division will allow for a better test of the formulated hypotheses[281].

A patient's stay in the hospital consists of several stages, each of which results in one segment of length of stay. The total length of stay is then no more than a sum of these segments. The rationale for splitting up length of stay in separate segments is based on the proposition that doctors are faced with a different set of constraints when deciding on the desirable admission time and pre-treatment period than when deciding on the desirable recovery period and discharge time.

Thus, contrasting the effect of certain variables on different segments of length of stay, has the potential of clarifying the relationship of these variables with the doctor's decision-making process and could lead to a better understanding of why and how certain variables affect duration of stay in the hospital.

In this chapter we shall formulate hypotheses with respect to the effects of the explanatory variables which will be entered in the basic length of stay equation. For patients within categories that are reasonably homogeneous, in terms of those clinical conditions that affect the applicable diagnostic and therapeutic clinical processes, the average length of stay per admission is determined by four sets of factors. These can be thought of as vectors of the characteristics of health status, hospital-related variables, the hospital and doctor and regional supply variables. Such factors capture the characteristics of the structure within which variations on any one dimension influence the observed length of stay.

Patient-related factors are represented by their health status indicators, which may affect length of stay. Such factors may be comorbidity (multiple diagnoses), complications after the operation, age, sex and the different surgical DRGs. Patients characteristics were consistently found to be one of the most important factors in explaining length of stay variations within diagnostic groups. For some diagnoses, the existence of age, complications and comorbidity significantly increased the length of stay. According to these analyses, both the proportion of the total variance explained by the sum of these predictors and the estimated relative effect of each predictor varied considerably among diagnoses.

These findings demonstrate rather thoroughly that diagnosis is the primary variable affecting hospital use, and without segregation of patients by diagnosis and carrying out analyses within diagnoses, little can be learned of the true network of influences of other independent variables.

The second set of factors is represented by a vector of characteristics of the event of the stay itself that may influence the length of stay. These may be the type of admission status (emergency and internal medicine vs. scheduled), the day of the week of admission, and the day of the week of discharge.

The third set of factors is represented by a vector of hospital specific efficiency characteristics, such as occupancy rate, cash-flow per bed, university versus non-university hospital, number of total hospital beds per 1,000 population, number of surgeons per 10,000 population, number of resident surgeons per 10,000 population, percentage of operations, number of beds per speciality per 1,000 population.

The last set of factors are the characteristics of the regional supply variables, such as the number of GPs per 10,000 population.

A detailed description of the variables (dependent and independent) is provided in Chapter 5.

6.3 Hypothesis Effects on Preoperative, Postoperative and Total Length of Stay

In this section we shall formulate hypotheses with respect to the effects of the explanatory variables.

One measure of the existence of illness used is the severity of cases that are admitted to hospital. One might thus expect that the more complex the case mix the more resources would be used as compared to cases admitted which were less severe. It can be said that when patients had health problems that were indicated by multiple diagnose or comorbidity, they stay longer than if they have no such problems. This effect is believed to be due to more pre-surgical work-up activities, higher risks for postoperative complications and more postoperative care.

The longer length of stay for patients with complications after the operation may be a result of the provision at extended postoperative care. The older the patient, the longer they stay in the hospital. Age is a proxy for the pace of recovery. Older patients will therefore consume more patient days for the same surgical DRG. As we saw in Chapter 3, there have been different results in the literature of the influence of male or female in the length of stay.

Emergency room admissions would have a negative effect on P1 if this variable reflected the necessity for immediate surgical intervention (in our sample, patients who have an operation on the same day of their admission were excluded). Differences in severity, expressed as differences between emergency and waiting list cases have an influence on length of stay. Admissions classified as emergency usually are found to be associated with longer length of stay, presumably because the medical condition of these types of admissions is relatively more severe than the medical condition of elective admissions. However, if there is only a positive effect on preoperative length of stay, this suggests that built-in organisational inefficiencies for emergency (e.g., lack of pre-admission testing) are the predominant factor, or that they were not scheduled and must queue for services.

If the hospitalised patient is admitted through another specialty (here we refer to internal medicine), the health problem would have been diagnosed already and the appropriate treatment will probably be clear. Thus those patients can be expected to have a shorter stay. However, the non significant effect on postoperative length of stay may suggest that cases admitted through internal medicine maybe are not more complicated than other patients. In the regression analysis for each surgical procedures, we will test this hypothesis.

Most Spanish hospitals aim at minimising available staff at the weekend and thus practically no admissions, discharges or medical treatments take place in this period. Patients admitted at the end of the week on Friday and Saturday have, as expected, a significantly longer preoperative and postoperative length of stay in this research. The fact that these patients do have not significantly longer postoperative stays could be interpreted as an indication of the inefficiency inherent in admitting surgical patients just before the weekend, when elective surgeries are usually not performed and not because Friday and Saturday admissions are more severely ill.

Organisational patterns prevailing during weekends may cause certain patients to stay in the hospital until Monday even they though they are ready to be discharged on Friday, Saturday and Sunday. If so, patients discharged on Mondays are expected to have a somewhat longer postoperative length of stay.

The occupancy rate has often been used as an explanatory variable in the length of stay analysis. The occupancy rate of a hospital is often interpreted as an indicator of inefficient organisation, hospitals with high occupancy rates experiencing organisational problems in the diagnostic, treatment and/or discharge phase resulting in longer mean stays. Hospital occupancy rate is expected to be negative because the higher the occupancy rate the less empty beds capacity is available, the greater the doctor peer pressure to ration the available bed space by limiting lengths of stay.

There are two theories on the effect of occupancy rate on the length of stay. The first: the rationing hypothesis suggests a negative relationship between the occupancy rate and preoperative, postoperative and total length of stay (high occupancy rates leading to delayed admissions and earlier discharges). The second theory produces opposite results, occupancy rate having a positive effect on preoperative, postoperative and total length of stay and would suggest that surgeons take hospital preferences for stand-by capacity into consideration and therefore maintain a low occupancy rate.

Some empirical studies indicate that average length of stay decreases with hospital turnover rate. It means that increasing the number of patients per beds will decrease the length of stay. The finding is in relation with the literature.

The supply of acute hospital beds are important factor explaining variations between hospitals. The fact that the utilisation of the hospital is positively associated with the number of beds available per specialty in an area has been observed repeatedly in studies of hospital use patterns. The number of beds per specialty in the hospital can be interpreted as a measure of the degree of competition between specialists for the use of clinical facilities. A relative large number of beds per specialities per 1,000 population in the area would reduce the pressure on the surgeons to cut down on length of stay and, therefore, would have a positive effect on preoperative and postoperative length of stay.

If teaching hospitals admit relatively more severe cases, even after controlling for diagnostic case mix, the lengths of stay are likely to be longer in these hospitals. If only the preoperative length of stay is significantly longer in teaching hospitals, the effect of more extensive diagnostic testing among resident surgeons is likely to dominate. A negative effect of teaching status on P2 and PT would support the hypothesis that teaching hospitals are practising more advanced techniques which reduce the need for postoperative hospital care. The teaching process may cause stays to be longer than strictly necessary.

The size of the hospital in terms of beds is strongly correlated with the extent of available facilities and the extent to which the hospital serves as a regional referral centre for severe cases. Thus, whether more facilities lead to either shorter or longer stays will be indirectly measured by the estimation results with respect to the total number of beds. A negative effect on the total number of beds per 1,000 population will support the hypothesis of economies of scale. We expect this effect to be stronger in situations of bed shortages than in situations where there is no shortage of beds.

We expect a negative relationship between the variable percentage of operations and the length of stay. Increasing the number of patients in the operating theatre will put pressure on the hospital beds resulting in a shorter length of stay.

The supply of medical manpower is an important factor explaining variations between hospitals. Empirical studies concerning the roles of surgeons in determining hospital use have focused principally on the relationship between the number of surgeons in an area and hospital utilisation. In general, it is expected that a large supply of surgeons will lead to lower utilisation of hospitals. A priori, we expect a large supply of surgeons per 10,000 population to be associated with shorter stays. Longer preoperative and postoperative length of stay may reflect lower quality of care or a more conservative attitude among surgeons where the discharge timing is concerned.

It is found that patients who are under the care of the surgeons have significantly shorter stays than patients who have interaction with resident surgeons. Resident sugeons per 10,000 population are also believed to keep patients longer because they are more cautious about releasing a patient and more likey to rely on time-consuming tests to assist in the diagnosis process.

General Practitioner density, which is operationalised as the number of GPs per 10,000 population is included in the regression as a supplement to the previous variables. The reason for this is that, besides providing care themselves, GPs fulfil a coordinating function substituting hospital treatment with primary health care facilities and are responsible for referral and post-operative care of patients referred back to primary facilities.

We expect large supplies of general practitioners to be associated with shorter stays. The presence of primary health care could further be measured by the availability of General Practitioners in the area. If so, a high ratio of GPs per 10,000 population would have a negative effect on P1, P2 and PT.

6.4 General Regression Results on the Preoperative, Postoperative and the Total Length of Stay

Using the statistical analysis technique stepwise multiple regression, we look at the extent to which patient health indicators, hospitalisation-related variables, hospital and doctor characteristics and regional supply variables were related to the preoperative, postoperative and the total length of stay in eight hospitals.

In Table 6.1, the length of stay is regressed against the patient's surgical Diagnoses Related Groups. The surgical DRGs alone explain about 19% of the variation between patients in preoperative length of stay, 43% in postoperative length of stay and 39% in the total length of stay. Table 6.1 shows the estimated results of the regression for the different diagnoses for the preoperative, postoperative and the total length of stay.

Table 6.1.
Results of the regression for the different surgical DRGs

Surgical DRGs	Preoperative	Postoperative	Total Length
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	2.69(0.08)**	4.39(0.07**	7.19(0.14)**
DRG 196 T.Cholecys.W CDE W/O CC	7.23(0.31)**	7.71(0.23)**	14.80(0.40)**
DRG 198 T.Cholecys.W/O CDE W/O CC	3.53(0.16)**	4.14(0.12)**	7.55(0.22)**
DRG 197 T.Cholecys.W/O CDE W CC	6.85(0.37)**	9.61(0.26)**	16.29(0.47)**
DRG 307 Prostatect.W/O CC	3.91(0.27)**	5.95(0.19)**	9.75(0.34)**
DRG 311 Trans.Proc.W/O CC	3.17(0.25)**	NS	3.08(0.32)**
DRG 195 T.Cholecys.W CDE W CC	8.12(0.75)**	13.82(0.53)**	21.83(0.94)**
DRG 337 Trans.Prost. W/O CC	3.22(0.30)**	1.78(0.21)**	4.89(0.38)**
DRG 336 Trans.Prost. W CC	6.98(0.77)**	6.40(0.55)**	13.27(0.97)**
DRG 310 Trans.Proc.W CC	5.17(0.61)**	7.04(0.44)**	12.09(0.77)**
DRG 306 Prostatect.W CC	3.22(0.58)**	10.35(0.41)**	13.47(0.73)**
DRG 157 Anal&Stomal Proc.W CC	7.61(1.52)**	3.90(1.08)**	11.41(1.90)**
DRG 160 Hernia Proc.Except Ingui&Fem Age>17 W/O CC	1.81(0.52)**	3.03(0.37)**	4.74(0.66)**
DRG 159 Hernia Proc. Except Ingui&Femo Age>17 W CC	3.45(1.05)**	9.89(0.75)**	13.24(1.32)**
DRG 163 Hernia Proc.Age<18	-1.60(0.51)**	-2.00(0.36)**	-3.71(0.64)**
DRG 355 Uterine, Adnexa Proc.Non Ovar/Adnexal Malignancy W/O CC	1.14(0.46)*	5.81(0.33)**	6.83(0.58)**
DRG 162 Inguinal & Femoral Hernia Proc Age>17 W/O CC	-0.50(0.22)*	1.41(0.16)**	0.81(0.28)**
DRG 267 Perianal & Pilonidal Proc	-1.46(0.67)*	2.61(0.47)**	NS
DRG 354 Uterine, Adnexa Proc. Non Ovar/Adnexal Malignancy W CC	NS	12.24(1.03)**	13.26(1.82)**
DRG 358 Uterine&Adnexa Proc. for Non-Malignancy W CC	NS	7.76(0.24)**	7.69(0.43)**
DRG 359 Uterine&Adnexa Proc. for Non-Malignancy W/O CC	NS	3.53(0.13)**	3.18(0.23)**
DRG 158 Anal&Stomal Procedure W/O CC	NS	NS	NS
DRG 161 Inguinal&Femoral Hernia Proc Age>17 W CC	NS	5.31(0.44)**	6.19(0.77)**
R Square	0.19	0.43	0.39
F	96**	266**	221**
N. of cases	7,053	7,053	7,053

Notes: ** Significant at 99% confidence level.
* Significant at 95% confidence level.
NS= not significant (p>.05)

The first hypothesis is corroborated in the regression analysis for the different surgical DRGs. The preoperative length of stay the range goes from 8.1 days for Total Cholecystectomy with C.D.E. with complications or comorbidity to -1.6 days for Hernia Procedures age less than 18 years old. The postoperative length of stay the range goes from -2.0 days for Hernia Procedure age less than 18 years old to 13.8 days for Total Cholecystectomy with C.D.E. with complications or comorbidity and for the total length of stay the range goes from 21.8 days for Total Cholecystectomy with C.D.E. with complications to -3.7 days for Hernia Procedures age less than 18 years old. The preoperative length of stay is expected to be relatively long for those procedures with a more severe diagnoses (e.g. Total Cholecystectomy with C.D.E. with complications or comorbidity) and short for those procedures with less severe diagnoses (e.g. Hernia Procedures age less than 18 years old). The greater risks for postoperative complications explain why Total Cholecystectomy with C.D.E. with complications or comorbidity and Uterine, Adnexa Proc for Non-Ovarian/Adnexal Malignancy with complication or comorbidity cases, tend to have longer postoperative length of stay. Hernia Procedures age less than 18 years old and Inguinal & Femoral Hernia Procedures age more than 17 years old without complication or comorbidity are likely to be less complicated resulting and shorter postoperative length of stay. Total length of stay will involve the most severe cases such as longer stay Total Cholecystectomy with C.D.E. with complication or comorbidity and Total Cholecystectomy with complication or comorbidity because this is the sum of the total process and, on the other hand, the less severe cases such shorter stay Hernia Procedures age less than 18 years old and Inguinal & Femoral Hernia Procedure age more than 17 without complication or comorbidity[5].

Further clarification on how those variables affect preoperative, postoperative and the total length of stay can be achieved when the DRGs-specific equation is applied to each surgical DRG separately. The results for the different surgical DRGs will be discussed in the second part of this chapter.

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[5]The reference group for the surgical DRG is Lens Procedures with or without Vitrectomy.

In table 6.2, preoperative, postoperative and the total length of stay is regressed against the variables describing health status, hospital related variables, hospital and doctors characteristics and regional supply variable.

Table 6.2 presents the lists of variables which are included in the preoperative, postoperative and the total length of stay regression. These variables explain about 41% of the variation in the preoperative length of stay (R Square measure), 46% of the variation in the postoperative length of stay and 52% of the variation in the total length of stay between hospitals.

Table 6.2
Results of the general regression

Explanatory Variables	Preoperative[6]	Postoperative	Total Length
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	2.56(0.53)**	4.56(0.41)**	6.97(0.77)**
DRG 196 T.Cholecys.W CDE W/O CC	1.51(0.28)**	5.95(0.25)**	7.85(0.43)**
DRG 198 T.Cholecys.W/O CDE W/O CC	NS	2.57(0.16)**	3.15(0.31)**
DRG 197 T.Cholecys.W/O CDE W CC	1.42(0.35)**	6.61(0.30)**	8.15(0.61)**
DRG 307 Prostatect.W/O CC	2.07(0.23)**	5.19(0.20)**	7.26(0.33)**
DRG 311 Trans.Proc.W/O CC	1.44(0.22)**	-0.65(0.19)**	0.77(0.32)*
DRG 195 T.Cholecys.W CDE W CC	NS	10.00(0.55)**	10.98(0.96)**
DRG 337 Trans.Prost.W/O CC	2.00(0.26)**	1.21(0.22)**	3.08(0.37)**
DRG 336 Trans.Prost.W CC	4.69(0.68)**	4.31(0.56)**	8.60(1.00)**
DRG 310 Trans.Proc.W CC	2.14(0.55)**	4.95(0.45)**	6.78(0.84)**
DRG 306 Prostatect.W CC	NS	7.63(0.44)**	7.88(0.83)**
DRG 157 Anal&Stomal Proc.W CC	NS	NS	NS
DRG 160 Hernia Proc Except Ingui & Fem Age>17 W/O CC	-1.27(0.45)**	1.51(0.38)**	NS
DRG 159 Hernia Proc Except Ingui & Femo Age>17 W CC	NS	6.03(0.76)**	4.47(1.25)**
DRG 163 Hernia Proc Age<18	-3.34(0.46)**	-3.13(0.36)**	-6.22(0.62)**
DRG 355 Uterine, Adnexa Proc.Non Ovar/Adnexal Malignancy W/O CC	1.34(0.39)**	5.46(0.34)**	7.34(0.55)**
DRG 162 Inguinal&Femoral Hernia Proc Age>17 W/O CC	-1.74(0.20)**	NS	-1.38(0.33)**
DRG 267 Perianal & Pilonidal Proc	-1.50(0.58)**	1.44(0.47)**	NS
DRG 354 Uterine, Adnexa Proc.Non Ovar/Adnexal Malignancy W CC	NS	9.49(1.03)**	10.30(1.68)**
DRG 358 Uterine&Adnexa Proc.for Non-Malignancy W CC	NS	5.36(0.31)**	5.48(0.62)**
DRG 359 Uterine&Adnexa Proc.for Non-Malignancy W/O CC	NS	3.34(0.17)**	4.05(0.28)**
DRG 158 Anal&Stomal Procedure W/O CC	-1.66(0.29)**	-1.43(0.25)**	-2.66(0.44)**
DRG 161 Inguinal & Femoral Hernia Proc Age>17 W CC	-2.03(0.54)**	2.11(0.46)**	NS

[6] Discharge on Monday and complications after the operation are deleted from the final preoperative length of stay analysis because they are not expected to have any significant effect on preoperative length of stay.

Table 6.2 (Continuation).

Explanatory variables	Preoperative	Postoperative	Total Length
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
admission through emergency room	7.01(0.16)**	0.49(0.13)**	7.41(0.21)**
admission through internal medicine	4.76(0.34)**	NS	4.91(0.45)**
turnover rate	-0.33(0.07)**	-0.56(0.06)**	-0.91(0.10)**
complications	NS	2.88(0.25)**	3.17(0.51)**
multiple diagnoses or comorbidity	1.59(0.26)**	NS	1.82(0.50)**
admitted to the hospital on a Friday	1.47(0.17)**	NS	1.55(0.22)**
admitted to the hospital on a Saturday	1.50(0.27)**	NS	1.71(0.34)**
discharge on a Monday	NS	0.51(0.10)**	0.42(0.16)**
sex	NS	-0.33(0.10)**	-0.55(0.16)**
over 76 years old patients	0.70(0.15)**	0.72(0.13)**	1.49(0.20)**
between 66 and 75 years old patients	0.29(0.12)*	0.59(0.10)**	0.92(0.16)**
percentage of operations	-0.17(0.04)**	-0.12(0.03)**	-0.21(0.05)**
number of surgeons	NS	4.10(0.48)**	2.48(0.87)**
number of resident surgeons	1.69(0.43)**	NS	2.04(0.56)**
number of beds per specialities	0.03(0.00)**	0.01(0.00)**	0.05(0.01)**
occupancy rate	NS	NS	NS
General Practitioner	NS	NS	NS
total number of hospital beds	-0.43(0.08)**	NS	-0.34(0.11)**
admitted to a teaching hospital	NS	NS	NS
R Square	0.41	0.46	0.52
F	186**	200**	225**
N. of cases	7,053	7,053	7,053

Notes: ** Significant at 99% confidence level.
* Significant at 95% confidence level.
NS= not significant (p>.05)

Health Status Indicators

The variables that reflect the patient's medical conditions are the most important factors influencing the length of stay. Let us consider briefly the coefficients of the Surgical DRGs in the regression with all the variables included. Patients with Transurethral Prostatectomy and Total Cholecystectomy W C.D.E. W CC have the longest stays for P1, P2 and PT. Patients with Hernia Procedures Age < 18 have the shortest stays for P1, P2 and PT. This again corraborates that the more complex cases mix the more resources would be used as compared to cases admitted which were less severe.

The cases with comorbidity or multiple diagnoses are indeed positive and statistically significant on preoperative and total lengths of stay. Therefore, multiple diagnoses reflect more severe medical conditions and more extensive hospital care results in longer P1 and PT as our hypothesis predicted.

Table 6.3
Length of stay for multiple diagnoses or comorbodity

	Preoperative	**Postoperative**	**Total length of stay**
Patients with multiple diagnoses or comorbidity	7.8 days	11.4 days	19.2 days
Patients without multiple diagnoses or comorbidity	4.2 days	7.2 days	11.4 days

The mean length of stay varies for patients without multiple diagnoses to patients with multiple diagnoses on preoperative, postoperative and total length of stay between hospitals (see table 6.3).

The result in the regression analysis indicates that the increase by one more patient with comorbidity or multiple diagnose, the P1 and PT will increase by 1.6 and by 1.8 days respectively between hospitals as compared with patients without comorbidity or multiple diagnoses. This corraborates with the general asumption pointed out in the literature that patients with multiple diagnoses stay longer. However, we have to be aware that these patients do not have a longer length of stay for the postoperative period. This finding is particularly important in the light of the attempts to develop relatively homogeneous Diagnosis Related Groups based in part on similar use of hospital resources.

The effect of postoperative complications on length of stay is a very important variable to study. In our research, patients with complications after the operation have a positive effect on P2 and PT.

Table 6.4
Length of stay for complications

	Postoperative	Total length of stay
Patients with Complications	14.0 days	19.0 days
Patients without complications	7.0 days	11.3 days

The mean length of stay varies for patients without complications to patients with complications on postoperative and total length of stay between hospitals (see table 6.4).

The result indicates that with the increase by one more patient with complications, the P2 and PT will increase by 2.9 and 3.2 days respectively between hospitals as compared with patients without complications. The possibility that infection may result from longer stays as well as cause them suggests that earlier discharge might be worth consideration on clinical as well as economic grounds. However, there are significant variations in complication rates between different hospitals that cannot be explained. This should be taken into account in future studies.

In order to capture the different age groups, the length of stay was extended with dummy variables indicating various age groups[7]. A relationship between age and length of stay can be expected. Patients between 66 and 75 years have a positive effect on P1, P2 and PT. Patients over 76 years also have a positive effect on P1, P2 and PT.

[7]The reference group for age is younger than 65 years.

The coefficient for patients between 66 and 75 years old indicates that the increase by one more patient, the P1, P2 and PT will increase by 0.3, 0.6 and 0.9 day respectively between hospitals. For patients over 76 years old the coefficient indicates that the increase of one more patient, the P1, P2 and PT will increase by 0.7, 0.7 and 1.5 days respectively between hospitals. The influence of age on utilization is as expected: old sub-groups have substantially higher hospital use than younger sub-groups. However, the observed effect of age may be an overestimation as age may also pick up some of the variation due to differences in home environment.

In our research the sex differences only have a significant negative effect on P2 and PT. The result for sex variable indicates that for P2 and PT, males have a short stay patient day rate, whilst females have longer stay, between 0.3 and 0.5 days. This may be because males put more pressure on doctors to get back to work.

Hospitalisation-Related Variables

For the patient's admission status, the length of stay was extended with dummy variables indicating the three different groups[8]. Patients can be admitted via the emergency room or through pre-arrangement as elective cases (waiting list admissions) through the outpatient department and from other departments (eg. internal medicine).

In this research patients admitted through the emergency room have, on the average, a significantly higher P1. In addition, emergency room admissions also have a positive effect on P2 and PT. This supports the proposition that unplanned admissions require more preoperative activities, some of which could otherwise have been performed on an outpatient basis. Other organisation routines, such as operation scheduling, also may be adversely affected by this type of admission resulting in delays and, therefore, longer preoperative periods.

[8]The reference group for admission status is admitted through waiting list.

The fact that patients admitted through the emergency room have significantly longer P1 than the other (elective) admissions raises some doubts as to the urgency of medical intervention. The significant effect on P2 may suggest that urgent admissions may be more complicated than the other or may be not all that different, medically speaking, from the elective admissions. So, it is not unlikely that urgent admissions have longer P1 only because the patients (as well as the hospital) are less prepared for the operation at the time of admission. However, in the regression for each surgical procedure we will test this hypothesis to obtain a deeper understanding. It is also important to mention that the effect in the correlation between admission through the emergency room of having complications is not significant and for multiple diagnoses or comorbidity is not very significant. The result indicates that the increase by one more patient admitted through the emergency room, the P1, P2 and PT will increase by 7.0, 0.5 and 7.4 days respectively between hospitals as compared with patients admitted through the waiting list.

In the general regression, being admitted through internal medicine has a positive effect on P1 and PT. The result also indicates that the increase by one more patient admitted through internal medicine, the P1 and PT will increase by 4.8 and 5.0 days respectively between hospitals as compared with patients coming through the waiting list. However, in the regression for each surgical procedure we will test this hypothesis to obtain a deeper understanding. It is also important to mention that the effect in the correlation between being admitted through internal medicine of having complications is not significant and for multiple diagnoses or comorbidity is not very significant.

Table 6.5
Length of stay for admission status

	Preoperative	**Postoperative**	**Total length of stay**
Waiting list	3.1 days	7.0 days	10.0 days
Emergency room	11.4 days	9.6 days	21.0 days
Internal medicine	8.9 days	10.2 days	19 days

The mean length of stay varies for patients admitted through the waiting list to patients admitted through the emergency room and patients admitted through the internal medicine department on preoperative, postoperative and total length of stay between hospitals (see table 6.5).

In order to capture the different days in the week of the admission, the length of stay was extended with dummy variables indicating various admission days of the week[9]. Patients admitted to the hospital on a Friday have a positive effect on P1 and PT. The coefficient for these patients indicates the increase by one more patient, the P1 and PT will increase by 1.5 and 1.6 days respectively between hospitals as compared to those admitted on other weekdays.

Patients admitted to the hospital on a Saturday have a positive effect on P1 and PT. The coefficient for these patients indicates that the increase by one more patient, the P1 and PT will increase by 1.5 and 1.7 days respectively between hospitals as compared to those admitted on other weekdays.

The effect in the correlation between admitted to the hospital on Friday and Saturday of having complications and multiple diagnoses or comorbidity are not statistically significant.

In our research, being discharged on a Monday has a positive effect on P2 and PT. These results suggest that pressures upon doctors to postpone or enhance discharges to certain days of the week do not seem to influence a surgeon's decision on the time of discharge. The result indicates that the increase by one more patient, the P2 and PT will increase by 0.5 and 0.4 day respectively between hospitals as compared to those discharged on other weekdays.

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[9]The reference group for admission week is admitted other day of the week.

Hospital and Doctor Characteristics

In this research the variable occupancy rate is not statistically significant for P1, P2 and PT.

The impact average number of admissions per bed (turnover rate or cash-flow per bed) has a negative effect on P1, P2 and PT. The coefficient for the turnover rate indicates that the increase by 10 per cent the length of stay will decrease for P1, P2 and PT by 3, 6 and 9 days respectively between hospitals.

In this research the number of beds available per specialities has a positive effect on P1, P2 and PT. A relatively large supply of hospital beds per specialities in the Districts would reduce the pressure on the surgeon to cut down on length of stay and, therefore, would have a positive effect on length of stay. This finding suggests that a reduced number of hospital beds per specialty in the District would decrease its number of very long stays.

The coefficient that the number of beds per specialty indicates that with the increase by one more bed per specialist per 1,000 population, the length of stay for P1, P2 and PT will increase. However, the results are not very significant. Once it becomes clear that surgeons ration the length of stay when high occupancy rates exist, it is only a small step to link occupancy rate with the availability of beds. Relatively high occupancy rates are likely to occur in areas with relatively few beds per 1,000 population. The correlation coefficient between the occupancy rate and the ratio of beds per specialty per 1,000 population ($r = -.20$) supports this proposition. After controlling for occupancy rate, beds per population ratios may no longer play a role in the doctor's decision-making on length of stay, except may be when occupancy rates do not reach a clinical minimun level.

In the regression analysis for this research, teaching hospitals are not statistically significant for P1, P2 and PT. No support can be found for the hypothesis that length of stay in teaching hospitals is longer than in other hospitals.

Teaching hospitals also tend to be concentrated in deprived inner city areas whose patients may be viewed as having greater social needs for hospital care. However, the effect on the teaching hospital of having multiple diagnoses or comorbidity is not statistically significant and for complications is negative and significant at 95 percent confidence level. This may reflect the requirements of teaching and the reduced case load of some academic appointments.

The total number of beds have a negative effect on P1 and PT. These results support the hypothesis of economies of scale. The bigger the hospital, the shorter the length of stay. The coefficient for the number of total hospital bed indicates that the increase by one more bed per 1,000 population, the length of stay for P1 and PT will decrease by 0.4 and 0.3 day respectively between hospitals, a high level of supply being related to shorter stays.

In our research the percentage of operations has a negative effect on P1, P2 and PT. The coefficient for the percentage of operations indicates that the increase of 10 per cent in the number of operations, the P1, P2 and PT will decrease by 1.7, 1.2 and 2.1 days respectively between hospitals. Greater numbers of operations will shorten the length of stay.

The number of surgeons has a positive effect on P2 and PT. The coefficient for surgeons indicates that the increase by one more surgeon per 10,000 population, P2 and PT will increase by 4.1 and 2.5 days respectively between hospitals. In areas with a relatively high supply of surgeons, surgical patients have longer P2 and PT.

The number of resident surgeons has a positive effect on P1 and PT. If the assumption is correct that the overall number of residents per 10,000 population in a hospital is a good proxy for the degree of teaching activity on the surgical department of that hospital, teaching activity itself has a significant effect on a patient's preoperative and the total length of stay. The coefficient indicates that for an increase by one more resident surgeon per 10,000 population, the P1 and PT will increase by 1.7 and 2.0 days respectively between hospitals.

Regional Supply Variable

In the regression the GP variable is not statistically significant for P1, P2 and PT. This suggests that surgeons do not discharge patients earlier because of the presence of relatively more general practitioners who may provide follow-up treatment.

It should come as no surprise that around 50% of the variation in the preoperative, postoperative and the total length of stay remains unexplained. In fact, most of the length of stay studies performed on specific cases across hospitals do not reach the R Square levels reported here. This is partly due to the fact that there is likely to be considerable random variation among individual cases and partly due to the fact that many of the independent variables used are imperfect measures of the underlying concepts. However, the importance of the R Square measure should not be overestimated.

While the R Square is a useful measure in terms of an overall indication of the extent to which the variables used in the equations capture variation in the dependent variable, it should be emphasised that the significance tests (t-scores) of the regression coefficients of the individual independent variables are far more relevant for the purpose of this research. A high R Square would be crucial to a model attempting to predict patients' lengths of stay based on certain quantifiable characteristics.

But the purpose of this research is to test hypothesised effects of certain variables on the preoperative, postoperative and the total length of stay, after controlling for as many confounding factors as possible. Even a relatively low R Square is acceptable as long as the unexplained variation is not expected to lead to biased regression coefficients for one or more of the independent variables included in the research. The results of most independent variables are, therefore, expected to be reasonably accurate.

It should be clear that including this set of medically related variables in the equation primarily serves the purpose of reducing unexplained variation and, more importantly, separating the medical condition related effects on preoperative, postoperative and total length of stay from the non-medical condition effects of other variables which are correlated with the first set of variables.

The general regression for the twenty-three selected surgical DRGs gives a good picture of the average effect of each variable on the preoperative, postoperative and the total length of stay. Further clarification on how those variables affect preoperative, postoperative and the total length of stay can be achieved when the regression is separately applied to each surgical DRGs.

6.5 Specific Surgical DRGs Regression Results on the Preoperative, Postoperative and the Total Length of Stay

Several researchers have stressed the importance of analysing hospital utilisation data for separate diagnoses. This would facilitate a more clear understanding of what goes on in a hospital and in clinical practice[282].

The eleven most common surgical DRGs were selected from the basis group of twenty-three to test the hypotheses. In presenting this theoretical framework, we have invoked a uniform model structure across eleven surgical DRGs that are different from each other. In some relatinships, we expect particular results, regardless of the surgical DRG. In other relationships, we expect different results, depending on which surgical DRG is analysed. These differences in expectations can occur either because some variables are irrelevant in some surgical DRGs.

It is hoped that the value of information and the results presented here will open a discussion among surgeons, hospital managers and policy-makers. The remainder of this second part is structured similarly to the first part of this chapter.

There is wide variation in preoperative, postoperative and the total length of stay for each surgical DRG as shown in Table 6.3. The R Squares range from 0.18 for Uterine & Adnexa Proc for Non-Malignancy without comorbidity and complications to 0.47 for Prostatectomy without comorbidity and complications for the preoperative length of stay regression. For the postoperative length of stay, the R Squares range from 0.00 for the

Transurethral Prostatectomy without comorbidity and complications and Total Cholecystectomy with C.D.E. without comorbidity and complications to 0.27 for Prostatectomy without comorbidity and complications and for the total length of stay the R Squares range from 0.17 for Uterine & Adnexa Proc for Non-Malignancy without comorbidity and complications to 0.50 for Prostatectomy without comorbidity and complications (henceforth, CC). Significant levels of individual variables sometimes differ drastically from procedure to procedure.

Table 6.6

Variations explained for each surgical DRG

DRGs	**Preoperative**	**Postoperative**	**Total Length**	**No of Cases**
	R square	R square	R square	
39	0.28	0.22	0.29	1646
307	0.47	0.27	0.50	362
337	0.44	0.00	0.39	285
311	0.41	0.14	0.39	433
358	0.30	0.17	0.23	220
359	0.18	0.06	0.17	1033
158	0.39	0.07	0.29	222
162	0.39	0.25	0.35	584
196	0.31	0.00	0.31	253
197	0.45	0.11	0.20	180
198	0.40	0.05	0.36	1158

The empirical results of the eleven surgical DRGs regressions are shown and explain in Appendix 3.

For the different surgical DRGs, the results for the different independent variables on the preoperative, postoperative and total length of stay dependent variables were the followings:

For Lens Procedures with or without Vitrectomy, increasing the number of patients per bed will decrease the length of stay. Complications and multiple diagnoses or comorbidity will increase the length of stay as compared with patients without complications and without multiple diagnoses. Patients admitted to the hospital on Friday and discharged on Monday have a longer length of stay as compared with patients admitted on other days of the week and discharged on other days of the week. Increasing the percentage of operations will increase length of stay. Patients admitted to a teaching hospital stay longer than patients admitted to other hospitals. However, for postoperative length of stay, patients stay shorter. A high supply of surgeons will decrease length of stay. A high supply beds per specialities will increase length of stay. However, the significant is very low. High occupancy rate will increase the length of stay. A high supply of GPs will decrease the preoperative length of stay and will increase the postoperative length of stay. A high supply of total number of hospital beds will decrease the length of stay.

For Prostatectomy W/O CC, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospitals. However, for postoperative length of stay, patients admitted through the emergency room only stay 0.9 day longer than elective patients and for patients admitted through internal medicine the length of stay is similar to elective patients. Increasing the number of patients per bed will increase the preoperative length of stay and will decrease the postoperative length of stay. Patients admitted to the hospital on Friday and Saturday stay longer in the hospital for preoperative and total length of stay but not for postoperative length of stay as compared with patients admitted on other days of the week. Patients discharged on Monday stay in the hospitals longer as compared with patients discharged on other days of the week. Older patients have a longer postoperative length of stay. High numbers of operations reduce the length of stay. Patients admitted to a teaching hospitals have a shorter length of stay. A high supply of surgeons decreases the postoperative length of stay. High occupancy rate decreases the total length of stay. High number of GPs increase the postoperative length of stay. A high number of total hospital beds increases length of stay.

For Transurethral Prostatectomy W/O CC, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital for preoperative and total length of stay. However, they do not stay longer for postoperative length of stay. Patients admitted to the hospital on Friday and on Saturday stay longer as compared with the patients admitted on other days of the week. These patients do not stay longer on the postoperative length of stay. Patients over 76 years old have a longer length of stay in the hospitals than the rest of the patients. Patients admitted to a teaching hospital have a longer total length of stay. A high supply of surgeons increases the total length of stay. High supply of beds per specialities increases the preoperative length of stay, however, the significant is very low. High occupancy rate will increase the length of stay. High supply of GPs increase the preoperative length of stay. A high number of total hospital beds will decrease the total length of stay.

For Transurethral Procedures W/O CC, patients admitted through the emergency room stay longer only for preoperative and total length of stay as compared with patients admitted through the waiting list and through internal medicine. Increasing the number of patients per bed will increase the length of stay. Patients discharged on Monday stay longer than patients discharged on another day of the week. Older patients stay longer in the hospital. Patients admitted to a teaching hospital stay longer than patients admitted to other hospitals. High supply of surgeons increases length of stay. However, high supply of resident surgeons decreases the total length of stay. High supply of beds per specialities increase and decrease the preoperative and postoperative length of stay respectively, however, the significant is quite low. High occupancy rate will increase the length of stay. High supply of GPs will increase and decrease the preoperative and postoperative length of stay respectively.

For Uterine & Adnexa Proc for Non-Malignancy W CC, patients admitted through internal medicine have a longer length of stay as compared with patients admitted through waiting list and through emergency room. Increasing the number of patients per bed will decrease the length of stay. Patients with multiple diagnoses or comorbidity stay longer in the hospital for preoperative length of stay and shorter for postoperative length of stay as compared with patients without multiple diagnoses. Patients discharged on Monday stay shorter in the hospital as compared with patients discharged on other days of the week. Older patients stay longer in the hospital. Patients admitted to a teaching hospital have shorter preoperative length of stay as compared with patients admitted to other hospitals. High supply of beds per specialities will decrease the total length of stay. High occupancy rate will decrease the length of stay.

For Uterine & Adnexa Proc for Non-Malignancy W/O CC, increasing the number of patients per bed will decrease the length of stay. Patients admitted on Friday and Saturday stay longer in the hospital as compared with patients admitted on other days of the week. Older patients stay longer in the hospital. Patients admitted to a teaching hospital have shorter postoperative length of stay as compared with patients admitted to other hospital. High supply of surgeons will increase the postoperative length of stay and decrease the preoperative and total length of stay. High supply of resident surgeons will increase the length of stay. High supply of beds per specialities will decrease the total length of stay, however it is not a high significant. High occupancy rate will decrease the preoperative length of stay. High supply of GPs will increase the preoperative length of stay. A high number of total hospital beds will decrease the preoperative length of stay.

For Anal & Stomal Procedures W/O CC, patients admitted through the emergency room and internal medicine stay longer as compared with patients admitted through the waiting list. Patients admitted on Friday have a shorter postoperative length of stay as compared with patients admitted on other days of the week. Patients admitted to a teaching hospital have a longer preoperative and total length of stay, however, the postoperative length of stay is shorter. A high number of total hospital beds will increase the postoperative length of stay.

For Inguinal & Femoral Hernia Procedures Age >17 W/O CC, patients admitted through the emergency room stay longer as compared with patients admitted through the waiting list and internal medicine. Increasing the number of patients per bed will increase the postoperative length of stay. Patients admitted to the hospital on Friday have a longer preoperative length of stay as compared with patients admitted on other days of the week. Patients discharged on Monday have a shorter postoperative length of stay as compared with patients discharge on other days of the week. Male patients have a shorter length of stay. Older patients have a longer length of stay in the hospitals. Increasing the percentage of operations the postoperative length of stay will decrease. Patients admitted to a teaching hospital have a longer total length of stay as compared with patients admitted to other hospitals. High supply of surgeons will increase the length of stay. High supply of resident surgeons will increase the preoperative length of stay and will decrease postoperative and total length of stay. High supply of beds per specialities will increase the preoperative length of stay. High occupancy rate will decrease the postoperative length of stay. High supply of GPs will decrease the postoperative length of stay.

For Total Cholecystectomy W C.D.E. W/O CC, patients admitted through the emergency room and internal medicine stay longer than patients admitted through the waiting list. Male patients stay shorter than female patients. High supply of surgeons and resident surgeons will decrease the length of stay.

For Total Cholecystectomy W/O C.D.E. W CC, patients admitted through the emergency room and internal medicine will stay longer as compared with patients admitted through waiting list. Patients with complications have a longer postoperative length of stay as compared with patients without complications. Patients discharged on Monday have a longer length of stay as compared with patients discharge on other days of the week. Increasing the number of operations will decrease the length of stay. High supply of resident surgeons will increase the postoperative length of stay. High occupancy rate will decrease the preoperative length of stay.

For Total Cholecystectomy W/O C.D.E. W/O CC, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Patients admitted to the hospital on Friday and Saturday stay longer in the hospital as compared with patients admitted on other days of the week. Patients discharged on Monday stay longer as compared with patients discharged on other days of the week. Older patients stay longer in the hospital than younger patients. Increasing the percentage of operations the length of stay will decrease. High supply of surgeons will decrease the length of stay. High supply of beds per specialities will increase the preoperative length of stay and will decrease the postoperative length of stay. However, the significant is very low.

6.6 Hospital Regression Results on the Preoperative, Postoperative and the Total Length of Stay for All Selected Surgical DRGs

In this section we investigate whether the results from the general and specific surgical DRGs regression estimated in the previous sections, can be refined by estimating separate equations for the different hospitals.

There is wide variation in preoperative, postoperative and the total length of stay for the eight hospitals as shown in Table 6.7. The R Square range from 0.14 for hospital 5 to 0.63 for hospital 4 for the preoperative length of stay regression. For the postoperative length of stay, the R Square range from 0.22 for hospital 8 to 0.46 for hospital 1 and for the total length of stay the R Square range from 0.25 to 0.60 for hospital 4.

Table 6.7
Variations explained for each hospital

Hospitals	Preoperative	Postoperative	Total Length	No of Cases
	R Square	R Square	R Square	
Hospital 1	0.52	0.46	0.56	578
Hospital 2	0.51	0.45	0.58	996
Hospital 3	0.38	0.39	0.40	986
Hospital 4	0.63	0.45	0.60	853
Hospital 5	0.14	0.29	0.29	623
Hospital 6	0.62	0.32	0.57	1512
Hospital 7	0.53	0.30	0.51	836
Hospital 8	0.24	0.22	0.25	663

The empirical results of the eight hospitals regressions are shown and explain in Appendix 4.

For hospital 1, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Increasing the number of patients per bed will decrease the postoperative length of stay. Patients with complications will increase the length of stay as compared with patients without complications. Patients with comorbidity will decrease the preoperative length of stay. However, patients with comorbidity will increase the postoperative length of stay. Patients admitted to the hospital on Friday and Saturday stay longer in the hospital as compared with patients admitted on other days of the week. Patients discharged on Monday stay in the hospital longer as compared with patients discharged on other days of the week. Male patients stay shorter than female patients. Older patients stay longer in the hospital. Increasing the numbers of operations will increase the length of stay. A high supply of surgeons decrease the postoperative and total length of stay. High occupancy rate increase the postoperative length of stay.

For hospital 2, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Increasing the number of patients per bed will increase the preoperative length of stay and will decrease the postoperative length of stay. Patients with complications will increase the length of stay as compared with patients without complications. Patients with comorbidity will increase the length of stay. Patients admitted to the hospital on Friday and Saturday stay longer in the hospital as compared with patients admitted on other days of the week. Patients discharged on Monday stay in the hospital longer postoperative length of stay as compared with patients discharged on other days of the week. Older patients stay longer in the hospital. A high supply of beds per specialities decrease the postoperative length of stay. High occupancy rate increase the total length of stay.

For hospital 3, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Increasing the number of patients per bed will decrease the total length of stay. Patients with complications will increase the postoperative and total length of stay as compared with patients without complications. However, these patients will decrease the preoperative length of stay. Patients with comorbidity will increase the length of stay.

Patients admitted to the hospital on Friday have a longer preoperative length of stay in the hospital as compared with patients admitted on other days of the week. Patients discharged on Monday stay in the hospital longer as compared with patients discharged on other days of the week. Older patients stay longer in the hospital. Increasing the number of operations will increase the postoperative length of stay. A high supply of surgeons will increase the total length of stay. A high supply of beds per specialities increase the postoperative length of stay. High occupancy rate decrease the preoperative and total length of stay. However, the postoperative length of stay will increase.

For hospital 4, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Patients with complications will increase the length of stay as compared with patients without complications. Patients with comorbidity will increase the length of stay. Patients admitted to the hospital on Friday and Saturday stay longer in the hospital as compared with patients admitted on other days of the week. Patients discharged on Monday stay in the hospital longer as compared with patients discharged on other days of the week. Patients between 66 and 75 years old stay longer in the hospital. A high supply of resident surgeons decrease the postoperative and total length of stay. A high supply of beds per specialities wil increase the postoperative and total length of stay.

For hospital 5, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Increasing the number of patients per bed will increase the postoperative length of stay. Patients with complications will increase the length of stay as compared with patients without complications. Patients with comorbidity will increase the length of stay as compared with patients without comorbidity. Patients admitted to the hospital on Friday have a longer total length of stay in the hospital as compared with patients admitted on other days of the week. Male patients stay longer than female patients. Older patients stay longer in the hospital. Increasing the numbers of operations will decrease the total length of stay. High occupancy rate decrease the preoperative and total length of stay.

For hospital 6, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Patients with complications will increase the length of stay as compared with patients without complications. Patients with comorbidity will increase the postoperative and total length of stay. Patients admitted to the hospital on Friday and Saturday stay longer in the hospital as compared with patients admitted on other days of the week. Male patients stay longer than female patients. Older patients stay longer in the hospital. A high supply of surgeons increase the postoperative and total length of stay. High supply of beds per specialities will increase the length of stay.

For hospital 7, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Increasing the number of patients per bed will decrease the preoperative length of stay and increase the total length of stay. Patients with complications will increase the length of stay as compared with patients without complications. Patients with comorbidity will increase the length of stay. Patients admitted to the hospital on Friday and Saturday stay longer in the hospital as compared with patients admitted on other days of the week. Older patients stay longer in the hospital. Increasing the numbers of operations will increase the length of stay. A high supply of surgeons decrease the preoperative length of stay. High supply of beds per specialities will decrease the preoperative length of stay and will increase the total length of stay. High occupancy rate decrease the postoperative length of stay.

For hospital 8, patients admitted to the hospital through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Patients with complications will increase the length of stay as compared with patients without complications. Male patients have a longer postoperative length of stay. Older patients have a longer total length of stay. A high supply of surgeons decrease the preoperative length of stay and increase the postoperative length of stay. High supply of beds per specialities will decrease the postoperative and total length of stay.

6.7 Conclusion

In this chapter we have analysed the factors affecting the preoperative, postoperative and the total length of stay for patients with twenty-three common surgical DRGs in eight general and teaching hospitals in Spain. A stepwise multiple regression was estimated on all hospitalisations and for eleven specific surgical DRGs in 1991. A regression was also estimated for the eight different hospitals for all the surgical DRGs. The regressions were derived on the basis of a description of the hospitalisation process and the results of the studies reviewed in Chapter 3.

The empirical analysis highlights the relative significance of certain variables compared to other variables as well as the relative significance of certain variables on the preoperative, postoperative and the total length of stay. Splitting length of stay up into preoperative, postoperative and the total length of stay clearly has contributed to a better understanding of what, how and why different factors influence surgeon decisions in relation to the duration of a patient's stay in the hospital. The results of the preoperative, postoperative and the total length of stay regression equation further clarified the nature of some variables.

The analysis presented in this chapter provides information for a discussion that is important both for hospital managers and for policy-makers interested in determining how hospitals might operate more efficiently. Specifically, the analysis suggests where efforts to shorten hospital stays are best directed. We were able to account for 41%, 46% and 52% of the variation in average preoperative, postoperative and total length of stay for the general regression and between 18% to 47% on preoperative length of stay, 0% to 27% on postoperative length of stay and 17% to 50% on total length of stay of the variation in specific surgical DRGs. We also were able to account between 14% to 63% on preoperative length of stay, 22% to 40% on postoperative length of stay and 25% to 58% on total length of stay of the variation in the eight hospitals for all the surgical DRGs. Clearly, there is a large proportion of variation left unexplained.

To investigate hospital efficiency in terms of patients' resource consumption and to understand the effects of nonclinical factors that may influence it, it is necessary to identify variations in patients' clinical characteristics. The creation of diagnostic categories within which patients are reasonably clinically homogenous is the initial step.

The empirical analysis showed that, not surprisingly, length of hospital stay is determined to a large extent by health status indicators. Moreover, decisions taken by the attending surgeons with respect to medical treatment appeared to affect the duration of stay in various ways. However, assuming that the health condition of a patient is the only valid criterion for staying in a hospital and if health status is sufficiently controlled for in the present analysis, the results suggest several ways in which length of stay may be reduced without damage to health status. Longer stays were estimated for patients with more severe DRGs, comorbidity or multiple diagnoses, complications after the operation, between 66 and 75 years old, over 76 years old, admitted through the emergency room, coming from internal medicine, admitted to the hospital on a Friday or a Saturday and discharged on a Monday, living in an area with a relative large supply of surgeons, beds per specialities and resident surgeons. In contrast, patients who were admitted to a hospital with a high turnover rate, high percentage of operations and high number of total hospital beds experience shorter lengths of stay.

The effects of particular variables on the length of stay found in this research are consistent with the effects found in the majority of publications dealing with these particular variables. The empirical analysis showed that, not surprisingly, length of hospital stay is determined to a large extent by health status indicators, hospital-related variables, the hospital and doctors and regional supply variable.

Case mix differences across patients play a major role in explaining differences in the preoperative, postoperative and the total length of stay. This result agrees with the findings of several studies published in the past. In this research it is also found that cases with multiple diagnoses and complications tend to stay significantly longer in the hospital than cases without multiple diagnoses and complications in the general regression. However, for one surgical DRGs, multiple diagnoses have a negative effect on P2. These finding underline the importance of controlling for case mix and severity of illness differences. It is for this reason that we convert the procedures into DRGs.

Age adds significantly to lengths of stay. Patients between 66 and 75 years and over 76 years stay longer periods than younger patients in the general regression and in most of the surgical DRGs for the preoperative, postoperative and the total length of stay. Women exhibit longer lengths of stay than men for one surgical DRGs on preoperative and postoperative length of stay and for two surgical DRGs on total length of stay.

Patients with emergency room admission status have longer stays for eight surgical DRGs on preoperative length of stay, for three surgical DRGs on postoperative length of stay and for eight surgical DRGs on total length of stay. Patients coming through internal medicine have longer stays on preoperative length of stay for seven surgical DRGs, on the postoperative length of stay for only one surgical DRG and for six surgical DRGs on total length of stay. This finding indicates that these patients do not have more severe medical conditions than the rest.

Unless an argument can be made that the extra days substantially improve quality of care, patients admitted through emergency room for elective surgeries should be eliminated and patients coming through internal medicine should be managed in a better way.

The fact that patients admitted on Fridays and Saturdays have been found to stay relatively longer in the hospital has often been attributed to the reduced operating activities during week-end days. This research shows that those patients have significantly longer preoperative and total length of stays but not significantly longer postoperative length of stay, which could indicate that these patients do not have a more severe medical condition. Our results can be interpreted as evidence that providers who make week-end admissions are simply less efficient in terms of days of care both in the preoperative and total phases of a hospital episode. The increase of one more patient admitted on Friday or Saturday will increase the length of stay by one and a half more days than the rest of the patients admitted on another day of the week for preoperative length of stay and between one day to two days for total length of stay, thus longer preoperative and total length of stay while their health condition need not make this necessary.

Patients discharged on a Monday have been found to stay longer for six surgical DRGs than the rest and shorter for two surgical DRGs on postoperative length of stay. Apparently, surgeons for some surgical DRGs have a preference to discharge their patients just after the weekend, despite the small or even absent financial incentives on the part of surgeons to follow such a course. However, the fact that comparable patients (in terms of case mix) stay less in a hospital, seems to suggest that these days are, in general, not necessary.

Occupancy rates were found to influence the preoperative, postoperative and the total length of stay in a positive way for two, two and three surgical DRGs on preoperative, postoperative and total length of stay respectively. This result is in line with Roemer's Law, which would suggest that stay is lengthened when there are empty hospital beds. Similarly, we would expect rationing to occur in periods of tight bed supply so that those patients most in need of hospital beds would be able to find available space. This results support the idea that reductions in availability of hospital beds in the area will decrease utilisation.

The results for the turnover rate indicates that the increase of the number of patients per beds will decrease the length of stay. However, in the specific regression for two surgical DRGs, increasing the number of patients per bed will increase the postoperative and the total length of stay.

An increment of number of beds per specialty will increase the length of stay in the general regression analysis on preoperative, postoperative and the total length of stay. The results for the surgical DRGs specific regression are similar to the general regression for four, one and one surgical DRGs on preoperative, postoperative and total length of stay respectively, however, for two and two surgical DRGs the number of beds per specialty will decrease on postoperative and total length of stay.

Patients admitted to a teaching hospital do not have any effect on length of stay for the general regression. However, for the surgical DRGs specific regressions, there are different results. For three and five surgical DRGs admitted to a teaching hospital will increase on preoperative and total length of stay respectively and for two, three and one surgical DRGs will decrease on preoperative, postoperative and total length of stay respectively. This finding suggests that a thorough examination of teaching hospitals might lead to ideas for improving the performance of these hospitals.

The increment on the percentage of operations will decrease the length of stay in the general and specific regression analysis.

In districts with relatively more general surgeons, the length of stay will increase on the postoperative and the total length of stay for the general regression. For the specific DRGs regression the number of surgeons will increase for three surgical DRGs on postoperative and total length of stay respectively. However, for three, two and three surgical DRGs the number of surgeons will decrease on preoperative, postoperative and total length of stay respectively.

The increment on the number of resident surgeons will increase the preoperative and the total length of stay in the general regression. For the specific DRG regression one and three surgical DRGs the number of residents will decrease on postoperative and total length of stay respectively and for two, one and one surgical DRGs will increase on preoperative, postoperative and total length of stay respectively.

In districts with relatively more GPs, the length of stay in the general regression does not have any significant effect. However, for the specific surgical DRGs regression, three and two surgical DRGs have a longer preoperative and postoperative length of stay and one and two surgical DRG shorter preoperative and postoperative length of stay.

The results for the different general and teaching hospitals indicate that patients admitted to the hospitals through the emergency room and internal medicine stay longer in the hospital as compared with patients admitted through the waiting list. Patients with complications after the operation stay longer in the hospital as compared with patients without complications. Patients with comorbidity or multiple diagnoses stay longer in the hospital as compared with patients without comorbidity or multiple diagnoses. Patients admitted to the hospital on Friday and Saturday stay longer in the hospital as compared with patients admitted on other days of the week. Patients discharged on Monday stay in four hospitals longer as compared with patients discharged on other days of the week. Older patients stay longer in the hospitals. A high supply of resident surgeons decrease the length of stay in one hospital.

The results indicate that certain variables do have different effects on preoperative, postoperative and the total length of stay. Some of these effects suggest that inefficiencies in admission status, admission scheduling, discharge planning, etc, do appear to exist. This corresponds with the observations made in some recent studies that unnecessary hospital days occur throughout a patient's stay in the hospital.

The results support the formulated hypothesis derived from the theory. However, for other variables such as turnover rate, sex, percentage of operations, number of surgeons per 10,000 population, number of beds per specialities per 1,000 population, occupancy rate, the formulated hypotheses have different results. One possible confounding factor suggested could be that a disproportionately large number of those surgical DRGs may be performed in certain hospitals located in some areas with relatively high/low beds per specialities per 1,000 population, surgeons per 10,000 population and that, due to the large volumes, treatment and length of stay may be more effective in those hospitals.

Different types of hospitals have different sets of goals and objectives and that these long term preferences are taken into account in the day-to-day decision-making on the duration of hospital stays. Further research is necessary to analyse whether these differences between hospitals exist and to determine how these differences affect hospital utilisation. There is a pressing need for clinical and health service research to help to determine the specific medical practices that are related to longer length of stay.

The objective of the surgical study has been to discover some of the factors contributing most to excessive utilization of hospital. The foregoing analysis was intended to advance our understanding of the problem of unnecessary utilization and clarify the need for and nature of particular policy alternatives. Some of the finding bring new insights concerning hospital utilisation patterns but further research is necessary to confirm and elaborate on these findings.

The segmentation of the total length of stay into preoperative, postoperative and the total length of stay has helped to clarify the relationship between these factors and the duration of hospital stay.

Chapter 7

Factors which Determine the Different Components of Inpatient Costs

In this chapter we present and discuss an empirical analysis of the costs of the various services related to the hospitalisation of different surgical Diagnosis Related Groups (DRGs) in four general hospitals in Spain. This analysis is based on the data described in Chapter 5. The purpose of this chapter is to compare the empirical results of each independent variable with the hypothesis formulated and to contrast the effects and significance levels of these independent variables on total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient (lab, x-ray, etc).

The chapter is divided into three parts. The first part focuses on the empirical analysis of all twenty-two selected surgical DRGs taken together in one general regression equation with the different components of inpatient costs as the dependent variables. In the second part, we will construct the different components of inpatient costs regression analysis specifically for the most important ten surgical DRGs. In the third part, we will construct the different components of inpatient costs regression analysis specifically for the four hospitals for all twenty-two selected surgical DRGs. The chapter end with a discussion of the findings in light of published emperical evidence.

7.1 Introduction

As public attention in Spain turns to the issues of hospital cost containment and reimbursement reforms, the role of output, or case mix in explaining cost variation across hospitals becomes increasingly important. A rational hospital cost containment programme is possible only if we understand the factors which account for hospital costs in different settings. In this chapter, we analyse and discuss the factors which determine inpatient costs in four acute general hospitals.

The volume of various services related to hospitalisation on the basis of cost data will be analysed by taking these cost-differences (Relative Value Units) into account, as previously described in Chapter 5.

We are not so much interested in costs as such, but primarily in the volume of services for which they are costed. Spanish pesetas (Pst) was the monetary unit used in this research. In particular, the aim was to interpret the costs for ancillary care (which comprise laboratory tests, x-rays, use of theatre time, drugs, etc) as proxies for the volumes of these services with the price for the various services functioning as weighting factors[10].

When a patient is admitted into a Spanish hospital, the following components of costs can be distinguished; the ward cost for each patient, consisting of ward costs related to length of stay and overheads; the drug cost for each patient; the test cost for each patient, consisting of the laboratory, x-ray, etc and the total cost per each patient, consisting of the sum of all these costs, plus operating theatre costs. To avoid unnecessary repetition of 'for each patient' we shall simply refer to total cost, ward cost, drug cost and test cost in what follows. But it should be remembered that when used in that way the relevant concept applies to each patient.

If cost variation reflects differences in case mix, it is important that this be taken into account explicitly whenever hospital costs are compared.

Implicit in this analysis is that to do more tests, to have more drugs or to require higher costs for producing the same product is inappropriate or wasteful behaviour, i.e., the behaviour is unnecessary in that the marginal benefits of more tests, drugs or total cost are minimal. The definition of an unnecessary test, drugs in this context, is one that does not make another patient better off undergoing the same operation, with the same outcome.

We argued that the cost of hospitalisation is a function of the health status, hospitalisation-related variables, hospital and doctor characteristics and regional supply variables. As noted, one of the most important factors influencing costs is the number of days

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[10]The fact that the prices of these services are zero in hospitals, led us to include the price.

for hospitalisation. Length of stay (preoperative and postoperative length of stay), however, has an effect on costs. It is well known that the average length of stay and the different components of hospital costs are highly correlated[283]. We therefore conducted analyses both including and excluding length of stay for the general regression and specifically for the 10 surgical DRGs.

7.2 Description of the General and Specific Surgical DRGs Regression Equation Formulated with Respect to Different Components of Inpatient Costs

In the first part, a sample of twenty-two very common surgical DRGs was selected to test the hypothesised effects of a series of variables on total cost, ward cost, drug cost and test cost. This sample includes data from 1,222 inpatients in four hospitals. In the second part, a sample of ten common surgical DRGs was selected from the twenty-two surgical DRGs to test the hypothesised effects of a series of variables on the different components of inpatient costs in the DRGs-specific equation.

The purpose of this chapter is to test the effect of certain explanatory variables on the different costs after controlling as many confounding factors as possible.

Previous research on the factors affecting costs has focused on determining the importance of selected variables. Consequently, we only report here only on the variables that have drawn the interest of previous researchers and ignore the other results they obtained.

The independent variables appearing in the equation of the regression basically form a selection of the variables that were employed in the empirical analyses of the previous Chapter 6 for preoperative, postoperative and the total length of stay. However, we excluded in this regression the variable of the teaching hospital and we included operating theatre minutes. The variables preoperative and postoperative length of stay will be included and excluded in the different regressions.

A detailed description of the variables (dependent and independent) is provided in Chapter 5.

7.3 Hypothesis Effects on Total Cost, Ward Cost, Drug Cost and Test Cost

An increase in the complexity of the different surgical DRGs cases treated increases costs. Variables reflecting case mix account for a considerable amount of the variation in the different components of inpatient costs. The variables that reflect the patient's medical conditions are one of the most important factors influencing the different components of inpatient costs.

We expect complications after the operation to have a higher cost because normally these patients consume more resources than patients without complications. One might thus expect that the more complex the case, the more resources would be used as compared to cases admitted which were less severe. Thus we expect patients with multiple diagnoses and comorbidity to use more resources than patients without multiple diagnoses.

Age can be expected to be a determinant of higher inpatients costs. As the patients age the more resources they will consume, for example drugs. We expect older patients to consume more resources than younger patients. However, patient age has been an inconsistent predictor of inpatient costs[284].

The patient's length of stay is an important variable contributing to costs. In fact, on average, the most important single factor contributing to the cost of a hospitalisation will be the patient's length of stay (preoperative and postoperative length of stay). We expect patients with a long preoperative length of stay to consume more resources than those patients who just come to the hospital with all the tests ready and then have the operation. We also expect patients with a long postoperative length of stay to consume more resources than patients who are discharged earlier. The surgical procedure will involve plenty of staff in patient care. All days and bottlenecks in this part of the process are expensive for the management of the department and the whole hospital.

The length of the anaesthesis care and the operation technique depend on the procedure undertaken, the general condition of the patient and the quality of care in the operating room. A longer time in the operating theatre may be due to related with more complicated patients or a more difficult technique or even a lack of the surgeon's experience.

Patients, as we have pointed out in the previous chapter on the length of stay, can be admitted via the emergency room, internal medicine and through prearrangement in elective cases. If patients enter through the emergency room or internal medicine, we would expect them to be less healthy and thus consume more resources as compared with patients admitted through the waiting list.

For the occupancy rate of a hospital there are mixed results in the different studies in relation to inpatient costs. The values for occupancy rate support the idea that hospitals tend to operate more efficiently when the occupancy rate is high. If we allocate more patients per bed, it will be expected to consume more resources. We expect larger hospitals to have lower costs than small hospitals and to support the concept of economies of scale.

We also expect to have a positive relationship between the number of surgeons and the resources consumed. Hospitals in areas with high supply of surgeons to population ratios report significantly higher costs than hospitals in areas with fewer surgeons. Under the supplier-induced demand hypothesis, one would expect areas with a large number of surgeons to have longer lengths of stay. We expect a strong positive relationship between the number of resident surgeons and the resources consumed. Resident surgeons are believed to be more likely to rely on time-consuming tests to aid in the diagnosis process. We expect a negative relationship between the number of GPs and the resources consumed in the hospital.

7.4 General Regression Results on the Different Components of Inpatient Cost

The variables identified in the literature are not all inclusive, but represent the factors most often identified as likely to affect costs.

The analyses consisted of series of regressions estimated using the statistical analysis technique stepwise multiple regression in which the different components of inpatient costs are regressed against a series of variables representing patient health indicators, hospitalisation-related variables, hospital and doctor characteristics and regional supply variables.

In table 7.1 the different components of inpatient costs as dependent variables are regressed against the patient's surgical DRGs. The surgical DRGs alone explain about 60 per cent of the variations between patients in total cost, 58 per cent in ward cost, 30 per cent in drug cost and 42 per cent in test cost. Table 7.1 shows the estimated results of the regression for the different diagnoses for total cost, ward cost, drug cost and test cost.

Table 7.1
Results of the regression for the different surgical DRGs

Surgical DRGs	Total cost	Ward cost
	Coefficient (St. error)Sig	Coefficient (St. error)Sig
Constant	238,842(966.0)**	108,573(4,085.5)**
DRG 196 T.Cholecys.W CDE W/O CC	400,288(18,966.1)**	246,973(14,203.0)**
DRG 198 T.Cholecys.W/O CDE W/O CC	169,154(11,711.1)**	108,504(8,641.1)**
DRG 197 T.Cholecys.W/O CDE W CC	383,475(21,418.4)**	226,249(16,070.5)**
DRG 307 Prostatect.W/O CC	109,874(14,446.5)**	86,541(10,747.8)**
DRG 311 Trans.Proc.W/O CC	NS	NS
DRG 195 T.Cholecys.W CDE W CC	610,783(39,483.6)**	369,066(29,771.5)**
DRG 337 Trans.Prost.W/O CC	122,807(17,679.6)**	82,609(13221.6)**
DRG 336 Trans.Prost.W CC	190,347(33,521.7)**	170,518(25,256.1)**
DRG 310 Trans.Proc.W CC	NS	NS
DRG 306 Prostatect.W CC	219,610(28,236.0)**	158,925(21,249.0)**
DRG 157 Anal&Stomal Proc.W CC	NS	NS
DRG 160 Hernia Proc.Except Ingui & Fem Age>17 W/O CC	60,440(22,956.4)**	61,001(17,240.2)**
DRG 159 Hernia Proc.Except Ingui & Femo Age>17 W CC	253,188(47,030.0)**	233,153(35,483.1)**
DRG 163 Hernia Proc.Age<18	NS	NS
DRG 355 Uterine, Adnexa Proc. Non Ovar/Adnexal Malignancy W/O CC	490,592(30,523.5)**	398,847(22,983.7)**
DRG 162 Inguinal & Femoral Hernia Proc. Age>17 W/O CC	NS	NS
DRG 354 Uterine, Adnexa Proc. Non Ovar/Adnexal Malignancy W CC	724,699(123,568.5)**	487,857(93,344.5)**
DRG 358 Uterine&Adnexa Proc. for Non-Malignancy W CC	423,510(20,644.5)**	357,492(15,481.5)**
DRG 359 Uterine&Adnexa Proc. for Non-Malignancy W/O CC	250,906(11,360.0)**	220,204(8,369.2)**
DRG 158 Anal&Stomal Procedure W/O CC	-61,044(14,120.7)**	NS
DRG 161 Inguinal & Femoral Hernia Proc.Age>17 W CC	117,975(25,890.6)**	100,609(19,469.1)**
R Square	0.60	0.58
F	114**	111**
N of cases	1,222	1,222

Table 7.1 (Continuation)

Surgical DRGs	Drug cost	Test cost
	Coefficient (St. error)Sig	Coefficient (St. error)Sig
Constant	1,672(373.0)**	3,267(471.8)**
DRG 196 T.Cholecys.W CDE W/O CC	12,088(1,326.0)**	34,245(1,704.1)**
DRG 198 T.Cholecys.W/O CDE W/O CC	7,769(804.0)**	14,670(1,031.0)**
DRG 197 T.Cholecys.W/O CDE W CC	28,038(1,501.1)**	27,471(1,929.6)**
DRG 307 Prostatect.W/O CC	8,916(1,002.0)**	6,576(1,286.4)**
DRG 311 Trans.Proc.W/O CC	5,372(2,148.5)*	NS
DRG 195 T.Cholecys.W CDE W CC	14,230(2,784.0)**	49,523(3,581.3)**
DRG 337 Trans.Prost. W/O CC	6,183(1,234.0)**	7,208(1,585.6)**
DRG 336 Trans.Prost. W CC	8,840(2,361.2)**	NS
DRG 310 Trans.Proc.W CC	9,373(3,581.0)**	NS
DRG 306 Prostatect.W CC	11,181(1,986.1)**	8,512(2,554.2)**
DRG 157 Anal&Stomal Proc.W CC	NS	NS
DRG 160 Hernia Proc.Except. Ingui & Fem Age>17 W/O CC	3,534(1,610.6)*	NS
DRG 159 Hernia Proc.Except. Ingui & Femo Age>17 W CC	NS	14,450(4,269.3)**
DRG 163 Hernia Proc.Age <18	NS	NS
DRG 355 Uterine, Adnexa Proc.Non Ovar/Adnexal Malignancy W/O CC	NS	14,067(2,763.3)**
DRG 162 Inguinal&Femoral Hernia Proc. Age>17 W/O CC	NS	NS
DRG 354 Uterine, Adnexa Proc.Non Ovar/Adnexal Malignancy W CC	NS	25,994(11,236.3)*
DRG 358 Uterine&Adnexa Proc. for Non-Malignancy W CC	3,885(1,446.0)**	15,000(1,858.5)**
DRG 359 Uterine&Adnexa Proc. for Non-Malignancy W/O CC	2,145(778.5)**	3,364(998.0)**
DRG 158 Anal & Stomal Procedure W/O CC	NS	6,453(2,339.6)**
DRG 161 Inguinal&Femoral Hernia Proc. Age>17 W CC	NS	NS
R Square	0.30	0.42
F	41**	68**
N of cases	1,222	1,222

Notes:** Significant at 99% confidence level.
* Significant at 95% confidence level.
NS= not significant (p>.05)

The regression analysis for the different surgical DRGs[11] in the total cost range from Pst 724,699 for Uterine, Adnexa Procedure for Non Ovarian/Adnexal Malignancy W CC to Pst -61, 044 for Anal & Stomal Procedures W/O CC. In ward cost the range goes from Pst 487,857 for Uterine, Adnexa Procedure for Non Ovarian/Adnexal Malignancy W CC to Pst 61,001 for Hernia Procedure Except Inguinal & Femoral Age >17 W/O CC. The drug cost range from Pst 28,038 for Total Cholecystectomy W/O CDE W CC to Pst 2,145 for Uterine & Adnexa Procedure for Non-Malignancy W/O CC and the test cost range from Pst 49,523 for Total Cholecystectomy W CDE W CC to Pst 3,364 for Uterine & Adnexa Procedure for Non-Malignancy W/O CC. The total cost and the ward cost are expected to be relatively more expensive for those procedures with a more severe diagnoses (e.g., Uterine, Adnexa Procedure for Non Ovarian/Adnexal Malignancy W CC) and less expensive for those procedures with less severe diagnoses (e.g., Anal & Stomal Procedures W/O CC and Hernia Procedure Except Inguinal & Femoral Age >17 W/O CC). The drug cost and the test cost are also expected to be relatively more expensive for those procedures with a more severe diagnoses (e.g., Total Cholecystectomy W/O CDE W CC and Total Cholecystectomy W CDE W CC). However, the drug cost and the test cost are less expensive for procedures with a severe diagnosis (e.g., Uterine & Adnexa Procedure for Non-Malignancy W/O CC). In most studies of severity of illness to date, there has been an implicit assumption that more severely ill patients consume more resources. However, patients who are the most severely ill may use fewer resources, because expensive and futile diagnostic and therapeutic interventions may be avoided.

Further clarification on how these variables affect the different components of inpatient costs can be achieved when the multiple regression is applied to each specific surgical DRG separately. The results for the different surgical DRGs will be discussed in the second part of this Chapter.

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[11] The reference group for the surgical DRG is Lens Procedures with or without Vitrectomy.

7.4.1 General regression including the variable of length of stay

In table 7.2 the variables describing health status, hospital related variables, hospital and doctors characteristics and regional supply variables are analysed including the variables of preoperative and postoperative length of stay.

Table 7.2
Results of the general regression, including the length of stay

Explanatory Variables	Total cost	Ward cost
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-14,230(6,954.6)**	74,823(12,005.3)**
DRG 196 T.Cholecys.W CDE W/O CC	NS	-35,120(6,596.6)**
DRG 198 T.Cholecys.W/O CDE W/O CC	NS	-16,258(3,827.0)**
DRG 197 T.Cholecys.W/O CDE W CC	NS	-44,733(7,265.4)**
DRG 307 Prostatect.W/O CC	NS	-15,387(4,480.9)**
DRG 311 Trans.Proc.W/O CC	NS	-19,655(8,958.3)*
DRG 195 T.Cholecys.W CDE W CC	NS	-39,811(12,661.5)**
DRG 337 Trans.Prost. W/O CC	20,810(5,982.2)**	NS
DRG 336 Trans.Prost. W CC	NS	NS
DRG 310 Trans.Proc.W CC	NS	-39,203(14,853.0)**
DRG 306 Prostatect.W CC	NS	-23,922(8,502.3)**
DRG 157 Anal&Stomal Proc.W CC	NS	NS
DRG 160 Hernia Proc.Except.Ingui&Fem Age >17 W/O CC	NS	NS
DRG 159 Hernia Proc.Except.Ingui&Femo Age >17 W CC	-51,565(14,930.0)**	-56,479(13,964.5)**
DRG 163 Hernia Proc.Age <18	NS	NS
DRG 355 Uterine, Adnexa Proc.Non Ovar/ Adnexal Malignancy W/O CC	217,132(9,825.0)**	228,964(9,393.1)**
DRG 162 Inguinal&Femoral Hernia Proc. Age >17 W/O CC	NS	NS
DRG 354 Uterine, Adnexa Proc.Non Ovar/ Adnexal Malignancy W CC	231,032(39,000.0)**	251,495(35,981.9)**
DRG 358 Uterine&Adnexa Proc.for Non-Malignancy W CC	208,980(6,626.8)**	213,758(6,494.5)**
DRG 359 Uterine&Adnexa Proc.for Non-Malignancy W/O CC	136,234(3,803.1)**	146.997(3,884.0)**
DRG 158 Anal&Stomal Procedure W/O CC	NS	NS
DRG 161 Inguinal&Femoral Hernia Proc. Age >17 W CC	NS	NS

Table 7.2 (Continuation)

Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St.error)Sig
preoperative length of stay	17,957(275.6)**	16,995(303.9)**
postoperative length of stay	19,395(305.7)**	18,538(332.3)**
operating theatre minutes	1901(35.6)**	113(34.9)**
admission through emergency room	NS	-10,091(3,806.4)**
admission through internal medicine	-14,230(6,954.6)*	-14,081(6,771.4)*
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	72,209(13,285.4)**	46,016(12,373.0)**
number of resident surgeons	NS	NS
number of beds per specialities	-663(95.2)**	-650(89.7)**
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	-43,024(5,621.7)**	-35,435(5,063.6)**
R Square	0.96	0.94
F	2290**	895**
N of cases	1,222	1,222

Notes:** Significant at 99% confidence level.
* Significant at 95% confidence level.
NS= not significant (p>.05)

Table 7.2 (Continuation)

Explanatory Variables	Drug cost	Test cost
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-13,062(5,203.3)*	3,938(2,324.5)NS
DRG 196 T.Cholecys.W CDE W/O CC	4,548(1,420.6)**	15,259(1,584)**
DRG 198 T.Cholecys.W/O CDE W/O CC	4,696(828.2)**	6,244(930.6)**
DRG 197 T.Cholecys.W/O CDE W CC	17,700(1,652.0)**	12,716(1,754.7)**
DRG 307 Prostatect.W/O CC	4,515(1,015)**	4,240(1,142.0)**
DRG 311 Trans.Proc.W/O CC	NS	NS
DRG 195 T.Cholecys.W CDE W CC	NS	24,256(3,074.3)**
DRG 337 Trans.Prost. W/O CC	3,961(1,211.6)**	5,819(1,429.4)**
DRG 336 Trans.Prost. W CC	NS	NS
DRG 310 Trans.Proc.W CC	NS	NS
DRG 306 Prostatect.W CC	NS	NS
DRG 157 Anal&Stomal Proc.W CC	NS	NS
DRG 160 Hernia Proc.Except.Ingui&Fem Age >17 W/O CC	NS	NS
DRG 159 Hernia Proc.Except.Ingui&Femo Age >17 W CC	NS	NS
DRG 163 Hernia Proc.Age <18	NS	NS
DRG 355 Uterine, Adnexa Proc.Non Ovar/ Adnexal Malignancy W/O CC	NS	NS
DRG 162 Inguinal&Femoral Hernia Proc. Age >17 W/O CC	NS	NS
DRG 354 Uterine, Adnexa Proc.Non Ovar/ Adnexal Malignancy W CC	NS	NS
DRG 358 Uterine&Adnexa Proc.for Non-Malignancy W CC	NS	8,129(1,545.4)**
DRG 359 Uterine&Adnexa Proc.for Non-Malignancy W/O CC	NS	NS
DRG 158 Anal&Stomal Procedure W/O CC	NS	NS
DRG 161 Inguinal&Femoral Hernia Proc. Age >17 W CC	NS	NS

Table 7.2 (Continuation)

Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St.error)Sig
preoperative length of stay	NS	1,238(75.6)**
postoperative length of stay	571(66.3)**	550(77.1)**
operating theatre minutes	31(7.6)**	45(8.3)**
admission through emergency room	2,348(778.4)**	4,204(960.5)**
admission through internal medicine	7,292(1,601.4)**	-8,488(1,744.2)**
turnover rate	NS	670(289.7)*
complications	NS	NS
multiple diagnoses or comorbidity	2,689(1,140.8)*	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	-1,376(524.2)**	1,474(569.5)**
over 76 years old patients	NS	1,734(784.2)*
between 66 and 75 years old patients	NS	NS
percentage of operations	-3,437(603.3)**	2,210(405.0)**
number of surgeons	NS	5,933(2,925.0)*
number of resident surgeons	NS	19,702(4,468.7)**
number of beds per specialities	-69(16.2)**	NS
occupancy rate	NS	NS
General Practitioner	3,013(582.7)**	NS
total number of hospital beds	10,225(2,615.0)**	-15,998(2,218.0)**
R Square	0.38	0.64
F	49**	114**
N of cases	1,222	1,222

Notes: ** Significant at 99% confidence level.
* Significant at 95% confidence level.
NS= not significant (p>.05)

Health Status Indicators

We consider briefly the coefficients of the Surgical DRGs in the regression with all the variables included. Patients with Uterine, Adnexa Proc for Non-Ovarian/Adnexal

Malignancy W CC, Total Cholecystectomy W/O C.D.E. W CC and Total Cholecystectomy W C.D.E. W CC are the more expensive for total cost, ward cost, drug cost and test cost. Patients with Hernia Procedures Except Inguinal & Femoral Age > 17 W CC, Transurethral Prostatectomy W/O CC and Total Cholecystectomy W/O C.D.E. W/O CC are less expensive for total cost, ward cost, drug cost and test cost.

Complication is not a significant variable in the regression including length of stay. This result is unexpected since one would expect patients with complications to be less well and thus to have more resources allocated to them. The explanation is that the variables preoperative and postoperative length of stay overtake the variable complication.

The coefficient for multiple diagnoses or comorbidity is statistically significant for drug cost. However, multiple diagnoses is not a significant variable for total cost, ward cost and test cost. This result is also unexpected since one would expect patients with multiple diagnoses to be less well and thus to have more resources allocated to them. However, we have to realize that normally these patients have a chronic disease and this can be the explanation for consuming more drugs and not other kinds of resources. An increase in one more patient with comorbidity or multiple diagnoses will increase the drug cost by Pst 2,689 as compared with patients without multiple diagnoses or comorbidity.

In the general equation, the coefficient for patients' age between 66 and 75 years is not statistically significant. However, the coefficient for patients aged over 76 years old has a positive effect on test cost. The coefficient for patients aged over 76 years indicates that the cost of these patients are Pst 1,734 more expensive for test cost than younger patients. The positive coefficient for age suggests as that patients over 76 years old make higher demands on tests, we could expect these patients to consume more drugs.

The coefficient for sex is significant positive on test cost. However, sex is significant negative on drug cost. The coefficient for sex indicates that males test cost is Pst 1,474 more than females and drug cost is Pst 1,376 less than females. It means that males consume more tests and less drugs than females.

Hospitalisation-Related Variables

As expected, preoperative length of stay is a significant predictor of the different determinants of inpatient costs. The preoperative length of stay has a positive effect on total cost, ward cost and test cost. The coefficient for preoperative length of stay indicates that with the increase by one more day in the preoperative length of stay, the cost of the patient will increase by Pst 17,957, 16,995 and 1,238 for total cost, ward cost and test cost respectively between hospitals.

One policy implication of these results is that transfering patients from inpatients to outpatients, seems cost-effective and may also prove a great saving for the hospital. Given that patients come to the hospital without all the results already done, they have to remain in the hospital for a longer time while all the tests are done. Nowdays, it also frequently happens that the same laboratory tests and X-rays are done several times before an operation takes place. These repetitive tests do not only represent a considerable amount of money for very little clinical value; they may even be detrimental to the patient. It can also be said that since preoperative tests can represent about 1.5 per cent of total health care expenditure, this part of the process presents considerable opportunity for substantial cost savings. Transfering the patients to the outpatient department and not allowing them to come to the hospital until all the tests are done should therefore be a priority in the hospitals.

The postoperative length of stay has a positive effect on total cost, ward cost, drug cost and test cost. The coefficient for postoperative length of stay indicates that the increase by one more day in the postoperative length of stay will increase the cost of the patient by Pst 19,395, 18,538, 571 and 550 for total cost, ward cost, drug cost and test cost respectively between hospitals. It can be pointed out that if patients stay in the hospital for various reasons, for example, inefficiencies as we have found out in this research, these patients while they wait for discharge are prescribed more drugs and they receive more tests.

The variable operating theatre minutes has a positive effect on total cost, ward cost, drug cost and test cost. The coefficient indicates that the increase by one more minute in the operating theatre, the cost of the patient will increase by Pst 1,901, 113, 31 and 45 for total cost, ward cost, drug cost and test cost respectively between hospitals.

Surprisingly, patients admitted through the emergency room do not have any significant effect on total cost and they are less expensive for ward cost. However, these patients have a positive and significant effect on drug cost and test cost. It could be argued that these patients consume more tests because they come to the hospital without their tests done and while they wait for them to be done, they are prescribed more drugs. The coefficient indicates that the increase by one more patient admitted through the emergency room, the ward cost will decrease by Pst 10,091. However, each patient admitted through emergency room will be more expensive by Pst 2,348 and 4,204 on drug cost and test cost respectively between hospitals as compared with patients admitted through the waiting list. However, this variable will be much better explained when we do the regressions for the different specific surgical DRGs.

Patients coming through Internal Medicine have a lower total cost, ward cost and test cost. These patients have a higher drug cost. The coefficient indicates that each patient admitted through internal medicine will increase by Pst 14,230, 14,081 and 8,488 on total cost, ward cost and test cost respectively between hospitals. However, each patient coming through internal medicine will increase by Pst 7,292 on drug cost between hospitals. These patients may be consume less tests because they have already had all the tests completed in the internal medicine department. However, it may be normal that they consume more drugs given that most of these patients have some comorbidity or other diagnoses.

Patients admitted at the end of the week on a Friday and a Saturday do not affect inpatient costs. The fact that these patients do not have a higher cost proves that they are not more severely ill as we have pointed out in the previous chapter for length of stay. Being discharged on a Monday is not statistically significant.

Hospital and Doctor Characteristics

For our research in the regression including length of stay, the occupancy rate is not statistically significant. Turnover rate has a positive effect on test cost. However, the significance is quite low. The coefficient for turnover rate indicates that for an increase by 1 per cent in the turnover rate the test cost will increase by Pst 670.

The number of beds available per speciality has a negative effect on total cost, ward cost and drug cost. However, the significance is very low. The coefficient indicates that for an increase by one more bed per speciality per 1,000 population, the total cost, the ward cost and the drug cost will decrease by Pst 663, 650 and 69 respectively between hospitals. A rise of the supply of beds in these specialties will decrease total cost, ward cost and drug cost.

The number of total hospital beds has a negative effect on total cost, ward cost and test cost. The drug has a positive effect. The coefficient for the number of total hospital beds indicates that for an increase by one more bed per 1,000 population, the total cost, the ward cost and the test cost will decrease by Pst 43,024, 35,435 and 15,998 respectively between hospitals. The drug cost will increase by Pst 10,225. A rise in the total number of hospital beds will decrease the total cost, the ward cost and the test cost. It means that larger hospitals have lower costs than small hospitals. However, the drug cost will increase. The values for total hospital beds support the concept of economies of scale.

The percentage of operations has a positive effect on test cost. The drug cost has a negative effect. The coefficient of operations indicates that the increase by 1 per cent the number of operations, the test cost will increase by Pst 2,210. The drug cost will decrease by Pst 3,437. A rise in the percentage of number of operations will increase the test cost, however, the drug cost will decrease. It can be said that surgical patients consume more tests than drugs.

The number of surgeons has a positive effect on total cost, ward cost and test cost. The coefficient for surgeons indicates that the increase by one more surgeon per 10,000 population, the total cost, the ward cost and the test cost will increase by Pst 72,209, 46,016 and 5,933 respectively between hospitals.

The number of resident surgeons has only a positive effect on test cost. The coefficient indicates that for an increase of one more resident surgeon per 10,000 population, the test cost will increase by Pst 19,702. Resident surgeons do order more tests in these hospitals. Resident surgeons are believed to be more likely to rely on time-consuming tests to aid in the diagnosis process. This finding confirms the hypothesis already expressed in Chapter 6, the relationship gives us fundamental to the length of stay.

Regional Supply Variable

General Practitioners has a positive effect on drug cost. The coefficient indicates that an increase by one more GP per 10,000 population will increase the drug cost by Pst 3,013. It can be said that normally doctors in the Spanish hospitals prescribe a great quantity of drugs and the GPs after patients leave the hospital still prescribe these drugs for a certain time.

7.4.2 General regression excluding the variable of length of stay

In tables 7.3 the variables describing health status, hospital related variables, hospital and doctors characteristics and regional supply variables are analysed excluding the variables preoperative and postoperative length of stay.

Table 7.3
Results of the general regression, excluding the length of stay

Explanatory Variables	Total cost	Ward cost
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	206,898(17,102.7)**	232,939(19,062.0)**
DRG 196 T.Cholecys.W CDE W/O CC	153,967(15,563.0)**	118,230(14,375.2)**
DRG 198 T.Cholecys.W/O CDE W/O CC	50,524(9,403.9)**	36,452(8,520.5)**
DRG 197 T.Cholecys.W/O CDE W CC	130,488(17,748.8)**	NS
DRG 307 Prostatect.W/O CC	70,396(11,259.8)**	48,772(10,147.9)**
DRG 311 Trans.Proc.W/O CC	NS	NS
DRG 195 T.Cholecys.W CDE W CC	224,269(30,695.8)**	92,615(28,240.4)**
DRG 337 Trans.Prost. W/O CC	79,125(14,396.6)**	44,574(12,120.3)**
DRG 336 Trans.Prost. W CC	135,284(25,994.8)**	NS
DRG 310 Trans.Proc.W CC	NS	NS
DRG 306 Prostatect.W CC	98,672(21,114.1)**	NS
DRG 157 Anal&Stomal Proc.W CC	NS	NS
DRG 160 Hernia Proc.Except.Ingui&Fem Age >17 W/O CC	NS	NS
DRG 159 Hernia Proc.Except.Ingui&Femo Age >17 W CC	129,181(35,416.7)**	NS
DRG 163 Hernia Proc.Age <18	NS	NS
DRG 355 Uterine, Adnexa Proc.Non Ovar/ Adnexal Malignancy W/O CC	371,437(22,636.0)**	381,271(21,004.4)**
DRG 162 Inguinal&Femoral Hernia Proc. Age >17 W/O CC	NS	NS
DRG 354 Uterine, Adnexa Proc.Non Ovar/ Adnexal Malignancy W CC	325,348(89,124.0)**	271,977(83,585)**
DRG 358 Uterine&Adnexa Proc.for Non-Malignancy W CC	312,626(17,599.7)**	244,745(17,059.2)**
DRG 359 Uterine&Adnexa Proc.for Non-Malignancy W/O CC	212,299(9,378)**	225,150(8,409.0)**
DRG 158 Anal&Stomal Procedure W/O CC	NS	NS
DRG 161 Inguinal&Femoral Hernia Proc. Age >17 W CC	NS	-52,778(19,329.6)**

Table 7.3 (Continuation)

Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St.error)Sig
operating theatre minutes	2,538(81.3)**	683(75.9)**
admission through emergency room	108,967(8,396.7)**	96,169(7,892.3)**
admission through internal medicine	65,088(17,036.6)**	72,209(15,490.8)**
turnover rate	-16,873(3,176.3)**	-16,886(2,925.5)**
complications	68,008(12,521.2)**	138,396(11,654.6)**
multiple diagnoses or comorbidity	NS	70,898(12,038.5)**
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	41,356(11,661.0)**	36,593(10,990.3)**
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	71,725(28,167.2)*	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	-30,726(9,717.1)**	-34,609(9,163.0)**
General Practitioner	NS	-6,706(3,233.0)*
total number of hospital beds	-67,765(8,773.8)**	-41,901(7,774.0)**
R Square	0.80	0.67
F	221**	125**
N of cases	1,222	1,222

Notes:** Significant at 99% confidence level.
* Significant at 95% confidence level.
NS= not significant (p>.05)

Table 7.3 (Continuation)

Explanatory Variables	Drug cost	Test cost
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-6,383(5,684.0)NS	12,445(3,318.6)**
DRG 196 T.Cholecys.W CDE W/O CC	6,640(1,451.4)**	22,915(1,705.5)**
DRG 198 T.Cholecys.W/O CDE W/O CC	4,938(860.0)**	9,279(1,009.1)**
DRG 197 T.Cholecys.W/O CDE W CC	21,983(1,610.6)**	15,345(2,090.5)**
DRG 307 Prostatect.W/O CC	7,620(1,042.5)**	5,331(1,156.9)**
DRG 311 Trans.Proc.W/O CC	NS	NS
DRG 195 T.Cholecys.W CDE W CC	8,098(2,815.8)**	28,477(3,395.4)**
DRG 337 Trans.Prost. W/O CC	6,231(1,359.4)**	7,935(1,441.6)**
DRG 336 Trans.Prost. W CC	8,154(2,343.2)**	NS
DRG 310 Trans.Proc.W CC	NS	NS
DRG 306 Prostatect.W CC	8,404(1,962.3)**	NS
DRG 157 Anal&Stomal Proc.W CC	NS	NS
DRG 160 Hernia Proc.Except.Ingui&Fem Age >17 W/O CC	NS	NS
DRG 159 Hernia Proc.Except.Ingui&Femo Age >17 W CC	NS	NS
DRG 163 Hernia Proc.Age <18	NS	NS
DRG 355 Uterine, Adnexa Proc.Non Ovar/ Adnexal Malignancy W/O CC	NS	10,867(2,490.7)**
DRG 162 Inguinal&Femoral Hernia Proc. Age >17 W/O CC	NS	NS
DRG 354 Uterine, Adnexa Proc.Non Ovar/ Adnexal Malignancy W CC	NS	NS
DRG 358 Uterine&Adnexa Proc.for Non-Malignancy W CC	NS	9,141(1,943.0)**
DRG 359 Uterine&Adnexa Proc.for Non-Malignancy W/O CC	NS	2,972.4(961.3)**
DRG 158 Anal&Stomal Procedure W/O CC	NS	NS
DRG 161 Inguinal&Femoral Hernia Proc. Age >17 W CC	NS	NS

Table 7.3 (Continuation)

Explanatory Variables	Drug cost	Test cost
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
operating theatre minutes	48(7.5)**	70(8.9)**
admission through emergency room	2,552(804.0)**	11,141(943.1)**
admission through internal medicine	7,862(1,631.5)**	-5,149(1,879.4)**
turnover rate	NS	NS
complications	NS	5,897(1,302.0)**
multiple diagnoses or comorbidity	NS	3,638(1,472.4)*
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	3,896(1,305.5)**
discharge on a Monday	NS	NS
sex	-1,106(552.5)*	NS
over 76 years old patients	NS	2,212(860.2)**
between 66 and 75 years old patients	NS	NS
percentage of operations	-2,997(636.3)**	2,253(447.4)**
number of surgeons	9,708(2,979.4)**	NS
number of resident surgeons	NS	25,775(4,698.7)**
number of beds per specialities	-96(19.3)**	39(19.6)*
occupancy rate	NS	NS
General Practitioner	2,688(602.7)**	NS
total number of hospital beds	5,957(3,064.0)*	-17,457(2,482.0)**
R Square	0.36	0.57
F	40**	79**
N of cases	1,222	1,222

Notes:** Significant at 99% confidence level.
* Significant at 95% confidence level.
NS= not significant (p>.05)

Health Status Indicators

We consider briefly the coefficients of the Surgical DRGs in the general regression with all the variables included. Patients with Uterine, Adnexa Procedures for Non-Ovarian/Adnexal Malignancy W/O CC, Total Cholecystectomy W/O C.D.E. W CC and

Total Cholecystectomy W C.D.E. W CC are more expensive surgical DRGs for total cost, ward cost, drug cost and test cost. Patients with Total Cholecystectomy W/O C.D.E. W/O CC, Inguinal & Femoral Hernia Procedures Age > 17 W CC, Total Cholecystectomy W/O C.D.E. W/O CC and Uterine & Adnexa Procedures for Non-Malignancy W/O CC are less expensive surgical DRGs for total cost, ward cost, drug cost and test cost respectively.

Complication has a positive effect on total cost, ward cost and test cost. These results are not a surprise since one would expect patients with complications to be less well and thus to have more resources allocated to them. An increase by one more patient with complications after the operation will increase the total cost, the ward cost and the test cost by Pst 68,008, 138,396 and 5,897 respectively between hospitals as compared with patients without complications.

The coefficient for multiple diagnoses or comorbidity is statistically significant for ward cost and test cost. However, multiple diagnoses is not significant for total cost and drug cost. The positive coefficient for multiple diagnoses suggests that these patients make higher demands on ward and tests. An increase by one more patient with comorbidity or multiple diagnoses is related to an increase in the ward cost and the test cost by Pst 70,898 and 3,638 respectively between hospitals as compared with patients without multiple diagnoses.

The coefficient for patients age between 66 and 75 years is not statistically significant. The coefficient for patients aged over 76 years old has a positive effect on test cost. The coefficient for patients aged over 76 years indicates that the cost of these patients are Pst 2,212 more expensive for test cost. The positive coefficient for age suggests that patients over 76 years old make higher demands on tests. We would be expected older patients to consume more drugs than tests. However, the finding is in the other way around.

The coefficient for sex is significantly negative on drug cost. The coefficient for sex indicates that the drug cost is Pst 1,105 less expensive. It means that males consume less drugs than females.

Hospitalisation-Related Variables

The variable operating theatre minutes has a positive effect on total cost, ward cost, drug cost and test cost. The coefficient indicates that with an increase by one more minute in the operating theatre time, the cost of the patient will increase by Pst 2,538, 683, 48 and 70 for total cost, ward cost, drug cost and test cost respectively between hospitals. It has been pointed out that before that this may be due a longer time in the operating theatre related with more complicated patients or a more difficult technique or even a lack of the surgeon's experience.

In the regression analysis, with preoperative and postoperative length of stay included patients admitted through the emergency room and internal medicine have a negative effect on total cost and ward cost. However, it can be pointed out that the variables preoperative and postoperative length of stay maybe overtake the variables patients admitted through the emergency room and internal medicine.

In the regression equation excluding length of stay it is confirmed that patients admitted through the emergency room have a positive effect on total cost, ward cost, drug cost and test cost as we expected. The coefficient for admission through the emergency room indicates that the cost of these patients is more expensive. Each patient admitted through the emergency room will increase the total cost, the ward cost, the drug cost and the test cost by Pst 108,967, 96,169, 2,552 and 11,141 respectively between hospitals as compared with patients admitted through the waiting list.

As we also expected, patients coming through Internal Medicine have a positive effect on total cost, ward cost and drug cost. These patients have a negative effect on test cost. The coefficient for admissions through internal medicine indicates that each patient coming through Internal Medicine will increase the total cost, the ward cost and the drug cost by Pst 65,088, 72,209 and 7,862 respectively as compared with patients admitted through the waiting list. However, these patients will decrease the test cost by Pst 5,149 between hospitals.

Patients admitted on a Friday are not statistically significant. Being discharged on a Monday is not statistically significant.

Patients admitted on a Saturday have a positive effect on total cost, ward cost and test cost. The coefficient indicates that one more patient admitted on a Saturday will increase the total cost, the ward cost and the test cost by Pst 41,356, 36,593 and 3,896 respectively between hospitals as compared with patients admitted other day of the week.

Hospital and Doctor Characteristics

Occupancy rate has a negative effect on total cost and ward cost. The coefficient indicates that an increase by 1 per cent of the occupancy rate, the total cost and the ward cost will decrease by Pst 30,726 and 34,609 respectively between hospitals.

Turnover rate has a negative effect on total cost, ward cost. The coefficient indicates that with an increase by 1 per cent of the turnover rate, the total cost and the ward cost will decrease by Pst 16,873 and 16,886 respectively between hospitals.

The number of beds available per speciality has a negative effect on drug cost and a positive effect on test cost. However, the significant is very low. The coefficient indicates that with an increase by one more bed per specialty per 1,000 population, the drug cost will decrease by Pst 96 and the test cost will increase by Pst 39 between hospitals. A rise of the supply of beds in these specialties will decrease the drug cost and will increase the test cost.

The number of total hospital beds has a negative effect on total cost, ward cost and test cost. The drug cost has a positive effect. The coefficient for the number of total hospital beds indicates that with an increase by one more in the total hospital beds per 1,000 population, the total cost, the ward cost and the test cost will decrease by Pst 67,765, 41,901 and 17,457 respectively between hospitals. The drug cost will increase by Pst 5,957. The results are similar to the general regression including the variables of preoperative and postoperative length of stay.

The percentage of operations has a positive effect on test cost. The drug cost has a negative effect. The coefficient of operations indicates that with an increase by 1 per cent the number of operations, the test cost will increase by Pst 2,253. The drug cost will decrease by Pst 2,997. The results are similar to the general regression including the variables of preoperative and postoperative length of stay. Increasing the number of operations will increase the number of tests. However, it will decrease the number of drugs.

The number of surgeons has a positive effect on total cost and drug cost. The coefficient for surgeons indicates that with an increase by one more surgeon per 10,000 population, the total cost and the drug cost will increase by Pst 71, 725 and 9,708 respectively between hospitals. A high supply of surgeons will increase the costs.

The number of resident surgeons has a positive effect on test cost. The coefficient indicates that for an increase of one more resident surgeon per 10,000 population, the test cost will increase by Pst 25,775. The results are similar to the general regression with the variables of preoperative and postoperative length of stay being included.

Regional Supply Variable

General Practitioners has a negative effect on the ward cost and a positive effect on the drug cost. The coefficient indicates that an increase of one GP per 10,000 population will decrease the ward cost of stay by Pst 6,706 and will increase the drug cost by Pst 2,688 between hospitals.

The equations including and excluding length of stay are identical in eight variables. On the other hand, the rest of the variables differ in different ways.

In Tables 7.2 and 7.3, we give several cost regression equations for all four hospitals with the F and maximum R square values for the given number of variables being included. The F value shows the equation to be a good predictor; variables with the length of stay included explain approximately 96% of the variation in total cost, 94% of the variation in ward cost, 38% of the variation in drug cost and 64% of the variation in test cost.

When length of stay is removed, only 80% of the variation in total cost, 67% of the variation in ward cost, 36% of the variation in drug cost and 57% of the variation in test cost are predicted.

The fit of the regression is satisfactory, R Square values ranging from a low 0.38% for drug cost to 0.96% for total cost with length of stay included. The R Square values ranging from a low 0.36% for drug cost to 0.80% for total cost with the length of stay excluded.

7.5 Surgical DRGs-Specific Regression Results on Different Components of Inpatient Costs

The ten most common surgical DRGs were selected from the basis group of twenty-two to test the hypotheses.

7.5.1 Surgical DRGs-specific regression including the length of stay

The regression for the specific surgical DRGs is presented. The variables preoperative and postoperative length of stay in the regression analysis were included.

There is wide variation in total cost, ward cost, drug cost and test cost for each surgical DRG as shown in table 7.4. The R Square ranges from 0.99 for Transurethral Prostatectomy W/O CC to 0.85 for Total Cholecystectomy W/O C.D.E. W CC for total cost. For ward cost, the R Square ranges from 0.99 for Transurethral Prostatectomy W/O CC to 0.87 for Total Cholecystectomy W/O C.D.E. W CC and Lens Procedures with or without Vitrectomy. For drug cost the R Square ranges from 0.63 for Total Cholecystectomy W/O C.D.E. W CC to 0.14 for Total Cholecystectomy W C.D.E. W/O CC and for test cost, the R Square ranges from 0.82 for Total Cholecystectomy W C.D.E. W/O CC to 0.26 for Inguinal & Femoral Hernia Procedures Age >17 W/O CC.

Table 7.4
Variations explained for each surgical DRG, including the length of stay

DRGs	Total cost	Ward cost	Drug cost	Test cost	Number of cases
	R Square	R Square	R Square	R Square	
39	0.94	0.87	0.60	0.42	258
307	0.98	0.98	0.59	0.68	87
337	0.99	0.99	0.50	0.47	54
358	0.98	0.98	0.32	0.51	38
359	0.94	0.94	0.15	0.48	162
158	0.98	0.97	0.23	0.42	92
162	0.98	0.96	0.37	0.26	136
196	0.96	0.91	0.14	0.82	46
197	0.85	0.87	0.63	0.48	35
198	0.93	0.93	0.19	0.71	149

For the different surgical DRGs the results of the independent variables on the dependent variables were the followings:

For Lens Procedures with or without Vitrectomy, patients with a longer preoperative and postoperative length of stay will be more expensive. Longer operating theatre stay will be more expensive on total cost. Increasing the number of patients per bed will increase the drug cost. Patients admitted to the hospital on Friday have a higher test cost as compared with patients admitted on other days of the week. A high supply of surgeons will decrease the inpatient costs. A high supply of resident surgeons will have a lower drug cost and a higher test cost. A high supply of GPs will decrease the test cost.

For Prostatectomy W/O CC, patients with a longer preoperative and postoperative length of stay will be more expensive. Patients staying in the operating theatre longer will be more expensive. Patients admitted through the emergency room will be more expensive as compared with patients admitted through the waiting list. Patients discharged on a Monday are more expensive as compared with patients discharged on other days of the week. Patients over 76 years old are more expensive on ward cost. High supply of surgeons will increase the drug cost. High supply of resident surgeons will increase the test cost. High occupancy rate will increase the drug cost.

For Transurethral Prostatectomy W/O CC, patients with a longer preoperative and postoperative length of stay will have higher inpatient costs. Increasing the minutes in the operating theatre will increase the total cost and the drug cost. Increasing the number of patients per bed will decrease the durg cost. Patients admitted to the hospital on Friday have higher inpatient costs as compared with patients admitted on other days of the week. Patients admitted on Saturday only test cost have a higher cost.

For Uterine & Adnexa Proc for Non-Malignancy W CC, patients with a longer preoperative and postoperative length of stay will be more expensive on total cost and ward cost. Increasing the minutes in the operating room will increase the inpatient costs. Patients admitted to the hospital on Saturday will increase the drug cost and the test cost as compared with patients admitted on other days of the week. High supply of surgeons will increase the test cost.

For Uterine & Adnexa Proc for Non-Malignancy W/O CC, patients with a longer preoperative and postoperative length of stay will increase inpatient costs. Increasing the minutes in the operating theatre will increase inpatient costs. Increasing the number of patients per bed will decrease the ward cost. High number of resident surgeons will increase the drug cost and the test cost. High occupancy rate will decrease the total cost.

For Anal & Stomal Procedures W/O CC, patients with a longer preoperative and postoperative length of stay will increase inpatient costs. Longer operating theatre minutes will increase total cost. Patients admitted through the emergency room and intenal medicine will decrease the test cost. Patients admitted to the hospital on Saturday will decrease the total cost and the ward cost as compared with patients admitted on other days of the week. High supply of resident surgeons will increase the drug cost. High supply of GPs will decrease the test cost.

For Inguinal & Femoral Hernia Procedures Age > 17 W/O CC, patients with a longer preoperative and postoperative length of stay will increase inpatient costs. Increasing the minutes of the operating theatre time the inpatient costs will increase. Patients admitted through emergency room will be more expensive as compare with patients admitted through the waiting list and internal medicine. Patients admitted to the hospital on Friday will be more expensive as compared with patients admitted on other days of the week. High occupancy rate will increase the drug cost. High supply of GPs will decrease the drug cost.

For Total Cholecystectomy W C.D.E. W/O CC, patients with longer preoperative and postoperative length of stay will increase the total cost and cost the ward cost. Increasing the operating theatre minutes will increase the total cost. Increasing the number of patients per bed will decrease the drug cost and the test cost. Patients admitted to the hospital on Saturday and discharged on Monday will be less expensive on total cost and ward cost respectively. Older patients will be less expensive on total cost. High occupancy rate will decrease the total cost and the test cost.

For Total Cholecystectomy W/O C.D.E. W CC, patients with a longer preoperative and postoperative length of stay will increase inpatient costs. Increasing the operating theatre minutes will increase the total cost and the drug cost. Patients admitted through the emergency room will increase the ward cost as compared with patients admitted on other days of the week. Males patient will decrease the drug cost. High supply of resident surgeons will decrease the drug cost. High supply of beds per specialities will increase the test cost.

For Total Cholecystectomy W/O C.D.E. W/O CC, patients with a longer preoperative and postoperative length of stay will increase inpatient costs. Increasing the operating threatre time will increase the total cost. Patients admitted to the hospital on Saturday will increase inpatient costs as compared with patients admitted on other days of the week. High supply of resident surgeons will decrease the ward cost. High supply of bed per specialities will increase the total cost and the test cost. High occupancy rate will decrease the test cost.

The empirical results of the specific surgical DRGs regression with the variables of preoperative and postoperative length of stay included are shown and explain in Appendix 5.

7.5.2 Surgical DRGs-specific regression excluding length of stay

The regression for the specific surgical DRGs is presented here. The variables preoperative and postoperative length of stay in the regression analysis were excluded.

There is wide variation in the total cost, ward cost, drug cost and test cost for each surgical DRG as shown in table 7.5. The R Squares range from 0.83 for Prostatectomy W/O CC to 0.27 for Total Cholecystectomy W/O C.D.E. W CC for total cost. For the ward cost, the R Squares range from 0.68 for Prostatectomy W/O CC to 0.00 for Total Cholecystectomy W/O C.D.E. W CC. For drug cost the R Squares range from 0.64 for Total Cholecystectomy W/O C.D.E. W CC to 0.07 for Uterine & Adnexa Procedure for Non-Malignancy W/O CC and for test cost, the R Squares range from 0.82 for Total Cholecystectomy W C.D.E. W/O CC to 0.15 for Inguinal & Femoral Hernia Procedures Age >17 W/O CC.

Table 7.5
Variations explained for each surgical DRG, excluding the length of stay

DRGs	Total cost	Ward cost	Drug cost	Test cost	Number of cases
	R Square	R Square	R Square	R Square	
39	0.80	0.51	0.60	0.37	258
307	0.83	0.68	0.59	0.67	87
337	0.60	0.40	0.35	0.35	54
358	0.68	0.53	0.32	0.51	38
359	0.38	0.25	0.07	0.31	162
158	0.53	0.15	0.10	0.13	92
162	0.80	0.47	0.27	0.15	136
196	0.72	0.40	0.14	0.82	46
197	0.27	0.00	0.64	0.57	35
198	0.51	0.42	0.10	0.50	149

For the surgical DRGs, the results for the indepedent variables on the dependent variabes are the followings:

For Lens Procedures with or without Vitrectomy, increasing the minutes in the operating theatre will increase inpatient costs. Increasing the number of patients per bed will increase the drug cost. Patients admitted to the hospital on Friday will increase inpatient costs. Patients discharged on Monday will increase the total cost and the ward cost. High supply of surgeons will decrease inpatient costs. High supply of resident surgeons will increase the total cost and decrease the drug cost. High supply of GPs will decrease inpatient costs. Increasing the total number of hospital beds will increase the total cost.

For Prostatectomy W/O CC, increasing the minutes in the operating theatre will increase the total cost and the drug cost. However, it will decrease the ward cost. Patients admitted through the emergency room will increase inpatient costs. Patients discharged on Monday will increase inpatient costs. Older patients are less expensive on total cost. High supply of surgeons will increase the drug cost. High supply of resident surgeon will increase the test cost. High occupancy rate will increase the drug cost. High supply of GPs will decrease the ward cost. High number of total hospital beds will decrease the total cost.

For Transurethral Prostatectomy W/O CC, increasing the minutes in the operating theatre will increase inpatient costs. Patients admitted through the emergency room have higher inpatient costs as compared with patients admitted through the waiting list and internal medicine. Increasing the number of patients per bed will decrease the drug cost. Patients admitted to the hospital on Saturday will increase the drug cost and the test cost as compared with patients admitted on other days of the week. High supply of surgeons will decrease the test cost. High occupancy rate will increase the total cost and the ward cost.

For Uterine & Adnexa Proc for Non-Malignancy W CC, increasing the minutes in the operating theatre will increase inpatient costs. Increasing the number of patients per bed will decrease the total cost and the ward cost. Patients admitted to the hospital on Saturday will increase the drug cost and the test cost. High supply of resident surgeons will increase the test cost.

For Uterine & Adnexa Proc for Non-Malignancy W/O CC, increasing the minutes in the operating threatre will increase inpatient costs. Increasing the number of patients per bed will decrease the total cost and the ward cost. Patients admitted to the hospital on Friday will increase the test cost. High supply of resident surgeons will increase the drug cost and the test cost.

For Anal & Stomal Procedures W/O CC, increasing the minutes in the operating room will increase the total cost. Patients admitted through the emergency room will increase the total cost and the ward cost as compared with patients admitted through the waiting list and internal medicine. High supply of resident surgeons will increase the drug cost. High supply of GPs will decrease the test cost.

For Inguinal & Femeral Hernia Procedures Age >17 W/O CC, increasing the number of operating theatre will increase inpatient costs. Patients admitted through the emergency room will be more expensive as compared with patients admitted through the waiting list and internal medicine. Male patients are less expensive than female. Older patients are more expensive than younger ones. High supply of GPs will decrease the drug cost. A high number of total hospital beds will increase the total cost and the ward cost.

For Total Cholecystectomy W C.D.E. W/O CC, increasing the minutes in the operating theatre will increase the total cost and the ward cost. Patients admitted through the emergency room will increase the total cost and the ward cost respectively as compared with patients admitted through the waiting list and internal medicine. Increasing the number of patients per bed will decrease the drug cost and the test cost. Incresing the number of operations will increase the total cost. High supply of surgeons will decrease the total cost. High occupancy rate will decrease the test cost.

For Total Cholecystectomy W/O C.D.E. W CC, increasing the minutes in the operating theatre will increase the total cost and the drug cost. Patients admitted to the hospital on Friday will increase the drug cost and will decrease the test cost as compared with patients admitted on othe days of the week. Male patients will decrease the drug cost as compared with female patients. Patients over 76 years old will increase the test cost. High supply of resident surgeons will decrease the drug cost. High supply of beds per specialities will increase the test cost. High occupancy rate will increase the drug cost. A high number of hospital beds will decrease the total cost.

For Total Cholecystectomy W/O C.D.E. W/O CC, increasing the number of minutes in the operating theatre will increase the total cost. Patients admitted through the emergency room will increase inpatient costs as compared with patients admitted through the waiting list and internal medicine. Patients admitted to the hospital on Saturday will increase inpatient costs as compared with patients admitted on other days of the week. Older patients are more expensive. High supply of resident surgeons will decrease the inpatient costs. High supply of beds per specialities will increase the test cost. A high number of hospital beds will increase the test cost.

The empirical results of the specific surgical DRGs regression are shown and explain excluded the variables preoperative and postoperative length of stay in Appendix 6.

7.6 Hospital Regression Results on Different Components of Inpatient Costs for All Selected Surgical DRGs

The four hospitals were selected to test the hypotheses.

7.6.1 Hospital Regression including the length of stay

The regression for the different hospitals is presented. The variables preoperative and postoperative length of stay in the regression analysis were included.

There is wide variation in the total cost, the ward cost, the drug cost and the test cost for each hospital as shown in table 7.6. The R Square ranges from 0.98 for hospital 1 to 0.94 to hospital 8 for the total cost. For the ward cost, the R Square ranges from 0.97 for hospital 1 to 0.91 for hospital 8. For the drug cost, the R Square ranges from 0.54 for hospital 2 to 0.29 for hospital 8 and for the test cost, the R Square ranges from 0.75 for hospital 2 to 0.28 for hospital 1.

Table 7.6
Variations explained for each hospital, including the length of stay

Hospital	Total cost	Ward cost	Drug cost	Test cost	Number of Cases
	R Square	R Square	R Square	R Square	
Hospital 1	0.98	0.97	0.48	0.28	250
Hospital 2	0.96	0.94	0.54	0.75	366
Hospital 4	0.96	0.94	0.43	0.63	339
Hospital 8	0.94	0.91	0.29	0.50	264

For the different hospitals the results of the independent variables on the dependent variables were the followings:

For hospital 1, patients with a longer preoperative and postoperative length of stay will be more expensive. Longer operating theatre stay will be more expensive. Increasing the number of patients per bed will increase inpatient costs. Patients with complications will be more expensive as compared with patients without complications. Patients with comorbidity will increase the total cost. Patients admitted to the hospital on Friday have a higher drug cost as compared with patients admitted on other days of the week. Increasing the number of operations will increase the drug cost. A high supply of surgeons will decrease the total cost and the ward cost. However, it will increase the drug cost and the test cost. High occupancy rate will increase the total cost and the ward cost and will decrease the drug cost.

For hospital 2, patients with a longer preoperative and postoperative length of stay will be more expensive. Longer operating theatre stay will be more expensive. Patients admitted through the emergency room will increase the drug cost and the test cost as compared with patients admitted through the waiting list. Patients admitted through the internal medicine will decrease the total cost and the ward cost. However, these patients will increase the test cost. Increasing the number of patients per bed will decrease inpatient costs. Patients with complications will increase the test cost as compared with patients without complications. Patients with comorbidity will increase the drug cost. Patients admitted to the hospital on Saturday have a higher drug cost as compared with patients admitted on other days of the week. Patients discharged on Monday will decrease the test cost. Male patients will increase the drug cost and the test cost. Patients over 76 years old will decrease the ward cost. A high supply of beds per specialities will decrease the total cost and the ward cost. However, it will increase the drug cost and the test cost. High occupancy rate will decrease the ward cost.

For hospital 4, patients with a longer preoperative and postoperative length of stay will be more expensive. Longer operating theatre stay will be more expensive.
Patients admitted through the emergency room will be less expensive as compared with patients admitted through the waiting list. Patients admitted through the internal medicine will decrease the drug cost. Increasing the number of patients per bed will increase inpatient costs. Patients with complications will increase the total cost and the ward cost. However, these patients will decrease the drug cost as compared with patients without complications.

Patients between 66 and 75 years old will decrease the drug cost. Increasing the percentage of operations will decrease the test cost. A high supply of surgeons will decrease the drug cost. A high supply of resident surgeons will decrease the total cost and the ward cost. A high supply of beds per specialities will increase the ward cost. High occupancy rate will decrease the total cost.

For hospital 8, patients with a longer preoperative and postoperative length of stay will be more expensive. Longer operating theatre stay will be more expensive. Patients admitted through emergency room will increase the drug cost and the test cost and patients admitted through internal medicine will increase the drug cost as compared with patients admitted through waiting list. Increasing the number of patients per bed will increase inpatient costs. Patients with comorbidity will be more expensive on inpatient costs are compared with patients without comorbidity. Patients admitted to the hospital on Friday and Saturday have a higher total cost and ward cost respectively as compared with patients admitted on other days of the week. Increasing the number of operations will decrease the drug cost. A high supply of surgeons will decrease the drug cost. A high supply of beds per specialities will decrease inpatient costs.

The empirical hospital regression results are shown and explain included the variables preoperative and postoperative length of stay in Appendix 7.

7.6.2 Hospital Regression excluding the length of stay

The regression for the different hospitals is presented. The variables preoperative and postoperative length of stay in the regression analysis were excluded.

There is wide variation in the total cost, the ward cost, the drug cost and the test for each hospital as shown in table 7.7. The R Square ranges from 0.83 for hospital 1 to 0.74 to hospital 8 for the total cost. For the ward cost, the R Square ranges from 0.72 for hospital 1 and hospital 4 to 0.58 for hospital 8. For the drug cost, the R Square ranges from 0.51 for hospital 2 to 0.21 for hospital 4 and for the test cost, the R Square ranges from 0.66 for hospital 2 to 0.24 for hospital 1.

Table 7.7
Variations explained for each hospital, excluding the length of stay

Hospital	Total cost	Ward cost	Drug cost	Test cost	Number of Cases
	R Square	R Square	R Square	R Square	
Hospital 1	0.83	0.72	0.43	0.24	250
Hospital 2	0.77	0.66	0.51	0.66	366
Hospital 4	0.81	0.72	0.21	0.43	339
Hospital 8	0.74	0.58	0.29	0.42	264

For the different hospitals the results of the independent variables on the dependent variables were the followings:

For hospital 1, longer operating theatre stay will be more expensive. Patients admitted through the emergency room and internal medicine will be more expensive as compared with patients admitted through the waiting list. Patients with complications will be more expensive as compared with patients without complications. Patients with comorbidity will be more expensive as compared with patients without comorbidity. Patients admitted to the hospital on Friday have a higher drug cost and patients admitted to the hospital on Saturday have a higher inpatient costs as compared with patients admitted on other days of the week. Patients discharged on Monday have a higher inpatient costs as compared with patients discharged on other days of the week. Male patients will be less expensive than female patients. Increasing the number of operations will increase the total cost, the drug cost and the test cost and will decrease the ward cost. A high supply of surgeons will decrease the total cost. A high supply of beds per specialities will increase the total cost and will decrease the ward cost. High occupancy rate will increase the ward cost and will decrease the drug cost.

For hospital 2, longer operating theatre stay will be more expensive. Patients admitted through the emergency room and internal medicine will be more expensive as compared with patients admitted through the waiting list. Increasing the number of patients per bed will decrease the drug cost. Patients with complications will be more expensive as compared with patients without complications. Patients with comorbidity will be more expensive as compared with patients without comorbidity. Patients admitted to the hospital on Saturday have a higher inpatient costs as compared with patients admitted on other days of the week. Male patients will increase the drug cost and the test cost as compared with female patients. Patients over 76 year old are more expensive on inpatient costs. A high supply of surgeons will decrease the inpatient costs. A high supply of resident surgeons will increase inpatient costs. A high supply of beds per specialities will increase the test cost. High occupancy rate will increase the total cost and the ward cost.

For hospital 4, longer operating theatre stay will be more expensive. Patients admitted through the emergency room and internal medicine will be more expensive as compared with patients admitted through the waiting list. Increasing the number of patients per bed will increase the total cost and the ward cost and will decrease the drug cost. Patients with complications will be more expensive as compared with patients without complications. Patients admitted to the hospital on Friday have a higher test cost and patients admitted to the hospital on Saturday have a higher inpatient costs as compared with patients admitted on other days of the week. Male patients will increase the drug cost as compared with female patients. A high percentage of operations will increase inpatient costs. A high supply of beds per specialities will increase the test cost. High occupancy rate will increase the ward cost.

For hospital 8, longer operating theatre stay will be more expensive. Patients admitted through the emergency room and internal medicine will be more expensive as compared with patients admitted through the waiting list. Increasing the number of patients per bed will decrease the total cost. Patients with complications will be more expensive as compared with patients without complications. Patients with comorbidity will be more expensive as compared with patients without comorbidity. A high percentage of operations will decrease the drug cost and the test cost. A high supply of surgeons will decrease the drug cost and the test cost. A high supply of resident surgeons will increase the test cost.
A high supply of beds per specialities will decrease the total cost and the ward cost. High occupancy rate will increase the total cost and the ward cost.

The empirical hospital regression results are shown and explain excluded the variables preoperative and postoperative length of stay in Appendix 8.

7.7 Conclusion

In this chapter we have analysed the factors affecting the components of inpatient costs with common surgical DRGs in four general hospitals in Spain.

A regression was estimated that attempts to capture the relations between four components of total inpatient costs associated with hospitalisation for those specific surgical DRGs in 1991. The technique stepwise multiple regression analysis provided considerable insight into the roles of specific independent variables in explaining differences between hospitals along the four utilisation measures (total cost, ward cost, drug cost and test cost). The increasing concern for curtailing rapidly rising hospital costs, and renewed interest in reducing the number of hospital beds, makes it increasingly important for health services researchers to learn more about how to influence doctor behaviour in a direction that increases hospital efficiency.

When the variables of preoperative and postoperative length of stay are included, the different components of inpatient costs can be predicted for internal improvement and efficiency. Several equations have R square values greater than 90%. However, for reimbursement purposes, it is important that the different components of inpatient costs do not include variables which are easily influenced by the hospital. Length of stay is such a variable and is therefore deleted from some of our regressions. The regressions in Table 7.3 with length of stay excluded reflect this more appropriately. The R square values show that only 80%, 67%, 36% and 57% of the variance in total cost, ward cost, drug cost and test cost respectively are explained.

The empirical analysis in the general equation showed that the components of inpatient costs are not determined to a large extent by health status indicators in the equation including the length of stay. However, in the equation excluding the length of stay the different components of inpatient costs are determined by health status indicators. Higher costs were estimated for patients with longer length of stay (preoperative and postoperative length of stay), longer operating theatre minutes, a high number of surgeons, patients admitted through the emergency room, patients referred by the Internal Medicine Department (only in the equation excluding length of stay), patients admitted to the hospital on a Saturday (only in the equation excluding length of stay). In contrast, patients referred by the Internal Medicine Department (only in the equation including length of stay), in hospitals with a high number of beds per specialty, a high number of total hospital beds, a high turnover rate (only in the equation excluding length of stay) and a high occupancy rate (only in the equation excluding length of stay) experience lower inpatient costs.

We report several important findings in the general equation. Complications is not a significant predictor of inpatient costs in the equation including the length of stay. However, for the equation without the length of stay, complications will increase the total cost, the ward cost and test cost. It is a normal factor that patients with complications after the operation consume more resources.

Comorbidity or multiple diagnoses, in the equation including the length of stay, have a consistent influence on drug cost. In the equation without length of stay, ward cost and test cost will increase. Case mix complexity is again documented to be an important predictor of inpatient costs.

Age over 76 years is a significant predictor of test cost. Patients over 76 years have more tests than patients between 66 and 75 years. It has been suggested that older men need more tests. The results of the regression analysis for the different dependent variables in inpatient costs, indicate that age was not the most significant patient characteristic in the analysis. Age had only a positive impact on test utilisation. The sex variable indicates that females have a higher drug cost.

As expected, the length of stay is the most significant predictor of inpatient costs in the general regression. If we increase length of stay (preoperative and postoperative length of stay), the different components of inpatient costs will also increase respectively.

The variable operating theatre minutes will increase the total cost, the ward cost, the drug cost and the test cost in both equations (including and excluding the length of stay).

For the general regression, patients admitted via the emergency room are more expensive for all components of inpatient costs (excluding the length of stay). However, they are more expensive only on drug cost and test cost in the equation where length of stay was included. Patients coming through internal medicine are less expensive for total cost, ward cost and test cost in the equation where length of stay was included. However, patients are more expensive on total cost, ward cost and drug cost in the equation which excludes the length of stay.

Patients admitted to the hospital on a Saturday will increase the total cost, the ward cost and the test cost, particularly in the equation which excludes the length of stay. Increasing the occupancy rate and the turnover rate will decrease the total cost and the ward cost respectively in the equation which excludes the length of stay.

The variable number of beds per specialty will decrease the total cost, the ward cost and the drug cost in the equation which included length of stay. In the equation excluding the length of stay the drug cost will decrease and the test cost will increase. Increasing the total number of hospital beds will decrease the total cost, the ward cost and the test cost in the two equations. However, the drug cost will increase. Increasing the number of operations will increase the test cost and will decrease the drug cost.

Increasing the number of surgeons will increase the total cost, the ward cost and the test cost in the equations with length of stay included. In the equation excluding the length of stay, the total cost and the drug cost will increase. Resident surgeons do order more tests. This variable is a significant predictor of test cost. Increasing the number of General Practitioners in the equation will increase the drug cost.

In the equations for the 10 specific surgical DRGs, we report several important findings. Comorbidity or multiple diagnoses, complications, age between 66 and 75 years old and sex are not very significant predictors in the different components of inpatient costs in the two equations. Age over 76 years old will increase the total cost and the test cost for two surgical DRGs only in the equation where length of stay is excluded.

Increasing preoperative and postoperative length of stay will increase in most of the specific surgical DRGs inpatient costs. Increasing operating theatre minutes will increase inpatient costs in the two equations. Patients coming through the emergency room will increase the total cost, the ward cost in six different surgical DRGs and the test cost in four surgical DRGs in the equation with the length of stay excluded. In the equation including the length of stay the total cost and the ward cost will increase for two surgical DRGs. Patients admitted to the hospital on a Friday and on a Saturday will increase inpatient costs in different surgical DRGs in the two equations. Patients discharged on a Monday will increase inpatient costs in the two equations.

Occupancy rate will decrease the total cost and the test cost in two surgical DRGs. However, for two surgical DRGs drug cost will increase. Increasing turnover rate will decrease inpatient costs in the two equations. The increase in the number of beds per speciality will increase for two surgical DRGs on test cost in the two equations. Increasing the total number of beds will increase the total cost for three surgical DRGs and for one surgical DRG on ward cost and test cost.

More resident surgeons will increase inpatient costs in the two equations, however, the drug cost will decrease. The increase in the number of General Practitioners will decrease inpatient costs per two surgical DRGs in the equation excluding the length of stay.

The results for the four hospitals, including the length of stay, indicate that patients with a longer preoperative and postoperative length of stay increase inpatient costs. Longer operating theatre time increase inpatient costs. Patients admitted through the emergency room and internal medicine decrease and increase inpatient costs. Increasing the number of patient per bed will increase inpatient costs. However, in one hospital it will decrease the inpatient costs. Patients with complications after the operation increase some inpatient costs as compared with patients without complications. Patients with comorbidity and multiple diagnoses increase some inpatient costs as compared with patients without comorbidity. Patients admitted to the hospital on Friday and Saturday increase some inpatient costs as compared with patients admitted on other days of the week. A high number of surgeons decrease some inpatient costs in three hospitals. However, it will increase the drug cost and the test cost in one hospital. A high supply of resident surgeons decrease inpatient costs in one hospital. A high number of beds per specialities decrease inpatient costs in two hospitals and increase some inpatient costs in two hospitals. High occupancy rate increase inpatient costs in one hospital and decrease inpatient costs in three hospitals.

On the other hand, the results for the four hospitals, excluding the length of stay, indicate that patients with longer operating theatre stay increase inpatient costs. Patients admitted through the emergency room and internal medicine increase inpatient costs as compared with patients admitted through the waiting list. Increasing the number of patients per bed will increase and decrease inpatient costs respectively. Patients with complications after the operation increase inpatient costs as compared with patients without complications. Patients with comorbidity and multiple diagnoses increase inpatient costs as compared with patients without comorbidity. Patients admitted to the hospital on Friday and Saturday increase inpatient costs as compared with patients admitted on other days of the week. Patients discharged on Monday increase inpatient cost in only one hospital as compared with patients discharged on other days of the week. Male patients increase and decrease inpatient costs in only one hospital. Patients over 76 years old increase inpatient cost only in one hospital. A high percentage of operations increase and decrease inpatient costs in two hospitals. A high supply of surgeons decrease inpatient costs in three hospitals, A high supply of resident surgeons increase inpatient cost in two hospitals. A high supply of beds per specialities decrease inpatient costs in two hospital and increase inpatient costs in three hospitals respectively. High occupancy rate increase inpatient costs.

It is likely that higher inpatient costs result from many factors, but the importance of each can be determined only by comparing treatments received by individual patients.

This analysis provides encouraging insights and a further understanding of the variables causing variations on inpatient costs. Adequate independent and dependent variables are now available to identify high cost diagnoses between hospitals for efficiency purposes. In the not too distant future inpatient costs will be sufficiently well understood and predictable so that reimbursement can be both prospective and rationally related to hospitals' clinical products.

The effect of particular variables on the components of inpatient costs are consistent with the effects found in the majority of publications dealing with these particular variables.

Surgeons have not been encouraged to address themselves to cost containment efforts, cost-effectiveness analysis, or clinical applications of decision analysis. Because surgeons' decisions generated the majority of medical care costs, it would seem logical to suggest that cost containment must begin in the minds of the surgeons. Formal training in decision analysis and economics should yield more rational decisions and perhaps better patient outcome. If some of the principles of cost-effective clinical decision-making would seep into the subconscious cognitive processes of Spanish surgeons, a less costly style of medical care might result.

Chapter 8

Surgeons' Explanations for Hospital Utilisation

8.1 Introduction

The relation between hospitals and doctors has attracted growing interest in recent years among researchers and managers of health care organisations. The main reasons for this interest are obvious. Doctors directly influence most of the expenditure on health care[285]. They control patient admissions, and their clinical decisions affect the utilisation of services and the length of stay. Relations between hospitals and doctors have become particularly important with the advent of prospective payment and the development of the internal market.

A study was conducted on the opinions of Spanish surgeons regarding their perceptions of problems relating to hospital efficiency. It was necessary to gather information about a wide range of questions on such issues as the information system, utilisation of services (amount of surgery, length of stay, cost of the services, cost per patient), participation, incentives, availability of resources (beds, theatres, anaesthetists, etc), alternative care (day surgery), etc. How could we explain higher numbers of excessively long stays and cost per case? Why did the length of stay and cost per inpatient patterns differ so much between hospitals? What factors were causing these differences?

Studies have suggested that providing information feedback to doctors may be a constructive way to stimulate change in practice patterns[286]. There is evidence that an increased understanding of cost and quality data may decrease resource use and improve clinical performance. If feedback can alter clinical behaviour, distribution of relevant information should become a management objective. Yet, the health care sector lags far behind other industries in providing information feedback about efficiency.

The surgeon is often uninformed as to the trade-offs between maximum treatment and limits on resources. It thus follows that if the surgeon was more aware of these trade-offs and encouraged to consider the efficiency of the organisation, his/her behaviour would change.

One difficulty in developing strategies to change medical attitudes towards the utilization of resources is the lack of knowledge about dominating factors which influence their practice of medicine.

In this chapter the level of involvement is examined and related to the frequency of information provision to surgeons within the organisation. Also explored is how the level of surgeons' involvement is related to administrative attitudes and support for the systems. Data quality and frequency of provision is explored in relation to the attitudes of surgeons. Lastly, questions are posed about the relationship between attitudes and length of stay and cost per inpatient. The search for answers to these questions was the focus of the last chapter of this research.

8.2 Methods

Given the significant role of surgeons in the process of hospital utilisation, it was important to obtain some indication of their views concerning some of the issues discussed in previous chapters.

An attempt was made to elicit from surgeons, who work in hospitals, their beliefs about what affects utilisation patterns. Although hospital variation in utilisation has been a problem addressed with increasing frequency by health researchers, the researcher thought that it would be helpful to send a questionnaire to surgeons who work in hospitals and who actually admit, discharge and request patients to have different tests.

The research was carried out using a questionnaire with eighteen questions. The survey questionnaire (Appendix 9) was delivered to surgeons in twenty different hospitals and in six different specialties (general surgery, ophthalmology, traumatology, urology, gynaecology and ENT).

8.2.1 Sampling and response rate

Seven hundred surgeons were surveyed from the Valencia Region by questionnaires from June to October 1992. Most of the questions were answered by the surgeons and the responses seemed appropriate and varied. The response rate for the questionnaire was 46% of the total number of surgeons. A single questionnaire was designed to be sent to surgeons in the whole region. Questions were included about their views of the health care system, their satisfaction with various aspects of the health care system, their perceptions of the quality of care delivered and their perceptions on the overuse and underuse of services within the system. Eighteen questions were asked, all of them with multiple parts.

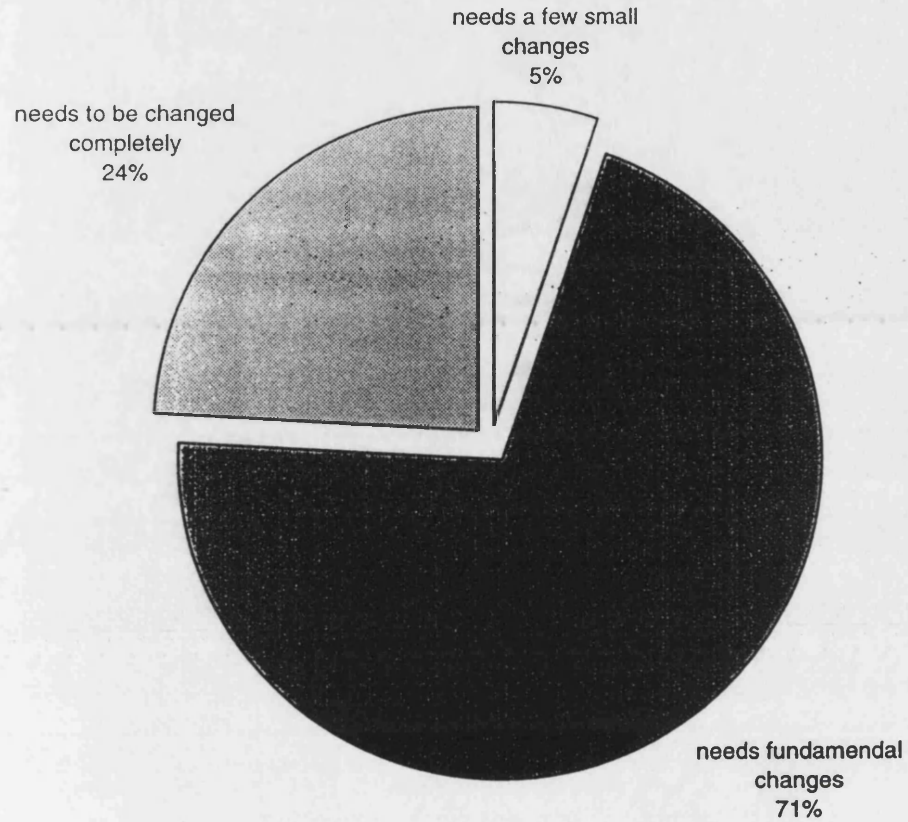
8.3 Result of the Findings

The questionnaire was examined from the viewpoint of practising surgeons in order to understand better the mechanisms of cost containment. The study provides helpful information but is not without it limitations. The rate of response in this study was low, although efforts were made, in accordance with standard survey practice, to encourage surgeons to respond.

A central element in the questionnaire was the assessment by surgeons of how well their health care system functions. Doctors are in a unique position to make this assessment because they make professional judgments as to when patients require hospitalisation and other services. In addition, doctors often serve as advocates for patients who require expensive tests or treatments.

Figure 1

Surgeons' opinion of the Valencia Health System

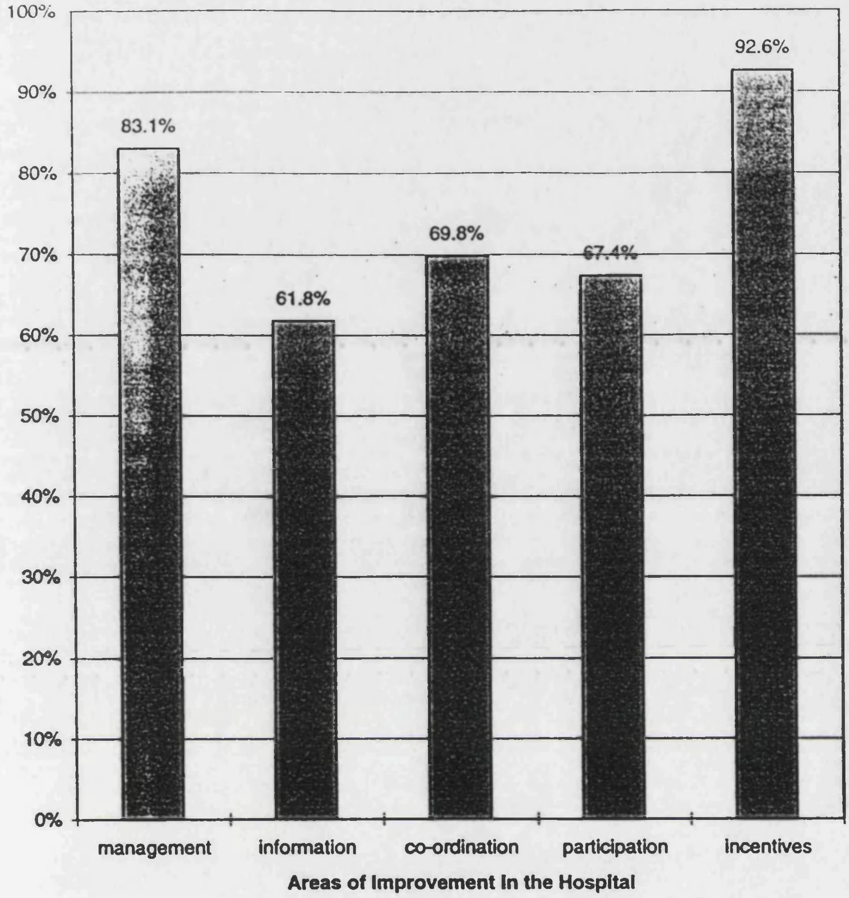


Surgeons were asked to select one of three statements to describe their view of the overall performance of their health care system. The majority of surgeons said that there are some good things about our health care system, but fundamental changes are needed to make it work better. From the figure we can see that surgeons do not want a major transformation of the Health System, however, fundamental changes should be made by the government.

As a follow-up to the question about the surgeons' general level of satisfaction with their health care system, each surgeon was asked to identify the most important problems of the health care system.

Figure 2

Most important problems in the Health Care System



Some of the problems that they identified were: improvements with incentives; management; coordination, participation and information. It appears that improvement in incentives and management are the driving forces for greater efficiency. Later in the questionnaire they pointed out what kind of incentive they prefer.

Sometimes surgeons are influenced in their medical decision-making by factors which are not strictly clinical. These factors include:

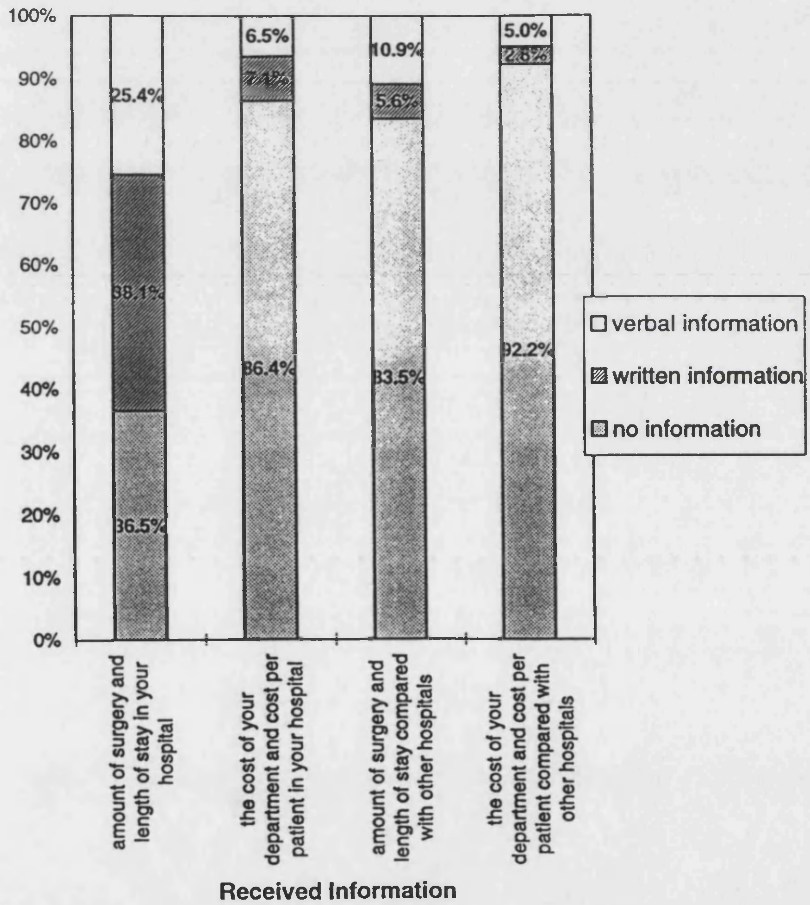
- the information they receive about activity (amount of surgery, average length of stay, cost per inpatient, etc) and the clarity, timeliness and usefulness of the information;
- coordination, participation and incentives;
- the availability of alternative care (day surgery);
- resources outside the hospital to supplement its services;

- the availability of surgical beds, theatre sessions, anaesthetists and other resources;
- problems with tests (laboratory, x-ray, etc); and
- administrative pressure to increase or reduce productivity.

Surgeons were asked to answer questions in relation to information about their own hospital and to compare them to other Valencia hospitals.

Figure 3

Information about performace indicators

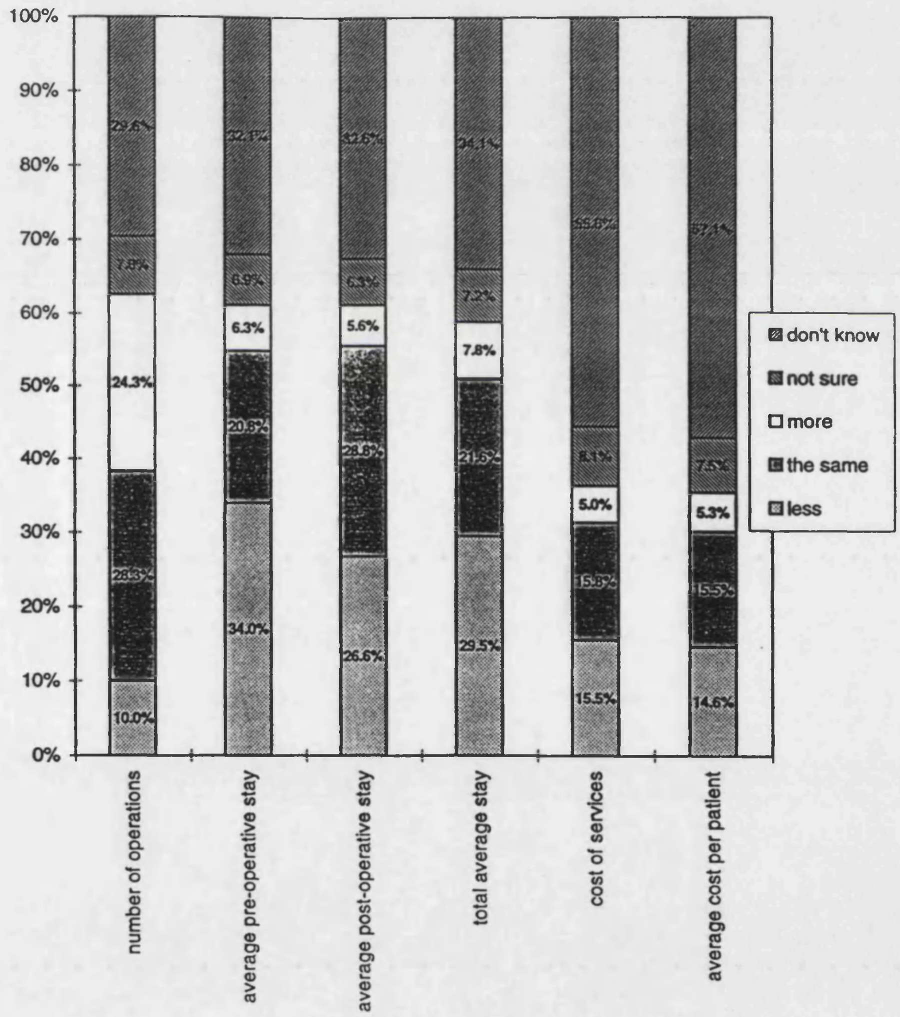


As expected, the provision of utilisation data to surgeons was generally very poor. They only received some information about the amount of surgery and length of stay in their hospital. A high percentage of surgeons do not receive enough information about the length of stay, cost of their services and cost per inpatient. This suggests that the comprehensive information required for a valid understanding of efficiency is not available to surgeons. Thus they were not given opportunities to understand the impact of clinical decisions on costs.

With reference to the average opinion surgeons might have about other hospitals, they were asked questions related to comparison of Performance indicators.

Figure 4

Comparations of performance indicators



From their responses, it appears that there is little information about cost of services and cost per inpatient.

A key to evaluating the information networks used within the hospitals is to explore where the data originates from and to evaluate the clarity, timeliness and usefulness of the information surgeons received. Surgeons were asked to answer the following questions in relation to information received about activity, where the information comes from and to evaluate the quality of the data. The question was the following: "In the past 12 months, how often have you received any information about the following surgical statistics that your hospital carries out?"

Table 8.1

Information about surgical statistics

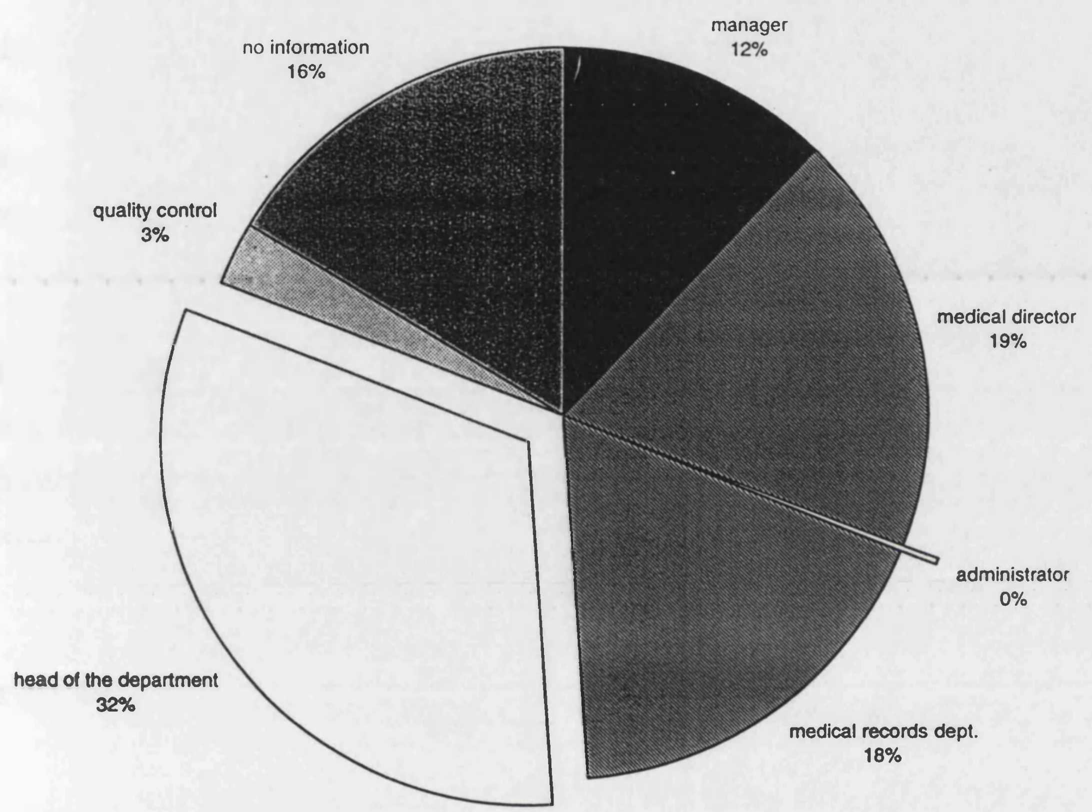
	Never	Once	Twice	More than Twice
Number of new patients per week /month	70.4%	9.7%	4.4%	15.6%
Surgery admissions per week/month	71%	10.4%	1.6%	17%
Number of operations per week/month	58.5%	16.8%	4.1%	20.6%
Average stay for surgery patients	57.4%	20.8%	2.9%	18.9%
The percentage of surgical patients occupying beds	54.4%	21.8%	4.4%	19.4%
Your average service stay	53.4%	19.6%	5.1%	21.9%
Cost of your services	89.3%	7.3%	0.9%	2.5%
Average cost per patient	90.7%	6.4%	1%	1.9%
Rotation percentage	62%	14.7%	6.7%	16.6%

From the replies we can see a lack of information in relation to surgical statistics. The feedback processes were found to be weak, a low percentage of surgeons received information about utilisation. Surgeons received relatively little feedback pertaining to direct indicators of resource use.

Other questions put to the surgeons were the source of the information concerning the duration of patients' stay in the hospital.

Figure 5

Sources of information



In Spanish hospitals, most of the data originated from the head of the department, the medical director and the medical record department. It seems that the head of the department plays a key role in processing information throughout the hospital. Nearly all utilisation information which reaches surgeons comes from the head of the department.

Surgeons were asked about the information available to them. It is interesting to note that the majority of surgeons said that they would like to receive more comparative information on the resources which were being used by the surgeons. Most surgeons do not have the necessary information for decision making. A large majority of surgeons in the twenty hospitals do not receive information about comparative resource use. Most of the surgeons surveyed would like more and better information (e,g,. more comparative data on utilisation) about surgery performed in their own hospital and other hospitals.

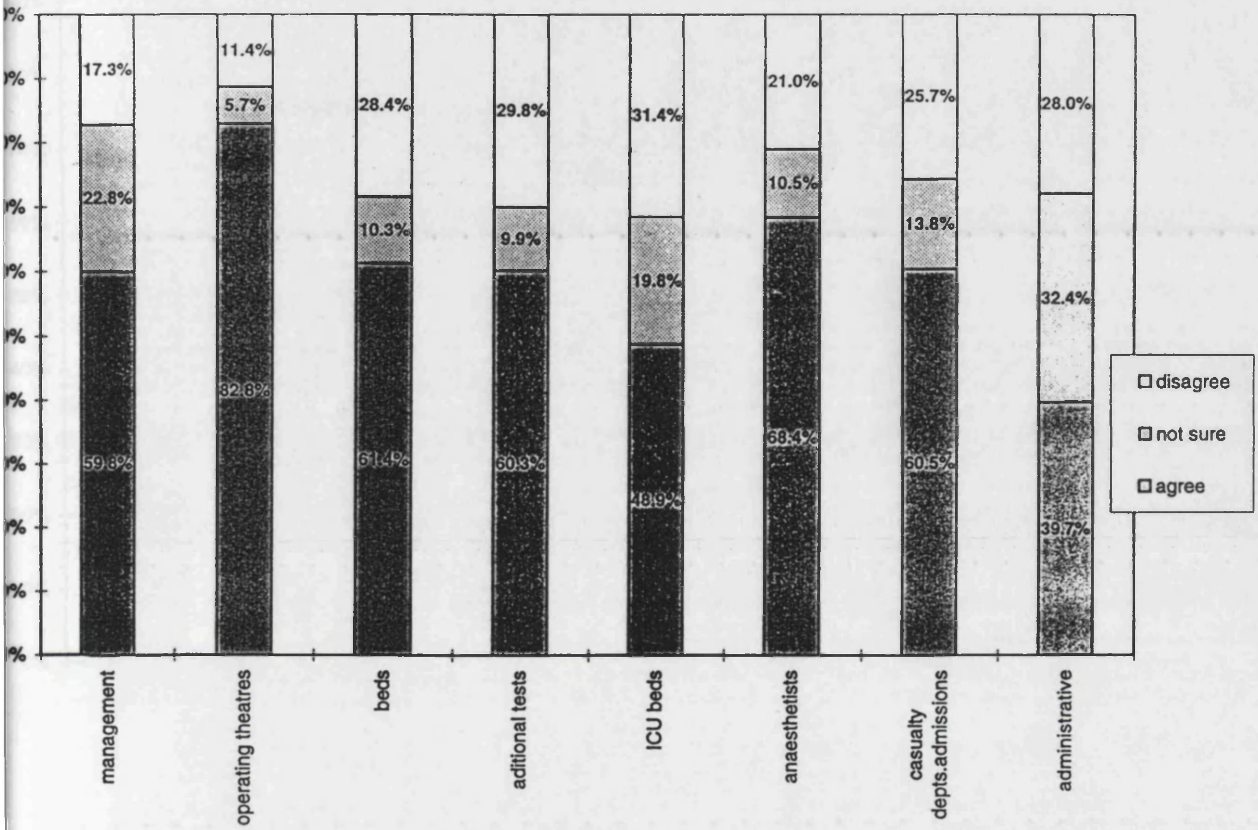
The majority of surgeons reported that the information quality was inadequate. Most of the surgeons said the information they received was unclear, outdated and not reliable. However, there was a positive attitude on the part of individual surgeons towards information as well as the use of information. It has been found that the majority of doctors are receptive to reviewing utilisation information.

Surgeons were asked to answer questions in relation to co-ordination, participation and incentives. The surgeons surveyed said that there was no adequate co-ordination between doctors and management and that there was no adequate involvement in management decisions about resource use. The majority of surgeons surveyed thought that there was no adequate participation and incentives in deciding on how to use resources.

Surgeons were asked to answer questions in relation to excessively long length of stay and cost per inpatient.

Figure 6

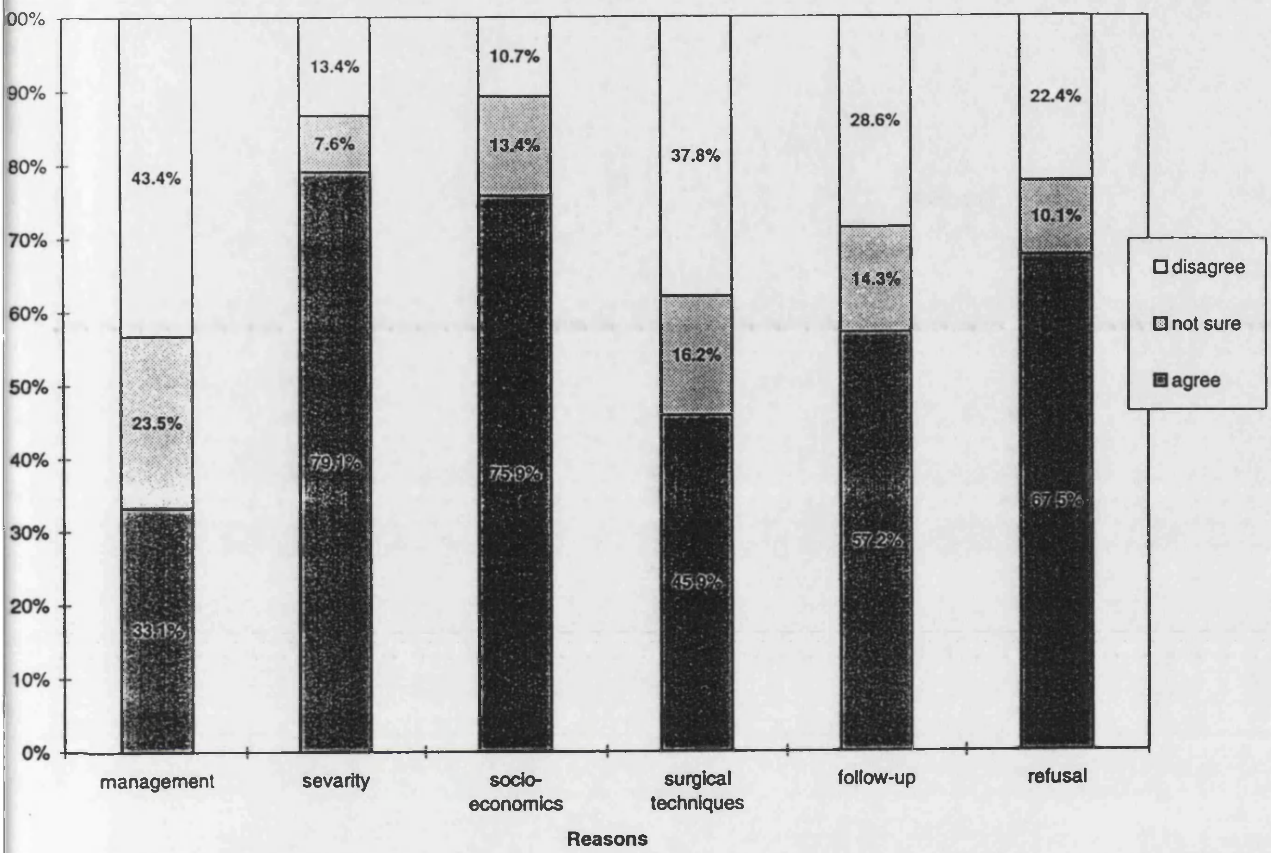
Causes of long preoperative stays



As to the causes of long preoperative stays, the primary factor cited for long preoperative length of stays in the hospital was problems with the availability of operating theatres. Other factors were lack of anaesthetists, problems with beds, problems with additional tests and problems with the management of the hospital. However, these results are more clear in Chapter 6 of the research. We have also pointed out as we have already said in Chapter 2, operating theatre in the hospital are closed in the afternoon that is why it is a priority to have the operating theatres open as long as possible.

Figure 7

Causes of long postoperative stays

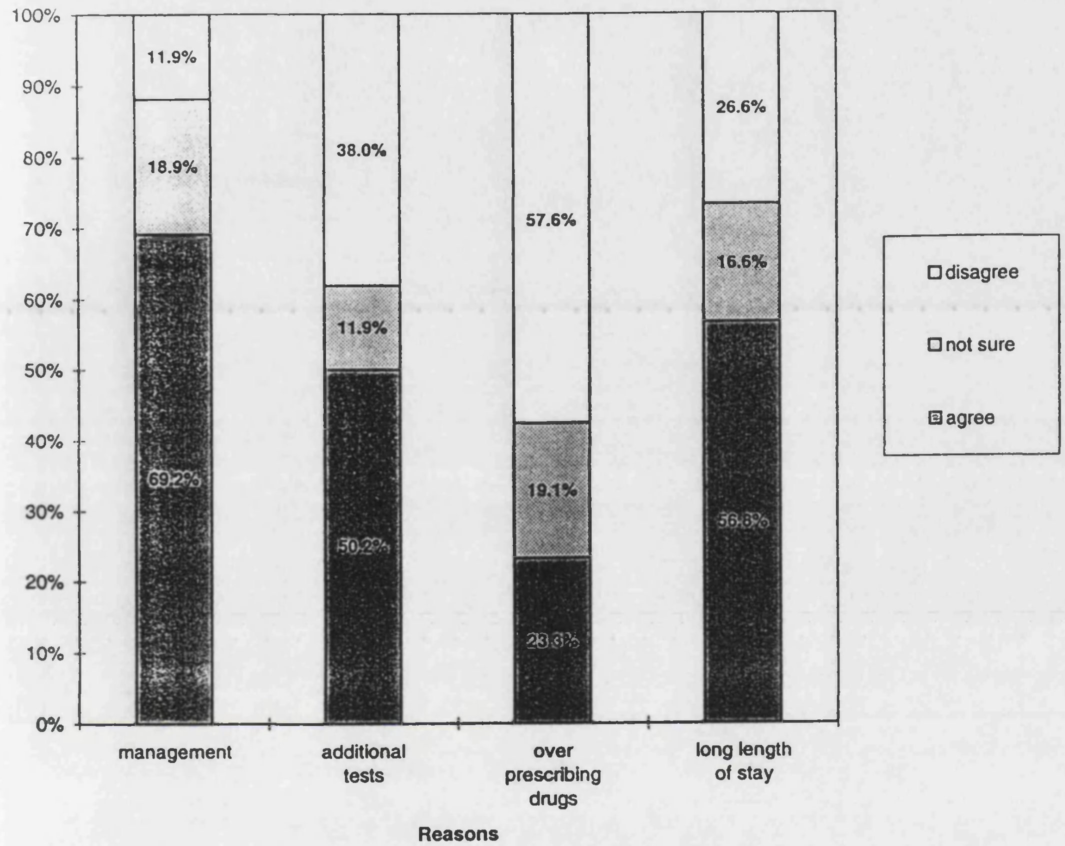


The majority of surgeons said that the primary factor cited for long postoperative length of stay were problems with complications and severity of the patients and socio-economic factors (living alone, poor housing, etc).

The patients' characteristics and their support system (family, environmental condition, etc) play an important role in overutilisation of health services. Other important factors could be the differences in the proportion of unnecassary hospital stay days reflecting differences in socioeconomics and cultural circustances. We have to be very cautious in interpreting this finding as interaction with other important factors such as employment status and marital status. We have to point out that in the same Region some researchers have been working in the same field and they found that socio-economic and family factors do not play an important role in longer length of stay. Factors related with organisation inefficiencies was the main cause.

Figure 8

Reasons for a high cost per patient

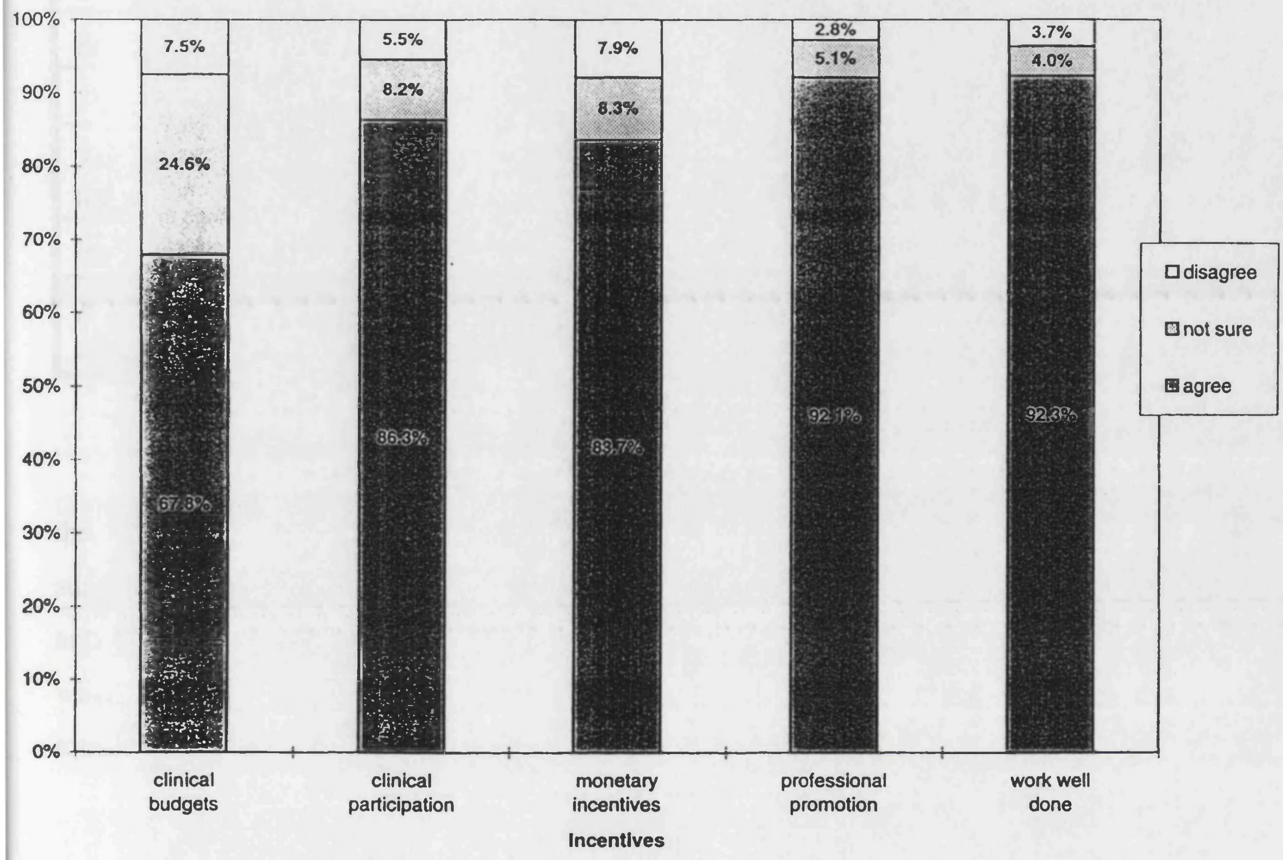


The majority of surgeons said that the following factors have contributed to a high average inpatient cost: the management of the hospital (eg., delays in hospital discharge is related to administrative scheduling of diagnostic tests or operating theatre procedures); additional tests and the average preoperative and postoperative length of stays in the hospital are too long.

Surgeons were asked to answer questions in relation to adequate incentives to lower length of stay and cost per patient.

Figure 9

Incentives to lower the average stay and cost per patient



The majority of surgeons said that the following incentives would contribute to cutting the average length of stay and cost per case: clinical budgets; clinical participation; monetary incentives; professional promotion and feedback on their work.

Surgeons were asked to answer questions in relation to cut the length of stay and the cost per inpatient.

Table 8.2

Measures to cut the average stay and cost per patient

	Agree	Not Sure	Disagree
Develop discharge protocols	73.9%	11.5%	14.6%
Strengthen quality controls	82.4%	14.5%	3.1%
Try to perform day-surgery	83%	8.8%	8.2%
Try to make additional tests in outpatient departments	35.3%	14.2%	50.6%
Patient follow-ups at home	93.5%	3.3%	3.3%
A greater co-ordiantion between the hospital and primary health care	61.8%	18.6%	19.6%

The majority of surgeons said that the following factors would contribute to cutting the length of stay and cost per inpatient: discharge protocols; quality control; short stay surgery; patients follow-up at home and greater co-ordination between primary health care and hospitals. Howerver, surgeons disagree of doing all the tests in outpatient department when we have seen in our research that this is an important factor for long length of stay and total cost for each patient.

Surgeons were asked to answer questions in relation to other measures to cut length of stay and cost per inpatient.

Table 8.3

Measures to cut the average stay and cost per patient

	Agree	Not Sure	Disagree
A policy that encourages day-surgery	62.6%	15.4%	21.9%
A policy that promotes the care and treatmetn at home	71.9%	15.5%	12.6%
A policy that might change the laws which cause doctors to order actions	63.7%	12.9%	23.4%
A policy that encourages doctors' participation in management and cost control	84.6%	12.2%	3.2%

The primary factor cited as to how to cut average stay and cost per patient was encouraging participation in management and doctors' cost control. The other set of factors involved were: treatment at home and strong support for day surgery; and in order to encourage the reduction of hospitalisation and policies that would discourage the laws related to malpractice, reducing the pressure on doctors to practice defensive medicine.

8.4 Conclusion

This chapter discusses the opportunities for hospital management and policy-makers to make greater use of data on doctors' hospital utilisation. Since doctors' practice patterns and style play such an important role in determining costs, resources, admissions, length of stay and by extension hospital financial performance, the need for improving working relationships with doctors has become imperative[287].

Some efforts have been made in Spain to gain greater control over how resources are being used by doctors. For the most part, these efforts have failed. A centralised budget supplemented by a planning and management system that encourages doctors input has not been effective in controlling resource distribution and efficiency.

The surgeon is not mainly motivated by factors which override his knowledge of organisational objectives, be it a personal desire to earn more money or to gain professional prestige. Rather, if better informed and encouraged, the surgeon could be motivated to weigh the efficiency consequences of his decisions when considering utilisation of resources.

Our survey of surgeons revealed that the majority of surgeons think that there are some good things about the health care system. However, fundamental changes should be taken. Some of the problems in the health system were often attributed to the incentives and management. These results illustrate a lack of adequate communication between surgeons and the administration.

There are not many sources of utilisation information available to hospitals in Spain. Surgeons tend to receive written information for the amount of surgery and length of stay. A high number of the surgeons surveyed said they received no information about the surgical services provided in their hospitals compared to others in the area. It is also interestin to note that most of the surgeons would like more information about activity and this include some data on comparative performance. However, information is not used consistently between hospitals for monitoring resource use. Within hospitals the coordination of information is very poor. There is a lack of financial information in the hospitals.

In the different hospitals, the head of the departments play a key role in processing information throughout the different specialities. Almost all utilisation information which reaches surgeons comes from them.

We found that there was not adequate involvement of surgeons in management decisions about resource use in the hospital. the majority of surgeons said there was not adequate coordination between specialities in their hospitals concerning the use of hospital resources.

The absence of alternative resources such as day surgery for patients discharged from the hospital mitigates against any rapid decrease in hospital stays. Lack of operating rooms and anaesthetists causes long preoperative length of stay. Patients severity was the most frequently mentioned group of factors causes long postoperative length of stay. However, we have already made clear that we had controlled for many such characteristics in our data analysis.

The management of the hospital (eg., delays in hospital discharge) was the most frequent mentioned factor causes high cost per patient. Work well done, professional promotion, clinical participation, monetary incentives and clinical budgets would contribute to short the length of stay and cut the cost per case in the hospitals. Other factors that contribute to short the length of stay and cut the cost per case would be, patients follow-up at home, short-stay surgery, qualities controls, develop discharge protocols and greater coordination between the hospital and primary health care. Moreover, surgeons believed that encouraging participation in management and doctors' cost control and treatment at home would cut the length of stay and cost per patient.

According to our survey, doctors would be receptive to incorporating resource information into their decisions. This would require giving doctors enough information about overall efficiency issues.

The soaring costs of health care delivery, and particularly those of hospital services, have prompted an increasing effort to reduce expenditure. Strategies to increase the efficiency of hospital care include mainly financial incentives such as budgets have been successful in controlling costs, but there is a concern that these measures may non-selectively reduce inappropriate services. Therefore, there is increasing necessity to use objective criteria to evaluate the appropriateness of hospital care.

We would recommend further documentation and analysis of the ways in which organisational and reimbursement policies affect the way doctors make decisions about patients stays and costs.

The different proportion of unjustified hospital stay days in the various departments of surgery constitute other facets of the surgeon factor in inappropriate hospital stay days.

Doctors are the critical decision-makers in hospitals, therefore, further research is required on the process by which they arrive at their criteria for keeping patients or sending them home.

Changing doctor behaviour, by induction of certain discharge policies in specific disease states and subpopulation of patients, may reduce significantly an inappropriate use of hospital days. Those policies have to be translated into explicit and very accurately defined criteria.

Chapter 9

Conclusion and Policy Implications

This chapter is divided into four subsections. The research began as a quantitative analysis because of differences in hospital utilisation patterns in some hospitals in Valencia Region. Subsequently, a qualitative component was added to the research design. The qualitative component involved a questionnaire with surgeons in the Valencia Region. Some suggestions concerning saving bed days for nine different surgical DRGs in the eight hospital under study were described. Finally, the determinants of the length of stay and inpatient cost variations within DRGs were analysed and addresses the question of whether DRG categories adequately represent homogenous clinical entities and hence the possible reimbursement to hospitals by DRGs.

9.1 Results of the Hospital Utilisation: Reasons for Differences in Length of Stay and Inpatient Costs

The analysis presented in this research provides information that is very important both for hospital managers and for policy makers interested in determining how hospitals might operate more efficiently. Specifically, the analysis suggests where efforts to shorten hospital stays and decrease costs should be directed.

The first objective of this research was to investigate which factors determine the hospital utilisation for patients with relatively common surgical DRGs. The focus of the analysis has been on hospital utilisation, as about 62.7% of total medical care expenditures in Spain are generated in the hospital sector.

The aspects of efficiency measures on which we focused were specifically: length of hospital stay (Chapter 6) and the different components of inpatient costs (Chapter 7). The length of stay was segmented into preoperative, postoperative and the total length of stay and the inpatient costs were subdivided in the total cost for each patient, the ward cost for each patient, the drug cost for each patient and the test cost for each patient.

On the basis of a survey of the relevant literature (Chapter 3 and 4), four indicators of explanatory factors: health status, hospitalisation-related variables, hospital and doctors characteristics and the variable regional supply were selected.

Multiple regression stepwise analysis provided considerable insight into the role of specific independent variables in explaining differences between hospitals along the seven utilisation measures (preoperative length of stay, postoperative length of stay, total length of stay, total cost, ward cost, test cost and drug cost). We were able to determine empirical measures for most of the factors believed to influence length of stay and inpatient costs.

We were able to account for 41%, 46% and 52% of the variations in preoperative, postoperative and the total length of stay respectively between hospitals in the general regression. For the different components of inpatient costs, we were able to account for 96%, 94%, 38% and 64% of the variations in total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient respectively between hospitals with the variables of preoperative and postoperative length of stay including in the general regression. However, with the variable length of stay excluded we were able to account for 80%, 67%, 36% and 57% of the variations in total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient respectively between hospitals in the general regression. For the specific surgical DRGs and hospitals in the length of stay and inpatient costs, we were able to account for a high percentage (see Appendixes).

This research demonstrates that diagnosis is the primary variable affecting hospital utilisation and without the segregation of patients by diagnosis and carrying out analysis within diagnosis, little can be learned of the true network of influence of other independent variables. Increasing case severity increases the length of stay and inpatient costs.

For most diagnoses, the existence of complications significantly increased postoperative and total length of stay. Complications have a longer length of stay and will increase cost in the general equation excluding the length of stay, however, for the specific surgical DRGs it is not significant.

There is a growing consensus among health care researchers that any theory of hospital utilisation should include measures of severity of illness. The results of this study confirm that such measures (e.g., multiple diagnoses) are important factors in explaining variation in hospital utilisation and need to be addressed in the formulation of any hospital behaviour model. Comorbidity or multiple diagnoses increase the length of stay and the different components of inpatient costs in the general equation. In the specific surgical DRGs equation this variable is not significant.

We found patient's age increases length of stay and the test cost, while the variable of sex indicates that males stay shorter period in the hospital and females have a higher drug cost.

As expected, length of stay increase inpatient costs in most of the specific surgical DRGs. Operating theatre times increase inpatient costs in the two equations.

Patients admitted through emergency room and internal medicine have a longer preoperative length of stay but the effect on postoperative length of stay is not very significant or not significant at all. In the light of this finding, it is recommended that a study be conducted concerning this practice. Patients admitted through the emergency room are more expensive for all components of inpatient costs in the equation excluding length of stay. However, they are more expensive only for the drug cost and the test cost in the equation where length of stay was included. Patients coming through internal medicine are less expensive in the equation where length of stay was included and more expensive in the equation where length of stay is excluded.

Several variables directly related to hospitalisation were estimated to have strong impacts on especially the length of stay. Patients admitted on a Friday and a Saturday and discharge on a Monday, tend to stay relatively longer in the hospital. This research shows that those patients (admitted on a Friday and a Saturday) do not have significantly longer postoperative lengths of stay than the patients admitted on the other days of the week. This pattern indicates that these patients admitted over the weekend do not have a more severe conditions. So, the distinctive utilisation patterns between weekday and weekend admissions is organisational rather than medical in nature. For the specific surgical DRGs, patients admitted on a Friday and a Saturday and discharge on a Monday increase inpatient costs in the two equations.

Occupancy rate increases the length of stay for specific surgical DRGs, however, occupancy rate will decrease inpatient costs for specific surgical DRGs. The turnover rate variable decreases the length of stay, but for two specific surgical DRGs turnover rate increases the length of stay. Turnover rate decreases inpatient costs in the two equations. Increasing the number of patients per bed will decrease the length of stay and inpatient costs.

Number of beds per specialty increases length of stay, however, number of beds per specialty decreases inpatient costs in the general equation, but in the specific surgical DRGs equation increases the test cost in two surgical DRGs. Patients admitted to a teaching hospital increases and decrease length of stay for some specific surgical DRGs.

The total number of hospital beds decreases preoperative and postoperative length of stay, as decreases inpatient costs in the general equation, however, this variable increases the total cost in three specific surgical DRGs. The percentage of operations decreases length of stay and the drug cost and increases the test cost.

The number of surgeons increases the length of stay and inpatient costs. The number of resident surgeons increases the length of stay and the test cost. The number of General Practitioners decreases the length of stay for some specific surgical DRGs and for two surgical DRGs it increases inpatient costs.

For the different general and teaching hospitals, patients admitted to the hospitals through the emergency room and internal medicine, patients with complications after the operation, patients with comorbidity or multiple diagnoses, patients admitted to the hospital on Friday and Saturday will increase the length of stay. Patients discharged on Monday will increase the length of stay in four hospitals. Older patients will increase the length of stay. A high supply of resident surgeons will decrease the length of stay in one hospital. However, for other variables such as turnover rate, sex, percentage of operations, number of surgeons, with similar medical conditions. One can, therefore, conclude that there are different stages of efficiency in the use of hospital resources and that cost saving in the health care field is expected to occur if the decision making process resulting in relatively long hospital stays and high inpatient costs are altered. Some improvements can be made to further efficiency in admission patterns (admission through the emergency room, admission through the internal medicine department), admission and discharge timing (admitted to the hospital on a Friday and a Saturday, discharge on a Monday), number of beds, surgeons, residents, etc.

The analyses comprised in this research in this field is totally new in Spain. The sizeable and reliable data base provides information for the determinant of length of stay and the different components of inpatient costs. This area is for the first time analysed at patient level. We have some hospital performance measures at this level for comparing hospital output whilst taking into account the case mix.

Given the encouraging results in this research, it is believed that the use of the length of stay segmentation and different components of inpatient costs technique could further increase our knowledge about hospital utilisation dynamics as they relate to surgical cases.

9.2 Results of the Questionnaire

The surgeons surveyed by the questionnaire suggested some explanations as to why hospital utilisation patterns vary across hospitals. Organisational methods and other factors were given as the most likely explanation for variations. The provision of utilisation data to surgeons and the feedback process were found to be very poor, a low percentage of surgeons received information about hospital utilisation. A high percentage of surgeons did not received adequate information about the length of stay and the cost of the services.

The most consistently mentioned factor was lack of adequate coordination between doctors and managers and there was inadequate involvement in management decisions about resources utilisation.

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Other major problems with long preoperative stays in the hospital utilisation included the un-availability of operating theatres, insufficient number of anaesthetists available, issues with beds, problems with additional tests and with the management of the hospital.

In relation to long postoperative stays, surgeons mentioned the following factors: the severity of the patient condition (secondary diagnoses and complications after the operation) and socio-economic factors (living alone, poor housing, etc), patient refusal to be discharged and inadequate follow-up of the patients outside the hospital.

The factors which contributed to higher costs per hospital stay were largely problems attributed to hospital management, far too many diagnoses tests and long length of stay.

The solutions for shorter lengths of stay and lower inpatient costs were in summary: strong support for day surgery and treatment at home, discharge protocols, quality controls and greater coordination between primarily health care centres and hospitals. Other factor involved was: doctors' participation in management and cost control.

9.3 Proposals for Savings in Bed Days and Inpatient Costs in the Valencia Region

In the past many proposals have been made to increase the efficiency of health care resources by cutting down on the use of hospital resources. The empirical results of this research suggest how we can implement some proposals to affect hospital utilisation in a significant way. However, they should be accompanied with some changes in the design of reimbursement systems which stimulate efficient use of hospital resources.

One of the aims of this research was to detect those hospitals that systematically deviate from the estimated average. Performance is subsequently measured as the relative difference between the actual level of care and the expected level, the latter being based mainly on the characteristics of the treated patients. One of the conclusions from this analysis is that the applied procedure is a potentially useful tool for detecting hospitals with systematically deviating treatment practices.

In this research we also want to measure the potential "saving" to the hospital from earlier discharge of acute inpatients.

A reduction in hospital days is possible if all hospitals were to have a length of stay pattern similar to that of the hospitals that have a significantly lower mean stay accounting for the same case mix. The hospital differences saving in the length of stay for bed days was analysed using the technique multiple regression stepwise analysis. The equation is estimated for each of the nine surgical DRGs described in the Chapter 6 with the following two sets of independent variables:

- The case mix variables that had an effect in the previous specific surgical DRGs equations (e.g., age, sex, comorbidity or multiple diagnoses and complications).
- The dummy variables for the different hospitals.

The unit of statistical analysis is the patient. The total length of stay is the dependent variable.

Substantial differences exist between hospitals in length of inpatient stay for the eleven common surgical DRGs (see Appendix 1). An indication of the resource implications of the variations in the length of stay is gained by taking the equation for the hospital with the best behaviour and the equation for the hospital with the average standard for comparison, albeit recognizing that this does not necessarily represent good practice. The hospitals with the largest stay can release 5,860 bed days per year for DRG 39 Lens Procedures with and without Vitrectomy, 2,377 bed days per year for DRG 307 Prostatectomy without comorbidity and complications, 600 bed days per year for DRG 337 Transurethral Prostatectomy without comorbidity and complications, 1,498 bed days per year for DRG 311 Transurethral Procedures without complication and comorbidity, 1,093 bed days per year for DRG 359 Uterine & Adnexa Procedure for Non-Malignancy without comorbidity and complications, 284 bed days per year for DRG 158 Anal & Stomal Procedures without comorbidity and complications, 548 bed days per year for DRG 162 Inguinal & Femoral Hernia Procedures Age >17 without comorbidity and complications, 400 bed days per year for DRG 196 Total Cholecystectomy with C.D.E. without comorbidity and complications, 1,984 bed days per year for DRG 198 Total Cholecystectomy without C.D.E. without comorbidity and complications above the best hospital behaviour for the selected surgical DRGs. A total of 14,644 bed days per year could be saved for the nine surgical DRGs in the eight hospitals in the Valencia region. Additional bed days in the longest stay hospitals would allow an increase in throughput while keeping constant the percentage of occupancy rate.

The bed days saved would of course be considerably lower if we were to take the hospital average for the nine selected surgical DRGs instead the best behaviour hospitals.

Differences in the social characteristics of patients is thus unlikely to account for the greater lengths of stay among all age groups in the hospitals with the largest stay.

Any policy of early discharge would, of course, involve some repercussions for services outside the hospitals. Moreover it would impose costs and benefits on patients and their families. No decision about changing inpatient length of stay should ignore these wider issues.

The scope for increasing administrative efficiency may however be limited by the availability of staff, theatres, etc. A further constraint on reducing lengths of stay can be the financial implications, because if this results in a greater throughput then total costs are increased although the total cost for each patient, drug cost and test cost are reduced in some surgical DRGs as we have found in Chapter 7. However, we have to point out that at the moment in the Health Service in the Valencia Region surgeons do not work in the evenings, only in the mornings and most of the operating theatres are closed in the evenings. Moreover, the health authorities are contracting services with the private sector (with extra cash) in order to manage the waiting lists that in some specialties such as ophthalmology, patients can wait for a DRG 39 Lens Procedure operation up to two years when in our research we found that a lot of improvements in the saving of bed days can be made.

It has also been demonstrated that doctors are for the most part unaware of the costs of the most common tests and procedures in the NHS in Spain. This is true in spite of the fact that nearly 70 per cent of the health care cost is under the direct control of the doctors.

Detailed information on the volume of various services, like tests (X-rays, lab-tests, etc) and drugs was been helpful in the analysis of hospitalisation-related costs. We have found that there is a high deviation on inpatient ancillary costs. Also we have observed great variations in the different components of inpatient costs between hospitals (see Appendix 2). Greater utilization of existing facilities will lower the aggregate cost of treating a given number of patients or increase the number that can be treated in the given supply of hospital beds.

Thus, we could also begin to address some of the recent recommendations made by some academic institutions urging medical schools to exercise their role in defining acceptable standards for the utilisation of tests and procedures.

9.4 Determinants of Length of Stay Variations within DRGs and Reimbursement Purposes

This research also reveals that the DRGs studied here are sufficiently sensitive from different levels of severity of illness. However, it is recommended, that may be some changes in the DRG classification system be adopted to account for the patients over 76 years.

DRGs are based on two assumptions. First, that patients with similar diagnostic and other case-management-relevant characteristics, such as age, secondary diagnoses and complications, represent reasonably similar clinical entities. Second, that to each such clinical entity corresponds a reasonably similar length of stay. To the extent that DRGs as currently defined capture the length of stay influencing clinical factors of case complexity and severity, observed variations of length of stay within DRGs should be attributable to nonclinical factors. Length of stay variation that exists within a DRG should not be associated with variance in the case mix but with nonclinical factors such as hospitalisation-related variables and hospital and doctor characteristics.

Of the twenty-three DRGs, eleven DRGs from the length of stay specific surgical DRGs equation were chosen to represent variation in health status while including a number of observations sufficient to apply and interpret regression analysis (see Appendix 3). There were a total of 6,376 patients in the eleven study DRGs.

The variables that can be taken to represent health status indicators within DRGs - multiple diagnoses or comorbidity, complications, between 66 and 75 years old patients and over 76 years old patients - are generally positive and statistically significant. The results of the Appendix 3 indicate that some of the explained variance in the length of stay within the study DRGs is attributable to variations in health status.

Comorbidity or multiple diagnoses is positively associated with a longer length of stay in DRG 39 Lens Procedures with or without Vitrectomy and DRG 358 Uterine & Adnexa Procedure for Non-Malignancy with complications and comorbidity. Complications is positively associated with a longer length of stay in DRG 39 Lens Procedure and DRG 197 Total Cholecystectomy without C.D.E. with complications and comorbidity.

Patients between 66 and 75 years old are positively associated with a longer length of stay in DRG 307 Prostatectomy without comorbidity and complications, DRG 311 Transurethral Procedures without comorbidity and complications, DRG 358 Uterine & Adnexa Procedure for Non-Malignancy with comorbidity and complications, DRG 162 Inguinal & Femoral Hernia Procedures Age >17 without comorbidity and complications and DRG 198 Total Cholecystectomy without C.D.E. without comorbidity and complications. Patients over 76 years are also positively associated with a longer length of stay in DRG 307 Prostatectomy without comorbidity and complications, DRG 337 Transurethral Prostatectomy without comorbidity and complications, DRG 311 Transurethral Procedures without comorbidity and complications, DRG 358 Uterine & Adnexa Procedure for Non-Malignancy with comorbidity and complications, DRG 359 Uterine & Adnexa Procedure for Non-Malignancy without comorbidity and complications, DRG 162 Inguinal & Femoral Hernia Procedures Age >17 without comorbidity and complications and DRG 198 Total Cholecystectomy without C.D.E. without comorbidity and complications.

The sex of the patients associated with the length of stay is not clear. For example, the findings show that females tend to stay longer in some DRGs

The findings clearly indicate that there remains substantial variation in health status indicators that affect case management within each of the DRGs tested. The four proxy variables (comorbidity or multiple diagnose, complications, between 66 and 75 years old patients and over 76 years old patients) consistently show that these patients stay longer. However, because cost are currently used to calculate the DRG weight, they provided the more appropriate measure of resource use for studying this issue.

Of the twenty-two DRGs, ten DRGs from the different components of inpatient costs specific surgical DRGs equation were chosen to represent variation in health status while including a number of observations sufficient to apply and interpret regression analysis (see Appendix 6). There were a total of 1,057 patients in the ten study DRGs.

Patients between 66 and 75 years old are positively associated with the total cost and ward cost in DRG 162 Inguinal & Femoral Hernia Procedure Age >17 without comorbidity and complications. Patients over 76 years are negatively associated with the total cost in DRG 307 Prostatectomy without comorbidity and complications and positively associated with the test cost in DRG 162 Inguinal & Femoral Hernia Procedure Age >17 without comorbidity and complications and DRG 197 Total Cholecystectomy without C.D.E. with complications and comorbidity and the total cost and ward cost in DRG 198 Total Cholecystectomy without C.D.E. without comorbidity and complications.

These results suggest that the older patients may have higher average length of stay, but the intensity of resources provided is low. The results, however, have important implications given current proposals in Spain for using DRGs as the foundation for reimbursement scheme.

By analysing the determinants of length of stay and inpatient cost variations within DRGs, in particular determining whether the variation is due to nonclinical or clinical factors, this research addresses the question of whether DRG categories adequately represent homogenous clinical entities and hence are useful for reimbursement purposes.

The role of reimbursement practice in influencing decisions about the length of stay and inpatients costs should be explored further. DRGs should be used as a planning tool within a system of global budgeting. This seems to be the intention of most European countries who are experimenting with DRGs, although this in not entirely clear. However, the problem is that DRGs standardisation cannot be useful as a planning tool until more is known about what represents efficient clinical practice. The current implication is that reducing variations around the prevailing average cost of treating people in any DRG will result in increasing efficiency, but we will have no idea what efficiency practice is. Thus, the main potential of DRGs seems to be that they give policy makers better information about the relationship between hospital activity and hospital costs. Using DRGs in global budgeting will probably not remove inefficiencies, but combined with monitoring of outcome they may improve the level of efficiency. The use of DRGs within a prospective global budgeting system has more potential, but only once efficient clinical practice has been established through clinical budgeting and cost-effectiveness analysis.

9.5 Conclusion

We found in our research that there were variations in the length of hospital stays and inpatient costs across hospitals even for patients with similar medical conditions. There are different degrees of efficiency in the use of hospital resources and cost savings are expected to occur if the decision making process leading to relatively long hospital stay and high cost is altered.

The data presented in this research also demonstrate, if implemented, might supply a more accurate tool for cost containment review with the potential for providing a means of in-depth evaluation for the overutilisation of hospital services.

The application of models such as the one presented in this research can be extremely useful for hospital managers and decision makers with the evaluation of the relative efficiency between different hospitals and budget allocation of hospitals.

Mechanisms for encouraging the widespread adoption of efficient forms of surgical management should be adopted. However, it is important to ensure that financial incentives and other mechanisms designed to achieve cost savings do not lead to a reduction in the standards of care.

A concurrent review of length of stay and a retrospective review of the cost for major ancillary services parameters, can be developed by professional specialists with an index of tests and procedures essential for treatment along with another index of outcomes. Cost parameters for evaluation can then be derived from these indices, yielding a set of cost parameters for the major categories of ancillary services applicable to a particular outcome. Further research is necessary in this field in the future.

Appendix 1

Means, standard deviations and number of cases for preoperative, postoperative and the total length of stay for the different surgical DRGs in the eight hospitals

DRG 39 LENS PROCEDURES WITH OR WITHOUT VITRECTOMY			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	2.7681	2.6516	1,647
HOSP1	1.0000	.0000	110
HOSP2	4.2551	2.5584	345
HOSP3	3.4906	3.1630	212
HOSP4	1.0050	0.4550	199
HOSP5	4.5747	3.0978	87
HOSP6	2.0583	2.3459	309
HOSP7	1.9965	1.4205	282
HOSP8	4.3107	3.6969	103

DRG 39 LENS PROCEDURES WITH OR WITHOUT VITRECTOMY			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	4.3910	2.8724	1,647
HOSP1	2.1727	1.1402	110
HOSP2	3.8957	1.4610	345
HOSP3	4.4858	3.1344	212
HOSP4	2.8291	1.5245	199
HOSP5	7.2759	3.9728	87
HOSP6	4.1003	2.2126	309
HOSP7	5.6560	1.8955	282
HOSP8	6.2136	5.9732	103

Continuation

DRG 39 LENS PROCEDURES WITH OR WITHOUT VITRECTOMY			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	7.1609	4.1933	1,647
HOSP1	3.1727	1.1402	110
HOSP2	8.1420	2.7995	345
HOSP3	7.9717	4.9105	212
HOSP4	3.8342	1.6105	199
HOSP5	11.8506	4.8645	87
HOSP6	6.1586	3.0839	309
HOSP7	7.6418	2.0551	282
HOSP8	10.6214	7.9250	103

DRG 307 PROSTATECTOMY W/O CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	6.6006	6.4601	363
HOSP1	1.2222	1.0420	45
HOSP2	4.3214	4.9992	84
HOSP3	8.7600	6.1477	150
HOSP4	1.0000	.0000	22
HOSP5	8.5926	6.9241	27
HOSP6	------	------	--
HOSP7	11.8788	7.7732	33
HOSP8	9.0000	2.8284	2

Continuation

DRG 307 PROSTATECTOMY W/O CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	10.3388	2.6475	363
HOSP1	9.5333	2.6423	45
HOSP2	10.3810	2.3228	84
HOSP3	10.6333	2.4941	150
HOSP4	7.4545	1.2994	22
HOSP5	10.3704	2.3882	27
HOSP6	-------	------	--
HOSP7	12.1515	3.0220	33
HOSP8	6.0000	2.8284	2

DRG 307 PROSTATECTOMY W/O CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	16.9421	7.5538	363
HOSP1	10.7556	2.7149	45
HOSP2	14.7024	5.4657	84
HOSP3	19.4000	7.0530	150
HOSP4	8.4545	1.2994	22
HOSP5	18.9630	8.1358	27
HOSP6	-------	------	--
HOSP7	24.0303	8.3684	33
HOSP8	15.0000	5.6569	2

Continuation

DRG 337 TRANSURETHRAL PROSTATECTOMY W/O CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	5.9126	6.9020	286
HOSP1	1.0000	.0000	3
HOSP2	3.2000	3.9384	10
HOSP3	10.1429	4.8452	7
HOSP4	3.1136	4.5710	44
HOSP5	9.0000	9.6437	3
HOSP6	4.1206	5.6359	141
HOSP7	12.8000	6.9252	30
HOSP8	9.5000	8.2977	48

DRG 337 TRANSURETHRAL PROSTATECTOMY W/O CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	6.1678	2.3753	286
HOSP1	7.3333	1.1547	3
HOSP2	6.0000	.9428	10
HOSP3	9.2857	4.5722	7
HOSP4	5.5455	1.7581	44
HOSP5	4.6667	1.1547	3
HOSP6	6.2340	2.4717	141
HOSP7	6.2333	1.9772	30
HOSP8	6.1042	2.3989	48

Continuation

DRG 337 TRANSURETHRAL PROSTATECTOMY W/O CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	12.0804	7.6730	286
HOSP1	8.3333	1.1547	3
HOSP2	9.2000	4.2635	10
HOSP3	19.4286	6.7788	7
HOSP4	8.6591	5.1170	44
HOSP5	13.6667	10.7858	3
HOSP6	10.3546	6.3921	141
HOSP7	19.0333	7.8542	30
HOSP8	15.6042	9.1993	48

DRG 311 TRANSURETHRAL PROCEDURES W/O CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	5.8571	5.7994	434
HOSP1	1.0417	.2041	24
HOSP2	3.4362	4.2516	94
HOSP3	8.9200	6.1463	75
HOSP4	2.1042	3.2304	48
HOSP5	6.0513	5.2270	78
HOSP6	4.6667	6.3509	3
HOSP7	9.1209	6.3959	91
HOSP8	5.1429	3.5677	21

Continuation

DRG 311 TRANSURETHRAL PROCEDURES W/O CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	4.4194	2.7022	434
HOSP1	6.7917	2.3402	24
HOSP2	3.3191	2.5995	94
HOSP3	5.1733	2.0689	75
HOSP4	4.0833	2.1121	48
HOSP5	3.6795	2.3327	78
HOSP6	3.0000	1.7321	3
HOSP7	4.8681	2.8253	91
HOSP8	5.7143	4.1127	21

DRG 311 TRANSURETHRAL PROCEDURES W/O CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	10.2742	6.6967	434
HOSP1	7.8333	2.3713	24
HOSP2	6.7553	5.0836	94
HOSP3	14.0800	6.5611	75
HOSP4	6.1875	4.1496	48
HOSP5	9.7308	6.0617	78
HOSP6	7.6667	7.3711	3
HOSP7	13.9890	7.4004	91
HOSP8	10.8571	5.1116	21

Continuation

DRG 358 UTERINE & ADNEXA PROC. FOR NON-MALIGNANCY W CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	2.7285	3.3328	221
HOSP1	1.6111	1.3346	18
HOSP2	4.5000	3.1168	8
HOSP3	2.4348	3.1412	69
HOSP4	1.7241	2.0684	29
HOSP5	7.0000	4.7329	6
HOSP6	2.6316	2.9739	57
HOSP7	4.8000	5.9777	10
HOSP8	3.3333	4.0718	24

DRG 358 UTERINE & ADNEXA PROC. FOR NON-MALIGNANCY W CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	12.1493	5.5539	221
HOSP1	9.1667	2.6178	18
HOSP2	15.5000	4.5040	8
HOSP3	13.7391	5.8376	69
HOSP4	10.8966	5.1363	29
HOSP5	11.3333	5.9889	6
HOSP6	11.3158	5.8345	57
HOSP7	13.8000	4.7796	10
HOSP8	11.7083	5.2542	24

Continuation

DRG 358 UTERINE & ADNEXA PROC. FOR NON-MALIGNANCY W CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	14.8778	6.3717	221
HOSP1	10.7778	2.9216	18
HOSP2	20.0000	3.2950	8
HOSP3	16.1739	6.9514	69
HOSP4	12.6207	5.1714	29
HOSP5	18.3333	5.4283	6
HOSP6	13.9474	6.2147	57
HOSP7	18.6000	8.6564	10
HOSP8	15.0417	5.3363	24

DRG 359 UTERINE & ADNEXA PROC FOR NON-MALIGNANCY W/O CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	2.4642	3.1342	1,034
HOSP1	1.3014	.7009	73
HOSP2	3.1828	3.1031	93
HOSP3	2.5319	3.0415	141
HOSP4	1.3883	1.0777	103
HOSP5	5.9195	5.9126	87
HOSP6	1.8876	2.5117	356
HOSP7	2.3382	1.3114	68
HOSP8	2.7522	3.0135	113

Continuation

DRG 359 UTERINE & ADNEXA PROC FOR NON-MALIGNANCY W/O CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	7.9188	2.1755	1,034
HOSP1	7.2192	.9895	73
HOSP2	8.4086	3.9294	93
HOSP3	9.0709	2.5597	141
HOSP4	7.5243	1.0832	103
HOSP5	7.9195	2.1899	87
HOSP6	7.5955	1.5398	356
HOSP7	7.4853	1.2155	68
HOSP8	8.1681	2.4817	113

DRG 359 UTERINE & ADNEXA PROC FOR NON-MALIGNANCY W/O CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	10.3733	3.7923	1,034
HOSP1	8.5342	1.0419	73
HOSP2	11.5914	4.9238	93
HOSP3	11.5957	3.9388	141
HOSP4	8.9126	1.5600	103
HOSP5	13.7241	5.8184	87
HOSP6	9.4831	3.0028	356
HOSP7	9.8235	1.8604	68
HOSP8	10.9204	3.8432	113

Continuation

DRG 158 ANAL & STOMAL PROCEDURES W/O CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	2.7937	3.9481	223
HOSP1	1.7857	2.1834	28
HOSP2	2.2778	3.5281	18
HOSP3	4.4074	5.2349	27
HOSP4	1.4348	1.9050	46
HOSP5	7.1111	5.3489	9
HOSP6	3.4412	4.1574	34
HOSP7	1.0000	.0000	23
HOSP8	3.7632	5.1066	38

DRG 158 ANAL & STOMAL PROCEDURES W/O CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	4.3453	2.5044	223
HOSP1	3.3214	1.8064	28
HOSP2	4.0556	1.8934	18
HOSP3	3.6667	1.5933	27
HOSP4	4.8261	2.2833	46
HOSP5	3.0000	1.3229	9
HOSP6	5.2353	3.3217	34
HOSP7	4.6087	3.1004	23
HOSP8	4.5000	2.6175	38

Continuation

DRG 158 ANAL & STOMAL PROCEDURES W/O CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	7.1390	4.7452	223
HOSP1	5.1071	3.2811	28
HOSP2	6.3333	4.4721	18
HOSP3	8.0741	5.8106	27
HOSP4	6.2609	3.0509	46
HOSP5	10.1111	5.5553	9
HOSP6	8.6765	5.1211	34
HOSP7	5.6087	3.1004	23
HOSP8	8.2632	5.9260	38

DRG 162 INGUINAL & FEMORAL HERNIA PROCEDURES AGE >17 W/O CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	2.1949	2.9271	585
HOSP1	1.5238	2.1987	63
HOSP2	3.2727	4.4740	44
HOSP3	2.6429	2.3604	28
HOSP4	1.3588	1.3305	131
HOSP5	3.6275	4.1998	51
HOSP6	2.9038	3.3458	104
HOSP7	1.1927	1.1261	109
HOSP8	3.1818	3.8350	55

Continuation

DRG 162 INGUINAL & FEMORAL HERNIA PROCEDURES AGE >17 W/O CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	5.8034	2.7224	585
HOSP1	4.0159	2.7795	63
HOSP2	5.6136	2.9900	44
HOSP3	8.3571	1.1930	28
HOSP4	6.0763	2.2348	131
HOSP5	3.9608	1.9795	51
HOSP6	6.9135	3.4756	104
HOSP7	5.8532	2.0540	109
HOSP8	5.5636	1.8335	55

DRG 162 INGUINAL & FEMORAL HERNIA PROCEDURES AGE >17 W/O CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	8.0017	4.3117	585
HOSP1	5.5397	4.2685	63
HOSP2	8.8864	6.4564	44
HOSP3	11.0000	2.5240	28
HOSP4	7.4275	2.6313	131
HOSP5	7.5882	5.6575	51
HOSP6	9.8269	4.8760	104
HOSP7	7.0642	2.2619	109
HOSP8	8.7455	4.4481	55

Continuation

DRG 196 TOTAL CHOLECYSTECTOMY W C.D.E. W/O CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	9.9213	6.7690	254
HOSP1	5.9524	4.6095	21
HOSP2	14.5814	7.1887	43
HOSP3	6.3333	4.6969	12
HOSP4	8.1364	5.5489	22
HOSP5	10.4571	5.8327	35
HOSP6	8.5373	6.9114	67
HOSP7	10.8750	7.2985	8
HOSP8	10.6087	6.2698	46

DRG 196 TOTAL CHOLECYSTECTOMY W C.D.E. W/O CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	12.1063	4.5649	254
HOSP1	12.5714	5.6087	21
HOSP2	12.3488	3.7726	43
HOSP3	12.0000	3.8376	12
HOSP4	12.5909	6.2538	22
HOSP5	11.3143	4.8735	35
HOSP6	11.7313	4.4435	67
HOSP7	12.2500	2.1213	8
HOSP8	12.5870	4.3847	46

Continuation

DRG 196 TOTAL CHOLECYSTECTOMY W C.D.E. W/O CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	21.9961	7.6842	254
HOSP1	18.5238	6.4313	21
HOSP2	26.9302	7.7318	43
HOSP3	18.3333	5.7892	12
HOSP4	20.7273	8.7895	22
HOSP5	21.7714	6.2970	35
HOSP6	20.2687	8.0765	67
HOSP7	23.1250	7.9000	8
HOSP8	23.0217	6.2592	46

DRG 197 TOTAL CHOLECYSTECTOMY W/O C.D.E. W CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	9.5414	8.4987	181
HOSP1	4.3500	3.7031	20
HOSP2	15.2069	10.1748	29
HOSP3	5.2222	2.9814	18
HOSP4	5.2400	6.0019	25
HOSP5	5.6429	3.6712	14
HOSP6	13.3571	8.4583	56
HOSP7	7.5556	10.8179	9
HOSP8	7.9000	6.8386	10

Continuation

DRG 197 TOTAL CHOLECYSTECTOMY W/O C.D.E. W CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	14.0000	7.1833	181
HOSP1	15.4500	8.8821	20
HOSP2	13.1724	6.4313	29
HOSP3	15.2222	8.8753	18
HOSP4	12.2400	5.3951	25
HOSP5	19.0000	9.7665	14
HOSP6	13.1786	6.4838	56
HOSP7	13.4444	4.4752	9
HOSP8	13.8000	5.9963	10

DRG 197 TOTAL CHOLECYSTECTOMY W/O C.D.E. W CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	23.4862	9.8481	181
HOSP1	19.8000	8.6426	20
HOSP2	28.3793	11.0758	29
HOSP3	20.4444	6.8790	18
HOSP4	17.4800	6.6965	25
HOSP5	24.6429	10.5947	14
HOSP6	26.5357	9.3808	56
HOSP7	19.8889	10.9253	9
HOSP8	21.7000	9.1049	10

Continuation

DRG 198 TOTAL CHOLECYSTECTOMY W/O C.D.E. W/O CC			
PREOPERATIVE (P1)	Means	Std Dev	Cases
Entire Population	6.2174	6.1673	1,159
HOSP1	5.0698	4.0780	86
HOSP2	10.5390	7.5579	141
HOSP3	4.7404	4.4396	208
HOSP4	3.6222	4.2863	90
HOSP5	7.6750	6.2284	120
HOSP6	5.7138	5.7326	290
HOSP7	4.4000	6.4001	115
HOSP8	8.1468	6.9493	109

DRG 198 TOTAL CHOLECYSTECTOMY W/O C.D.E. W/O CC			
POSTOPERATIVE (P2)	Means	Std Dev	Cases
Entire Population	8.5289	3.1969	1,159
HOSP1	9.0814	3.8201	86
HOSP2	7.9787	2.4596	141
HOSP3	8.1827	3.0606	208
HOSP4	7.8000	2.2446	90
HOSP5	9.1083	2.8691	120
HOSP6	8.7724	3.3083	290
HOSP7	9.0261	3.2430	115
HOSP8	8.2569	4.0629	109

Continuation

DRG 198 TOTAL CHOLECYSTECTOMY W/O C.D.E. W/O CC			
TOTAL LENGTH (PT)	Means	Std Dev	Cases
Entire Population	14.7446	7.1052	1,159
HOSP1	14.1512	6.1310	86
HOSP2	18.5177	8.2120	141
HOSP3	12.9231	5.6358	208
HOSP4	11.4222	5.3042	90
HOSP5	16.7833	6.3711	120
HOSP6	14.4793	6.7656	290
HOSP7	13.4261	7.7506	115
HOSP8	16.4037	8.1071	109

Appendix 2

Means, standard deviations and number of cases for total cost for each patient, ward cost for each patient, drug cost for each patient and test cost for each patient for the different surgical DRGs in the four hospitals

DRG 39 LENS PROCEDURES WITH OR WITHOUT VITRECTOMY			
Total cost	Means	Std Dev	Cases
Entire Population	237287.440	80421.3198	259
HOSP1	183393.632	40773.8188	38
HOSP2	245794.615	39313.9637	117
HOSP4	188278.725	49303.4383	69
HOSP8	363979.629	110638.616	35

DRG 39 LENS PROCEDURES WITH OR WITHOUT VITRECTOMY			
Ward cost	Means	Std Dev	Cases
Entire Population	104224.015	48805.9896	259
HOSP1	58227.6316	18937.3161	38
HOSP2	128931.316	29420.3425	117
HOSP4	69590.6667	38850.4978	69
HOSP8	139847.143	59224.2811	35

DRG 39 LENS PROCEDURES WITH OR WITHOUT VITRECTOMY			
Drug cost	Means	Std Dev	Cases
Entire Population	1589.2008	1180.0023	259
HOSP1	3360.3421	1449.3286	38
HOSP2	817.4274	179.3242	117
HOSP4	2096.7391	935.8643	69
HOSP8	1245.6000	467.5785	35

Continuation

DRG 39 LENS PROCEDURES WITH OR WITHOUT VITRECTOMY			
Test cost	Means	Std Dev	Cases
Entire Population	3481.8224	4265.4833	259
HOSP1	376.1053	762.0800	38
HOSP2	5651.6496	4779.8296	117
HOSP4	527.0870	1997.8598	69
HOSP8	5425.3714	1706.5424	35

DRG 307 PROSTATECTOMY W/O CC			
Total cost	Means	Std Dev	Cases
Entire Population	348716.511	80675.9616	88
HOSP1	297833.846	31754.9667	26
HOSP2	318065.000	41151.1483	12
HOSP4	376537.776	78875.2543	49
HOSP8	676242.000	.0000	1

DRG 307 PROSTATECTOMY W/O CC			
Ward cost	Means	Std Dev	Cases
Entire Population	195114.489	56917.2682	88
HOSP1	166295.500	28657.8184	26
HOSP2	223850.143	52836.7210	49
HOSP4	130921.333	17471.9684	12
HOSP8	306679.000	.0000	1

Continuation

DRG 307 PROSTATECTOMY W/O CC			
Drug cost	Means	Std Dev	Cases
Entire Population	10587.1705	5393.2577	88
HOSP1	15251.2308	2368.9434	26
HOSP2	9659.7755	4540.5732	49
HOSP4	3301.3333	1389.3243	12
HOSP8	22194.0000	.0000	1

DRG 307 PROSTATECTOMY W/O CC			
Test cost	Means	Std Dev	Cases
Entire Population	9843.3864	12052.3743	88
HOSP1	4281.3566	2756.0769	26
HOSP2	14732.1429	13430.5694	49
HOSP4	3549.2500	3796.4027	12
HOSP8	30094.0000	.0000	1

DRG 337 TRANSURETHRAL PROSTATECTOMY W/O CC			
Total cost	Means	Std Dev	Cases
Entire Population	361649.836	149630.999	55
HOSP1	207558.667	34125.6463	3
HOSP2	326409.167	43623.2706	6
HOSP4	311284.042	122141.322	24
HOSP8	447217.864	162336.157	22

Continuation

DRG 337 TRANSURETHRAL PROSTATECTOMY W/O CC			
Ward cost	Means	Std Dev	Cases
Entire Population	191182.400	109914.773	55
HOSP1	134508.333	18638.0214	3
HOSP2	145269.000	50011.0594	6
HOSP4	153136.875	84894.0742	24
HOSP8	252936.727	125831.371	22

DRG 337 TRANSURETHRAL PROSTATECTOMY W/O CC			
Drug cost	Means	Std Dev	Cases
Entire Population	7854.6182	5460.2217	55
HOSP1	12617.0000	5026.4553	3
HOSP2	4690.1667	2160.9806	6
HOSP4	7109.7083	5721.5848	24
HOSP8	8880.8636	5427.1212	22

DRG 337 TRANSURETHRAL PROSTATECTOMY W/O CC			
Test cost	Means	Std Dev	Cases
Entire Population	10475.6000	12428.1239	55
HOSP1	1.0000	.0000	3
HOSP2	3128.0000	3493.4232	6
HOSP4	9741.2083	15743.2959	24
HOSP8	14709.0000	8504.4774	22

Continuation

DRG 358 UTERINE & ADNEXA PROC. FOR NON-MALIGNANCY W CC			
Total cost	Means	Std Dev	Cases
Entire Population	662351.974	177534.128	39
HOSP1	519577.667	170275.019	9
HOSP2	882098.000	124563.996	4
HOSP4	629738.733	110570.773	15
HOSP8	743732.273	168112.979	11

DRG 358 UTERINE & ADNEXA PROC. FOR NON-MALIGNANCY W CC			
Ward cost	Means	Std Dev	Cases
Entire Population	466065.564	138600.156	39
HOSP1	360803.333	105362.585	9
HOSP2	673745.000	68085.9527	4
HOSP4	438988.667	92118.8983	15
HOSP8	513592.455	141552.782	11

DRG 358 UTERINE & ADNEXA PROC. FOR NON-MALIGNANCY W CC			
Drug cost	Means	Std Dev	Cases
Entire Population	5556.6154	3578.0407	39
HOSP1	5047.4444	4531.7760	9
HOSP2	4140.0000	402.2172	4
HOSP4	5646.2667	3695.8242	15
HOSP8	6366.0909	3358.4602	11

Continuation

DRG 358 UTERINE & ADNEXA PROC. FOR NON-MALIGNANCY W CC			
Test cost	Means	Std Dev	Cases
Entire Population	18266.9487	16249.3950	39
HOSP1	8476.6667	16146.8386	9
HOSP2	15944.7500	15522.4697	4
HOSP4	14529.5333	10711.3232	15
HOSP8	32218.0909	15440.3692	11

DRG 359 UTERINE & ADNEXA PROC FOR NON-MALIGNANCY W/O CC			
Total cost	Means	Std Dev	Cases
Entire Population	489748.129	136023.843	163
HOSP1	414857.710	57086.9754	31
HOSP2	540523.167	192637.097	42
HOSP4	469964.976	89808.6934	42
HOSP8	510996.958	124389.384	48

DRG 359 UTERINE & ADNEXA PROC FOR NON-MALIGNANCY W/O CC			
Ward cost	Means	Std Dev	Cases
Entire Population	328777.141	116579.045	163
HOSP1	277248.194	41866.4000	31
HOSP2	409927.238	169128.005	42
HOSP4	292187.048	50363.6867	42
HOSP8	323066.250	98460.5130	48

Continuation

DRG 359 UTERINE & ADNEXA PROC FOR NON-MALIGNANCY W/O CC			
Drug cost	Means	Std Dev	Cases
Entire Population	3816.9816	3105.1383	163
HOSP1	3085.0968	3628.1285	31
HOSP2	3565.7857	598.2680	42
HOSP4	3188.7857	1115.8767	42
HOSP8	5059.1250	4592.9368	48

DRG 359 UTERINE & ADNEXA PROC FOR NON-MALIGNANCY W/O CC			
Test cost	Means	Std Dev	Cases
Entire Population	6630.9877	8759.1832	163
HOSP1	2607.9355	4634.2797	31
HOSP2	4784.4762	6114.3855	42
HOSP4	4732.5238	5824.5565	42
HOSP8	12506.0625	11676.5037	48

DRG 158 ANAL & STOMAL PROCEDURES W/O CC			
Total cost	Means	Std Dev	Cases
Entire Population	177310.309	86497.8018	94
HOSP1	107940.429	41542.8594	21
HOSP2	184983.308	88494.6094	13
HOSP4	201591.588	88013.7364	34
HOSP8	197750.885	84607.3800	26

Continuation

DRG 158 ANAL & STOMAL PROCEDURES W/O CC			
Ward cost	Means	Std Dev	Cases
Entire Population	102184.798	62818.9422	94
HOSP1	79428.9524	39456.3865	21
HOSP2	97977.3846	79300.6469	13
HOSP4	100050.794	54776.3022	34
HOSP8	125458.846	73767.5991	26

DRG 158 ANAL & STOMAL PROCEDURES W/O CC			
Drug cost	Means	Std Dev	Cases
Entire Population	796.1398	726.5666	93
HOSP1	453.6190	370.6839	21
HOSP2	530.9167	350.0061	12
HOSP4	937.3529	1084.0922	34
HOSP8	1010.5385	142.3523	26

DRG 158 ANAL & STOMAL PROCEDURES W/O CC			
Test cost	Means	Std Dev	Cases
Entire Population	2414.3763	4948.9229	93
HOSP1	92.9524	177.9113	21
HOSP2	3376.4167	3310.6020	12
HOSP4	1466.6176	2396.8290	34
HOSP8	5084.7308	8005.6495	26

Continuation

DRG 162 INGUINAL & FEMORAL HERNIA PROCEDURES AGE >17 W/O CC			
Total cost	Means	Std Dev	Cases
Entire Population	245566.489	108962.422	137
HOSP1	129979.966	81275.6240	29
HOSP2	275468.857	115943.522	21
HOSP4	282215.279	79586.9391	61
HOSP8	264354.308	106490.544	26

DRG 162 INGUINAL & FEMORAL HERNIA PROCEDURES AGE >17 W/O CC			
Ward cost	Means	Std Dev	Cases
Entire Population	118865.569	61926.6535	137
HOSP1	75234.1379	74461.1157	29
HOSP2	109414.905	67404.8664	21
HOSP4	130120.705	40422.0209	61
HOSP8	148758.346	59784.5903	26

DRG 162 INGUINAL & FEMORAL HERNIA PROCEDURES AGE >17 W/O CC			
Drug cost	Means	Std Dev	Cases
Entire Population	1768.8394	2082.1722	137
HOSP1	727.0345	903.0097	29
HOSP2	2311.4762	3425.8596	21
HOSP4	1506.7213	1125.7120	61
HOSP8	3107.5385	2589.0473	26

Continuation

DRG 162 INGUINAL & FEMORAL HERNIA PROCEDURES AGE >17 W/O CC			
Test cost	Means	Std Dev	Cases
Entire Population	2819.1533	4789.8003	137
HOSP1	1966.3793	5594.7867	29
HOSP2	2700.7619	3518.3359	21
HOSP4	2805.4426	4732.2868	61
HOSP8	3898.1154	4902.1714	26

DRG 196 TOTAL CHOLECYSTECTOMY W C.D.E. W/O CC			
Total cost	Means	Std Dev	Cases
Entire Population	639130.298	173485.686	47
HOSP1	409653.833	33020.7110	6
HOSP2	755341.824	211927.475	17
HOSP4	663914.500	3074.0388	8
HOSP8	589317.125	68403.4970	16

DRG 196 TOTAL CHOLECYSTECTOMY W C.D.E. W/O CC			
Ward cost	Means	Std Dev	Cases
Entire Population	355546.447	128790.374	47
HOSP1	204517.833	43288.5138	6
HOSP2	431269.176	157597.711	17
HOSP4	357259.000	33210.9510	8
HOSP8	330870.500	83433.2954	16

Continuation

DRG 196 TOTAL CHOLECYSTECTOMY W C.D.E. W/O CC			
Drug cost	Means	Std Dev	Cases
Entire Population	13759.9574	6490.0713	47
HOSP1	9008.1667	3229.2349	6
HOSP2	15896.3529	1865.9497	17
HOSP4	9990.5000	3549.7638	8
HOSP8	15156.6875	9604.0301	16

DRG 196 TOTAL CHOLECYSTECTOMY W C.D.E. W/O CC			
Test cost	Means	Std Dev	Cases
Entire Population	37512.5532	17607.6122	47
HOSP1	4575.3333	4109.7969	6
HOSP2	49350.0000	3389.2690	17
HOSP4	52720.0000	1199.4685	8
HOSP8	29683.0000	12276.5864	16

DRG 197 TOTAL CHOLECYSTECTOMY W/O C.D.E. W CC			
Total cost	Means	Std Dev	Cases
Entire Population	622317.861	169792.403	36
HOSP1	589195.700	219201.471	10
HOSP2	685753.385	143512.927	13
HOSP4	567901.800	116537.660	10
HOSP8	639224.667	238174.884	3

Continuation

DRG 197 TOTAL CHOLECYSTECTOMY W/O C.D.E. W CC			
Ward cost	Means	Std Dev	Cases
Entire Population	334822.389	130016.763	36
HOSP1	324639.700	130257.169	10
HOSP2	378168.692	156008.392	13
HOSP4	291243.700	74606.0294	10
HOSP8	326193.000	161423.671	3

DRG 197 TOTAL CHOLECYSTECTOMY W/O C.D.E. W CC			
Drug cost	Means	Std Dev	Cases
Entire Population	29709.6667	44067.0017	36
HOSP1	54166.8000	74467.0574	10
HOSP2	33590.6154	19958.3649	13
HOSP4	5247.8000	3719.9077	10
HOSP8	12908.0000	8539.0105	3

DRG 197 TOTAL CHOLECYSTECTOMY W/O C.D.E. W CC			
Test cost	Means	Std Dev	Cases
Entire Population	30738.2778	24831.4623	36
HOSP1	20654.3000	23525.9178	10
HOSP2	51474.4615	20841.8423	13
HOSP4	19785.6000	16157.0954	10
HOSP8	11003.6667	5615.8861	3

Continuation

DRG 198 TOTAL CHOLECYSTECTOMY W/O C.D.E. W/O CC			
Total cost	Means	Std Dev	Cases
Entire Population	407996.347	128636.502	150
HOSP1	383699.655	109718.338	29
HOSP2	454440.660	143861.684	50
HOSP4	420493.219	103321.733	32
HOSP8	356265.282	120208.080	39

DRG 198 TOTAL CHOLECYSTECTOMY W/O C.D.E. W/O CC			
Ward cost	Means	Std Dev	Cases
Entire Population	217077.560	103488.303	150
HOSP1	211168.448	97281.2007	29
HOSP2	252940.560	115463.990	50
HOSP4	209129.375	86545.1144	32
HOSP8	182014.897	93194.5062	39

DRG 198 TOTAL CHOLECYSTECTOMY W/O C.D.E. W/O CC			
Drug cost	Means	Std Dev	Cases
Entire Population	9440.3000	8194.4217	150
HOSP1	11258.3448	8449.6586	29
HOSP2	8794.3000	6674.9393	50
HOSP4	8554.3125	9216.4992	32
HOSP8	9643.5897	8953.2844	39

Continuation

DRG 198 TOTAL CHOLECYSTECTOMY W/O C.D.E. W/O CC			
Test cost	Means	Std Dev	Cases
Entire Population	17937.0600	16958.8254	150
HOSP1	9573.1724	11723.5271	29
HOSP2	30541.5000	18666.1997	50
HOSP4	18318.9375	12777.4476	32
HOSP8	7683.4872	8573.1984	39

Appendix 3
Specific surgical DRGs regression results

DRG 39 Lens Procedures with or without Vitrectomy			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	12.47(0.52)**	-9.81(1.43)**	-0.69(1.51)NS
admission through emergency room	NS	NS	NS
admission through internal medicine	NS	NS	NS
turnover rate	-0.22(0.05)**	-0.47(0.09)**	-1.10(0.12)**
complications	NS	3.13(0.70)**	NS
multiple diagnoses or comorbidity	1.29(0.55)*	NS	NS
admitted to the hospital on a Friday	1.51(0.15)**	NS	1.24(0.24)**
admitted to the hospital on a Saturday	NS	NS	NS
discharge on a Monday	NS	0.85(0.15)**	0.59(0.22)**
sex	NS	NS	NS
over 76 years old patients	NS	NS	NS
between 66 and 75 years old patients	NS	NS	NS
percentage of operations	NS	NS	0.51(0.12)**
admitted to a teaching hospital	0.59(0.18)**	-0.51(0.26)*	1.73(0.30)**
number of surgeons	NS	-15.37(3.52)**	NS
number of resident surgeons	NS	NS	NS
number of beds per specialities	NS	0.14(0.01)**	0.14(0.01)**
occupancy rate	NS	4.78(0.62)**	1.69(0.55)**
General Practitioner	-1.22(0.09)**	1.43(0.20)**	NS
total number of hospital beds	-1.28(0.09)**	NS	-1.06(0.24)**
R Square	0.28	0.22	0.29
F	104**	57**	83**
N of cases	1,646	1,646	1,646

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 39, Lens Procedures with or without Vitrectomy, increasing by 1 per cent the turnover rate, the length of stay will decrease by 0.2, 0.5 and 1.1 day on P1, P2 and PT respectively between hospitals. Each patient with complications has a longer postoperative length of stay by 3.1 days. Each patient with multiple diagnoses or comorbidity will spend 1.3 days longer on the preoperative length of stay. Each patient admitted to the hospital on Friday will spend 1.5 and 1.2 day longer on P1 and PT respectively between hospitals. Each patient discharged on Monday will have longer preoperative and postoperative lengths of stay by 0.9 and 0.6 days respectively between hospitals. Increase by 1 per cent the percentage of operations, the total length of stay will increase by 0.5 day. Each patient admitted to a teaching hospital will stay longer by 0.6 and 1.7 days on P1 and PT respectively. However, the length of stay will be shorter by 0.5 day on P2 between hospitals. Increasing by one more the number of surgeons per 10,000 population, the length of stay will decrease by 15.4 days between hospitals. Increase by one the number of beds per specialities per 1,000 population, the length of stay will increase by 0.1 and 0.1 on P2 and PT. The results are not very significant for the number of beds per specialities. Increase by 1 per cent the occupancy rate, the length of stay will increase by 4.8 and 1.7 days on P2 and PT respectively between hospitals. Increasing by one more the number of GPs per 10,000 population, the preoperative length of stay will decrease by 1.2 day and the postoperative length of stay will increase by 1.4 day. Increasing by one the total number of hospital beds per 1,000 population, the length of stay will decrease by 1.3 and 1.1 day on P1 and PT respectively between hospitals.

Continuation

DRG 307 Prostatectomy W/O CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	-12.71(2.96)**	3.70(1.81)*	4.98(2.06)*
admission through emergency room	6.69(0.71)**	0.91(0.34)**	7.71(0.82)**
admission through internal medicine	12.18(2.81)**	NS	11.95(3.22)**
turnover rate	3.62(0.90)**	-2.24(0.54)**	NS
complications	NS	NS	NS
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on a Friday	2.93(1.05)**	NS	3.17(1.22)**
admitted to the hospital on a Saturday	6.12(1.84)**	NS	7.62(2.11)**
discharge on a Monday	NS	1.63(0.28)**	1.40(0.69)*
sex	NS	NS	NS
over 76 years old patients	NS	1.16(0.35)**	NS
between 66 and 75 years old patients	NS	0.61(0.27)*	NS
percentage of operations	-2.57(0.32)**	-1.98(0.32)**	-4.84(0.47)**
admitted to a teaching hospital	-7.33(1.20)**	NS	-9.85(1.40)**
number of surgeons	NS	-55.85(14.14)**	NS
number of resident surgeons	NS	NS	NS
number of beds per specialities	NS	NS	NS
occupancy rate	NS	NS	-11.73(3.30)**
General Practitioner	NS	5.82(1.16)**	NS
total number of hospital beds	12.30(1.42)**	NS	19.33(2.03)**
R Square	0.47	0.27	0.50
F	39**	16**	39**
N of cases	362	362	362

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 307, Prostatectomy W/O CC, each patient admitted through the emergency room stays longer by 6.7, 0.9 and 7.7 days on P1, P2 and PT respectively between hospitals. Each patient admitted through internal medicine stays longer by 12.2 and 12.0 days on P1 and PT respectively between hospital. Increasing the turnover rate by 1 per cent the preoperative length of stay will increase by 3.6 days. However, the postoperative length of stay will decrease by 2.2 days. Each patient admitted to the hospital on Friday stays longer by 3.0 and 3.2 days on P1 and PT respectively between hospitals. Each patient admitted to the hospital on Saturday stays longer by 6.1 and 7.6 days on P1 and PT respectively between hospital. Each patient discharged on Monday stays longer by 1.6 and 1.4 days on P2 and PT respectively between hospitals. Patients over 76 years old stay longer by 1.2 day on P2 and patients between 66 and 75 years old stay longer 0.6 day. Increasing the percentage of operations by 1 per cent the length of stay will decrease by 2.6, 2.0 and 4.8 days on P1, P2 and PT respectively between hospitals. Each patient admitted to a teaching hospital stays shorter by 7.3 and 10.0 days on P1 and PT respectively between hospitals. Increasing by one more surgeons per 10,000 population, the postoperative length of stay will decrease by 55.85 days between hospitals. Increasing by 1 per cent the occupancy rate, the total length of stay will decrease by 12.0 days between hospitals. One more GP per 10,000 population will increase the postoperative length of stay by 6.0 days between hospitals. Increasing by one more the total number of hospital beds, the length of stay will increase by 12.3 and 19.3 days on P1 and PT respectively between hospitals.

Continuation

DRG 337 Transurethral Prostatectomy W/O CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	-44.65**	//	-8.03(4.28)NS
admission through emergency room	9.40(1.06)**	NS	9.10(1.26)**
admission through internal medicine	8.81(3.14)**	NS	9.42(3.67)*
turnover rate	NS	NS	NS
complications	NS	NS	NS
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on a Friday	NS	NS	2.64(1.21)*
admitted to the hospital on a Saturday	3.24(1.38)*	NS	3.79(1.63)*
discharge on a Monday	NS	NS	NS
sex	NS	NS	NS
over 76 years old patients	2.09(0.77)**	NS	2.94(0.91)**
between 66 and 75 years old patients	NS	NS	NS
percentage of operations	NS	NS	NS
admitted to a teaching hospital	NS	NS	3.88(1.90)*
number of surgeons	NS	NS	83.63(14.01)**
number of resident surgeons	NS	NS	NS
number of beds per specialities	0.13(0.02)**	NS	NS
occupancy rate	18.91(2.19)**	NS	12.57(1.87)**
General Practitioner	6.02(0.73)**	NS	NS
total number of hospital beds	NS	NS	-3.21(1.09)**
R Square	0.44	0.00	0.39
F	31**	//	20**
N of cases	285	285	285

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 337, Transurethral Prostatectomy W/O CC, each patient admitted throuth the emergency room has a longer length of stay by 9.4 and 9.1 days on P1 and PT. Each patient admitted through internal medicine has a longer length of stay by 8.8 and 9.4 days on P1 and PT respectively between hospitals. Each patient admitted to the hospital on Friday stays longer by 2.6 days on PT. Each patient admitted to the hospital on Saturday stays longer by 3.2 and 3.8 days on P1 and PT respectively between hospitals. Patients over 76 years old stay longer by 2.1 and 3.0 days on P1 and PT respectively between hospitals. Each patient admitted to a teaching hospital stays 3.9 days on PT longer. One more surgeon per 10,000 population will increase the length of stay by 83.6 days on PT. Increasing by one more bed per speciality per 1,000 population, the length of stay will increase by 0.1 day on P1. Increasing the occupancy rate by 1 per cent will increase the length of stay by 19.0 and 12.6 days on P1 and PT respectively between hospitals. One more GP per 10,000 population will increase the length of stay by 6.0 days on P1. Increasing by one more the total number of hospital beds per 1,000 population will decrease the hospital length of stay by 3.2 days on PT between hospitals.

Continuation

DRG 311 Transurethral Procedures W/O CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	-37.17(3.51)**	4.88(2.55)NS	-27.41(3.29)**
admission through emergency room	7.20(0.62)**	NS	7.63(0.74)**
admission through internal medicine	NS	NS	NS
turnover rate	NS	1.49(0.45)**	7.97(1.51)**
complications	NS	NS	NS
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on a Friday	NS	NS	NS
admitted to the hospital on a Saturday	NS	NS	NS
discharge on a Monday	NS	0.85(0.31)**	NS
sex	NS	NS	NS
over 76 years old patients	1.09(0.52)*	0.76(0.30)*	2.19(0.67)**
between 66 and 75 years old patients	NS	NS	1.16(0.59)*
percentage of operations	NS	NS	NS
admitted to a teaching hospital	3.64(0.55)**	NS	6.28(1.19)**
number of surgeons	NS	27.37(7.04)**	63.71(7.24)**
number of resident surgeons	NS	NS	-86.61(22.65)**
number of beds per specialities	0.12(0.01)**	-0.06(0.01)**	NS
occupancy rate	11.34(1.35)**	2.36(0.98)*	10.82(1.58)**
General Practitioner	4.95(0.45)**	-1.25(0.55)*	NS
total number of hospital beds	NS	NS	NS
R Square	0.41	0.14	0.39
F	50**	10**	35**
N of cases	433	433	433

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 311, Transurethral Procedures W/O CC, each patient admitted through the emergency room stays longer in the hospital by 7.2 and 7.6 days on P1 and PT respectively. Increasing by 1 per cent the turnover rate will increase the length of stay by 1.5 and 8.0 days on P2 and PT respectively between hospitals. Each patient discharged on Monday have a longer postoperative length of stay by 0.9 day. Patients over 76 years old stay longer by 1.1, 0.8 and 2.2 days on P1, P2 and PT respectively. Patients between 66 and 75 years old have a longer total length of stay by 1.2 day. Each patient admitted to a teaching hospital will increase the length of stay by 3.6 and 6.3 days on P1 and PT respectively. Increasing by one more surgeon per 10,000 population, the postoperative and total length of stay will increase by 27.4 and 63.7 days respectively between hospitals. However, increasing by one more the number of resident surgeons per 10,000 population, the total length of stay wil decrease by 86.6 days. Increasing by one more the number of beds per specialities, the preoperative length of stay will increase by 0.1, however, for the postoperative length of stay the number of beds per especialities will decrease. The significant for this variable is very low. Increasing by 1 per cent the occupancy rate the length of stay will increase by 11.3, 2.4 and 10.8 days on P1, P2 and PT respectively between hospitals. One more GP per 10,000 population will increase the preoperative length of stay by 5.0 days and will decrease the postoperative length of stay by 1.3 day.

Continuation

DRG 358 Uterine & Adnexa Proc for Non-Malignancy W CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	5.70(1.24)**	18.83(1.50)**	33.21(4.94)**
admission through emergency room	NS	NS	NS
admission through internal medicine	13.12(2.86)**	12.58(5.16)*	25.13(5.71)**
turnover rate	NS	-1.96(0.46)**	-1.75(0.57)**
complications	NS	NS	NS
multiple diagnoses or comorbidity	2.39(0.40)**	-2.16(0.73)**	NS
admitted to the hospital on a Friday	NS	NS	NS
admitted to the hospital on a Saturday	NS	NS	NS
discharge on a Monday	NS	-2.51(0.97)*	NS
sex	NS	NS	NS
over 76 years old patients	4.18(1.44)**	NS	6.77(2.90)*
between 66 and 75 years old patients	1.87(0.71)**	4.01(1.29)**	6.12(1.43)**
percentage of operations	NS	NS	NS
admitted to a teaching hospital	-1.17(0.54)*	NS	NS
number of surgeons	NS	NS	NS
number of resident surgeons	NS	NS	NS
number of beds per specialities	NS	NS	-0.16(0.06)**
occupancy rate	-6.41(1.83)**	NS	-6.03(2.99)*
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.30	0.17	0.23
F	16**	9**	11**
N of cases	220	220	220

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 358, Uterine & Adnexa for Non-Malignancy W CC, each patient admitted through internal medicine has a longer length of stay by 13.1, 12.6 and 25.1 days on P1, P2 and PT respectively between hospitals. Increasing by 1 per cent the turnover rate, the length of stay will decrease by 2.0 and 1.8 days on P2 and PT respectively between hospitals. Each patient with multiple diagnoses or comorbidity will spend 2.4 longer on P1, however, for postoperative length of stay these patients will spend 2.2 days shorter as compared with patients without multiple diagnoses. Each patient discharged on Monday has a shorter postoperative length of stay by 2.5 days. Patients over 76 years old have a longer length of stay by 4.2 and 6.8 days on P1 and PT respectively. Patients between 66 and 75 years old have a longer length of stay by 1.9, 4.0 and 6.1 days respectively on P1, P2 and PT respectively. Each patient admitted to a teaching hospital, the length of stay will decrease by 1.2 days on P1. Increasing by one the number of beds per specialities, the length of stay will decrease by 0.2 day on PT. Increasing by 1 per cent the occupancy rate the length of stay will decrease by 6.4 and 6.0 days on P2 and PT respectively between hospitals.

Continuation

DRG 359 Uterine & Adnexa Proc for Non-Malignancy W/O CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	5.94(1.40)**	9.58(0.66)**	25.34(1.92)**
admission through emergency room	NS	NS	NS
admission through internal medicine	NS	NS	NS
turnover rate	NS	-0.89(0.13)**	-1.78(0.19)**
complications	NS	NS	NS
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on a Friday	3.01(0.53)**	NS	3.24(0.64)**
admitted to the hospital on a Saturday	2.67(0.83)**	NS	2.35(1.01)*
discharge on a Monday	NS	NS	NS
sex	NS	NS	NS
over 76 years old patients	1.35(0.55)*	NS	1.34(0.67)*
between 66 and 75 years old patients	NS	NS	NS
percentage of operations	NS	NS	NS
admitted to a teaching hospital	NS	-0.44(0.16)**	NS
number of surgeons	-5.85(1.42)**	3.05(0.91)**	-4.66(1.81)*
number of resident surgeons	7.40(1.34)**	NS	5.02(0.89)**
number of beds per specialities	NS	NS	-0.12(0.02)**
occupancy rate	-5.19(1.08)**	NS	NS
General Practitioner	0.67(0.21)**	NS	NS
total number of hospital beds	-1.15(0.13)**	NS	NS
R Square	0.18	0.06	0.17
F	27**	23**	30**
N of cases	1,033	1,033	1,033

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 359, Uterine & Adnexa Proc for Non-Malignancy W/O CC, Increasing the turnover rate by 1 per cent, the length of stay will decrease by 0.9 and 1.8 days on P2 and PT respectively. Each patient admitted to the hospital on Friday will stay longer by 3.0 and 3.2 days on P1 and PT respectively. Each patient admitted to the hospital on Saturday stays longer by 2.7 and 2.4 days on P1 and PT respectively. Patients over 76 years old stay longer by 1.4 and 1.3 day on P1 and PT respectively. Each patient admitted to a teaching hospital has a negative effect on P2 by 0.4 day. Increasing by one more the number of surgeons per 10,000 population, the length of stay will increase by 3.1 days on postoperative length of stay, however for preoperative and total length of stay, increasing by one the number of surgeons, the P1 and PT will decrease by 5.9 and 4.7 days respectively between hospitals. Increasing by one more the number of resident surgeons per 10,000 population the length of stay will increase by 7.4 and 5.0 days on P1 and PT respectively between hospitals. Increasing one more bed per speciality per 1,000 population will decrease the total length of stay by 0.1 day. Increasing by 1 per cent the occupancy rate, the preoperative length of stay will decrease by 5.2 days. Increasing by one more the number of GPs per 10,000 population, the preoperative length of stay will increase by 0.7 day. Increasing by one more the total number of hospital beds per 1,000 population, the preoperative length of stay will decrease by 1.2 day.

Continuation

DRG 158 Anal & Stomal Procedures W/O CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	1.15(0.27)**	2.34(0.63)**	5.42(0.35)**
admission through emergency room	5.70(0.54)**	NS	5.80(0.70)**
admission through internal medicine	4.10(1.58)*	NS	6.33(2.04)**
turnover rate	NS	NS	NS
complications	NS	NS	NS
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on a Friday	NS	-1.46(0.70)*	NS
admitted to the hospital on a Saturday	NS	NS	NS
discharge on a Monday	NS	NS	NS
sex	NS	NS	NS
over 76 years old patients	NS	NS	NS
between 66 and 75 years old patients	NS	NS	NS
percentage of operations	NS	NS	NS
admitted to a teaching hospital	1.67(0.45)**	-0.92(0.45)*	1.72(0.59)**
number of surgeons	NS	NS	NS
number of resident surgeons	NS	NS	NS
number of beds per specialities	NS	NS	NS
occupancy rate	NS	NS	NS
General Practitioner	NS	NS	NS
total number of hospital beds	NS	1.06(0.31)**	NS
R Square	0.39	0.07	0.29
F	46**	5**	30**
N of cases	222	222	222

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 158, Anal & Stomal Procedure W/O CC, each patient admitted through emergency room will stay longer by 5.7 and 5.8 days on P1 and PT respectively between hospitals. Each patient admitted through internal medicine will stay longer by 4.1 and 6.3 days on P1 and PT respectively between hospitals. Each patient admitted to the hospital on Friday has a shorter length of stay by 1.5 on P2. Each patient admitted to a teaching hospital has a longer length of stay by 1.7 and 1.7 day on P1 and PT respectively, however, for postoperative length of stay these patients have a shorter length of stay by 0.9 day. Increasing by one the total number of hospital beds the length of stay will increase by 1.1 day on P2.

Continuation

DRG 162 Inguinal & Femoral Hernia Procedures Age >17 W/O CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	-1.07(1.09)NS	5.67(1.39)**	7.49(1.16)**
admission through emergency room	5.07(0.30)**	1.11(0.33)**	6.17(0.46)**
admission through internal medicine	NS	NS	NS
turnover rate	NS	2.03(0.57)**	NS
complications	NS	NS	NS
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on a Friday	0.71(0.36)*	NS	NS
admitted to the hospital on a Saturday	NS	NS	NS
discharge on a Monday	NS	-0.47(0.24)*	NS
sex	-0.85(0.23)**	-0.95(0.28)**	-2.35(0.36)**
over 76 years old patients	NS	1.80(0.36)**	2.48(0.53)**
between 66 and 75 years old patients	NS	1.03(0.26)**	0.92(0.37)*
percentage of operations	NS	-0.41(0.07)**	NS
admitted to a teaching hospital	NS	NS	2.75(0.59)**
number of surgeons	NS	13.37(2.08)**	4.23(2.15)*
number of resident surgeons	1.91(0.61)**	-2.93(0.90)**	-5.51(1.70)**
number of beds per specialities	0.04(0.01)**	NS	NS
occupancy rate	NS	-3.83(0.65)**	NS
General Practitioner	NS	-1.18(0.27)**	NS
total number of hospital beds	NS	NS	NS
R Square	0.39	0.25	0.35
F	73**	17**	45**
N of cases	584	584	584

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 162, Inguinal & Femoral Hernia Procedure Age > 17 W/O CC, each patient admitted through the emergency room stays longer by 5.1, 1.1 and 6.2 days on P1, P2 and PT respectively. Increasing by 1 per cent the turnover rate the length of stay will increase by 2.0 days on P2. Each patient admitted to the hospital on Friday has a longer preoperative length of stay by 0.7 day. Each patient discharged on Monday has a shorter postoperative length of stay by 0.5 day. Males have a shorter length of stay by 0.9, 1.0 and 2.4 days on P1, P2 and PT respectively. Patients over 76 years old have a longer length of stay by 1.8 and 2.5 days on P2 and PT respectively. Patients between 66 and 75 years old have a longer length of stay by 1.0 and 0.9 day on P2 and PT respectively. Increasing by 1 per cent the percentage of operations the postoperative length of stay will decrease by 0.4 day. Each patient admitted to a teaching hospital will stay longer by 2.8 days on PT. Increasing by one more the number of surgeons per 10,000 population, the length of stay will increase by 13.4 and 4.2 on P2 and PT respectively. Increasing by one more the number of resident surgeons per 10,000 population, the preoperative length of stay will increase by 2.0 days, however, the postoperative and total length of stay will decrease by 3.0 and 5.5 days respectively. Increasing by one more the number of beds per speciality per 1,000 population, the preoperative length of stay will increase, however the significant is very low. Increasing by 1 per cent the occupancy rate the preoperative length of stay will decrease by 3.8 days. Increasing by one more GP per 10,000 population, the postoperative length of stay will decrease by 1.2 day.

Continuation

DRG 196 Total Cholecystectomy W C.D.E. W/O CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	18.24(2.71)**	//	34.13(3.69)**
admission through emergency room	7.15(0.79)**	NS	7.81(0.91)**
admission through internal medicine	5.07(1.30)**	NS	3.34(1.50)*
turnover rate	NS	NS	NS
complications	NS	NS	NS
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on a Friday	NS	NS	NS
admitted to the hospital on a Saturday	NS	NS	NS
discharge on a Monday	NS	NS	NS
sex	NS	NS	-2.05(0.86)*
over 76 years old patients	NS	NS	NS
between 66 and 75 years old patients	NS	NS	NS
percentage of operations	NS	NS	NS
admitted to a teaching hospital	NS	NS	NS
number of surgeons	-26.47(5.35)**	NS	-25.74(6.25)**
number of resident surgeons	NS	NS	-5.47(2.34)*
number of beds per specialities	NS	NS	NS
occupancy rate	NS	NS	NS
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.31	0.00	0.31
F	38**	//	22**
N of cases	253	253	253

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 196, Total Cholecystectomy W C.D.E. W/O CC, each patient admitted through the emergency room will stay longer by 7.2 and 7.8 days on P1 and PT respectively between hospitals. Each patient admitted through internal medicine will stay longer by 5.1 and 3.3 days on P1 and PT respectively between hospitals. Male patients have a shorter total length of stay by 2.1 days. Increasing by one more surgeon per 10,000 population the length of stay will decrease by 26.5 and 25.7 days on P1 and PT respectively between hospitals. Increasing by one more the number of resident surgeons per 10,000 population, the total length of stay will decrease by 5.5 days.

Continuation

DRG 197 Total Cholecystectomy W/O C.D.E. W CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	13.77(2.39)**	10.47(0.97)**	25.17(1.66)**
admission through emergency room	10.14(1.03)**	NS	6.47(1.35)**
admission through internal medicine	6.74(1.71)**	NS	NS
turnover rate	NS	NS	NS
complications	NS	3.41(1.06)**	NS
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on a Friday	NS	NS	NS
admitted to the hospital on a Saturday	NS	NS	NS
discharge on a Monday	NS	3.22(1.25)*	NS
sex	NS	NS	NS
over 76 years old patients	NS	NS	NS
between 66 and 75 years old patients	NS	NS	NS
percentage of operations	-1.47(0.30)**	NS	-1.18(0.33)**
admitted to a teaching hospital	NS	NS	NS
number of surgeons	NS	NS	NS
number of resident surgeons	NS	7.53(3.31)*	NS
number of beds per specialities	NS	NS	NS
occupancy rate	-7.94(2.92)**	NS	NS
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.45	0.11	0.20
F	36**	8**	23**
N of cases	180	180	180

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p > .05)

For surgical DRG 197, Total Cholecystectomy W/O C.D.E. W CC, each patient admitted through the emergency room stays longer by 10.1 and 6.5 days on P1 and PT respectively. Each patient admitted through internal medicine has a longer preoperative length of stay by 6.7 days. Each patient with complications after the operation has a longer postoperative length of stay by 3.4. Each patient discharged on Monday has a longer postoperative length of stay by 3.2 days. Increasing by 1 per cent the percentage of operations the length of stay will decrease by 1.5 and 1.2 day on P1 and PT respectively. Increasing by one more resident surgeon per 10,000 population, the postoperative length of stay will increase by 7.5 days. Increasing by 1 per cent the occupancy rate, the preoperative length of stay will decrease by 8.0 days.

Continuation

DRG 198 Total Cholecystectomy W/O C.D.E. W/O CC			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	2.59(1.71)NS	11.09(0.95)**	14.75(1.06)**
admission through emergency room	7.33(0.33)**	0.65(0.21)**	8.01(0.38)**
admission through internal medicine	5.85(0.57)**	NS	6.05(0.68)**
turnover rate	NS	NS	NS
complications	NS	NS	NS
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on a Friday	1.42(0.47)**	NS	1.61(0.56)**
admitted to the hospital on a Saturday	1.90(0.56)**	NS	1.71(0.67)*
discharge on a Monday	NS	0.70(0.24)**	1.12(0.44)*
sex	NS	NS	NS
over 76 years old patients	NS	1.29(0.34)**	2.03(0.63)**
between 66 and 75 years old patients	NS	1.00(0.22)**	0.97(0.40)*
percentage of operations	-0.25(0.09)**	NS	-0.35(0.10)**
admitted to a teaching hospital	NS	NS	NS
number of surgeons	-5.17(1.63)**	NS	-5.06(1.93)**
number of resident surgeons	NS	NS	NS
number of beds per specialities	0.05(0.02)**	-0.04(0.01)**	NS
occupancy rate	NS	NS	NS
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.40	0.05	0.36
F	110**	12**	73**
N of cases	1,158	1,158	1,158

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 198, Total Cholecystectomy W/O C.D.E. W/O CC, each patient admitted through the emergency room stay longer by 7.3, 0.7 and 8.0 days on P1, P2 and PT respectively. Each patient admitted through internal medicine stay longer by 5.9 and 6.1 days on P1 and PT respectively between hospitals. Each patient admitted to the hospital on Friday stays longer by 1.4 and 1.6 day on P1 and PT respectively between hospitals. Each patient admitted to the hospital on Saturday stays longer by 1.9 and 1.7 days on P1 and PT respectively between hospitals. Each patient discharged on Monday stays longer by 0.7 and 1.1 days on P1 and PT respectively. Patients over 76 years old have a longer length of stay by 1.3 and 2.0 days on P2 and PT respectively. Patients between 66 and 75 years old have a longer length of stay by 1.0 and 1.0 day on P2 and PT respectively. Increasing by 1 per cent the percentage of operations the length of stay will decrease by 0.3 and 0.4 day on P1 and PT respectively. Increasing by one more surgeon per 10,000 population, the length of stay will decrease by 5.2 and 5.1 days on P1 and PT respectively. Increasing by one more the number of beds per speciality per 1,000 population, the preoperative length of stay will increase and the postoperative length of stay will decrease. However, the significance is very low.

Appendix 4
Hospital regression results for all selected surgical DRGs

HOSPITAL 1			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	-11.31(4.20)**	13.56(0.95)**	-132.38(11.55)**
admission through emergency room	6.29(0.35)**	3.57(0.70)**	9.73(0.82)**
admission through internal medicine	4.01(0.28)**	2.77(0.56)**	6.67(0.66)**
turnover rate	NS	-0.86(0.11)**	
complications	NS	4.72(0.56)**	4.70(0.65)**
multiple diagnoses or comorbidity	-1.06(0.31)**	1.52(0.58)**	NS
admitted to the hospital on Friday	1.08(0.46)*	NS	2.43(1.00)*
admitted to the hospital on Saturday	NS	1.71(0.82)*	2.32(0.96)*
discharge on Monday	NS	0.88(0.42)*	1.17(0.49)*
sex	NS	-1.75(0.39)**	-1.57(0.38)**
over 76 years old patients	NS	1.67(0.58)**	1.50(0.67)*
between 66 and 75 years old patients	0.39(0.19)*	NS	NS
percentage of operations	2.42(0.80)**	NS	28.36(2.35)**
admitted to a teaching hospital	NS	NS	NS
number of surgeons	NS	-12.20(2.0)**	-14.41(2.38)**
number of resident surgeons	NS	NS	NS
number of beds per specialities	NS	NS	NS
occupancy rate	NS	5.19(0.87)**	NS
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.52	0.46	0.56
F	103**	43**	73**
N of cases	578	578	578

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 1, each patient admitted through the emergency room has a longer length of stay by 6.3, 3.6 and 9.7 days on P1, P2 and PT respectively. Each patient admitted through internal medicine has a longer length of stay by 4.0, 2.8 and 6.7 days on P1, P2 and PT respectively. Increasing the turnover rate by 1 per cent, the postoperative length of stay will decrease by 0.9 days. Each patient with complications will spend 4.7 and 4.7 days longer on the P2 and PT respectively. Each patient with multiple diagnoses or comorbidity will spend 1.1 days shorter on preoperative length of stay and 1.5 days longer on postoperative length of stay. Patients admitted to the hospital on Friday will stay longer by 1.1 and 2.4 days on P1 and PT respectively. Patients admitted to the hospital on Saturday will stay longer by 1.7 and 2.3 days on P2 and PT respectively. Each patient discharged on Monday has a longer P2 and PT by 0.9 and 1.2 days respectively. Male patients have a shorter length of stay by 1.8 and 1.6 days on P2 and PT respectively. Patients over 76 years old have a longer length of stay by 1.7 and 1.5 days on P2 and PT respectively. Patients between 66 and 75 years old have a longer preoperative length of stay by 0.4 days. Increasing by 1 per cent the percentage of operations, the P1 and PT will increase by 2.4 and 28.4 days respectively. Increasing the number of surgeons per 10,000 population, the P2 and PT will decrease by 12.2 and 14.4 days respectively. Increasing by 1 per cent the occupancy rate, the postoperative length of stay will increase by 5.2 days.

Continuation

HOSPITAL 2			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	0.40(0.89)NS	27.53(1.76)**	6.62(0.38)**
admission through emergency room	10.30(0.39)**	1.56(0.32)**	11.23(0.47)**
admission through internal medicine	14.20(2.16)**	NS	11.56(2.82)**
turnover rate	1.08(0.34)**	-4.84(0.34)**	NS
complications	NS	8.29(0.52)**	9.24(0.84)**
multiple diagnoses or comorbidity	2.69(0.64)**	3.35(0.52)**	6.09(0.84)**
admitted to the hospital on Friday	1.70(0.39)**	NS	1.89(0.51)**
admitted to the hospital on Saturday	2.63(0.68)**	1.44(0.55)**	3.98(0.89)**
discharge on Monday	NS	0.85(0.25)**	NS
sex	NS	NS	NS
over 76 years old patients	NS	1.25(0.31)**	1.84(0.50)**
between 66 and 75 years old patients	NS	0.60(0.26)*	1.33(0.42)**
percentage of operations	NS	NS	NS
admitted to a teaching hospital	NS	NS	NS
number of surgeons	NS	NS	NS
number of resident surgeons	NS	NS	NS
number of beds per specialities	NS	-0.11(0.01)**	NS
occupancy rate	NS	NS	7.41(0.99)**
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.51	0.45	0.58
F	169**	90**	149**
N of cases	996	996	996

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 2, each patient admitted through emergency room has a longer length of stay by 11.3, 1.6 and 11.2 days on P1, P2 and PT respectively. Each patient admitted through the internal medicine has a longer length of stay by 14.2 and 11.6 days on P1 and PT respectively. Increasing by 1 per cent the turnover rate, the preoperative length of stay will increase by 1.1 days and the postoperative length of stay will decrease by 4.8 days. Each patient with complications will spend 8.3 and 9.2 days longer on P2 and PT respectively. Each patient with multiple diagnoses or comorbidity will spend 2.7, 3.4 and 6.1 days longer on P1, P2 and PT respectively. Patients admitted to the hospital on Friday will stay longer by 1.7 and 1.9 days on P1 and PT respectively. Patients admitted to the hospital on Saturday will stay longer by 2.6, 1.4 and 4.0 days on P1, P2 and PT respectively. Patients discharged on Monday have a longer postoperative length of stay by 0.9 days. Patients over 76 years old have a longer length of stay by 1.3 and 1.8 on P2 and PT respectively. Patients between 66 and 75 years old have a longer P2 and PT by 0.6 and 1.3 days respectively. Increasing by one the number of beds per specialities per 1,000 population, the postoperative length of stay will decrease by 0.1 days. Increasing by 1 per cent the occupancy rate, the total length of stay will increase by 7.4 days.

Continuation

HOSPITAL 3			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	9.41(0.52)**	-63.01(29.89)**	35.78(6.11)**
admission through emergency room	5.66(0.39)**	NS	6.22(0.58)**
admission through internal medicine	3.46(1.37)**	NS	NS
turnover rate	NS	NS	-5.74(1.91)**
complications	-1.00(0.49)*	6.40(0.46)**	5.49(0.73)**
multiple diagnoses or comorbidity	2.39(.64)**	3.43(0.61)**	5.94(0.95)**
admitted to the hospital on Friday	1.73(0.49)**	NS	NS
admitted to the hospital on Saturday	NS	NS	NS
discharge on Monday	NS	0.98(0.29)**	0.94(0.46)*
sex	NS	NS	NS
over 76 years old patients	1.43(0.38)**	1.30(0.37)**	2.76(0.57)**
between 66 and 75 years old patients	0.83(0.32)*	1.71(0.31)**	2.60(0.48)**
percentage of operations	NS	10.94(9.08)**	NS
admitted to a teaching hospital	NS	NS	NS
number of surgeons	NS	NS	5.18(1.81)**
number of resident surgeons	NS	NS	NS
number of beds per specialities	NS	0.34(0.02)**	NS
occupancy rate	-13.56(1.06)**	24.96(2.52)**	-32.63(2.90)**
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.38	0.39	0.40
F	75**	78**	72**
N of cases	986	986	986

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 3, each patient admitted through the emergency room has a longer length of stay by 5.7 and 6.2 days on P1 and PT respectively. Each patient admitted through internal medicine has a longer preoperative length of stay by 3.5 days. Increasing the turnover rate by 1 per cent, the total length of stay will decrease by 5.7 days. Each patient with complications will spend 6.4 and 5.5 days longer on the P2 and PT respectively. However, each patient with complications will spend 1.0 days shorter on preoperative length of stay. Each patient with multiple diagnoses or comorbidity will spend 2.4, 3.4 and 6.0 days longer on P1, P2 and PT respectively. Patients admitted to the hospital on Friday will stay longer preoperative length of stay by 1.7 days. Each patient discharged on Monday has a longer P2 and PT by 1.0 and 1.0 days respectively. Patients over 76 years old have a longer length of stay by 1.4, 1.3 and 2.8 days on P1, P2 and PT respectively. Patients between 66 and 75 years old have a longer length of stay by 0.8, 1.7 and 2.6 days on P1, P2 and PT respectively. Increasing by 1 per cent the percentage of operations, the postoperative length of stay will increase by 11.0 days. Increasing the number of surgeons per 10,000 population, the total length of stay will increase by 5.2 days. Increasing by one more the number of beds per specialities per 1,000 population, the postoperative length of stay will increase by 0.3 days. Increasing by 1 per cent the occupancy rate, the preoperative length of stay and total length of stay will decrease by 13.6 and 32.6 days and the postoperative length of stay will increase by 25.0 days.

Continuation

HOSPITAL 4			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	1.26(0.70)**	-1.54(0.45)**	-0.75(0.56)NS
admission through emergency room	8.40(0.26)**	2.62(0.38)**	11.14(0.47)**
admission through internal medicine	13.99(0.98)**	NS	14.81(1.79)**
turnover rate	NS	NS	
complications	NS	4.88(0.37)**	5.03(0.46)**
multiple diagnoses or comorbidity	NS	2.00(0.47)**	2.49(0.59)**
admitted to the hospital on Friday	2.85(0.57)**	NS	3.34(1.04)**
admitted to the hospital on Saturday	1.63(0.41)**	NS	NS
discharge on Monday	NS	0.55(0.24)*	NS
sex	NS	NS	NS
over 76 years old patients	NS	NS	NS
between 66 and 75 years old patients	NS	0.74(0.23)**	0.61(0.29)*
percentage of operations	NS	NS	NS
admitted to a teaching hospital	NS	NS	NS
number of surgeons	NS	NS	NS
number of resident surgeons	NS	-42.68(4.92)**	-46.63(6.11)**
number of beds per specialities	NS	0.14(0.01)**	0.16(0.01)**
occupancy rate	NS	NS	NS
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.63	0.45	0.60
F	359**	100**	159**
N of cases	853	853	853

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 4, each patient admitted through the emergency room has a longer length of stay by 8.4, 2.6 and 11.1 days on P1, P2 and PT respectively. Each patient admitted through internal medicine has a longer length of stay by 14.0 and 14.8 days on P1 and PT respectively. Each patient with complications will spend 4.9 and 5.0 days longer on the P2 and PT respectively. Each patient with multiple diagnoses or comorbidity will spend 2.0 and 2.5 days longer on P2 and PT respectively. Patients admitted to the hospital on Friday will stay longer by 2.9 and 3.3 days on P1 and PT respectively. Patients admitted to the hospital on Saturday will stay longer by 1.6 days on the preoperative length of stay. Each patient discharged on Monday has a longer postoperative length of stay by 0.6 days. Patients between 66 and 75 years old have a longer P2 and PT by 0.7 and 0.6 days respectively. Increasing the number of resident surgeons per 10,000 population, the P2 and PT will decrease by 42.7 and 46.6 days respectively. Increasing by one the number of beds per specialities per 1,000 population, the P2 and PT will increase by 0.1 and 0.2 days respectively.

Continuation

HOSPITAL 5			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	8.29(1.07)**	-2.19(1.08)*	49.45(15.15)**
admission through emergency room	4.73(0.50)**	2.46(0.43)**	6.99(0.70)**
admission through internal medicine	3.60(1.66)*	4.63(1.37)**	7.98(2.22)**
turnover rate	NS	2.58(0.49)**	NS
complications	NS	4.53(1.35)**	6.12(2.19)**
multiple diagnoses or comorbidity	NS	7.46(0.70)**	7.26(1.14)**
admitted to the hospital on Friday	NS	NS	1.96(0.84)*
admitted to the hospital on Saturday	NS	NS	NS
discharge on Monday	NS	NS	NS
sex	NS	1.16(0.38)**	1.97(0.60)**
over 76 years old patients	1.51(0.66)*	2.58(0.56)**	4.08(0.92)**
between 66 and 75 years old patients	NS	1.76(0.41)**	2.18(0.66)**
percentage of operations	NS	NS	-9.85(3.95)*
admitted to a teaching hospital	NS	NS	NS
number of surgeons	NS	NS	NS
number of resident surgeons	NS	NS	NS
number of beds per specialities	NS	NS	NS
occupancy rate	-7.62(2.10)**	NS	-12.62(3.01)**
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.14	0.29	0.29
F	26**	32**	25**
N of cases	623	623	623

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

For hospital 5, each patient admitted through the emergency room has a longer length of stay by 4.7, 2.5 and 7.0 days on P1, P2 and PT respectively. Each patient admitted through internal medicine has a longer length of stay by 3.6, 4.6 and 8.0 days on P1, P2 and PT respectively. Increasing the turnover rate by 1 per cent, the postoperative length of stay will increase by 2.6 days. Each patient with complications will spend 4.5 and 6.1 days longer on the P2 and PT respectively. Each patient with multiple diagnoses or comorbidity will spend 7.5 and 7.3 days longer on postoperative and total length of stay. Patients admitted to the hospital on Friday will stay longer by 2.0 days on total length of stay. Male patients have a longer length of stay by 1.2 and 2.0 days on P2 and PT respectively. Patients over 76 years old have a longer length of stay by 1.5, 2.6 and 4.1 days on P1, P2 and PT respectively. Patients between 66 and 75 years old have a longer length of stay by 1.8 and 2.2 days on P2 and PT respectively. Increasing by 1 per cent the percentage of operations, the total length of stay will decrease by 10.0 days. Increasing by 1 per cent the occupancy rate, the postoperative and total length of stay will decrease by 7.6 and 13.0 days respectively.

Continuation

HOSPITAL 6			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	-7.56(1.62)**	-15.20(1.96)**	-23.97(2.72)**
admission through emergency room	11.10(0.29)**	NS	11.35(0.45)**
admission through internal medicine	7.28(0.59)**	NS	8.14(0.89)**
turnover rate	NS	NS	NS
complications	NS	4.87(0.39)**	4.49(0.53)**
multiple diagnoses or comorbidity	4.45(0.42)**	2.42(0.44)**	6.71(0.63)**
admitted to the hospital on Friday	2.04(0.24)**	NS	2.51(0.36)**
admitted to the hospital on Saturday	3.43(0.50)**	NS	3.29(0.74)**
discharge on Monday	NS	NS	NS
sex	0.40(0.19)*	0.90(0.21)**	1.41(0.29)**
over 76 years old patients	NS	1.23(0.30)**	1.52(0.42)**
between 66 and 75 years old patients	NS	0.74(0.22)**	0.80(0.31)**
percentage of operations	NS	NS	NS
admitted to a teaching hospital	NS	NS	NS
number of surgeons	NS	20.49(1.07)**	21.23(1.58)**
number of resident surgeons	NS	NS	NS
number of beds per specialities	0.11(0.02)**	0.16(0.02)**	0.29(0.03)**
occupancy rate	NS	NS	NS
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.62	0.32	0.57
F	350**	100**	183**
N of cases	1512	1512	1512

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

For hospital 6, each patient admitted through the emergency room has a longer length of stay by 11.1 and 11.4 days on P1 and PT respectively. Each patient admitted through internal medicine has a longer length of stay by 7.3 and 8.1 days on P1 and PT respectively. Each patient with complications will spend 4.9 and 4.5 days longer on the P2 and PT respectively. Each patient with multiple diagnoses or comorbidity will spend 4.5, 2.4 and 6.7 days longer on P1, P2 and PT respectively. Patients admitted to the hospital on Friday will stay longer by 2.0 and 2.5 days on P1 and PT respectively. Patients admitted to the hospital on Saturday will stay longer by 3.4 and 3.3 days on P1 and PT respectively. Male patients have a longer length of stay by 0.4, 0.9 and 1.4 days on P1, P2 and PT respectively. Patients over 76 years old have a longer length of stay by 1.2 and 1.5 days on P2 and PT respectively. Patients between 66 and 75 years old have a longer length of stay by 0.7 and 0.8 days on P2 and PT. Increasing the number of surgeons per 10,000 population, the P2 and PT will increase by 20.5 and 21.2 days respectively. Increasing by one more the number of beds per specialities per 1,000 population, the P1, P2 and PT will increase by 0.1, 0.2 and 0.3 days respectively.

Continuation

HOSPITAL 7			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	95.46(78.60)**	-73.82(18.10)**	-43.75(38.32)**
admission through emergency room	9.31(0.68)**	2.48(0.53)**	11.46(0.92)**
admission through internal medicine	8.70(1.65)**	4.20(1.28)**	13.06(2.20)**
turnover rate	-9.32(7.47)**	NS	6.71(0.85)**
complications	NS	6.68(0.54)**	6.05(0.94)**
multiple diagnoses or comorbidity	2.06(0.63)**	2.15(0.50)**	4.07(0.86)**
admitted to the hospital on Friday	2.85(0.44)**	NS	2.25(0.59)**
admitted to the hospital on Saturday	4.26(1.02)**	2.40(0.79)**	6.65(1.36)**
discharge on Monday	NS	NS	NS
sex	NS	NS	NS
over 76 years old patients	0.80(0.36)*	1.12(0.31)**	2.30(0.54)**
between 66 and 75 years old patients	NS	0.87(0.26)**	1.51(0.46)**
percentage of operations	NS	20.84(4.66)**	20.53(9.13)**
admitted to a teaching hospital	NS	NS	NS
number of surgeons	-50.06(37.31)**	NS	NS
number of resident surgeons	NS	NS	NS
number of beds per specialities	-7.72(0.63)**	NS	0.98(0.07)**
occupancy rate	NS	-1.45(0.45)**	NS
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.53	0.30	0.51
F	103**	40**	77**
N of cases	836	836	836

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 7, each patient admitted through the emergency room has a longer length of stay by 9.3, 2.5 and 11.5 days on P1, P2 and PT respectively. Each patient admitted through internal medicine has a longer length of stay by 8.7, 4.2 and 13.1 days on P1, P2 and PT respectively. Increasing the turnover rate by 1 per cent, the preoperative length of stay will decrease by 9.3 days. However, the total length of stay will increase by 6.7 days. Each patient with complications will spend 6.7 and 6.1 days longer on the P2 and PT respectively. Each patient with multiple diagnoses or comorbidity will spend 2.1, 2.2 and 4.1 days longer on P1, P2 and PT respectively. Patients admitted to the hospital on Friday will stay longer by 2.9 and 2.3 days on P1 and PT respectively. Patients admitted to the hospital on Saturday will stay longer by 4.3, 2.4 and 6.7 days on P1, P2 and PT respectively. Patients over 76 years old have a longer length of stay by 0.8, 1.1 and 2.3 days on P1, P2 and PT respectively. Patients between 66 and 75 years old have a longer P2 and PT by 0.9 and 1.5 days respectively. Increasing by 1 per cent the percentage of operations, the P2 and PT will increase by 20.8 and 20.5 days respectively. Increasing by one the number of surgeons per 10,000 population, the preoperative length of stay will decrease by 50.1 days. Increasing by one the number of beds per specialities per 1,000 population, the preoperative length of stay will decrease by 7.7 days and the total length of stay will increase by 1.0 days. Increasing by 1 per cent the occupancy rate, the postoperative length of stay will decrease by 1.5 days.

Continuation

HOSPITAL 8			
Explanatory Variables	**Preoperative**	**Postoperative**	**Total Length**
	Coefficient (St.error)Sig	Coefficient (St.error)Sig	Coefficient (St.error)Sig
Constant	7.87(0.75)**	6.86(2.06)**	NS
admission through emergency room	5.30(0.45)**	1.59(0.41)**	6.69(0.65)**
admission through internal medicine	9.54(1.07)**	2.48(0.94)**	11.76(1.51)**
turnover rate	NS	NS	NS
complications	NS	6.30(0.58)**	7.01(0.94)**
multiple diagnoses or comorbidity	NS	NS	NS
admitted to the hospital on Friday	NS	NS	NS
admitted to the hospital on Saturday	NS	NS	NS
discharge on Monday	NS	NS	NS
sex	NS	1.21(0.43)**	NS
over 76 years old patients	NS	NS	2.02(0.90)*
between 66 and 75 years old patients	NS	NS	NS
percentage of operations	NS	NS	NS
admitted to a teaching hospital	NS	NS	NS
number of surgeons	-8.40(1.58)**	3.43(1.76)*	NS
number of resident surgeons	NS	NS	NS
number of beds per specialities	NS	-0.04(0.02)*	-0.70(0.03)*
occupancy rate	NS	NS	NS
General Practitioner	NS	NS	NS
total number of hospital beds	NS	NS	NS
R Square	0.24	0.22	0.25
F	70**	30**	44**
N of cases	663	663	663

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p > .05)

For hospital 8, each patient admitted through the emergency room has a longer length of stay by 5.3, 1.6 and 6.7 days on P1, P2 and PT respectively. Each patient admitted through internal medicine has a longer length of stay by 9.5, 2.5 and 11.8 days on P1, P2 and PT respectively. Each patient with complications will spend 6.3 and 7.0 days longer on the P2 and PT respectively. Male patients have a longer postoperative length of stay by 1.2 days. Patients over 76 years old have a longer total length of stay by 2.0 days. Increasing by one the number of surgeons per 10,000 population, the preoperative length of stay will decrease by 8.4 days and the postoperative length of stay will increase by 3.4 days. Increasing by one the number of beds per specialities per 1,000 population, the P2 and PT will decrease by 0.1 and 0.7 days respectively.

Appendix 5
Specific surgical DRGs regression results, including the length of stay

DRG 39 Lens Procedures with or without Vitrectomy		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	31,504(10,617.5)**	30,299(8,564.5)**
preoperative length of stay	15,461(628.3)**	15,092(515.7)**
postoperative length of stay	15,862(717.8)**	15,662(577.5)**
operating theatre minutes	1,757(61.4)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	-104,247(43,963.1)*	-86,272(30,310.5)**
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.94	0.87
F	921**	561**
N of cases	258	258

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 39 Lens Procedures with or without Vitrectomy		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	3,932(518.5)**	6,112(2,582.4)*
preoperative length of stay	NS	594(138.2)**
postoperative length of stay	73(26.4)**	285(119.4)*
operating theatre minutes	NS	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	490(39.6)**	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	1,896(738.8)*
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	-13,089(2,089.8)**	NS
number of resident surgeons	-19,673(1476.3)**	12,820(5,715.9)*
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	-1,075(372.5)**
total number of hospital beds	NS	NS
R Square	0.60	0.42
F	95**	36**
N of cases	258	258

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 39, Lens Procedures with or without Vitrectomy, increasing by one more day the preoperative length of stay, the total cost, the ward cost and the test cost will increase by Pst 15,461, 15,092 and 594 respectively between hospitals. Increasing by one more day the postoperative length of stay, the total cost, the ward cost, the drug cost and test cost will increase by Pst 15,862, 15,662, 73 and 285 respectively between hospitals. Increasing by one more minute the operating theatre time, the total cost will increase by Pst 1,757. Increasing by 1 per cent the turnover rate, the drug cost will increase by Pst 490. Each patient admitted to the hospital on Friday will increase the test cost by Pst 1,896. Increasing by one more the number of surgeons per 10,000 population, the total cost, the ward cost and the drug cost will decrease by Pst 104,247, 86,272 and 13,089 respectively between hospitals. Increasing by one more the number of resident surgeons per 10,000 population, the drug cost will decrease by Pst 19,673 and the test cost will increase by Pst 12,820. Increasing by one more the number of GPs per 10,000 population, the test cost will decrease by Pst 1,075.

Continuation

DRG 307 Prostatectomy W/O CC		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St. error)Sig	Coefficient(St.error)Sig
Constant	11,796(11,280)NS	7,190(4,066.5)NS
preoperative length of stay	16,477(702.5)**	15,924(270.1)**
postoperative length of stay	15,622(1,066)**	15,436(422.2)**
operating theatre minutes	1,865(58.7)**	NS
admission through emergency room	31,148(9,362.8)**	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	9,822(4,088.9)*	NS
sex	NS	NS
over 76 years old patients	NS	5,517(2,419.3)*
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.98	0.98
F	729**	1669**
N of cases	87	87

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 307 Prostatectomy W/O CC		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-15,363(4,104.4)**	1,681(1,228.6)NS
preoperative length of stay	NS	875(415.8)*
postoperative length of stay	NS	NS
operating theatre minutes	39(16.1)*	NS
admission through emergency room	NS	27,152(5,013.5)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	2,511(909.2)**	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	61,951(13,421.1)**	NS
number of resident surgeons	NS	256,387(54,230.4)**
number of beds per specialities	NS	NS
occupancy rate	27,098(3,686.3)**	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.59	0.68
F	30**	60**
N of cases	87	87

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 307, Prostatectomy W/O CC, increasing by one more day the preoperative length of stay, the total cost, the ward cost and the test cost will increase by Pst 16,477, 15,924 and 875 respectively between hospitals. Increasing by one more day the postoperative length of stay, the total cost and the ward cost will increase by Pst 15,622 and 15,436 respectively between hospitals. Increasing by one more minute the operating theatre time, the total cost and the drug cost will increase by Pst 1,865 and 39 respectively between hospitals. Each patient admitted through the emergency room will increase the total cost and the test cost by Pst 31,148 and 27,152 respectively between hospitals. Patients discharged on a Monday will increase the total cost and the drug cost by Pst 9,822 and 2,511 respectively between hospitals. Patients over 76 years old will increase the ward cost by Pst 5,517. Increasing by one more the number of surgeons per 10,000 population, the drug cost will increase by Pst 61,951. Increasing by one more the number of resident surgeons per 10,000 population, the test cost will increase by Pst 256,387. If we increase by 1 per cent the occupancy rate, the drug cost will increase by Pst 27,098.

Continuation

DRG 337 Transurethral Prostatectomy W/O CC		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-1,957(9,007.0)NS	3,299(5,387.2)NS
preoperative length of stay	17,404(352.4)**	15,890(229.4)**
postoperative length of stay	18,184(1,202.4)**	16,039(798.4)**
operating theatre minutes	1,818(73.1)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	43,889(16,271.0)**	32,009(10,992.3)**
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.99	0.99
F	1181**	1860**
N of cases	54	54

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 337 Transurethral Prostatectomy W/O CC		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	27,435(8,995.9)**	4,095(1,629.7)*
preoperative length of stay	332(88.5)**	935(204.4)**
postoperative length of stay	816(309.4)*	NS
operating theatre minutes	51(20.3)*	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	-15,490(4,510.2)**	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	19,438(9,442.2)*
admitted to the hospital on a Saturday	NS	14,827(5,007.3)**
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.50	0.47
F	12**	15**
N of cases	54	54

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 337, Transurethral Prostatectomy, patients with a longer preoperative length of stay will increase the total cost, the ward cost, the drug cost and the test cost by Pst 17,404, 15,890, 332 and 935 respectively between hospitals. Patients with a longer postoperative length of stay will increase the total cost, the ward cost and the drug cost by Pst 18,184, 16,039 and 816 respectively between hospitals. Increasing by one more minute the operating theatre time, the total cost and the drug cost will increase by Pst 1,818 and 51 respectively between hospitals. Increasing by 1 per cent the turnover rate, the drug cost will decrease by Pst 15,490. Each patient admitted to the hospital on Friday will increase the total cost, the ward cost and the test cost by Pst 43,889, 32,009 and 19,438 respectively between hosptals. Each patient admitted to the hospital on Saturday will increase the test cost by Pst 14,827.

Continuation

DRG 358 Uterine & Adnexa Proc for Non-Malignancy W CC		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-6,686(18,204.1)NS	10,556(13,331.3)NS
preoperative length of stay	34,218(1,451.1)**	32,891(1,139.5)**
postoperative length of stay	32,790(1,391.5)**	32,747(1,059.7)**
operating theatre minutes	1,916(165.5)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.98	0.98
F	583**	725**
N of cases	38	38

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 358 Uterine & Adnexa Proc for Non-Malignancy W CC		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-516(1,917.5)NS	-12,865(7,574.0)NS
preoperative length of stay	NS	NS
postoperative length of stay	NS	NS
operating theatre minutes	53(16.8)**	237(68.6)**
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	10,088(3,120.2)**	27,881(12,291.1)*
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	57,928(15,737.7)**
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.32	0.51
F	9**	12**
N of cases	38	38

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 358, Uterine & Adnexa Proc for Non-Malignancy W CC, patients with a longer preoperative length of stay will increase the total cost and the ward cost by Pst 34,218 and 32,891 respectively between hospitals. Patients with a longer postoperative length of stay will increase the total cost and the ward cost by Pst 32,790 and 32,747 respectively between hospitals. Increasing by one minute the operating theatre time, the total cost, the drug cost and the test cost will increase by 1,916, 53 and 237 respectively between hospitals. Patients admitted to the hospital on Saturday will increase the drug cost and the test cost by Pst 10,088 and 27,881 respectively between hospitals. Increasing by one more the number of resident surgeons per 10,000 population, the test cost will increase by Pst 57,928.

Continuation

DRG 359 Uterine & Adnexa Proc for Non-Malignancy W/O CC		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	44,851(18,982.7)*	49,239(19,421.6)*
preoperative length of stay	33,300(1,377.0)**	31,349(1,248.2)**
postoperative length of stay	32,820(962.1)**	31,807(877.7)**
operating theatre minutes	1,646(91.7)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	-9,937(4,389.7)*
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	-55,938(19,505.1)**	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.94	0.94
F	615**	773**
N of cases	162	162

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 359 Uterine & Adnexa Proc for Non-Malignancy W/O CC		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	970(738.9)NS	-11,092(2,154.3)**
preoperative length of stay	304(115.6)**	1,761(255.4)**
postoperative length of stay	216(54.4)**	596(181.5)**
operating theatre minutes	NS	79(17.7)**
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	6,453(1,783.7)**	25,318(4,052.7)**
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.15	0.48
F	9**	37**
N of cases	162	162

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 359, Uterine & Adnexa Proc for Non-Malignancy W/O CC, patients with a longer preoperative length of stay will increase the total cost, the ward cost, the drug cost and the test cost by Pst 33,300, 31,349, 304 and 1,761 respectively between hospitals. Patients with a longer postoperative length of stay will increase the total cost, the ward cost, the drug cost and the test cost by Pst 32,820, 31,807, 216 and 596 respectively between hospitals. Increasing by one more minute the operating theatre time, the total cost and the test cost will increase by Pst 1,646 and 79 respectively between hospitals. Increasing by 1 per cent the turnover rate, the ward cost will decrease by Pst 9,937. Increasing by one the number of resident surgeons per 10,000 population, the drug cost and the test cost will increase by Pst 6,453 and 25,318 respectively between hospitals. Increasing by 1 per cent the occupancy rate, the total cost will decrease by Pst 55,938.

Continuation

DRG 158 Anal & Stomal Procedures W/O CC		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	2,333(3,141.7)NS	2,620(2,577.5)NS
preoperative length of stay	16,008(389.5)**	15,304(356.7)**
postoperative length of stay	16,044(570.6)**	15,380(496.1)**
operating theatre minutes	1,776(52.8)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	-20,724(6,393.9)**	-16,740(5,764.9)**
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.98	0.97
F	1126**	935**
N of cases	92	92

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 158 Anal & Stomal Procedures W/O CC		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	91(151.9)NS	9,410(2,830.6)**
preoperative length of stay	NS	838(146.3)**
postoperative length of stay	115(29.0)**	513(173.8)**
operating theatre minutes	NS	NS
admission through emergency room	NS	-3,606(1,368.2)**
admission through internal medicine	NS	-5,858(2,366.0)*
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	2,993(1,218.8)*	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	-1,795(453.2)**
total number of hospital beds	NS	NS
R Square	0.23	0.42
F	13**	13**
N of cases	92	92

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 158, Anal & Stomal Procedures W/O CC, patients with a longer length of stay will increase the total cost, the ward cost and the test cost by Pst 16,008, 15,304 and 838 respectively between hospitals. Patients with a longer postoperative length of stay will increase the total cost, the ward cost, the drug cost and the test cost by Pst 16,044, 15,380, 115 and 513 respectively between hospitals. Increasing by one more minute the operating theatre time the total cost will increase by Pst 1,776. Each patient admitted through the emergency room will decrease the test cost by Pst 3,606 and each patient admitted through the internal medicine will decrease the test cost by Pst 5,858. Each patient admitted to the hospital on Saturday will decrease the total cost and the ward cost by Pst 20,724 and 16,740 respectively between hospitals. Increasing by one more the number of resident surgeons per 10,000 population, the drug cost will increase by Pst 2,993. Increasing by one more the number of GPs per 10,000 population, the test cost will decrease by Pst 1,795.

Continuation

DRG 162 Inguinal & Femoral Hernia Procedures Age >17 W/O CC		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-1,362(3,545.2)NS	2,558(2,777.8)NS
preoperative length of stay	15,095(721.7)**	13,949(604.4)**
postoperative length of stay	16,093(591.7)**	15,553(451.4)**
operating theatre minutes	1,839(38.3)**	
admission through emergency room	12,409(5,806.5)*	13,379(4,776.7)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	24,258(6,789.7)**	21,433(5,682.0)**
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.98	0.96
F	1294**	725**
N of cases	136	136

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 162 Inguinal & Femoral Hernia Procedures Age >17 W/O CC		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	1,608(1,569.3)NS	-1,063(850.4)NS
preoperative length of stay	NS	800(152.7)**
postoperative length of stay	278(64.1)**	420(141.1)**
operating theatre minutes	19(4.5)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	1,545(718.6)*	NS
General Practitioner	-571(194.2)**	NS
total number of hospital beds	NS	NS
R Square	0.37	0.26
F	19**	24**
N of cases	136	136

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 162, Inguinal & Femoral Hernia Procedure Age >17 W/O CC, patients with a longer preoperative length of stay will increase the total cost, the ward cost and the test cost by Pst 15,095, 13,949 and 800 respectively between hospitals. Patients with a longer postoperative length of stay will increase the total cost, the ward cost, the drug cost and the test cost by Pst 16,093, 15,553, 278 and 420 respectively between hospitals. Increasing by one more minute the operating theatre time the total cost and the drug cost will increase by Pst 1,839 and 19 respectively between hospitals. Each patients admitted through the emergency room will increase the total cost and the ward cost by Pst 12,409 and 13,379 respectively between hospitals. Each patient admitted to the hospital on Friday will increase the total cost and the ward cost by Pst 24,258 and 21,433 respectively between hospitals. Increasing the occupancy rate by 1 per cent, the drug cost will increase by Pst 1,545. Increasing by one more the number of GPs per 10,000 population, the drug cost will decrease by Pst 571.

Continuation

DRG 196 Total Cholecystectomy W C.D.E. W/O CC		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	79,012(38,210.8)*	2,126(20,297.1)NS
preoperative length of stay	15,212(951.6)**	15,251(842.6)**
postoperative length of stay	15,659(1,255.4)**	16,347(1,267.1)**
operating theatre minutes	2,037(214.3)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	-43,417(17,686.1)*	NS
discharge on a Monday	NS	-31,542(14,116.4)*
sex	NS	NS
over 76 years old patients	-25,975(11,926.8)*	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	-77,855(25,538.3)**	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.96	0.91
F	156**	150**
N of cases	46	46

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 196 Total Cholecystectomy W C.D.E. W/O CC		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	30,869(6,285.0)**	142,835(11,380.7)**
preoperative length of stay	NS	NS
postoperative length of stay	NS	NS
operating theatre minutes	NS	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	-8,205(2,984.1)**	-31,207(4,542.6)**
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	-80,165(5,699.2)**
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.14	0.82
F	8**	100**
N of cases	46	46

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 196, Total Cholecystectomy W C.D.E. W/O CC, each patient with a longer preoperative length of stay will increase the total cost and the ward cost by Pst 15,212 and 15,251 respectively between hospitals. Patients with a longer postoperative length of stay will increase the total cost and the ward cost by Pst 15,659 and 16,347 respectively between hospitals. Increasing by one more minute the operating theatre time the total cost will increase by Pst 2,037. Increasing by 1 per cent the turnover rate the drug cost and the test cost will decrease by Pst 8,205 and 31,207 respectively between hospitals. Each patient admitted to the hospital on Saturday will decrease the total cost by Pst 43,417. Each patient discharged on Monday will decrease the ward cost by Pst 31,542. Patients over 76 year old will decrease the total cost by Pst 25,975. Increasing the occupancy rate by 1 per cent, the total cost and the test cost will decrease by Pst 77,855 and 80,165 respectively between hospitals.

Continuation

DRG 197 Total Cholecystectomy W/O C.D.E. W CC		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-12,807(51,791.7)NS	-10,507(26,876.0)NS
preoperative length of stay	15,806(1,533.8)**	12,890(1,188.1)**
postoperative length of stay	19,439(2,000.2)**	16,347(1,464.5)**
operating theatre minutes	1,877(296.9)**	NS
admission through emergency room	NS	39,233(18,840.3)*
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.85	0.87
F	62**	70**
N of cases	35	35

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

Continuation

DRG 197 Total Cholecystectomy W/O C.D.E. W CC		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-25,819(21,831.4)NS	-76,718(27,277.2)*
preoperative length of stay	NS	1,010(426.8)*
postoperative length of stay	1,977(815.4)*	NS
operating theatre minutes	767(149.3)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	-35,109(11,297.0)**	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	-467,100(106,910.0)**	NS
number of beds per specialities	NS	1,137(325.1)**
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.63	0.48
F	13**	15**
N of cases	35	35

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 197, Total Cholecytectomy W/O C.D.E. W CC, each patient with a longer preoperative length of stay will increase the total cost, the ward cost and the test cost by Pst 15,806, 12,890 and 1,010 respectively between hospitals. Each patient with a longer postoperative length of stay will increase the total cost, the ward cost and the drug cost by Pst 19,439, 16,347 and 1,977 respectively between hospitals. Increasing by one more minute the operating theatre time, the total cost and the drug cost will increase by Pst 1,877 and 767 respectively between hospitals. Each patient admitted through the emergency room will increase the ward cost by Pst 39,233. Male patients will decrease the drug cost by Pst 35,109. Increasing by one more the number of resident surgeons per 10,000 population, the drug cost will decrease by Pst 467,100. Increasing by one more the number of beds per specialities per 1,000 population, the ward cost will increase by Pst 1,137.

Continuation

DRG 198 Total Cholecystectomy W/O C.D.E. W/O CC		
Explanatory variables	**Total cost**	**Ward cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	-78,469(27,313.0)**	1,395(8,341.2)NS
preoperative length of stay	16,148(571.1)**	14,363(455.4)**
postoperative length of stay	19,446(1,087.5)**	16,553(896.4)**
operating theatre minutes	1,783(102.3)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	28,897(9,964.4)**	22,580(8,102.5)**
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	-85,065(39,060.4)*
number of beds per specialities	803(278.6)**	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.93	0.93
F	390**	466**
N of cases	149	149

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 198 Total Cholecystectomy W/O C.D.E. W/O CC		
Explanatory variables	**Drug cost**	**Test cost**
	Coefficient(St. error)Sig	Coefficient(St. error)Sig
Constant	1,445(1,936.4)NS	-44,061(7,190.5)**
preoperative length of stay	NS	1,640(143.4)**
postoperative length of stay	908(235.0)**	1,790(289.5)**
operating theatre minutes	NS	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	6,703(1,960.8)**	NS
discharge on a Monday	NS	NS
sex	NS	S
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	530(75.7)**
occupancy rate	NS	-16,039(3,015.1)**
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.19	0.71
F	17**	88**
N of cases	149	149

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 198, Total Cholecystectomy W/O C.D.E. W/O CC, patients with a longer preoperative length of stay will increase the total cost, the ward cost and the test cost by Pst 16,148, 14,363 and 1,640 respectively between hospitals. Patients with a longer postoperative length of stay will increase the total cost, the ward cost, the drug cost and the test cost by Pst 19,446, 16,553, 908 and 1,790 respectively between hospitals. Increasing by one more minute the operating theatre time, the total cost will increase by Pst 1,783. Each patient admitted to the hospital on Saturday will increase the total cost, the ward cost and the drug cost by Pst 28,897, 22,580 and 6,703 respectively between hospitals. Increasing by one more the number of resident surgeons per 10,000 population, the ward cost will decrease by Pst 85,065. Increasing by one more the number of beds per specialities per 1,000 population, the total cost and the test cost will increase by Pst 803 and 530 respectively between hospitals. Increasing the occupancy rate by 1 per cent will decrease the test cost by Pst 16,039.

Appendix 6
Specific surgical DRGs regression results, excluding the length of stay

DRG 39 Lens Procedures with or without Vitrectomy		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	69,270(43,052.3)NS	375,906(23,085.5)**
operating theatre minutes	2,301(119.5)**	494(99.6)**
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	15,986(8,039.9)*	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	14,443(5,660.3)*	15,005(5,359.2)**
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	-470,787(70,172.8)**
number of resident surgeons	786,916(160,714.1)**	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	-21,515(4,687.8)**	-33,582(2,812.0)**
total number of hospital beds	43,681(17,995.8)*	NS
R Square	0.80	0.51
F	171**	67**
N of cases	258	258

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 39 Lens Procedures with or without Vitrectomy		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	4,287(567.0)**	23,701(2,402.1)**
operating theatre minutes	6(2.5)*	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	519(47.2)**	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	2,476(742.4)**
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	-15,540(2,755.0)**	-19,372(6,020.5)**
number of resident surgeons	-19,201(1,455.1)**	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	-2,746(260.8)**
total number of hospital beds	NS	NS
R Square	0.60	0.37
F	93**	51**
N of cases	258	258

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For the surgical DRG 39, Lens Procedures with or without Vitrectomy, increasing by one minute the operating theatre time the total cost, the ward cost and the drug cost will increase by Pst 2,301, 494 and 6 respectively between hospitals. Increasing by 1 per cent the turnover rate, the drug cost will increase by Pst 519. Each patient admitted to the hospital on Friday will increase the total cost and the test cost by Pst 15,986 and 2,476. Each patient discharged on Monday will increase the total cost and the ward cost by Pst 14,443 and 15,005 respectively between hospitals. Increasing by one more surgeon per 10,000 population, the ward cost, the drug cost and the test cost will decrease by Pst 470,787, 15,540 and 19,372 respectively between hospitals. Increasing by one more resident surgeon per 10,000 population, the total cost will increase by Pst 786,916 and the drug cost will decrease by Pst 19,201. Increasing by one more GP per 10,000 population, the total cost, the ward cost and the test cost will decrease by Pst 21,515, 33,582 and 2,746 respectively between hospitals. Increasing by one more bed the total hospital beds per 1,000 population, the total cost will increase by Pst 43,681.

Continuation

DRG 307 Prostatectomy W/O CC		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St.error)Sig
Constant	301,073(24,038.2)**	360,063(43,872.4)**
operating theatre minutes	1,647(168.3)**	-396(148.7)**
admission through emergency room	179,490(17,697.0)**	142,872(17,473)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	39,795(10,296.3)**	32,329(9,586.5)**
sex	NS	NS
over 76 years old patients	-23,273(11,655.1)*	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	-27,404(7,221.9)**
total number of hospital beds	-62,750(14,287.5)**	NS
R Square	0.83	0.68
F	78**	44**
N of cases	87	87

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 307 Prostatectomy W/O CC		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-15,363(4,104.4)**	2,797(1,130.5)**
operating theatre minutes	39(16.1)*	NS
admission through emergency room	NS	35,270(3,265.7)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	2,511(909.2)**	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	61,951(13,421.1)**	NS
number of resident surgeons	NS	301,874(50,728.3)**
number of beds per specialities	NS	NS
occupancy rate	27,098(3,686.3)**	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.59	0.67
F	30**	85**
N of cases	87	87

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p > .05)

For surgical DRG 307, Prostatectomy W/O CC, increasing by one more minute the operating theatre time, the total cost and the drug cost will increase by Pst 1,647 and 39 respectively between hospitals. However, it will decrease the ward cost by Pst 396. Each patient admitted through the emergency room will increase the total cost, the ward cost and the drug cost by Pst 179,490, 142,872 and 35,270 respectively between hospitals. Each patient discharge on Monday will increase the total cost, the ward cost and the drug cost by Pst 39,795, 32,329 and 2,511 respectively between hospitals. Patients over 76 years old will decrease the total cost by Pst 23,273. Increasing by one more surgeon per 10,000 population, the drug cost will increase by Pst 61,951. Increasing by one more resident surgeon per 10,000 population, the test cost will increase by Pst 301,874. Increasing by 1 per cent the occupancy rate, the drug cost will increase Pst by 27,098. Increasing by one more GP per 10,000 population, the ward cost will decrease by Pst 27,404. Increasing by one more the total hospital beds per 1,000 population, the total cost will decrease by Pst 62,750.

Continuation

DRG 337 Transurethral Prostatectomy W/O CC		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St.error)Sig
Constant	58,275(38,968.8)NS	56,710(35,152.7)NS
operating theatre minutes	2,848(432.0)**	908(389.6)**
admission through emergency room	124,668(34,174.8)**	113,523(30,828.2)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	115,501(36,453.0)**	103,614(32,883.2)**
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.60	0.40
F	26**	11**
N of cases	54	54

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

Continuation

DRG 337 Transurethral Prostatectomy W/O CC		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	37,289(9,380.3)**	26,371(9,300.6)**
operating theatre minutes	76(21.7)**	NS
admission through emergency room	NS	9,346(3,648.2)*
admission through internal medicine	NS	NS
turnover rate	-18,193(4,979.2)**	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	5,366(2,404.0)*	18,988(5,385.9)**
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	-82,960(39,596.5)*
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.35	0.35
F	9**	9**
N of cases	54	54

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p > .05)

For surgical DRG 337, Transurethral Prostatectomy W/O CC, increasing by one more minute the operating theatre time, the total cost, the ward cost and the drug cost will increase by Pst 2,848, 908 and 76 respectively between hospitals. Each patient admitted through the emergency room will increase the total cost, the ward cost and the test cost by Pst 124,668, 113,523 and 9,346 respectively between hospitals. Increasing by 1 per cent the turnover rate, the drug cost will decrease by Pst 18,193. Each patient admitted to the hospital on Saturday will increase the drug cost and the test cost by Pst 5,366 and 18,988 respectively between hospitals. Increasing by one more surgeon per 10,000 population, the test cost will decrease by Pst 82,960. Increasing by 1 per cent the occupancy rate, the total cost and the ward cost will increase by Pst 115,501 and 103,614 respectively between hospitals.

Continuation

DRG 358 Uterine & Adnexa Proc for Non-Malignancy W CC		
Explanatory Variables	**Total cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	862,858(173,095.8)**	879,555(164,791.0)**
operating theatre minutes	3,883(572.7)**	1,964(545.2)**
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	-169,516(4,0451.8)**	-170,445(38,511.0)**
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.68	0.53
F	39**	20**
N of cases	38	38

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 358 Uterine & Adnexa Proc for Non-Malignancy W CC		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-516(1,917.4)NS	-12,865(7,574.0)**
operating theatre minutes	53(16.8)**	237(68.6)**
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	10,088(3,120.1)**	27,881(12,291.1)*
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	57,928(15,737.7)**
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.32	0.50
F	9**	12**
N of cases	38	38

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 358, Uterine & Adnexa Proc for Non-Malignancy W CC, increasing by one more minute the operating theatre time, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 3,883, 1,964, 53 and 237 respectively between hospitals. Increasing by 1 per cent the turnover rate, the total cost and the ward cost will decrease by Pst 169,516 and 170,445 respectively between hospitals. Each patient admitted to the hospital on Saturday will increase the drug cost and the test cost by Pst 10,088 and 27,881 respectively between hospitals. Increasing by one more the number of resident surgeons per 10,000 population, the test cost will increase by Pst 57,928.

Continuation

DRG 359 Uterine & Adnexa Proc for Non-Malignancy W/O CC		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	579,085(52,798.2)**	577,275(49,710.2)**
operating theatre minutes	2,686(299.6)**	1,072(282.1)**
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	-98,782(15,119.7)**	-100,687(14,235.4)**
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.38	0.25
F	49**	27**
N of cases	162	162

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 359 Uterine & Adnexa Proc for Non-Malignancy W/O CC		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	3,299(280.5)**	-4,745(1,948.8)*
operating theatre minutes	NS	97(20.2)**
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	8,466(3,728.5)*
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	6,288(1,846.2)**	24,522(4,652.8)**
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.07	0.31
F	12**	24**
N of cases	162	162

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 359, Uterine & Adnexa Proc for Non-Malignancy W/O CC, increasing by one more minute, the total cost, the ward cost and the test cost will increase by Pst 2,686, 1,072 and 97 respectively between hospitals. Increasing by 1 per cent the turnover rate, the total cost and the test cost will decrease by Pst 98,782 and 100,687 respectively between hospitals. Each patient admitted to the hospital on Friday will increase the test cost by Pst 8,466. Increasing by one more the number of resident surgeons, the drug cost and the test cost will increase by Pst 6,288 and 24,522 respectively between hospitals.

Continuation

DRG 158 Anal & Stomal Procedures W/O CC		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	73,388(12,106.2)**	90,777(6,692.4)**
operating theatre minutes	2,291(243.0)**	NS
admission through emergency room	67,523(16,166.7)**	63,850(15,653.0)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.53	0.15
F	51**	17**
N of cases	92	92

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p > .05)

Continuation

DRG 158 Anal & Stomal Procedures W/O CC		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	524(113.6)**	12,419(2,748.0)**
operating theatre minutes	NS	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	3,985(1,285.2)**	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	-1,757(475.2)**
total number of hospital beds	NS	NS
R Square	0.10	0.13
F	10**	14**
N of cases	92	92

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 158, Anal & Stomal Procedures W/O CC, increasing by one more minute the operating theatre time, the total cost will increase by Pst 2,291. Each patient admitted through the emergency room will increase the total cost and the ward cost by Pst 67,523 and 63,850 respectively between hospitals. Increasing by one more the number of resident surgeons, the drug cost will increase by Pst 3,985. Increasing by one more the number of GPs, the test cost will decrease by Pst 1,757.

Continuation

DRG 162 Inguinal & Femoral Hernia Procedures Age >17 W/O CC		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	69,808(35,375.4)*	64,009(33,148.4)NS
operating theatre minutes	2,182(121.5)**	337(113.8)**
admission through emergency room	116,863(14,130.4)**	111,123(13,240.8)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	-30,293(10,254.7)**	-27,785(9,609.1)**
over 76 years old patients	NS	NS
between 66 and 75 years old patients	22,188(10,328.4)*	21,598(9,678)*
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	25,906(13,088.6)*	27,048(12,264.7)*
R Square	0.80	0.47
F	107**	23**
N of cases	136	136

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 162 Inguinal & Femoral Hernia Procedures Age >17 W/O CC		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	4,873(1,002.1)**	366(802.8)NS
operating theatre minutes	21(4.0)**	26(9.9)**
admission through emergency room	NS	4,165(1,290.8)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	3,194(1,493.2)*
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	-774(163.3)**	NS
total number of hospital beds	NS	NS
R Square	0.27	0.15
F	25**	8**
N of cases	136	136

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 162, Inguinal & Femoral Hernia Procedures Age >17 W/O CC, increasing by one more minute the operating theatre time, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 2,182, 337, 21 and 26 respectively between hospitals. Each patient admitted through the emergency room will increase the total cost, the ward cost and the test cost by Pst 116,863, 111,123 and 4,165 respectively between hospitals. Male patients have a lower total cost and ward cost by Pst 30,293 and 27,785 respectively between hospitals. Patients over 76 years old will increase the test by Pst 3,194. Patients between 66 and 75 years old will increase the total cost and the ward cost by Pst 22,188 and 21,598 respectively between hospitals. Increasing by one more GP per 10,000 population, the drug cost will decrease by Pst 774. Increasing by one more bed the total number of hospital beds, the total cost and the ward cost will increase by Pst 25,906 and 27,048 respectively between hospitals.

Continuation

DRG 196 Total Cholecystectomy W C.D.E. W/O CC		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	663,030(191,491.4)**	64,917(62,448.8)NS
operating theatre minutes	3,019(487.6)**	1,731(471.5)**
admission through emergency room	81,553(32,638.6)*	103,326(31,979.3)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	33,721(16,652.0)*	NS
number of surgeons	-1,269,690(432,670.7)**	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.72	0.40
F	26**	14**
N of cases	46	46

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 196 Total Cholecystectomy W C.D.E. W/O CC		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	30,869(6,285.0)**	142,835(11,380.8)**
operating theatre minutes	NS	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	-8,205(2,984.1)**	-31,207(4,542.6)**
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	-80,165(5,699.2)**
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.14	0.82
F	8**	100**
N of cases	46	46

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 196, Total Cholecystectomy W C.D.E. W/O CC, increasing by one more minute the operating theatre time, the total cost and the ward cost will increase by Pst 3,019 and 1,731 respectively between hospitals. Each patient admitted through the emergency room will increase the total cost and the ward cost by Pst 81,553 and 103,326 respectively. Increasing by 1 per cent the turnover rate, the drug cost and the test cost will decrease by Pst 8,205 and 31,207 respectively between hospitals. Increasing by 1 per cent the percentage of operations, the total cost will increase by Pst 33,721. Increasing by one more surgeon per 10,000 population, the total cost will decrease by Pst 1,269,690. Increasing by 1 per cent the occupancy rate, the test cost will decrease by Pst 80,165.

Continuation

DRG 197 Total Cholecystectomy W/O C.D.E. W CC		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	630,168(133,026.9)**	NS
operating theatre minutes	1,914(644.8)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	-143,158(63,6489.0)*	NS
R Square	0.27	0.00
F	6**	NS
N of cases	35	35

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

Continuation

DRG 197 Total Cholecystectomy W/O C.D.E. W CC		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-21,955(23,714.4)NS	-116,168(24,369.0)**
operating theatre minutes	785(150.6)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	37,462(21,840.5)**	-33,478(12,918.5)*
admitted to the hospital on a Saturday	NS	NS
discharge on a Monday	NS	NS
sex	-35,636(11,280.9)**	NS
over 76 years old patients	NS	26,884(8,573.7)**
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	-357,222(115,260.2)**	NS
number of beds per specialties	NS	1,659(275.6)**
occupancy rate	35,862(19,795.6)*	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.64	0.57
F	11**	14**
N of cases	35	35

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For surgical DRG 197, Total Cholecystectomy W/O C.D.E. W CC, increasing by one more minute the operating theatre time will increase the total cost and the drug cost by Pst 1,914 and 785 respectively between hospitals. Patients admitted to the hospital on Friday will increase the drug cost by Pst 37,462 and will decrease the test cost by Pst 33,478. Male patients will be less expensive on drug cost by Pst 35,636. Patients over 76 years old will be more expensive on test cost by Pst 26,884. Increasing by one more the resident surgeons per 10,000 population, the drug cost will decrease by Pst 357,222. Increasing by one more bed the number of beds per specialities, the test cost will increase by Pst 1,659. Increasing by 1 per cent the occupancy rate, the drug cost will increase by Pst 35,862. Increasing by one more the total number of hospital beds, the total cost will decrease by Pst 143,158.

Continuation

DRG 198 Total Cholecystectomy W/O C.D.E. W/O CC		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	198,137(27,650.1)**	186,441(10,485.0)**
operating theatre minutes	1,922(274.0)**	NS
admission through emergency room	86,163(15,816.8)**	72,811(13,759.5)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	128,763(25,352.4)**	109,312(21,992.0)**
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	65,784(26,402.0)*	59,197(22,979.4)*
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	-391,923(124,945.5)**	-314,148(109,099.4)**
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.51	0.42
F	30**	26**
N of cases	149	149

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

DRG 198 Total Cholecystectomy W/O C.D.E. W/O CC		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	8,499(674.9)**	-263,544(51,021.7)**
operating theatre minutes	NS	NS
admission through emergency room	NS	10,993(2,117.8)**
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on a Friday	NS	NS
admitted to the hospital on a Saturday	8,304(2,004.7)**	12,482(3,207.4)**
discharge on a Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	2,241(378.3)**
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	46,394(10,619.7)**
R Square	0.10	0.50
F	17**	37**
N of cases	149	149

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

For surgical DRG 198, Total Cholecystectomy W/O C.D.E. W/O CC, increasing by one more minute the operating theatre time, the total cost will increase by Pst 1,922. Each patient admitted through the emergency room will increase the total cost, the ward cost and the test cost by Pst 86,163, 72,811 and 10,993 respectively between hospitals. Each patient admitted to the hospital on Saturday will increase the total cost, the ward cost, the drug cost and the test cost by Pst 128,763, 109,312, 8,304 and 12,482 respectively between hospitals. Patients over 76 years old will increase the total cost and the ward cost by Pst 65,784 and 59,197 respectively between hospitals. Increasing by one the number of resident surgeons per 10,000 population, the total cost and the ward cost will decrease by Pst 391,923 and 314,148 respectively between hospitals. Increasing by one more the number of beds per specialities per 1,000 population, the test cost will increase by Pst 2,241. Increasing by one the total number of hospital beds, the test cost will increase by 46,394.

Appendix 7
Hospital regression results, including the length of stay

HOSPITAL 1		
Explanatory Variables	**Total Cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	36,673(9,709.3)**	82,245(7,786.6)**
preoperative length of stay	17,229(751.7)**	16,448(622.1)**
postoperative length of stay	17,925(496.9)**	15,912(359.0)**
operating theatre minutes	2,075(60.8)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	6,427(1,130.6)**	9,351(852.6)**
complications	15,973(5,703)**	11,021(4,711.0)*
multiple diagnoses or comorbidity	15,575(5,742)**	NS
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	NS	NS
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	-412,931(19,770.1)**	-536,449(15,842.5)**
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	206,502(7,618.8)**	252,497(6,206.8)**
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.98	0.97
F	1223**	1141**
N of cases	250	250

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

Continuation

HOSPITAL 1		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-243,898(85,412.6)**	-9,297(2,351)**
preoperative length of stay	NS	723(234.6)**
postoperative length of stay	1,603(251.7)**	396(130.8)**
operating theatre minutes	206(33.4)**	67(17.2)**
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	NS	4,628(1,770.8)**
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on Friday	25,010(6,175.3)**	NS
admitted to the hospital on Saturday	NS	NS
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	44,006(16,971.0)*	NS
number of surgeons	35,505(10,811.7)**	9,684(4,317.5)*
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	-30,491(5,308.3)**	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.48	0.28
F	37	19
N of cases	250	250

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 1, increasing by one more day the preoperative length of stay, the total cost, the ward cost and the test cost will increase by Pst 17,229, 16,448 and 723 respectively. Increasing by one more day the postoperative length of stay, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 17,925, 15,912, 1,603 and 396 respectively. Increasing by one more minute the operating theatre time, the total cost, the drug cost and the test cost will increase by Pst 2,075, 206 and 67 respectively. Increasing by 1 per cent the turnover rate, the total cost and the ward cost will increase by Pst 6,427 and 9,351 respectively. Patients with complications will increase the total cost, the ward cost and the test cost by Pst 15,973, 11,021 and 4,628 respectively. Patients with multiple diagnoses or comorbidity will increase the total cost by Pst 15,575. Each patient admitted to the hospital on Friday will increase the drug cost by Pst 25,010. Increasing by 1 per cent the percentage of operations, the drug cost will increase by Pst 44, 006. Increasing by one more the number of surgeons per 10,000 population, the total cost, the ward cost will decrease by Pst 412,931 and 536,449 respectively and the drug cost and the test cost will increase by Pst 35,505 and 9,684 respectively. Increasing by 1 per cent the occupancy rate, the total cost and the ward cost will increase by Pst 206,502 and 252,497 respectively and the drug cost will decrease by Pst 30,491.

Continuation

HOSPITAL 2		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	820,480(34,149.0)**	1,327,586(223,938.3)**
preoperative length of stay	17,159(413.4)**	15,289(415.3)**
postoperative length of stay	21,619(571.9)**	19,880(591.8)**
operating theater minutes	1,881(72.0)**	NS
admission through emergency room	NS	NS
admission through internal medicine	-154,300(28,140.0)**	-144,497(27,437.9)**
turnover rate	-99,968(6,560.7)**	-176,338(42,829.1)**
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	NS	NS
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	-12,020(5,501.9)*
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	-6,435(213.4)**	-9,349(1,095.9)**
occupancy rate	NS	-147,437(72,415.1)*
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.96	0.94
F	1512**	777
N of cases	366	366

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

Continuation

HOSPITAL 2		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-18,165(3,278.9)**	-34,824(5,206.8)**
preoperative length of stay	NS	1,214(126.1)**
postoperative length of stay	624(77.4)**	995(125.6)**
operating theatre minutes	31(10.7)**	NS
admission through emergency room	3,279(933.2)**	14,426(1,855.3)**
admission through internal medicine	NS	4,889(2,321.3)**
turnover rate	NS	NS
complications	NS	6,709(2,418.4)**
multiple diagnoses or comorbidity	11,195(1,475.8)**	NS
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	7,282(1,439.4)**	NS
discharge on Monday	NS	-2,249(1,114.2)**
sex	1,709(695.6)**	4,569(1,107.7)**
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	144(29.9)**	293(47.2)**
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.54	0.75
F	61**	131**
N of cases	366	366

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 2, increasing by one more day the preoperative length of stay, the total cost, the ward cost and the test cost will increase by Pst 17,159, 15,289 and 1,214 respectively. Increasing by one more day the postoperative length of stay, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 21,619, 19,880, 624 and 995 respectively. Increasing by one more minute the operating theatre time, the total cost and the drug cost will increase by Pst 1,881 and 31 respectively. Each patient admitted through the emergency room will increase the drug cost and the test cost by Pst 3,279 and 14,426 respectively. Each patient admitted through the internal medicine will decrease the total cost and the ward cost by Pst 154,300 and 144,497 respectively and will increase the test cost by Pst 4,889. Increasing by 1 per cent the turnover rate, the total cost and the ward cost will decrease by Pst 99,968 and 176,338 respectively. Patients with complications will increase the test cost by Pst 6,709. Patients with multiple diagnoses or comorbidity will increase the drug cost by Pst 11,195. Each patient admitted to the hospital on Saturday will increase the drug cost by Pst 7,282. Each patient discharged on Monday will decrease the test cost by Pst 2,249. Male patients will increase the drug cost and the test cost by Pst 1,709 and 4,569 respectively. Patients over 76 years old will decrease the ward cost by Pst 12,020. Increasing by one more the number of beds per specialities per 1,000 population, the total cost and the ward cost will decrease by Pst 6,435 and 9,349 respectively and the drug cost and the test cost will increase by Pst 144 and 293 respectively. Increasing by 1 per cent the occupancy rate, the ward cost will decrease by Pst 147,437.

Continuation

HOSPITAL 4		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-216,651(10,322)**	-235,552(9,241.6)**
preoperative length of stay	20,712(792.8)**	17,585(716.4)**
postoperative length of stay	18,845(751.7)**	16,826(632.5)**
operating theater minutes	1,816(64.2)**	NS
admission through emergency room	-19,623(9,189.3)*	-16,972(8,392.7)*
admission through internal medicine	NS	NS
turnover rate	99,533(4,440.2)**	75,566(4,959.6)**
complications	26,231(7,469.6)**	29,465(6,784.2)**
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	NS	NS
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	-766,479(66,129.2)**	-1,399,204(134,261.2)**
number of beds per specialities	NS	1,798(287.3)**
occupancy rate	-50,511(8,905.2)**	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.96	0.94
F	964**	684**
N of cases	339	339

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

Continuation

HOSPITAL 4		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	2,074(644.7)**	162,211(79,684.2)*
preoperative length of stay	900(83.9)**	2,288(129.5)**
postoperative length of stay	531(63.5)**	1,261(143.7)**
operating theatre minutes	NS	46(13.7)**
admission through emergency room	-3,576(943.2)**	NS
admission through internal medicine	-16,453(3,601.5)**	NS
turnover rate	NS	NS
complications	-1,492(729.3)*	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	NS	NS
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	-1,227(442.0)**	NS
percentage of operations	NS	-20,837(9,658.5)**
number of surgeons	-7,322(1,373.7)**	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.43	0.63
F	37	145
N of cases	339	339

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 4, increasing by one more day the preoperative length of stay, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 20,712, 17,585, 900 and 2,288 respectively. Increasing by one more day the postoperative length of stay, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 18,845, 16,826, 531 and 1,261 respectively. Increasing by one more minute the operating theatre time, the total cost and the test cost will increase by Pst 1,816 and 46 respectively. Each patient admitted through the emergency room will decrease the total cost, the ward cost and the drug cost by Pst 19,623, 16,972 and 3,576 respectively. Each patient admitted through the internal medicine will decrease the drug cost by Pst 16,453. Increasing by 1 per cent the turnover rate, the total cost and the ward cost will increase by Pst 99,533 and 75,566 respectively. Patients with complications will increase the total cost and the ward cost by Pst 26,231 and 29,465 respectively and will decrease the drug cost by Pst 1,492. Patients between 66 and 75 years old will decrease the drug cost by Pst 1,227. Increasing by 1 per cent the percentage of operations, the test cost will decrease by Pst 20,837. Increasing by one more the number of surgeons per 10,000 population, the drug cost will decrease by Pst 7,322. Increasing by one more the number of resident surgeons per 10,000 population, the total cost and the ward cost will decrease by Pst 766,479 and 1,399,204 respectively. Increasing by one more the number of beds per specialities per 1,000 population, the ward cost will increase by Pst 1,798. Increasing by 1 per cent the occupancy rate, the total cost will decrease by Pst 50,511.

Continuation

HOSPITAL 8		
Explanatory Variables	Total cost	Ward cost
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	264,087(58,550.0)**	127,307(49,862.9)*
preoperative length of stay	18,437(727.1)**	17,776(655.3)**
postoperative length of stay	18,293(870.2)**	17,706(700.5)**
operating theater minutes	2,001(102.0)**	NS
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	43,630(8,498.5)**	70,725(6,513.0)**
complications	NS	NS
multiple diagnoses or comorbidity	44,708(18,493.5)*	39,148(17,291.4)*
admitted to the hospital on Friday	34,411(13,633.9)*	NS
admitted to the hospital on Saturday	NS	35,444(12,737.4)**
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	-4,946(558.0)**	-3,739(469.0)**
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.94	0.91
F	599**	422**
N of cases	264	264

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p > .05)

Continuation

HOSPITAL 8		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	463,446(69,746.8)**	15,520(4,620.0)**
preoperative length of stay	NS	771(132.1)**
postoperative length of stay	NS	798(146.4)**
operating theatre minutes	63(8.4)**	90(15.5)**
admission through emergency room	2,585(831.0)**	3,555(1,484.9)**
admission through internal medicine	4,671(2,223.5)*	NS
turnover rate	NS	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	6,636(3,322.8)*
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	NS	NS
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	-94,660(14,235.1)**	NS
number of surgeons	-26,081(4,978.0)**	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	-317(57.6)**
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.29	0.50
F	21**	44**
N of cases	264	264

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 8, increasing by one more day the preoperative length of stay, the total cost, the ward cost and the test cost will increase by Pst 18,437, 17,776 and 771 respectively. Increasing by one more day the postoperative length of stay, the total cost, the ward cost and the test cost will increase by Pst 18,293, 17,706 and 798 respectively. Increasing by one more minute the operating theatre time, the total cost, the drug cost and the test cost will increase by Pst 2,001, 63 and 90 respectively. Each patient admitted through the emergency room will increase the drug cost and the test cost by Pst 2,585 and 3,555 respectively. Each patient admitted through internal medicine will increase the drug cost by Pst 4,671. Increasing by 1 per cent the turnover rate, the total cost and the ward cost will increase by Pst 43,630 and 70,725 respectively. Patients with multiple diagnoses or comorbidity will increase the total cost, the ward cost and the test cost by Pst 44,708, 39,148 and 6,636 respectively. Each patient admitted to the hospital on Friday will increase the total cost by Pst 34,411. Each patient admitted to the hospital on Saturday will increase the ward cost by Pst 35,444. Increasing by 1 per cent the percentage of operations, the drug cost will decrease by Pst 94,660. Increasing by one more the number of surgeons per 10,000 population, the drug cost will decrease by Pst 26,081. Increasing by one more the number of beds per specialities per 1,000 population, the total cost, the ward cost and the test cost will decrease by 4,946, 3,739 and 317 respectively.

Appendix 8
Hospital regression results, excluding the length of stay

HOSPITAL 1		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-7,166,569(581,026.3)**	4,125,271(477,047)**
operating theater minutes	2,894(155.0)**	757(139.5)**
admission through emergency room	99,990(21,648.0)**	93,505.4(19,486.4)**
admission through internal medicine	107,980(17,298.4)**	93,285.6(15,571.1)**
turnover rate	NS	NS
complications	94,697(14,295)**	81,658(12,868.3)**
multiple diagnoses or comorbidity	39,685(15,036.6)**	27,628(13,535.1)*
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	93,230(22,792.0)**	83,028(20,516.1)**
discharge on Monday	29,951(11,186.4)**	23,839(10,069.4)*
sex	-30,247(11,223.0)**	-28,802(10,102.4)**
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	1,448,944(116,690.4)**	-764,133(90,555.8)**
number of surgeons	-1,480,216(149,107.1)**	NS
number of resident surgeons	NS	NS
number of beds per specialities	5,172(722.6)**	-4,157(314.0)**
occupancy rate	NS	480,077(36,093.5)**
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.83	0.72
F	109**	57**
N of cases	250	250

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

HOSPITAL 1		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-1,381,164(477,510.5)**	-92,893(25,964.6)**
operating theatre minutes	277(33.3)**	94(16.0)**
admission through emergency room	NS	NS
admission through internal medicine	NS	NS
turnover rate	NS	NS
complications	6,209(3,086.1)*	6,922(1,725.8)**
multiple diagnoses or comorbidity	8,503(3,270.0)**	NS
admitted to the hospital on Friday	25,601(6,621.6)**	NS
admitted to the hospital on Saturday	NS	6,870(2,701.3)*
discharge on Monday	5,736(2,437.0)*	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	265,003(91,063.4)**	17,163(4,925.2)**
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	-63,164(17,573.0)**	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.43	0.24
F	21**	19**
N of cases	250	250

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

For hospital 1, increasing by one more minute the operating theatre time, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 2,894, 757, 277 and 94 respectively. Each patient admitted through the emergency room will increase the total cost and the ward cost by Pst 99,990 and 93,505 respectively. Each patient admitted through internal medicine will increase the total cost and the ward cost by Pst 107,980 and 93,285 respectively. Patients with complications will increase the total cost, the ward cost, the drug cost and the test cost by Pst 94,697, 81,658, 6,209 and 6,922 respectively. Patients with multiple diagnoses or comorbidity will increase the total cost, the ward cost and the drug cost by Pst 39,685, 27,628 and 8,503 respectively. Each patient admitted to the hospital on Friday will increase the drug cost by Pst 25,601. Each patient admitted to the hospital on Saturday will increase the total cost, the ward cost and the test cost by 93,230, 83,028 and 6,870 respectively. Each patient discharge on Monday will increase the total cost, the ward cost and the drug cost by 29,951, 23,839 and 5,736 respectively. Male patients will decrease the total cost and the ward cost by Pst 30,247 and 28,802 respectively. Increasing by 1 per cent the percentage of operations, the total cost, the drug cost and the test cost will increase by Pst 1,448,944, 265,003 and 17,163. However, the ward cost will decrease by Pst 764,133. Increasing by one more the number of surgeons per 10,000 population, the total cost will decrease by Pst 1,480,216. Increasing by one more the number of beds per specialities, the total cost will increase by Pst 5,172 and the ward cost will decrease by Pst 4,157 respectively. Increasing by 1 per cent the occupancy rate, the ward cost will increase by Pst 480,077 and the drug cost will decrease by Pst 63,164 respectively.

Continuation

HOSPITAL 2		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	167,416(52,270.6)**	140,078(48,919.1)**
operating theater minutes	2,726(173.4)**	915(159.6)**
admission through emergency room	196,441(16,058.9)**	NS
admission through internal medicine	NS	165,767(15,117)**
turnover rate	NS	NS
complications	166,399(23,454.2)**	143,537(21,955.0)**
multiple diagnoses or comorbidity	58,983(24,469.0)*	NS
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	60,312(23,729.0)*	48,658(22,343.5)*
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	28,732(13,614.9)*	25,221(12,814.2)*
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	-1,174,926(129,550.2)**	-1,246,970(121,106.9)**
number of resident surgeons	1,879,737(407,089.1)**	2,431,810(380,007)**
number of beds per specialities	NS	NS
occupancy rate	944,428(72,093)**	1,051,462(67,783.6)**
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.77	0.66
F	136**	86**
N of cases	366	366

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

HOSPITAL 2		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	23,050(4,335.8)**	-28,463(6,004.4)**
operating theatre minutes	45(10.9)**	75(18.6)**
admission through emergency room	4,527(960.8)**	25,966(1,715.2)**
admission through internal medicine	7,675(1,487.7)**	NS
turnover rate	-7,067(1,111.2)**	NS
complications	5,649(1,473.0)**	14,580(2,609.4)**
multiple diagnoses or comorbidity	12,486(1,538.3)**	NS
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	NS	8,737(2,663.7)**
discharge on Monday	NS	NS
sex	1,540(721.4)*	4,590(1,283.0)**
over 76 years old patients	NS	3,245(1,476.3)*
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	-24,781(7,322.5)**	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	262(54.9)**
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.51	0.66
F	47**	98**
N of cases	366	366

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant ($p > .05$)

For hospital 2, increasing by one more minute the operating theatre time, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 2,726, 915, 45 and 75 respectively. Each patient admitted through the emergency room will increase the total cost, the drug cost and the test cost by Pst 196,441, 4,527 and 25,966 respectively. Each patient admitted through internal medicine will increase the ward cost and the drug cost by Pst 165,767 and 7,675 respectively. Increasing by 1 per cent the turnover rate, the drug cost will decrease by Pst 7,067. Patients with complications will increase the total cost, the ward cost, the drug cost and the test cost by Pst 166,399, 143,537, 5,649 and 14,580 respectively. Patients with multiple diagnoses or comorbidity will increase the total cost and cost the drug cost by Pst 58,983 and 12,486 respectively. Each patient admitted to the hospital on Saturday will increase the total cost, the ward cost and the test cost by 60,312, 48,658 and 8,737 respectively. Male patients will increase the drug cost and the test cost by Pst 1,540 and 4,590 respectively. Patient over 76 years old will increase the total cost, the ward cost and the test cost by Pst 28,732, 25,221 and 3,245 respectively. Increasing by one more the number of surgeons per 10,000 population, the total cost, the ward cost and the drug cost will decrease by Pst 1,174,926, 1,246,970 and 24,781 respectively. Increasing by one more the number of resident surgeons per 10,000 population, the total cost and the ward cost will increase by Pst 1,879,737 and 2,431,810 respectively. Increasing by one more the number of beds per specialities, the test cost will increase by Pst 262. Increasing by 1 per cent the occupancy rate, the total cost and the ward cost will increase by Pst 944,428 and 1,051,462 respectively.

Continuation

HOSPITAL 4		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-6,394,167(750,936.2)**	-7,613,122(1,049,810.8)**
operating theater minutes	2,629(126.8)**	713(112.0)**
admission through emergency room	145,837(15,448.7)**	127,069(13,883.3)**
admission through internal medicine	235,866(72,888.4)**	216,690(64,475.4)**
turnover rate	116,575(7,864.9)**	121,218(7,951.1)**
complications	96,098(14,851.5)**	91,285(13,159.6)**
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	77,577(22,708.4)**	61,046(20,051.1)**
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	743,704(90,303)**	888,699(126,928.0)**
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	NS
occupancy rate	NS	37,430(17,892.8)*
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.81	0.72
F	200**	107**
N of cases	339	339

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

HOSPITAL 4		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	-137,488(41,579.2)**	-9,583(1,968.6)**
operating theatre minutes	24(6.8)**	113(15.5)**
admission through emergency room	2,213(843.7)**	15,943(2,063.2)**
admission through internal medicine	NS	21,060(9,415.1)*
turnover rate	-1,078(489.5)*	NS
complications	NS	NS
multiple diagnoses or comorbidity	NS	NS
admitted to the hospital on Friday	NS	8,802(4,351.9)*
admitted to the hospital on Saturday	4,583(1,244.3)**	11,071(2,950.7)**
discharge on Monday	NS	NS
sex	1,645(536.4)**	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	16,786(5,003.1)**	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	NS	82(26.4)**
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.21	0.43
F	14**	41**
N of cases	339	339

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p > .05)

For hospital 4, increasing by one more minute the operating theatre time, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 2,629, 713, 24 and 113 respectively. Each patient admitted through the emergency room will increase the total cost, the ward cost, the drug cost and the test cost by Pst 145,837, 127,069, 2,213 and 15,943 respectively. Each patient admitted through internal medicine will increase the total cost, the ward cost and the test cost by Pst 235,866, 216,690 and 21,060 respectively. Increasing by 1 per cent the turnover rate, the total cost and the ward cost will increase by Pst 116,575 and 121,218 respectively. However, the drug cost will decrease by Pst 1,078. Patients with complications will increase the total cost and the ward cost by Pst 96,098 and 91,285 respectively. Each patient admitted to the hospital on Friday will increase the test cost by Pst 8,802. Each patient admitted to the hospital on Saturday will increase the total cost, the ward cost, the drug cost and the test cost by 77,577, 61,046, 4,583 and 11,071 respectively. Male patients will increase the drug cost by Pst 1,645. Increasing by 1 per cent the percentage of operations, the total cost, the ward cost and the drug cost will increase by Pst 743,704, 888,699 and 16,786 respectively. Increasing by one more the number of beds per specialities, the test cost will increase by Pst 82. Increasing by 1 per cent the occupancy rate, the ward cost will increase by Pst 37,430.

Continuation

HOSPITAL 8		
Explanatory Variables	**Total cost**	**Ward cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	906,450(115,930.2)**	633,712(49,296.9)**
operating theater minutes	3,555(179.9)**	1,519(154.3)**
admission through emergency room	64,401(18,061.0)**	67,765(15,208.5)**
admission through internal medicine	NS	NS
turnover rate	-47,647(17,872.5)**	NS
complications	124,095(22,863.8)**	121,970(21,415.2)**
multiple diagnoses or comorbidity	98,893(39,016.1)*	87,782(36,739.5)*
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	NS	NS
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	NS	NS
number of surgeons	NS	NS
number of resident surgeons	NS	NS
number of beds per specialities	-13,547(1,982.5)**	-11,173(1,819.2)**
occupancy rate	392,883(199,262.8)*	386,145(182,281.7)*
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.74	0.58
F	105**	59**
N of cases	264	264

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

Continuation

HOSPITAL 8		
Explanatory Variables	**Drug cost**	**Test cost**
	Coefficient(St.error)Sig	Coefficient(St. error)Sig
Constant	463,446(69,746.8)**	486,386(133,326.9)**
operating theatre minutes	63(8.4)**	162(16.5)**
admission through emergency room	2,585(831.0)**	5,967(1,657.9)**
admission through internal medicine	4,671(2,223.5)*	NS
turnover rate	NS	NS
complications	NS	5,432(2,098.8)*
multiple diagnoses or comorbidity	NS	9,032(3,581.6)*
admitted to the hospital on Friday	NS	NS
admitted to the hospital on Saturday	NS	NS
discharge on Monday	NS	NS
sex	NS	NS
over 76 years old patients	NS	NS
between 66 and 75 years old patients	NS	NS
percentage of operations	-94,660(14,235.1)**	-99,562(27,413.8)**
number of surgeons	-26,081(4,978.0)**	-50,943(12,193.9)**
number of resident surgeons	NS	50,962(14,886.1)**
number of beds per specialities	NS	NS
occupancy rate	NS	NS
General Practitioner	NS	NS
total number of hospital beds	NS	NS
R Square	0.29	0.42
F	21**	27**
N of cases	264	264

Notes: ** Significant at the 99 percentage level
* Significant at the 95 percentage level
NS= not significant (p>.05)

For hospital 8, increasing by one more minute the operating theatre time, the total cost, the ward cost, the drug cost and the test cost will increase by Pst 3,555, 1,519, 63 and 162 respectively. Each patient admitted through the emergency room will increase the total cost, the ward cost, the drug cost and the test cost by Pst 64,401, 67,765, 2,585 and 5,967 respectively. Each patient admitted through internal medicine will increase the drug cost by Pst 4,671. Increasing by 1 per cent the turnover rate, the total cost will decrease by Pst 47,647. Patients with complications will increase the total cost, the ward cost and the test cost by Pst 124,095, 121,970 and 5,432 respectively. Patients with multiple diagnoses or comorbidity will increase the total cost, the ward cost and the test cost by Pst 98,893, 87,782 and 9,032 respectively. Increasing by 1 per cent the percentage of operations, the drug cost and the test cost will decrease by Pst 94,660 and 99,562 respectively. Increasing by one more the number of surgeons per 10,000 population, the drug cost and the test cost will decrease by Pst 26,081 and 50,943 respectively. Increasing by one more the number of resident surgeons per 10,000 population, the test cost will increase by Pst 50,962. Increasing by one more the number of beds per specialities, the total cost and the ward cost will decrease by Pst 13,547 and 11,173 respectively. Increasing by 1 per cent the occupancy rate, the total cost and the ward cost will increase by Pst 392,883 and 386,145 respectively.

Appendix 9

Questionnaire for surgeons

QUESTIONNAIRE FOR SURGEONS

THANK YOU VERY MUCH FOR FILLING OUT THIS QUESTIONNAIRE.

I HOPE YOU WILL FIND IT INTERESTING AND THAT IT ONLY TAKES A FEW MINUTES OF YOUR TIME.

PLEASE READ EACH QUESTION CAREFULLY. ALL QUESTIONS CAN BE ANSWERED BY TICKING THE RELEVANT BOX/ES.

THIS QUESTIONNAIRE IS COMPLETELY ANONYMOUS.

1.- WHICH OF THE FOLLOWING STATEMENTS COMES CLOSEST TO YOUR OPINION OF THE VALENCIA HEALTH SYSTEM?

PLEASE TICK THE RELEVANT BOX/ES.

A) I BELIEVE THE VALENCIA HEALTH SYSTEM DOES A GOOD JOB AND THAT THERE ARE ONLY A FEW SMALL CHANGES NECESSARY	
B) I BELIEVE THERE ARE GOOD THINGS IN OUR VALENCIA HEALTH SYSTEM BUT IT NEEDS SOME FUNDAMENTAL CHANGES TO MAKE IT BETTER	
C) THE VALENCIA HEALTH SYSTEM DOES A BAD JOB AND THEREFORE NEEDS TO BE CHANGED COMPLETELY	

2.- PLEASE PUT AN "X" NEXT TO THE AREA/S WHERE YOU BELIEVE THE MOST IMPORTANT IMPROVEMENTS SHOULD BE CARRIED OUT.

A) MANAGEMENT	
B) INFORMATION	
C) CO-ORDINATION	
D) PARTICIPATION	
E) INCENTIVE	

F) OTHER (PLEASE SPECIFY) ______________________________

____

3.- DO YOU RECEIVE ANY INFORMATION ABOUT THE AMOUNT OF SURGERY PERFORMED AND THE AVERAGE HOSPITAL STAY IN YOUR HOSPITAL? IF SO, HOW DO YOU RECEIVE THIS INFORMATION?

PLEASE TICK THE RELEVANT BOX/ES.

A) NO INFORMATION RECEIVED	
B) WRITTEN INFORMATION	
C) VERBAL INFORMATION AT MEETINGS	

D) OTHER (PLEASE SPECIFY) ______________________________

____

4.- DO YOU RECEIVE ANY INFORMATION ABOUT THE COST OF YOUR SERVICES AND THE COST PER PATIENT IN YOUR HOSPITAL?

PLEASE TICK THE RELEVANT BOX/ES.

A) NO INFORMATION RECEIVED	
B) WRITTEN INFORMATION	
C) VERBAL INFORMATION AT MEETINGS	

D) OTHER (PLEASE SPECIFY) ______________________________

____

5.- DO YOU RECEIVE ANY INFORMATION ABOUT THE AMOUNT OF SURGERY PERFORMED AND THE AVERAGE HOSPITAL STAY **COMPARED WITH** OTHER VALENCIA HOSPITALS?

IF SO, HOW DO YOU RECEIVE THIS INFORMATION?

PLEASE TICK THE RELEVANT BOX/ES.

A) NO INFORMATION RECEIVED	
B) WRITTEN INFORMATION	
C) VERBAL INFORMATION AT MEETINGS	

D) OTHER (PLEASE SPECIFY) ______________________________

____

6.- DO YOU RECEIVE ANY INFORMATION ABOUT THE COST OF YOUR DEPARTMENT AND THE COST PER PATIENT COMPARED TO OTHER VALENCIA HOSPITALS?
IF SO, HOW DO YOU RECEIVE THIS INFORMATION?

PLEASE TICK THE RELEVANT BOX/ES.

A) NO INFORMATION RECEIVED	
B) WRITTEN INFORMATION	
C) VERBAL INFORMATION AT MEETINGS	

D) OTHER (PLEASE SPECIFY) ______________________________

____

7.- HOW WOULD YOU ESTIMATE YOUR HOSPITAL COMPARED TO OTHER VALENCIA HOSPITALS?

PLEASE TICK THE RELEVANT BOX/ES.

	LESS	THE SAME	MORE	NOT SURE	DON'T KNOW
A) NUMBER OF OPERATIONS					
B) AVERAGE PRE-OPERATIVE STAY					
C) AVERAGE POST-OPERATIVE STAY					
D) TOTAL AVERAGE STAY					
E) COST OF SERVICES					
F) AVERAGE COST PER PATIENT					

8.- IN THE PAST 12 MONTHS HOW OFTEN HAVE YOU RECEIVED ANY INFORMATION ABOUT THE FOLLOWING SURGICAL STATISTICS THAT YOUR HOSPITAL CARRIES OUT?

PLEASE TICK THE RELEVANT BOX/ES.

	NEVER	ONCE	TWICE	MORE THAN TWICE
A) NUMBER OF NEW PATIENTS PER WEEK /MONTH				
B) SURGERY ADMISSIONS PER WEEK/MONTH				
C) NUMBER OF OPERATIONS PER WEEK/MONTH				
D) AVERAGE STAY FOR SURGERY PATIENTS				
E) THE PERCENTAGE OF SURGICAL PATIENTS OCCUPYING BEDS				
F) YOUR AVERAGE SERVICE STAY				
G) COST OF YOUR SERVICES				
H) AVERAGE COST PER PATIENT				
I) ROTATION PERCENTAGE				

9.- PLEASE INDICATE THE SOURCE OF THE INFORMATION CONCERNING THE DURATION OF PATIENTS' STAY IN THE HOSPITAL?

PLEASE TICK THE RELEVANT BOXES/ES.

A) FROM THE MANAGER	
B) FROM THE MEDICAL DIRECTOR	
C) FROM THE ADMINISTRATOR	
D) FROM MEDICAL RECORDS DEPARTMENT	
E) FROM THE DEPARTMENT HEAD	
F) FROM THE QUALITY CONTROL SERVICE	

G) OTHER (PLEASE SPECIFY) ______________________________

____

10.- BELOW, THERE ARE SEVERAL STATEMENTS MADE BY MEDICAL PROFESSIONALS ABOUT THE INFORMATION AVAILABLE TO SURGEONS.

PLEASE TICK THE RELEVANT BOX/ES.

	COMPLETELY AGREE	AGREE	NOT SURE	DISAGREE	COMPLETELY DISAGREE
A) I WOULD LIKE TO RECEIVE MORE INFORMATION RELATING TO ACTIVITY /COSTS WHICH MY DEPARTMENT PROVIDES, AS COMPARED TO OTHER VALENCIA HOSPITALS.					
B) I WOULD LIKE TO RECEIVE MORE INFORMATION RELATING TO ACTIVITIES/COSTS WHICH OTHER DEPARTMENTS PROVIDE IN MY HOSPITAL AS COMPARED TO OTHER VALENCIA HOSPITALS.					
C) THE INFORMATION I RECEIVE DOES NOT COME IN A CLEAR AND EASY FORMAT THAT I CAN UNDERSTAND.					
D) THE INFORMATION THAT I RECEIVE ARRIVES SO LATE THAT IT IS NOT MUCH USE TO ME.					
E) THE OFFICIAL INFORMATION THAT I RECEIVE DOES NOT AGREE WITH THE INFORMATION THAT I HAVE.					
F) RECEIVING INFORMATION ON HOW SURGICAL RESOURCES ARE USED IN MY HOSPITAL WOULD HELP ME IN MY CLINICAL JUDGEMENT.					

11.- BELOW, THERE ARE SEVERAL STATEMENTS MADE BY MEDICAL PROFESSIONALS ABOUT THE OPPORTUNITIES THAT SURGEONS HAVE IN THE CO-ORDINATION AND UTILISATION OF RESOURCES.

PLEASE TICK THE RELEVANT BOX/ES.

	COMPLETELY AGREE	AGREE	NOT SURE	DISAGREE	COMPLETELY DISAGREE
A) IN MY HOSPITAL AMONG THE SPECIALTIES THERE IS ADEQUATE CO-ORDINATION IN THE USE OF RESOURCES					
B) IN MY HOSPITAL AMONG THE SPECIALTIES THERE IS NOT ADEQUATE CO-ORDINATION IN THE USE OF RESOURCES					
C) I HAVE ADEQUATE OPPORTUNITIES TO PARTICIPATE IN DECIDING ON HOW THE RESOURCES SHOULD BE USED (FOR EXAMPLE: BEDS, OPERATING ROOMS, ETC.) IN THE HOSPITAL					
D) I DO NOT HAVE ADEQUATE OPPORTUNITIES TO PARTICIPATE IN DECIDING ON HOW RESOURCES SHOULD BE USED (FOR EXAMPLE: BEDS, OPERATING ROOMS, ETC.) IN THE HOSPITAL					

12.- BELOW, THERE ARE SEVERAL STATEMENTS MADE BY MEDICAL PROFESSIONALS ABOUT THE INCENTIVES SURGEONS HAVE TO CUT THE AVERAGE STAY AND COST PER PATIENT.

PLEASE TICK THE RELEVANT BOX/ES.

	COMPLETELY AGREE	AGREE	NOT SURE	DISAGREE	COMPLETELY DISAGREE
A) THERE IS ADEQUATE INCENTIVE TO CUT THE AVERAGE STAY AND COST PER PATIENT					
B) THERE IS INSUFFICIENT INCENTIVE TO CUT THE AVERAGE STAY AND COST PER PATIENT					
C) THERE IS NO INCENTIVE TO CUT THE AVERAGE STAY AND COST PER PATIENT					

13.- BELOW, THERE ARE SEVERAL STATEMENTS MADE BY MEDICAL PROFESSIONALS ABOUT THE CAUSES OF LONG **PREOPERATIVE** STAYS.

PLEASE TICK THE RELEVANT BOX/ES.

	COMPLETELY AGREE	AGREE	NOT SURE	DISAGREE	COMPLETELY DISAGREE
A) PROBLEMS WITH THE MANAGEMENT OF THE HOSPITAL					
B) PROBLEMS WITH THE AVAILABILITY OF OPERATING ROOMS					
C) PROBLEMS WITH BEDS					
D) PROBLEMS WITH ADDITIONAL TESTS					
E) UNAVAILABILITY OF INTENSIVE CARE UNITS BEDS					
F) LACK OF ANAESTHETISTS					
G) PROBLEMS WITH SCHEDULED SURGERY ADMITTED BY THE CASUALTY DEPARTMENT					
H) ADMINISTRATIVE PROBLEMS					

14.- BELOW, THERE ARE SEVERAL STATEMENTS MADE BY MEDICAL PROFESSIONALS ABOUT THE CAUSES OF LONG **POSTOPERATIVE** STAYS.

PLEASE TICK THE RELEVANT BOX/ES.

	COMPLETELY AGREE	AGREE	NOT SURE	DISAGREE	COMPLETELY DISAGREE
A) PROBLEMS WITH THE MANAGEMENT OF THE HOSPITAL					
B) PROBLEMS WITH THE SEVERITY OF THE PATIENT (SECONDARY DIAGNOSIS, COMPLICATIONS, ETC)					
C) SOCIO-ECONOMIC PROBLEMS OF THE PATIENT (LIVES ALONE, POOR HOUSING, ETC)					
D) PROBLEMS WITH CERTAIN SURGICAL TECHNIQUES					
E) NOT HAVING AN ADEQUATE FOLLOW-UP OF THE PATIENT OUTSIDE THE HOSPITAL					
F) PATIENT REFUSAL TO BE DISCHARGED					

15.- BELOW, THERE ARE SEVERAL STATEMENTS MADE BY MEDICAL PROFESSIONALS ABOUT THE REASONS WHY THE AVERAGE **COST PER PATIENT** IN THE HOSPITAL IS TOO HIGH.

PLEASE TICK THE RELEVANT BOX/ES.

	COMPLETELY AGREE	AGREE	NOT SURE	DISAGREE	COMPLETELY DISAGREE
A) PROBLEMS WITH THE MANAGEMENT OF THE HOSPITAL					
B) ORDERING THE PATIENT A LARGE NUMBER OF ADDITIONAL TESTS					
C) OVER-PRESCRIBING OF MEDICINE					
D) AVERAGE PRE/POST OPERATIVE STAY IS TOO LONG					

16.- BELOW THERE ARE SEVERAL STATEMENTS MADE BY MEDICAL PROFESSIONALS ABOUT ADEQUATE **INCENTIVES** TO LOWER THE AVERAGE STAY AND COST PER PATIENT.

PLEASE TICK THE RELEVANT BOX/ES.

	COMPLETELY AGREE	AGREE	NOT SURE	DISAGREE	COMPLETELY DISAGREE
A) CLINICAL BUDGETS					
B) GREATER CLINICAL PARTICIPATION					
C) SELECTIVE INCENTIVE OF A MONETARY NATURE					
D) PROFESSIONAL PROMOTION					
E) THE RECOGNITION OF WORK WELL DONE					

17.- BELOW THERE ARE SEVERAL STATEMENTS MADE BY **MEDICAL PROFESSIONALS** ABOUT HOW TO CUT THE AVERAGE STAY AND COST PER PATIENT.

PLEASE TICK THE RELEVANT BOX/ES.

	COMPLETELY AGREE	AGREE	NOT SURE	DISAGREE	COMPLETELY DISAGREE
A) DEVELOP DISCHARGE PROTOCOLS					
B) STRENGTHEN QUALITY CONTROLS					
C) TRY TO PERFORM SHORT-STAY SURGERIES IN SPECIAL OPERATING ROOMS WITHOUT HAVING THE PATIENT SPEND THE NIGHT					
D) TRY TO MAKE ADDITIONAL TESTS IN OUTPATIENT DEPARTMENTS EASIER AND QUICKER					
E) FORM SPECIAL TEAMS (SURGEONS, NURSES) TO DO PATIENT FOLLOW-UPS AT HOME					
F) A GREATER CO-ORDINATION BETWEEN THE HOSPITAL AND PRIMARY HEALTH CARE CENTRES					

18.- BELOW, THERE ARE SEVERAL STATEMENTS MADE BY POLICY MAKERS AND MANAGERS IN THE N.H.S. ABOUT HOW TO CUT THE AVERAGE STAY AND COST PER PATIENT.

PLEASE TICK THE RELEVANT BOX/ES.

	COMPLETELY AGREE	AGREE	NOT SURE	DISAGREE	COMPLETELY DISAGREE
A) A POLICY THAT ENCOURAGES THE PATIENTS TO HAVE THEIR OPERATIONS IN OUTPATIENT DEPARTMENTS OR SPECIAL OPERATING ROOMS WITHOUT HAVING TO SPEND THE NIGHT					
B) A POLICY THAT PROMOTES THE CARE AND TREATMENT OF THE PATIENT AT HOME OR IN SPECIAL RESIDENCIES THAT SUBSTITUTE THE HOSPITAL					
C) A POLICY THAT MIGHT CHANGE THE LAWS WHICH CAUSE DOCTORS TO ORDER ACTIONS JUST TO PROTECT THEMSELVES FROM THE LAW					
D) A POLICY THAT ENCOURAGES DOCTORS PARTICIPATION IN MANAGEMENT AND COST CONTROL					

GENERAL OBSERVATIONS

**THANK YOU VERY MUCH FOR FILLING OUT THIS QUESTIONNAIRE.
I HOPE YOU HAVE FOUND IT INTERESTING.**

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