Development, Implementation and Evaluation of a Community-Based Surveillance System in Rural Cambodia

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ABSTRACT

A community-based surveillance system was developed and implemented in rural areas in Cambodia. The system aimed to provide timely and representative information on major health problems and life events that would permit rapid and effective control of outbreaks and communicable diseases in general in rural communities. In the system, lay people were trained as Village Health Volunteers to report suspected outbreaks, important infectious diseases, and vital events occurring in their communities to local health staff who analysed the data and gave feedback to the volunteers during their monthly meetings.

An evaluation conducted one year after implementation of the community-based surveillance system began found that the system was able to detect outbreaks early, regularly monitor communicable disease trends, and to continuously provide updated information on pregnancies, births and deaths in the rural areas. The sensitivity and specificity of case reporting by Village Health Volunteers were found to be quite high. In addition, the community-based surveillance system triggered effective responses from both health staff and Village Health Volunteers in outbreak and disease control and prevention.

The results suggest that a community-based surveillance system can successfully fill the gaps of the current health facility-based disease surveillance system in the rapid detection of outbreaks, in the effective monitoring of communicable diseases, and in the notification of vital events in rural Cambodia. Empowered local people and health staff can accurately report, analyse and act upon significant health problems in their community within a surveillance system they develop, own and operate. The community-based surveillance system could easily be integrated with the current disease surveillance system. Its replication or adaptation for use in other rural areas in Cambodia and in other developing countries would be likely feasible and beneficial, as well as cost-effective.

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ABBREVIATIONS AND ACRONYMS

ARI	Acute Respiratory Infection
BHWs	Barangay Health Workers
CBHD	Community-based Health Development
CBDDS	Community-based Disease and Death Surveillance
CBRHP	Community-Based Reproductive Health Project
CBS	Community-based Surveillance
CBSS	Community-based Surveillance System
CDC	Centre for Disease Control and Prevention
CHAs	Community Health Agents
CHVs	Community Health Volunteers
CHWs	Community health workers
CMS	Community Monitoring System
DHF	Dengue Hemorrhagic Fever
EC-RMCP	European Commission –Regional Malaria Control Project
EPI	Expanded Programme of Immunisation
EpiInfo 2000	Windows-based software packages developed by the CDC and designed to provide data construction, entry, and analysis with epidemiologic, statistic, map, and graphs
EWORS	Early Outbreak Warning and Response System
HIS	Health Information System
IMR	Institute of Medical Research
KSCSP	Kean Svay Child Survival Project
LSHTM	London School of Hygiene & Tropical Medicine
MoH	Ministry of Health
NAMRU-2	United States Naval Medical Research Unit-2
NGO	Non-Governmental Organisation
NIPH	National Institute of Public Health (Cambodia)
NIS	National Institute of Statistics (Cambodia)
No.	Number
OD	Operational (Health) District
PHC	Primary Health Care

PHD	Provincial Health Department
PHF	Public health facilities
PNG	Papua New Guinea
PPV	Positive Predictive Value
PW	Pregnant women
RH	Referral Hospital
S	Sensitivity
SCA	Save the Children Australia
SECI	Sistema Epidemiologica Communitario Integral
TB	Tuberculosis
TBAs	Traditional Birth Attendants
TP	True Positive
TT2+	Two or more doses of tetanus toxoid
UNICEF	United Nations Children's Fund
UNDP	United Nations Development Programme
US	United States of America
USAID	United States Agency for International Development
VBDCP	Vector Born Disease Control Programme
VC	Volunteer Collaborator
VCN	Volunteer Collaborator Networks
VHHs	Village Health Helpers
VHVs	Village Health Volunteers
VHWs	Villager Health Workers
WHO	World Health Organisation
WV-C	World Vision-Cambodia

1 INTRODUCTION

This section begins with the rationale of the study through background information on surveillance systems in developing countries including their intended purpose and use as well as their limitations. A statement of the aim, objectives and hypothesis of the study follows and the section terminates with a description of the organisation of the thesis.

1.1 Rationale

1.1.1 Public health surveillance

Surveillance, "the process of systematic collection, collation, analysis and interpretation of data with prompt dissemination to those who need to know, for relevant action to be taken" (WHO 2001), has been developed for monitoring disease trends, identification of high risk groups and detection of outbreaks (Buehler 1998). This process is accomplished by a system composed of organised groups of people and comprises activities at different levels of the health system, from the peripheral to the national and to the international levels (Buehler 1998). Surveillance was limited in the past to communicable diseases especially those of epidemic potential such as cholera and those of high endemicity such as Guinea worm, malaria, and tuberculosis but has been extended in the last decades to include non-communicable diseases and finally, to also include other health-related events of major public health importance. At present, public health surveillance encompasses all disease surveillance activities, whether targeted to communicable or non-communicable diseases, or other health-related events.

1.1.2 Limitations of surveillance systems in developing countries

In developing countries, disease surveillance is mainly based on data reported from all levels of public health facilities including the rural or commune health centre, district hospitals, and provincial or regional hospitals as well as national hospitals. This type of surveillance activity is commonly called routine disease surveillance. For some specific diseases and conditions, only selected hospitals or health

institutions are involved, and this type of surveillance activity is known as sentinel surveillance. The frequency of case reporting ranges from weekly to monthly. These health facility-based types of disease surveillance have allowed different levels of health authorities to detect outbreaks and monitor diseases trends to some extent, as well as to develop plans and strategies to prevent and control diseases in their respective catchment areas (WHO 2000a, 2000b).

This routine health facility-based surveillance, however, has weaknesses that limit its potential ability to contribute to effective disease control (Woodall 1988). First, it cannot capture all events of interest because only certain proportions of patients use health facilities. For instance, only about 30% of patients used health facilities- and were therefore reported- in Cambodia in 1998 (NPHRI 1998) and only around 10% of neonatal tetanus cases were reported by the health system in India in the year 1980s (Singh and Kaur 1996). This low utilisation of public health care services resulted from limitations in the range and quality of services offered by public health facilities, and from traditional beliefs and preferences of the population. Difficult accessibility to health facilities for people living in rural areas, for instance due to long distances, poor roads, lack of transportation, and affordability constraints due to user fees are other factors leading to low utilisation of health facilities. The routine surveillance system therefore covers only a sub-population which is not representative of the general population.

Second, there have been delays and irregularities in data reporting, especially from remote rural areas, which have resulted in late detection and ineffective control of epidemics. Poor means of communication from peripheral areas to the provincial and central levels has been a major reason for late reporting, and lack of commitment of local health staff was a major cause of irregular and incomplete reporting. "In developing countries routine data collection is often done poorly, usually because peripheral health workers have a heavy work-load, and are often asked to collect statistics which are not meaningful to them" (Woelk *et al.* 1987).

Third, limited use, if any, of data at the levels where they are collected further limits the efficiency and efficacy of health facility-based surveillance. It is common practice that peripheral level staff seldom make use of data they collect, only sending it to the upper level of the health system. The lack of use of data at the peripheral level and the latter's dependency on the central level for initiating responses has rendered surveillance systems in many developing countries less than effective. This

is generally caused by the lack of skills of local staff in data analysis and interpretation, the absence of feedback of information from the upper levels, as well as the allocation of inadequate resources to the peripheral levels of the health system.

Population-based surveys have been commonly used to bridge the gaps identified in health facility-based surveillance systems in developing countries (White 1985). Cross-sectional surveys carried out on a representative sample of the population can usually provide much better estimates of health indicators than can routine or sentinel surveillance. However, such surveys are quite time consuming and expensive if of good quality and repeated during the year. In addition, they may not be able to detect outbreaks as well as the health facility-based surveillance system. The surveys are rather useful, however, for providing baseline information for the implementation of an intervention or project and for the evaluation of achievements, especially for monitoring and evaluating Primary Health Care in developing countries (Carlson 1985; Lemeshow and Robinson 1985).

Community-based surveillance (CBS) is a particular type of surveillance activity that involves local people in collecting and reporting health-related data from their own community. It was described as "a means of accessing community-level data and as a means of providing community members with the information necessary to involve them in the planning and decision-making of actions on the health status of their community" (O'Neil 1993).

1.2 Aim and objectives of the study

1.2.1 Aim of the study

The study aimed to demonstrate that a CBS system, when appropriately designed and locally managed, could fill significant gaps in the current disease surveillance system in providing adequate, representative and timely information on important infectious diseases and vital events in the rural communities for effective disease and outbreaks control and prevention.

1.2.2 Objectives of the study:

1. To develop with key stakeholders a CBS system that can detect disease outbreaks in a timely fashion and effectively monitor priority communicable diseases and vital events in rural Cambodia,

2. To empower local health staff and lay people to implement the CBS system in their community, and

3. To evaluate the performance of the system in the study areas within 12 months of its implementation

1.2.3 Hypothesis:

1. CBS system can provide more timely and representative data on major health problems in the rural areas than existing health facility-based disease surveillance system.

2. Empowered lay people can accurately and comprehensively report suspected outbreaks and cases of major communicable diseases as well as vital events in their community.

3. Trained local health staff can correctly analyse data and skilfully communicate the information derived to the communities.

4. Information derived from CBSS, when graphically fed back in a timely fashion to people who collect it, can greatly trigger their responses and substantially sustain their motivation.

5. A multiple-disease and vital events CBSS that is developed, operated, and managed by local health staff and people is likely to be more cost-effective and sustainable than those systems targeting a single disease and/or those vertically managed.

1.3 Organisation of the dissertation

The next section of the thesis (i.e. Chapter 2) will review selected CBS systems in several developing countries in order to assess the extent to which these systems can bridge the gaps commonly occurring in formal routine disease surveillance. Chapter 3 and 4 will describe the development and implementation of a CBS system in rural Cambodia respectively. Chapter 5 will provide an assessment of the performance of the system within a year of its implementation and Chapter 6 will discuss values added and weaknesses of the implementation of the CBS system in Cambodia with reference to the other CBS systems reviewed as well as to the formal routine disease surveillance system already in place. Chapter 7 will draw conclusions from the Cambodian experience and will identify practical implications with a view to further improving the system and expanding it in to other rural areas of the country.

2 COMMUNITY-BASED SURVEILLANCE

2.1 *Defining Community-based Surveillance*

Community-based surveillance has been defined as the:

> Detection and reporting of diseases from within the community usually by local people or leaders who have received basic instruction on how to recognise certain conditions (WHO 1999); and
>
> Surveillance where the starting point for notification is from community level, normally reported by a community worker. It can be active (looking for cases) or passive (reporting cases). (WHO 2001)

For the purpose of this study, we define community-based surveillance as *ongoing and systematic collection of disease and health-related events in the community by trained community members.* We exclude from our definition population surveys and screening activities because they are not ongoing. Experiences with CBS systems from developing countries will be selected for review, their characteristics will be discussed, and lessons will be drawn.

2.2 *Selection of CBS systems reviewed*

A literature search for published materials on CBS during the past twenty years was conducted through Medline and other databases using the following key words: community or village or population-based surveillance, community or village health information, community or lay reporting, village health volunteers, community health workers and community participation. In addition, available unpublished reports on the CBS systems in developing countries were also reviewed. Field trials that explored the potential use of lay people or community leaders in gathering community-based data about diseases and conditions, surveillance systems in refugee

camps, and CBS systems without data on their operation available were not selected for review (Bang *et al.* 1994; Bang *et al.* 1990; Chand and Khale 1989; Elias *et al.* 1990; Fagbule *et al.* 1994; Gyapong *et al.* 1995; Gyapong *et al.* 1998; Lapau 1983; Laveissiere *et al.* 1998; Main *et al.* 2001; Scott 1988). Eighteen experiences from developing countries using CBS system that matched our definition were selected for review.

Case study 1: Guinea Worm Eradication Programmes in Africa
(Brieger 1996; Brieger and Kendall 1992, 1996; Brieger *et al.* 1997; Briger *et al.* 1996; Cairncross *et al.* 1999; Cairncross *et al.* 1996; Hours and Cairncross 1994; Sam-Abbenyi *et al.* 1999)

In the early 1990s, most African countries adopted a CBS system to replace the costly annual surveys started in the 1980s for detecting cases of Guinea worm, with the aim of eradicating this debilitating disease in Africa. The system was based on "village health workers" (VHWs) who reported on a monthly basis the cases of Guinea worm in their village to the nearest health centre, and as well provided health education to the patients. These VHWs spent on average one or two days a month collecting data through household visits. The system was able to detect most of endemic villages, to report most of cases of Guinea worm in many countries and to contribute to a great extent to the reduction of Guinea worm in Africa.

The system, implemented by national Guinea Worm Eradication Programme (GWEP) managers and international donors, cost an average of US$100 to US$200 per village per year, including training, supervision and health education. Material and financial reward, training, per diems for training and travel costs for attending meeting, recognition, regular supervision, and attending meetings were among factors that motivated VHWs to work in the system.

However in Nigeria many VHWs did not regularly send in their reports and in 1995 the Ministry of Health (MoH) received only about 62% of reports from the 1857 participating villages. On the other hand, successful experience was reported in Cameroon where from 1990 to 1995 active surveillance had been combined with other interventions including provision of safe water, and case containment to substantially reduce the number of endemic villages and new cases of Guinea worm in Mayo Sava. In this endemic area, two VHWs per village were selected and provided an initial six-day training course followed by a two-day refresher course.

Trained VHWs recorded new cases of Guinea worm they had detected in their village in the village register daily and reported them to "health outreach teams" who visited every week. The latter subsequently forwarded village-based surveillance data to the GWEP for weekly consolidation, analysis and follow-up action.

Case study 2: Yaws Surveillance and Control Programme in Ecuador
(Anselmi *et al.* 1995)

Community Health Workers (CHWs) within the existing community-based health care system in Ecuador were enrolled in the control and surveillance of some tropical diseases including malaria, leprosy, onchocerciasis, and leshmaniasis. From 1988 to 1993 these CHWs were additionally trained to detect and treat cases of yaws and their contacts in Esmeraldas province where this disease is endemic.

The project reduced substantially the number of endemic villages and individual cases as well as successfully preventing disease transmission to other areas. In contrast, the traditional vertically run control programme in the control of endemic yaws were described as having "incomplete coverage", "poor community co-operation", and were said to be less likely to be sustainable, and unable to detect and treat cases and their contacts once treatment campaigned ended.

Case study 3: Volunteer Collaborator Networks of Latin America
(Okanurak and Ruebush 1996; Ruebush *et al.* 1992; Ruebush and Godoy 1992; RuebushII *et al.* 1994)

Volunteer Collaborator Networks (VCN) were established in most countries in Latin America in the late 1950s to monitoring malaria incidence within the malaria eradication programmes initiated by the World Health Organisation (WHO). VCN workers are known as "Volunteer Collaborators" (VCs). They were selected by National Malaria Service (NMS) field workers in consultation with villagers based on criteria such as residency in the community, ability to read and write, availability most of time at home, and willingness to work without pay. VCs received on-site training on the identification, treatment and prevention of malaria. Their duties were to provide malaria treatment to patients in their village and to report malaria cases to NMS workers who came and visited them every two to three months. Health care benefits, prestige and personal satisfaction were cited as the main factors of motivation of the volunteers.

VCs numbered about 100,000 over 17 countries in Central and South America, Mexico, and the Caribbean in 1996 and were responsible for the majority of malaria cases detected and treated in their regions. In addition, the cost per patient detected and treated by VCs was substantially lower than that of cases handled by programme staff.

Case study 4: Malaria Control Programme in Tigray, Ethiopia
(Ghebreyesus *et al.* 1996; Ghebreyesus *et al.* 1999; Ghebreyesus *et al.* 2000)

A programme based on CHWs was developed in 1993 to control malaria in Tigray, Ethiopia. In the programme 681 CHWs were elected by villagers based upon pre-defined criteria including willingness to volunteer, ability to read and write, and permanent residency in the village. Most CHWs were male farmers who on average were 36 years old and had three years' schooling. CHWs received seven-day initial training at the district level. They provided services from their home or from the village health post, and served a rural population of about 2500 each. Services provided consisted of treatment for uncomplicated malaria cases, referral of severe cases to the health centre, and provision of health education to the population. They sent weekly reports on the number of patients treated to the district, which subsequently forwarded aggregated data from all villages to the regional level of the health system for analysis. CHWs received feedback information from the regional level every two months, at their monthly evaluation meetings with local health authorities.

In this programme, CHWs received no remuneration for their work but were motivated by continuous training, regular supply of anti-malaria drugs, and the use of their services by the population. Within three years the programme had achieved remarkable success: a high proportion of malaria cases in these endemic areas was being treated, and fewer than 5% of initially trained CHWs dropped out.

Case study 5: Village-based Malaria Treatment Programme, Medang, Papua New Guinea (Moir *et al.* 1985a, 1985b)

A village-based Malaria Treatment Programme started in 1982 in Medang, Papua New Guinea (PNG) by the PNG Institute of Medical Research (IMR). In the programme 74 "village aides" were elected from 35 villages and hamlets representing a population of about 52,000 during 1982-1983. The village aides were trained for

two weeks by PNG IMR staff to recognise and treat or refer cases of malaria in their village, as well as record each case treated in a village register. The PNG IMR staff supervised village aides every week initially and later on every two weeks, during which visits data on treated cases were collected.

An evaluation carried out by the PNG IMR in 1984 shown that village aides could have a substantial effect on fever cases by shortening disease duration through early administration of presumptive treatment for malaria. Village aides enrolled in this programme were all literate, and many were male, married, and aged between 20 to 40 years. Within two years, 28 (38%) initially trained village aides had dropped out, however, and another 9 (12%) were only partially active.

Case study 6: Village Volunteer Malaria Collaborator Programme in Thailand
(Okanurak and Ruebush 1996; Okanurak and Sommani 1989, 1992; Okanurak *et al.* 1991)

A "Village Volunteer Malaria Collaborator Programme" was initiated in Thailand in the early 1960s based on volunteers extending malaria control activities to communities. These volunteers, selected by either the malaria field officer or community leaders, received one to two days initial training followed by occasional refresher courses. They were supervised by malaria field officers on a weekly basis, and their tasks were to record patient information and take blood smears and provide presumptive treatment to suspected cases or high-risk people.

There were around 40,000 malaria volunteers in Thailand in the early 1990s. These volunteers received no salary but received per diems when they attended training or refresher courses as well as free medical care and a certificate of recognition. They contributed to the detection of 8.8% of all malaria cases detected in 1991 and the cost per case detected by malaria volunteers was lower than the cost of active case detection by malaria programme staff. However, within three decades one third of volunteers dropped out of the programme and half of those who remained were inactive.

Case study 7: Primary Health Care Malaria Control Project in Malaysia
(Hii *et al.* 1996; Manderson 1992a; Manderson 1992b; Riji 1993)

A Primary Health Care (PHC) Malaria Control project was developed in Malaysia as part of a project entitled "Implementation Plan on PHC with Special

Reference to Prevention and Control of Malaria". The project was first implemented in mid-1990s in some states of Malaysia including Kelatan and then expanded countrywide. The project aimed to assist the Vector Born Disease Control Programme (VBDCP) in controlling malaria in remote rural areas of the country. The project was based on PHC workers whose tasks consisted of case finding, blood smear collection, malaria treatment, referral, and health education. Overall, there were more than 2,000 PHC workers involved in the project in the late 1990s. These workers were selected by VBDCP staff or by village leaders, based upon criteria such as literacy, individual willingness to serve their community, and community acceptance. They were trained for two days and were supervised by health staff at least once a month.

PHC workers constituted a village clinic for providing timely treatment for malaria among relatively remote communities, and contributed to reducing malaria incidence in Malaysia. The main factor for their motivation was regular supervision by VBDCP staff.

Case study 8: Community-based Malaria Control Programme in the Philippines (Lariosa 1993; Manderson 1992a; Manderson 1992b)

The CBS system in the Philippines was based on two types of village health volunteers: Barangay Health Workers (BHWs) enrolled by the Government and Community Health Workers supported by Non Government Organisations (NGOs). BHWs, who formed the largest group of village health volunteers in the Philippines, were formally trained throughout the country between 1981-1985. They received initially three to five days training followed by periodic in-service training provided by Public Health Midwife and Malaria Control Service personnel. Numbering at least two per village, volunteers assisted malaria control in their village including symptomatic case finding, collection of blood smears, presumptive malaria therapy, registration of patients, referral of cases, and health education. In addition, they performed other tasks including nutrition programme activities, maternal and child health services, and environmental sanitation. They received weekly supervision and backup support from Primary Health Midwife.

In Quezon province, volunteers detected up to 24% of reported cases, collected up to 16% of all submitted blood smear slides, and treated up to 10% of cases. However, it appears that BHWs did not fully contribute to malaria control

activities in the country due to inadequate support including logistics and community support.

Case study 9: Community-based Tuberculosis Surveillance in Tamil Nadu, India (Balasubramanian *et al.* 1995)

A community-based tuberculosis surveillance system was implemented in 61 hamlets in a tribal area in Tamil Nadu, situated in South India in 1992. In the system, 61 young males and literate tribal volunteer were selected by health staff and hamlet leader and received one-day field training on tuberculosis identification and sputum collection. They recorded persons having chest symptoms (i.e. two weeks or more coughing, and/or fever of one month or more, and/or haemoptysis), collected sputum during their monthly household visits and took the samples to the health centre at their monthly meeting with programme health staff.

It was found that village volunteers were able to detect more cases of pulmonary tuberculosis than health centre staff for the same period and without any extra cost. In addition, the sensitivity and specificity of cases reported by village volunteers were remarkably high. In fact, within a one-year period (1992-1993) volunteers reported 338 symptomatic cases of which 318 were true tuberculosis cases (positive predictive value =94.1%) in the study area where there were 321 cases detected by Tuberculosis Research Centre staff (sensitivity =99.1%). In addition, the tuberculosis smear-positive rate from patients identified with respiratory symptoms by VHVs was comparable to the detection rate by skilled paramedical workers in the same area.

Case study 10: Community-based Health Development Programme in Saradidi, Kenya

(Kaseje and Sempebwa 1989; Kaseje *et al.* 1987c; Kaseje *et al.* 1987d; Spencer *et al.* 1987a; Spencer *et al.* 1987b)

A community-based health development (CBHD) programme was established In Saradidi, a rural area in western Kenya, in 1979. In the programme, 126 "village health helpers" (VHHs) were selected from 56 villages and continuously trained to serve a population of about 43,000, with each VHH serving a maximum of 100 households having on average four persons.

In the project area, VHHs collected data on births and deaths, provided malaria and first-line treatment to patients in the village, assisted in deliveries, and provided health education to the population. They spent on average five to ten days per month on programme activities, which included visiting about 15 households per month.

Within four years, only three percents of VHHs dropped out. Continuous training, willingness to serve the community, and personal development were among factors that had motivated VHHs to spending their busy time working for the community.

Case study 11: Community-based Information System in Ceara State, Brazil
(Anon 1992; O'Neil 1993)

A community-based information system was implemented in 1988 in Ceara State, Brazil, covering 177 municipalities and 4 million inhabitants. The system enrolled 7,150 community health agents (CHAs) who collected data on children including births, deaths, malnutrition, and immunisation status as well as on pregnant women, and water and sanitation during their weekly household health and nutrition education visits. CHAs were resident in the community, were selected by health staff and 95% of them women. Each CHA served about 80 and 225 households in rural and urban areas respectively.

Data collected were reported every month to the municipal supervisor. Data were consolidated by health staff at the municipal level and were mainly used to compare trends related to children's morbidity and mortality between regions. The system financed by the State Government, cost about US$4.8 million per year.

Case study 12: Community Monitoring System in Kenya
(O'Neil 1993)

A Community Monitoring System (CMS), developed by the Kenyan Government in collaboration with UNICEF as part of the Bamako Initiative, was implemented in four districts in South Nyanza, Kenya in 1991. The CMS enrolled CHWs to collect data on diseases including malaria, diarrhoea and fever as well as on vaccination coverage, nutrition, and water and sanitation during their weekly household visits. CHWs were trained and supervised by health centre staff. They

also provided treatment to patients using essential drugs supplied by the local health centre.

In the system data collected by CHWs were presented to a community health committee on a monthly basis and were aggregated and posted on a chalkboard which was displayed in the community pharmacy. These data were then compared with data from previous months by CHWs and health centre staff for appropriate remedial action.

Case study 13: "VHWs Health Information System" in Zimbabwe
(Jaravaza *et al.* 1982a; Jaravaza *et al.* 1982b; Jaravaza *et al.* 1982c)

A "VHWs Health Information System" (VHWHIS) was developed in the early 1980s by the MoH of Zimbabwe to constitute, together with the existing facility-based reporting system, the "Unified National Health Information System" of the country. The system was based on VHWs whose duties were to monthly report disease and health-related data from their village to their supervising health centre. Data to be reported by VHWs included vital events; cases of fever, diarrhoea and vomiting, cough, injuries, scabies, and measles; the number of patients referred to the health centre or hospital; number of protected wells, vented latrines, outside pot racks and refuse pits; and numbers of health education sessions and people who attended. VHWs received eight-week initial training at the regional training centre followed by another four weeks of supervised fieldwork, with financial support from UNICEF.

Overall, 7,000 VHWs were selected and trained by 1984 throughout the country. They received bicycles and essential drugs including anti-malaria drugs and antipyretics, as well as an allowance from the MoH. The system, based on multiple diseases and an integrated approach, used easy-to-fill-in tally sheets to record and report data.

Case study 14: Child Survival Project in Kean Svay District, Cambodia
(Oum 2000a)

A community-based surveillance system has been operated since 1997 in Kean Svay District, Cambodia, to monitor interventions undertaken by the Kean Svay Child Survival project (KSCSP), which include immunisation, vitamin A supplementation, birth spacing, and management of childhood illnesses. The system involved two volunteers per village to collect and report data on vital events and on major infectious diseases namely measles, Dengue Haemorrhagic Fever (DHF), and severe

diarrhoea. Overall, there were 96 Village Health Volunteers (VHVs) operating in the 46 villages and 12 communes of the District, covering a population of about 150,000 inhabitants. These VHVs were all literate, mostly female and relatively young.

In the system vital events and health interventions were recorded on village registers, which were aggregated into commune registers and sent monthly to the KSCSP office and health centre. Data on targeted diseases were written down on pieces of paper and sent to the project office within twenty-four hours of notification. Consolidated data were reported by the project team leader to the health centre and upper levels of the health system every month, and feedback given to village volunteers during a one-day monthly training at the project office. Responses to the information were immediate and comprehensive, including disease and death investigations as well as outbreak detection and control.

Village volunteers received bicycles, per diems for their monthly training, as well as occasional presents and rewards. None of them dropped out during the first four years of the system's operation. The surveillance system substantially helped the project to achieve its objectives within a short period. However, involvement of local health staff in data compilation, analysis and use was limited and the system may not be sustained once financial and technical support from the NGO ceases.

Case study 15: Community-Based Disease and Death Surveillance in Sorsogon province, Philippines
(Kalter 1999)

A Community-based Disease and Death Surveillance (CBDDS) system was developed in 1999 in Sorsogon province, Philippines, by a consultant from John Hopkin University and local health staff. The system was then implemented in two pilot municipalities of the province. It was designed to accurately monitor polio, measles and neonatal tetanus morbidity as well as neonatal, child and maternal mortality in the pilot areas.

The system involved VHWs to report data on diseases and vital events they obtained from different sources in their village to peripheral health staff known as the Rural Health Midwife. The latter investigated maternal deaths, occasionally validated reported neonatal and child deaths, and reported village-based data to the Rural Health Unit. Rural Health Unit Team, in turn, conducted outbreak investigations for measles, neonatal tetanus and polio; provided feedback to the community; and sent

reports to the Provincial Health Office. The information derived from the system was used to develop provincial plans and strategies, to educate people and to undertake remedial actions. The project was co-funded by World Vision and local government.

Case study 16: Maternal and Perinatal Surveillance in Mwanza, Tanzania
(Ahluwalia *et al.* 1999; Kilonzo *et al.* 2001)

A maternal and perinatal health care surveillance system has been implemented since March 2000 in 22 villages in Kwimba and Missungwi districts, Mwanza region in Tanzania. The system is part of the Community-based Reproductive Health Project (CBRHP) funded by the USAID and implemented by the Tanzanian MoH in collaboration with the Centre for Disease Control and Prevention (CDC) and the international NGO CARE. The system aims to (1) monitor pregnancy outcomes; and (2) enable local and district health staff to determine baseline estimates of perinatal, infant, and maternal mortality and other obstetric care indicators. In the system, two to three village health workers per village were selected and trained to record data on socio-medical and obstetric history, pregnancy outcome, and birth weight during health education visits to pregnant and post-partum women in their assigned areas. Information on maternal, foetal, and infant deaths were displayed on a "community monitoring board". Community meetings with village leaders and health staff reviewed the information generated by the system and planned for prevention and intervention.

The CBS system was found to (1) providing better estimates on perinatal mortality rates in the area than the routine health information system in place, and (2) greatly assisting programme managers to monitor trends in reproductive outcomes in order to set up appropriate remedial actions.

Case study 17: Community Epidemiology Surveillance in Bolivia
(Howard-Grabman 2000)

A community epidemiology surveillance system known as "SECI" (Sistema Epidemiologica Communitario Integral) was developed by an NGO in collaboration with health services providers and community in Bolivia. The system, funded by USAID, was piloted in 1998 in ten communities in Eucalyptus district of Oruro, Bolivia. In the system, "community health promoters' (CHPs) collected PHC data from their community and together with health staff merged these data with those

obtained from health facilities. CHPs and health staff then presented and analysed the information derived during regular monthly meetings with the community. Community representatives subsequently presented results of the community meeting to the district level for follow-up action, the progress of which was closely monitored by the communities and health staff.

The system was reported to substantially improve health services to the population in the pilot areas. A particular feature of the system was the use of combined community and health facilities' data to address community health problems through the joint participation of community members and health services providers.

Case study 18: Community-based Nutritional Surveillance in Thailand
(Valyasevi *et al.* 1995)

A community-based nutritional surveillance programme was introduced in Thailand in the early 1980s and was gradually expanded to all rural areas as part of the country's PHC and Basic Minimum Needs approaches. In the programme, existing village health volunteers were trained to monitor under-five children's growth and detect protein-energy malnutrition. Data collected were forwarded both to the sub district level of the health system for micro planning and to the central level for macro planning. At the community level, villagers and local health staff used information generated by the nutritional surveillance system to detect malnutrition, analyse causal factors and undertake remedial action.

The programme covered practically every rural village in the country although not all children were regularly monitored. The trends of malnutrition for under-five Thai children have markedly decreased since the introduction of the surveillance.

2.3 Characteristics of the CBS Systems Reviewed

The CBS systems reviewed differ from one another in terms of data collected, system operation, resources and system performance.

2.3.1 Types and uses of data collected

The types of health-related data collected, summarised in Table 1, varied according to the objectives of each CBS system. They ranged from cases and deaths

from infectious diseases and conditions; through vital events; through maternal and child health indicators; through process indicators.

Many CBS systems collected data on a single disease in order to monitor progress in its eradication or to support disease elimination and control programmes. These programmes started decades ago and were largely managed vertically from the central level by the country's national programmes with support from international organisations and donors.

On the other hand, recent CBS systems were designed to collect village-based data on multiple diseases, syndromes and conditions including births, deaths and malnutrition as well environmental health and other PHC indicators. These data were used for different purposes, ranging from addressing major local public health problems to project monitoring and evaluation, to programme planning. For instance, the CBS system in Zimbabwe was designed mainly to gather data from rural areas for country level health planning purpose, while the CBS system in Cambodia had been used for district level project monitoring and evaluation. Some other systems monitored other health-related events such as pregnancy outcomes in Tanzania and PHC data in Bolivia, with the aim of improving maternal and child health or health services provision in the project areas. These systems were in general initiated and supported by international or non-governmental organisations with a variable degree of participation by local health staff in the system design, development and use. For instance, the CBS systems in Sorsogon Province, Philippines, and in Kean Svay District, Cambodia, were developed and supported by World Vision International and the surveillance system in Bolivia was assisted by Save the Children US.

2.3.2 Operation of the CBS systems

The operation of the CBS systems selected is summarised in Table 2. All systems reviewed were implemented in rural areas and many of them in remote villages such as the surveillance systems for guinea worm in Africa, yaws in Ecuador, malaria in Latin America and Asia, and tuberculosis in tribal hamlets in India. In many of these areas infectious diseases such as malaria and Guinea worm were highly endemic and severe due to favourable climatic, environmental and social conditions, as well as the difficulty of access (poor roads and lack of transportation) to existing pubic health services.

The population in the areas where the CBS systems were implemented were generally poor, mostly illiterate and highly vulnerable to infectious diseases due to lack of adequate knowledge in disease prevention and health protection. However, people living in these circumstances were likely to have a stronger sense of community and mutual help than people living in other areas, especially urban populations.

The process of data collection varied from one CBS system to another not only in terms of types of data collected, but also in terms of frequency and method of data collection. It ranged from active case findings through home visits such as the case of pulmonary tuberculosis detection in tribal areas in India to passive, home-based data recording in the case of malaria surveillance in Thailand and Malaysia. Within active case findings, the frequencies of home visits also varied from monthly to weekly, depending on the requirement of the system but also on the commitment of data collectors.

The process by which data were transferred from the village level to the health facility level also varied from one system to another. For Guinea worm and malaria surveillance in many African countries and Latin America, for instance, personnel from either the health centre or programme collected reports from village volunteers during their weekly, monthly or quarterly supervision visits to the village; village volunteers in Ethiopia sent their weekly report to the area health centre; and village volunteers in tribal hamlets in Tamil Nadu, India, brought their report in person to the health centre during their monthly meeting with health staff.

Data were analysed at different levels of the health system. They were analysed at the central or regional levels in Zimbabwe and Ethiopia; at the health centre level in Sorsogon, Philippines; and at the community level in Tanzania and Bolivia. The feedback of information to village volunteers took place a month later or more. It was done collectively during village volunteers' meetings with health staff or individually during health staff supervision visits. In all CBS systems reviewed but one (i.e., Bolivia), village volunteers and health centre staff were not involved in either data analysis or decision-making.

2.3.3 Resources and cost of the CBS systems

Many CBS systems were funded by external agencies, some by government and the other by both donors and government. Information on the cost of the systems,

if available, could not be separated from the intervention programmes of which the systems were an integral part. For instance, the cost of the Guinea worm eradication programme in Africa ranged from $100 to $200 per village per year (Cairncross *et al.* 1996). Beside, the annual cost of the KSCSP in Cambodia and that of the Ceara project in Brazil were around US$1.20 per capita (O'Neil 1993; Lim Somaly, personal communication, 31 July 2000).

2.3.4 Village Health Volunteers

Local individuals upon whom the CBS systems depend to collect village-based data have been given different names. Some are called "Community Health Workers" while others are known as "Village Health Volunteers", "Village Health Helpers", "Village Aides", "Volunteer Collaborators", "Community Health Agents", "Barangay Health Workers" and so on. Their tasks varied greatly depending on the programme objectives which ranged from (1) collecting and reporting village level data to the nearest health facility or relevant control programme; (2) providing feedback information to the community members; (3) administering therapies; (4) referring cases to local health facilities; and (5) undertaking health prevention and promotion activities.

Those involved as village volunteers in the CBS systems varied from one project to another. Volunteers were elected by community members in some projects and were selected by either health staff or village leaders or both in the others. In most circumstances, the selection of village volunteers was based upon certain pre-defined criteria including residency, literacy and willingness to serve the community without pay. The age, sex and occupation distribution as well as education background of village volunteers also varied from one project to another.

The training of village volunteers varied in terms of length, content and organisation. While the training of many volunteers took only few days, that of others lasted for several weeks or months. In addition, some volunteers received only one-time training while others received continuous training. Finally some training was organised on site while other training was conducted at health facilities or regional training centres.

Most of the volunteers worked on a voluntary based, with some receiving small incentives in kind or cash from the communities, the government or donors. Continuous training, adequate supervision, health care benefits, status within the

community, the active use of services by the communities and linkages with existing administrative structures were reported to boost village volunteers' motivation and performance and sustain their activities.

The attrition rates of village volunteers varied amongst projects reviewed. In some projects, few village volunteers dropped out whereas in others up to 50% of them quit or became inactive after a year or two, mainly because of lack of interest in the work, excessive work, and/or insufficient financial support.

2.3.5 Performance of the CBS systems

Many CBS systems were found to be successful in monitoring trends of targeted diseases or conditions, in providing good estimates of morbidity and mortality rates related to the events under surveillance, and in facilitating the evaluation of the impact of the control or eradication programme involved. For instance, Guinea worm surveillance was able to detect almost all endemic villages and most individual cases in many countries in Africa (Cairncross *et al.* 1996), allowing appropriate interventions that resulted in dramatic decreases in the disease during the past decade. Yaws surveillance had helped to reduce substantially the disease prevalence in endemic communities in Ecuador and to effectively prevent the disease from spreading to other areas. However, in Kenya an evaluation did not find evidence of any impact of the Community-based Health Development Programme on either overall mortality or malaria-specific mortality rates in the areas where this programme was implemented (Spencer *et al.* 1987b).

Completeness and validity of recorded data was a problem for some systems. For example, in Nigeria "fake" reports were discovered, revealing that only two-third of villages had regularly sent authentic Guinea worm surveillance reports to the MoH (Brieger *et al.* 1996).

Lag time between steps in the CBS systems varied. The frequency of data reporting ranged from one week to two to three months, and information feedback to communities took one to two months or longer. In Cambodia, the timeliness of measles surveillance in Kean Svay District during 1997 to 2000 was quite good, with delays from rash onset to reporting to investigation taking on average five days and one day respectively (Oum 2000a).

The extent to which the CBS system was able to detect outbreaks and to report diseases and health-related events in the communities was documented in some

projects. In Cambodia, the CBS system in Kean Svay district was able to detect all measles outbreaks in a timely fashion, and to report almost deaths in the district (Oum 2000a). In India, village volunteers detected pulmonary tuberculosis patients in the tribal area in Tamil Nadu more effectively than did the health centre, and the sensitivity and specificity of case reporting were remarkably high (Balasubramanian *et al.* 1995). In Latin America, village volunteers detected and treated the majority of malaria cases in the region (Ruebush *et al.* 1992).

Table 1 Operation of CBS systems

Project (Location)	**Data collection and reporting (Frequency)**	**Data analysis/ decision-makin (Feedback mechanism)**
1. Guinea worm eradication (Several African countries)	Household visits (monthly); data kept in village register; report sent to health centre (monthly)	Programme staff
2. Yaws control (Ecuador)	Active case finding and treatment	Programme staff: for disease eradication
3. Malaria control (Latin America)	Passive data collection from home services; report collected by programme staff (every 2-3 months)	Programme and district staff
4. Malaria control (Ethiopia)	Passive data collection; report sent to district level then to regional level (weekly)	Regional level staff (feedback every 2 months); Health centre staff (monthly meeting)
5. Malaria control (PNG)	Passive data collection; Report collected by programme staff (fortnightly)	Programme staff
6-8 Malaria control (Thailand, Malaysia & Philippines)	Passive data collection; report collected by programme staff (weekly to monthly)	National malaria control programme staff
9.Tuberculosis control (India)	Household visits (monthly); data kept in census book; Data submitted to health centre (monthly)	Health centre staff (Monthly meeting at health centre)

10.CBHD programme (Kenya)	Households visits (monthly) and home services; report submitted to health centre (monthly meeting)	Programme staff (Monthly meeting at programme centre)
11. CHWs' Information system (Ceara Brazil)	Household visits (weekly); data reported to municipal supervisor (monthly)	Municipal level staff
12. CMS (Kenya)	Household visits (weekly); data reported to Community Health Committee (monthly)	HC staff and volunteers (monthly feedback via chalkboard displayed in the community Pharmacy)
13.VHW HIS (Zimbabwe)	Households visits and home services; report sent to health centre (monthly) then to district, provincial and central levels.	Central level staff (Feedback from central level through health centre)
14. KSCSP (Cambodia)	Active search through household visits (village registers); report sent to (NGO) Project staff (monthly; immediate for diseases)	Project staff (Monthly feedback meetings at Project office)
15. CBDD Surveillance, (Philippines)	Data collected from key informants; data reported to Rural Health Midwife then to Rural Health Unit.	Rural Health Unit staff (Feedback to the community)
16. Maternal & Perinatal Surveillance (Tanzania)	Active search during health education visits to pregnant & post-partum women; data displayed on Community Monitoring Board	Village leaders and health staff (Feedback via Community Monitoring Board)
17. SECI (Bolivia)	Active search; data submitted to health centre and merged with health facilities data for analysis and presentation (monthly)	Health staff, volunteers and community members (Community monthly meetings)
18. Nutritional surveillance (Thailand)	Periodic growth monitoring in the village; report collected by health staff and then forwarded to upper levels	Sub-district staff (micro-planning) and central level staff (macro-planning)

Table 2 Characteristics of VHVs in CBS systems

Project (location)	**Profile & selection**	**Training (place) & supervision (frequency)**	**Incentive/ motivation**
1. Guinea worm eradication (African countries)	2 volunteers per village (Cameroon); selected by health staff and communities	6 days initial training and 2 days refresher course (Cameroon: 2 weeks on PHC plus 1 day on surveillance); supervised by health team (weekly)	Honorarium; Material rewards, presents, training, supervision, meeting and travel costs
2. Yaws (Ecuador)	Existing volunteers	Trained and supervised by health staff	(not available)
3. Malaria control (Latin America)	Selected by Programme staff; (Guatemala: 61% male)	2 days (on-site) training; one-to-one supervision by programme staff (every 2-3 months)	Health care benefits, prestige, job satisfaction
4. Malaria control (Ethiopia)	1volunteer per 2500 population, thirties, mostly men, 3 schooling years; farmers; elected by communities	7 days training (district); supervised by programme staff (monthly visits)	Continuous training, regular drug supplies, population use of services
5. Malaria control (PNG)	2 volunteers per village; literate, male, 20-40 years; selected by communities	2 weeks training; supervised by programme staff (every 1-2 weeks)	Token gift
6-8. Malaria control (Philippines Thailand & Malaysia)	2 volunteers per village; Selected by programme staff and community leaders	1-2 days to 3-5 days (Philippines) initial training plus refresher courses; Supervised by programme staff (weekly)	Free medical care; recognition; per diem for training
9.Tuberculosis control (India)	1 volunteer per hamlet; young tribal men, literate; selected by health staff and hamlet head	1 day (o0n-site) training; supervised by programme staff	Voluntarism

10.CBHD Programme (Kenya)	2 volunteers per village; married women, farmers, 25 - 40 years old; literate; elected	2-week initial training plus one-day monthly training; relied for assistance mostly on health staff	Voluntarism; continued training, occasional allowances.
11. CHWIS (Brazil)	1 volunteer per 80-225 households, women; selected by health staff	2-month initial training; supervised by health centre nurses (monthly)	State government salary
12. CMS (Kenya)	Selected by community	3-month training; supervised by health staff and village health committee (monthly)	Voluntarism
13.VHW HIS (Zimbabwe)	7000 volunteers in 1984; literate; selected by community	8-week initial training, plus 4-week field work; supervised by health staff	Allowance (MoH), bicycle, basic drugs
14.KSCSP (Cambodia)	2 volunteers per village, mostly women, 20 - 40 years, literate; selected by NGO staff	1-day training initially plus monthly refresher course; supervised by NGO staff	Per diem for monthly meetings, bicycle, material rewards.
15.CBDDS (Philippines)	1 volunteer per village, women	Rural health midwife	Incentive from NGO (World Vision)
16. Maternal & Perinatal Surveillance (Tanzania)	2-3 volunteers per village, women; Selected by village leaders and Project staff	Trained & supervised by Project staff	Incentive from local government funds
17. SECI (Bolivia)	"Community Health Promoters"	Trained and supervised by project staff	(Not available)
18. Nutritional surveillance (Thailand)	1 volunteer per village, both sex, literate (existing VHVs)	10-day training; supervised by health centre staff	Remuneration from resale of drugs

Table 3 Coverage, funding, and cost of CBS systems

Project (Location)	Population covered	Funding sources (Costs)
1. Guinea worm (African countries)	Most countries in Africa	GWEP & International donors ($100-200/village/year)
2. Yaws control (Ecuador)	20 communities in a province	Programme
3. Malaria control (Latin America)	All endemic areas (1:580 residents in Guatemala)	Government ($1.85-2.45 per patient detected & treated)
4. Malaria control (Ethiopia)	Rural population of 1,682 319 inhabitants	Government
5-8. Malaria control (PNG, Philippines, Thailand, & Malaysia)	Rural endemic areas	Government (Thailand: US$3.34 per case detected)
9.Tuberculosis control (India)	61 hamlets (96,000 inhabitants)	"No additional costs"
10. CBHD Programme (Kenya)	56 villages (43,000 inhabitants)	Community and MoH/African Medical Research Foundation
11. CHWIS (Brazil)	177 municipalities (4 million inhabitants)	Government (Ceara Sate)
12. CMS (Kenya)	85 pharmacies each serving about 4,000 people	Government/ UNICEF
13. VHW HIS (Zimbabwe)	Rural areas	Government & UNICEF (training)
14.KSCSP (Cambodia)	46 villages (150,000 people)	NGO (WV-C)/USAID (120,000/ year)
15. CBDD Surveillance, (Philippines)	1 province	NGO & Local government
16. Maternal & Perinatal Surveillance (Tanzania)	2 districts (22 villages): 150,000 women	USAID & local government
17. SECI (Bolivia)	1 district (10 villages)	USAID
18. Nutritional surveillance (Thailand)	All rural areas	Government

Table 4 Performance of CBS systems

Project (location)	Usefulness	System attributes	Constraints/Issues
1. Guinea worm eradication (African countries)	Dramatic decrease of cases	-Detected almost endemic villages & most cases	-Only 66% villages sent reports regularly in Nigeria
2. Yaws control (Ecuador)	Reduced endemic villages by 75%, 95% individuals with dermal lesions, and 97% latent infections	Very cost-effective in detection and treatment of new cases after mass treatment	(Not available)
3. Malaria control (Latin America)	Reduction of malaria prevalence	-Detected & treated majority of malaria cases in the region	Male and married volunteers had lower turnover rates than female and unmarried volunteers
4. Malaria control (Ethiopia)	Malaria treatment and control in remote area	-High proportion of population treated	-5% Drop-out in 3 years; -Under-utilised by women and children under 5
5-8. Malaria control (PNG, Philippines, Thailand, & Malaysia)	Reduction of malaria incidence	-Detected 24% cases in a province in Philippines and 9% cases in 1991 in Thailand	Many Volunteers dropped out or became inactive; Too much work (Philippines)
9.Tuberculosis control (India)	Detected more pulmonary tuberculosis cases than health centre	-High sensitivity (99%) & Positive Predictive Value (94%) of cases reported	-Initial reluctance of health centre staff to accept lay people in sputum collection & drug delivery -Many volunteers did not collect 2nd sputum
10. CBHD Programme (Kenya)	Information on vital events and malaria	No evidence of impact on mortality rates	Irregular reporting due to unclear understanding of the meaning of report

11. CHWIS (Ceara, Brazil)	Maternal and child health indicators for municipal level	More adequate data coverage than routine health information system	About 30% of municipalities did not report on time
12. CMS (Kenya)	Increase population's awareness of health problems	More complete data coverage than routine health information system	Only cases treated by CHWs were aggregated on the chalkboard
13. VHWHIS (Zimbabwe)	Data for Planning at central level	Simplicity of recording & reporting forms	Volunteers dropouts due to low pay; Irregular reports sent to health sector
14.KSCSP (Cambodia)	Increase children immunisation and Vitamin A coverage	All under-5 child and maternal deaths & outbreaks investigated promptly	No involvement of VHVs and local health staff in data analysis and decision-making (NGO project run)
15. CBDDS (Philippines)	Comprehensive detection of cases and deaths	Community feedback by Rural Health Unit	No involvement of Volunteers in data analysis & decision making
16. Maternal & Perinatal Surveillance (Tanzania)	Monitoring trends of reproductive outcomes and prioritisation of corrective actions	More accurate assessment of perinatal mortality rates than health facility-based system	Sustainability of the system depending on community support to Volunteers (incentive, supervision)
17. SECI (Bolivia)	Improvement of health services and household behaviours	Participatory analysis of PHC data by community and health staff	(Not available)
18. Nutritional surveillance (Thailand)	Reduction of under-5 child malnutrition	Data coverage and quality likely to be inadequate	About 1/3 children not regularly monitored; Many Volunteers inactive

2.4 Lessons learnt

Routine disease surveillance systems could provide neither a complete nor representative picture of health problems in the communities because patients could not get access to public health facilities or choose not to use them were not reported by these systems. On the other hand, community-based surveillance systems that are based upon a network of lay people involved in the systematic detection and report of health-related events from their community have shown to bring much needed information missed by health facility-based surveillance systems in developing countries. This information has helped programme managers to effectively monitor trends of diseases and conditions as well as to detecting outbreaks of infectious diseases in a timely fashion. It has improved progress monitoring in the eradication and control of major endemic diseases such as guinea worm, yaws, malaria, tuberculosis and resulting in programme managers better able to prioritise resources and direct interventions in the most efficient way to combat these major public health problems. Intervention programmes associated with CBS systems have subsequently been found to be substantially more effective in reducing disease burden, and hence decreasing mortality and improving the population's health.

Community-based surveillance is more cost-effective than periodic surveys or active case findings undertaken by health staff. In addition, it can bring improved equity in service availability to remote rural areas and to the most deprived and vulnerable populations (Taylor 1992). It also has the potential to empower the rural population vis-à-vis addressing their own health problems and improving the health status of their communities. Rifkin (1996) emphasized that community participation can lead both to "improved health status" and "empowering community people".

Lay people who collect and report data from within their communities have been given many different titles but for the purpose of this study are called **Village Health Volunteers** (VHVs) due to their voluntary work and the fact that the community where they live is generally a village. VHVs play a tremendous role in CBS systems by providing information from the community to the health facility as well as by acting as a 'change' or 'development' agent in the community (Walt 1988). Appropriate selection, training and supervision of VHVs are key to the success of the CBSS system. First, experience has shown that VHVs who *live in the community* and are selected by community members perform far better that those living outside the

community. This is because they usually know quite well all the people in their area and are likely to be aware of any major health events in their village more quickly and comprehensively and quickly than are outsiders. In Africa, for example, "villagers are usually aware of all cases of Guinea worm disease occurring within a radius of about two kilometres of their home (Cairncross *et al.* 1996). In addition, VHVs *resident* in the community where they serve have an "inherent desire to render assistance" because often the majority of the people in their community are their relatives (Lariosa 1993) and are therefore more likely to devote more time and energy in rendering services to their fellow villagers on a voluntary basis than "outsiders". Beside, the selection of volunteers by community members, which was reported as another key factor in the success of many CBS projects reviewed, reassures volunteers of their community acceptance and provided them prestige and motivation to better perform their tasks.

Second, some *occupations* appear to perform better than others in data collection and community development. Okanuark and Ruebush (1996) who reported on community-based malaria control programmes in Thailand and Latin America underlined the "economic benefits" to a volunteer who participated in the programme by observing that VHVs who were also traditional healers and small shop owners appear "to serve the programme longer and care for more patients" because their "malaria volunteer activities help them to attract patients/customers". However, in XX conflict of interest

Third, both *male and female VHVs* performed quite well in the CBS system reviewed. For instance female VHVs in the Kean Svay district, Cambodia contributed significantly to enhancing EPI and tetanus immunization coverage as well as childhood diseases and outbreak detection in the project district (Oum 2000a). Similarly, male VHVs in Latin America, Ethiopia, and India were reported to be very active in data collection, to contribute substantially in disease control and prevention and to have low turnover rates. Nevertheless female VHVs are likely to detect more cases of childhood illnesses and infant deaths than their male colleagues as they spend more time in the village and have more contact with mothers.

Fourth, adequate initial training reinforced by regular *refresher training* had greater impact than a one-time training in building VHVs' capacity because continuous training reinforces previous training, improves retention of information, and updates knowledge of participants. In addition, refresher training is an important

source of motivation to sustain volunteers' work. Experience from many CBSS including the system in Saradidi, Kenya suggests that " brief initial training can be very effective as long as refresher courses are regular and supervision is continuous and appropriate" (Kaseje *et al.* 1987d) and that "training was a form of payment as was prestige" (Kaseje *et al.* 1987a).

Fifth, regular *supportive supervision* by health staff also had a great impact on the performance of VHVs as well as on their motivation because VHVs who receive adequate backup support tend to be more active and less likely to drop out.

Some **issues** arose, nevertheless, from the implementation of CBS systems in the past two decades. First, *vertically run programmes* and projects developed and implemented by national, international or non-governmental organisations are often not sustainable once external support ceases, because of lack of ownership and active participation of the part of local health staff and communities.

Second, programmes or projects focusing on a *single disease* do not use rationally scarce resources available at the peripheral level and may not able to sustain the interest of people who collect the data because the targeted disease may not prevalent year round. For instance, the use of VHVs to tackle only malaria in Saradidi, Kenya, appears to have little impact on the total mortality rate in an area where measles accounted for 36% and 41 % of infant and under-5 mortality respectively. (Spencer *et al.* 1987b) Single disease control activities should be integrated with other community participation disease control programmes, in order to rationally use resources (Manderson 1992a)and to make "health worker's monthly visits more interesting, more positive, and less morbidly focused on a single disease which, even in highly endemic villages, is almost absent for much of the year" (Cairncross *et al.* 1996).

Third, the ways by which each CBS system *operates* have tremendous effects on its efficiency. Irregular or infrequent feedback; delays in data analysis; and passive participation of local health staff and the communities in health-related events monitoring, decision-making and action-taking have all been found to hamper the systems' data quality as well as the commitment of their key stakeholders. If VHVs do not clearly understand the use of data on which they are supposed to report they often fail to detect events of interest in their communities, or fail to report on them regularly or reliability.

Fourth, how appropriate health authorities *respond* to the information generated by the CBS systems was very critical to the sustainability of the CBS system. Any CBS system that did not lead to concrete actions and to positive impact on the health of the communities involved would soon lose VHVs' motivation and active participation.

Finally, a key to the *sustainability* of any CBS system is to maintain active participation of VHVs. However, the question of how to sustain long-lasting active participation of Volunteers in a CBS system without providing any payment or reward has not yet received a satisfactory answer.

3 DEVELOPMENT OF A CBS SYSTEM IN RURAL CAMBODIA

3.1 Country profile

3.1.1 Geo-demography

Cambodia is a country of 181,035 square kilometres situated on the South-western Indo-Chinese Peninsula in Southeast Asia. It is bordered by the Lao People's Democratic Republic, Thailand and Vietnam (Figure 1). The country comprises 24 provinces and municipalities, 183 districts, 1609 communes, and 13,406 villages. A census in 1998 revealed a population size of 11.4 million inhabitants, an estimated annual growth rate of 2.4%, and the proportion of female population and children less than 15 years to be 51.8% and 42.8% respectively (NIS 1999). About three quarters of the population of Cambodia lives in rural areas and women head 25% of households. The majority of the population (90%) is ethnic Khmer and Buddhist.

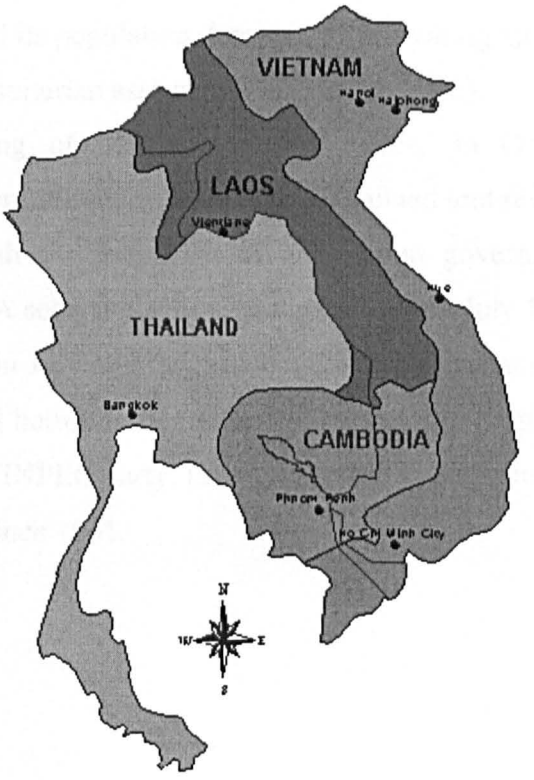


Figure 1 Location of Cambodia within the South East Asia region

3.1.2 Political situation

Following its independence from France in 1954 to 1969 the Kingdom of Cambodia experienced a period of peace, development, and prosperity. Since 1969, the country and its people have been subjected to particularly dramatic changes. In 1970, an American-backed coup d'etat deposed the Head of State, Prince Norodom Sihanouk, and a republican regime was established (Lanjouw *et al.* 1999). The latter involved the country in a bloody civil war, and Cambodia was drawn into the Vietnam War. "More than 700,000 Cambodians were killed and millions of peasants were displaced" during the first half of 1970s (Curtis 1998).

In 1975 the Chinese-backed Khmer Rouge overthrew the republican government and established a totalitarian communist regime. The population was forced into the countryside and the country was isolated from the outside world. By end of 1978 over a million Cambodians "had died as the result of forced labour, starvation, lack of medical care, and wholesale execution" and "much of the country's physical infrastructure was dismantled or destroyed" (Curtis 1998).

In 1979 the Khmer Rouge were defeated and a Vietnamese-backed government was installed (Lanjouw *et al.* 1999). During the subsequent decade, Cambodia was again politically and economically isolated from the outside non-socialist world and its population deprived of everything apart from a small amount of international humanitarian assistance (Mysliwiec 1988).

The signing of the Paris Peace Accord in October 1991 allowed the repatriation of over 300,000 refugees from Thailand and resulted in national elections in May 1993 with the formation of a coalition government in September 1993 (Chandler 2000). A second election was conducted in July 1998 following civil unrest which took place in July 1997. A new coalition government was subsequently formed in December 1998 between the two major parties, the Cambodian People's Party and the royalist FUNCINPEC party. In February 2002 commune-level elections were held for the first time since 1941.

3.1.3 Socio-economic situation

Cambodia is among the poorest countries in Asia. Agriculture, mainly wet season rice cultivation, is the main economic activity. Per capita Gross Domestic Product remains very low at US$139 and approximately 36% of the population live below the poverty line (UNDP 1998). Vulnerable groups abound, such as the high proportion of female-headed households and people with amputations (one in every 25 persons-the highest in the world). The national literacy rate among the population aged seven years and above was 62.8% in the 1998 census, ranging from 60.3% in rural areas to 75.5% in urban areas (NIS 1999). An inadequate transportation system has been a main constraint in the growth and development of the country with the remote provinces being the most deprived.

3.2 Health sector

The health sector in Cambodia has been particularly impacted by the dramatic socio-economic and political events experienced by Cambodians over the past three decades and is summarised in figure 2 below.

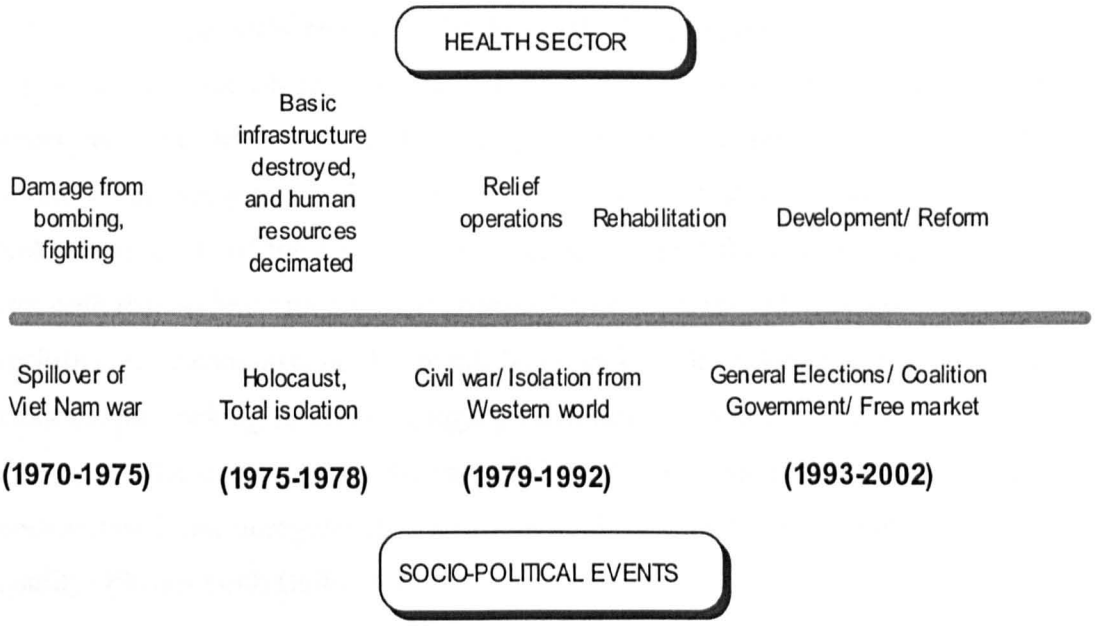


Figure 2 Health and socio-political events during the last 3 decades in Cambodia (Adopted from Oum 2000b)

3.2.1 Historic

The health care system was largely destroyed during the 1970s by the ravages of war and then by the Khmer Rouge regime. The country's health infrastructure was virtually decimated; in the early 1990s "only 20% of health facilities were in reasonable condition, and the MoH headquarters level was ill equipped and lacked staff with appropriate training" (Walford *et al.* 1999). Furthermore, the Cambodian health workforce had been badly destroyed during the "killing fields", with fewer than 10% of its estimated 600 medical doctors in 1975 remaining alive in 1979. The acute personnel shortage led to accelerated trainings during the 1980s, "mainly focussing on curative care" (WHO 2002), which in turn led to a current workforce of young health care providers and health services managers of questionable quality.

"Public health services are weak, under-funded, or non-existent in large tracts of the country" (Lee *et al.* 1994). The government budget devoted to health remains at only $1 per capita per year and health managers have been unable to access the full budget approved by the Government and national parliament. This problem has occurred particularly at provincial level, where the annual budget implementation in most places is only about 30 -50 per cent. In addition, government salaries are inadequate; ranging from US$10 to US$15 per month they are clearly incompatible with a civil servant's minimum basic needs for providing adequately for his/her family, an amount which is at least ten times higher (Oum 2000b). This has led to a generally low level of staff motivation which is reflected by considerable absenteeism, irregular work times and low quality of services on the part of many staff at all levels of the health system and throughout the country, and people often pay both formal fees and informal charges for services provided by government health facilities. Consequently, public health facilities have been largely under-utilised with most people seeking services through private health providers, which have flourished throughout the country since the early 1990s. Private sector services are in the main unsupervised and unregulated, with some of them very lucrative and of questionable quality (Phnom Penh Daily 2000).

3.2.2 Health problems

Cambodia's health profile is amongst the worst in the world. The infant mortality rate and under-five child mortality rate were estimated at 89 and 115 per 1000 live births respectively in 1998 (NIPH 1999), far higher than the average corresponding mortality rates in the Western Pacific Region, which were only 38 and 50 per 1 000 live births respectively in the same period (WHO 2002).

The leading causes of morbidity and mortality in Cambodia are infectious and epidemic-prone diseases. Malaria is endemic and severe in many rural areas, especially along the Cambodian borders with Thailand and Laos due to the population movements from and to these areas (Singhasivanon 1999). *Plasmodium falciparum* is the main cause of severe malaria in Cambodia and is resistant to many anti-malarial drugs presently available (Denis and Meek 1992). DHF, on the other hand, is epidemic every two to three years in many urban areas and claims the lives of hundreds of young children during epidemic years. Acute respiratory infections along with acute diarrhoea are the leading causes of morbidity and mortality among children. Tuberculosis is also a major public health problem due to its prevalence and multi-drug resistance. Outbreaks of cholera and measles had been noted from time to time, and neonatal tetanus remains a problem in rural areas. HIV infection, first detected in 1991, has become a high priority public health problem in Cambodia, with an estimated 180,000 cases of HIV/AIDS in 1999 (Phalla, *et al.* 1998; Solomon and Isham 2000). Furthermore, malnutrition is widespread, with more than half of children under-five moderately or severely stunted (UNDP 1998). Most infectious diseases are highly prevalent, severe, and often epidemic in remote and rural areas where access is difficult, the population are poor and health care services are limited.

3.2.3 Current health system

Since the mid-1990s the MoH has undertaken overall health sector reform, with the aim of rehabilitating and improving the efficiency of the health sector through structural and organizational reform of the health care system, financial reform and human resource development (MoH 1997). Organisational reform, which focuses on delivering essential health services to rural areas where the majority of the population lives, has led to the establishment of "operational (health) districts" (ODs) comprising a referral hospital (RH) and a network of around ten health centres. Each health centre serves a catchment area of approximately 10,000 inhabitants living in

two to three communes of about five to ten villages each. The provincial Health Department (PHD) constitutes the intermediate level of the health system between the MoH and the OD level.

Health centres are staffed with five to seven people and provide a basic integrated package of health care services referred to as the Minimum Package of Activities. These services comprise basic preventive, promotive and curative care including prenatal care, immunisation, birth spacing, prevention of micronutrient malnutrition, and treatment of acute respiratory infections and diarrhoea. The RH, for its part, receives cases referred from the health centres and manages complicated cases, operations, serious illnesses requiring admission, inpatients, etc. These services are referred to as the Complimentary Package of Activities (MoH 1997).

Health financing reform has focused on specific issues such as improving budgets and the introduction of different models of health financing schemes. Since 1999 a public-private partnership has been tested through a number of initiatives including the contracting of NGOs to manage some ODs ("contracting in"), or to provide health services in some districts ("contracting out"). In the latter scheme health services are entirely run by NGOs with full funding support from the MoH through Asian Development Bank and World Bank loans. This scheme provides health care services free to the population and provides health personnel with a minimum basic needs salary. "Contracting in", on the other hand, involves outside management contractors hired to work with existing local health staff with the provision of supplementary operational costs but without salary supplements for the health staff. A "cost-recovery" scheme is also piloted in some urban health facilities where patients are charged to cover most of the running costs of the facilities as well as to supplement health staff salaries. Finally, rural health facilities not covered by the "contracting in or out" schemes in general charge a small fee to the population using their services.

3.3 Disease surveillance system

The control and prevention of major infectious diseases in Cambodia are implemented through different programmes managed by different national centres and co-ordinated by the MoH. For instance, the control of diarrhoeal diseases including cholera is the responsibility of the National Maternal and Child Health Centre, which

equally manages acute respiratory infection (ARI) control, Expanded Programme of Immunisation (EPI) including polio eradication and measles and neonatal tetanus elimination. On the other hand, the control of malaria and DHF are under the National Centre for Malaria Control; whereas the control of sexually transmitted diseases (STD) including HIV/AIDS are under the National Centre for HIV/AIDS and STD Control; and the control of tuberculosis is under the responsibility of the National Centre for Tuberculosis Control. These centres receive financial and technical support from donors, and multilateral agencies and other organisations to run their specific programmes vertically from the central to peripheral levels of the health system throughout the country. They developed and until recently used their own surveillance systems to monitor the progress of their programmes.

In the early 1990s, a national Health Information System (HIS) was developed by the MoH aiming first to integrate reporting systems in use by different national centres, thus preventing duplication and reducing staff workload; and second to standardise the information and case definitions (MoH 1995).

The HIS has three components: the "Routine Reporting System", the "Alert System", and the "Inventory of Health Facilities". The HIS was first implemented in 1994, then was adjusted to the Health Coverage Plan within the Health Sector Reform process in 1997, and finally was revised again in early 2000. In the current HIS, data are collected at health centre and hospital levels using specific reporting forms for health centres (HC1 form) and for hospitals (H02 form). These data are aggregated by OD (DO3 form) and forwarded to the PHD where data from all the ODs are then collated (PO4 form) and forwarded to the MoH (Figure 3). The frequency of reporting is quarterly for the Inventory Report, monthly for the Routine Report and weekly for the Alert Report. The information produced through the Routine and Inventory Reports is mainly used for management and planning purpose and is the responsibility of the Department of Planning and HIS, whereas the information drawn from the Alert System is used for disease surveillance and control and is managed by the Communicable Disease Control Department.

The national disease surveillance system or Alert System is a weekly reporting of priority epidemic-prone diseases, including cholera, DHF, and measles. The system draws its information from all levels of public health facilities. Data generated through the Alert Report is often delayed and incomplete, partly due to late, irregular and/or incomplete reporting from the peripheral health facilities. As a result,

outbreaks of infectious diseases that occurred in remote provinces were often detected late and therefore less effectively controlled.

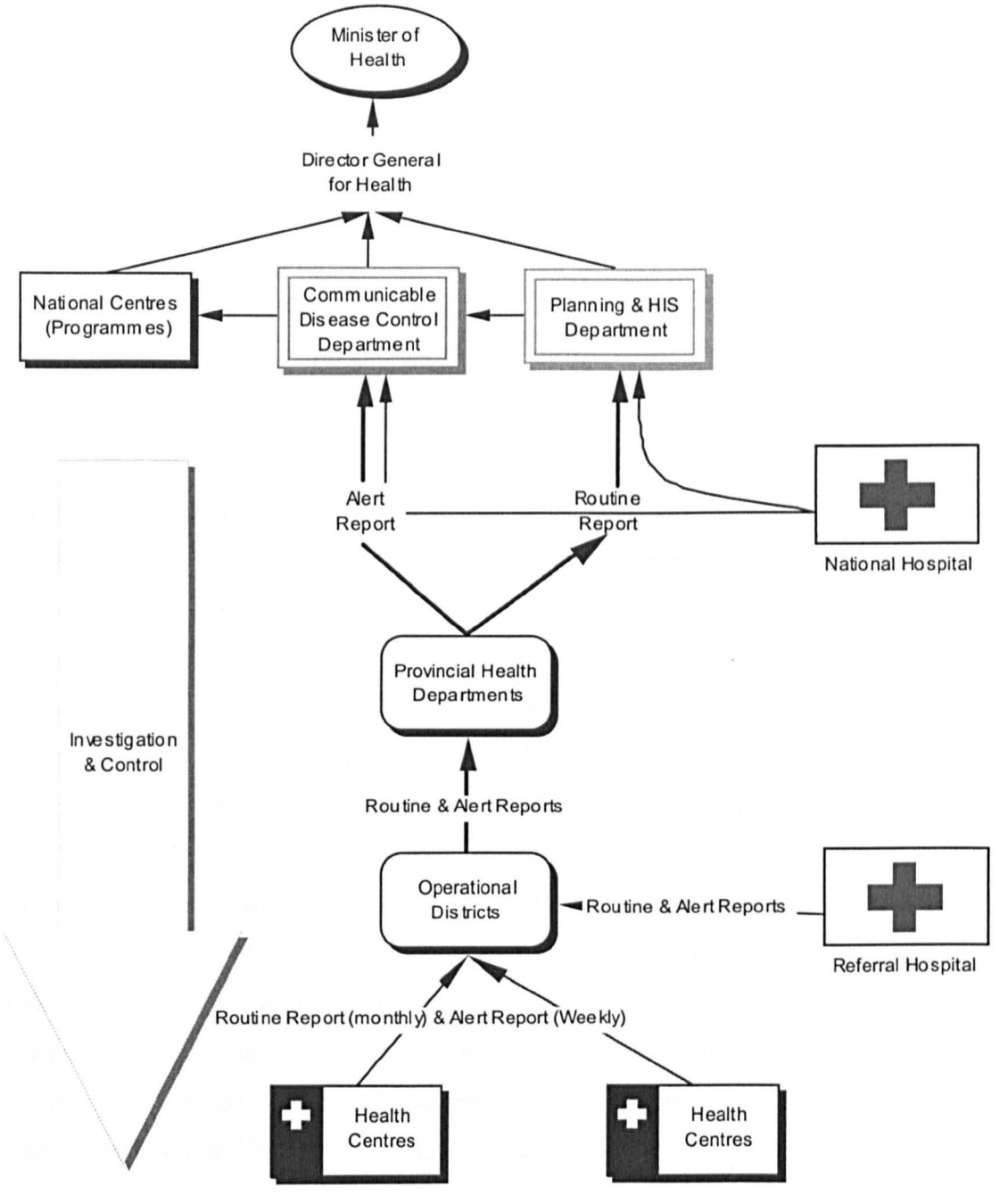


Figure 3 Flow chart of health information and disease surveillance systems in Cambodia, 2000-2002

In 1999, a cholera outbreak occurred in a northern province bordering Lao PDR. The province has around 50,000 inhabitants, mostly composed of ethnic minorities. The Communicable Disease Control Department was not informed about the epidemic until 5 weeks after its onset, when the disease had already spread to many communes and districts. The information did not reach the MoH through its Alert System, but rather through a phone call from "Health Unlimited", a NGO working in the province. Several national teams were successively sent to assist the province in the control of the outbreak. This outbreak ended with over 3000 cases and 138 deaths. No proper investigation was done to identify the sources and causes of the outbreak, which remain until now unknown. (Oum 2000b)

Deficiencies in disease surveillance are related to the system itself, which is passive in nature and health facility-based. A recent survey found that only about one-third of all patients used health facilities and therefore were reported by the system, which therefore missed the other two-third of patients who use traditional/ home remedies, buy medicines, or use private care providers services (NIPH 1999) (Figure 4). Another problem for disease surveillance comes from difficult accessibility of remote areas, due to bad roads and lack of means of rapid communication, which puts rural areas on their own when dealing with outbreaks. In addition, health staff's competence in disease surveillance and control is generally weak. Local health staff generally do not make use of data gathered by the HIS and Alert systems, except to send them to the upper level of the health system (Chivun 1996). This lack of skills together with the lack of operating resources have led peripheral health authorities to rely almost entirely on national programmes, and NGOs, if any, in the control and prevention of diseases and outbreaks. This in turn leads to late and ineffective outbreak response, as well as to weak disease control and prevention.

An "Early Warning Outbreak and Response System" (EWORS) has been piloted in two hospitals in Phnom Penh and one provincial hospital, by the National Institute of Public Health (NIPH) in collaboration with the United States Naval Medical Research Unit- 2 (NAMRU-2). In the EWORS, syndromic data from patients seeking treatment at these hospitals are entered into a microcomputer, and emailed to the NIPH within twenty-four hours. The system is programmed to allow real time

data analysis at the hospital and NIPH and therefore enables a rapid detection of outbreaks. The system depends however on hospital-based data and therefore would not be able to detect an outbreak in a remote area where access to the provincial or national hospital is impossible for the majority of patients due to distance, poor road and lack of means of transportation.

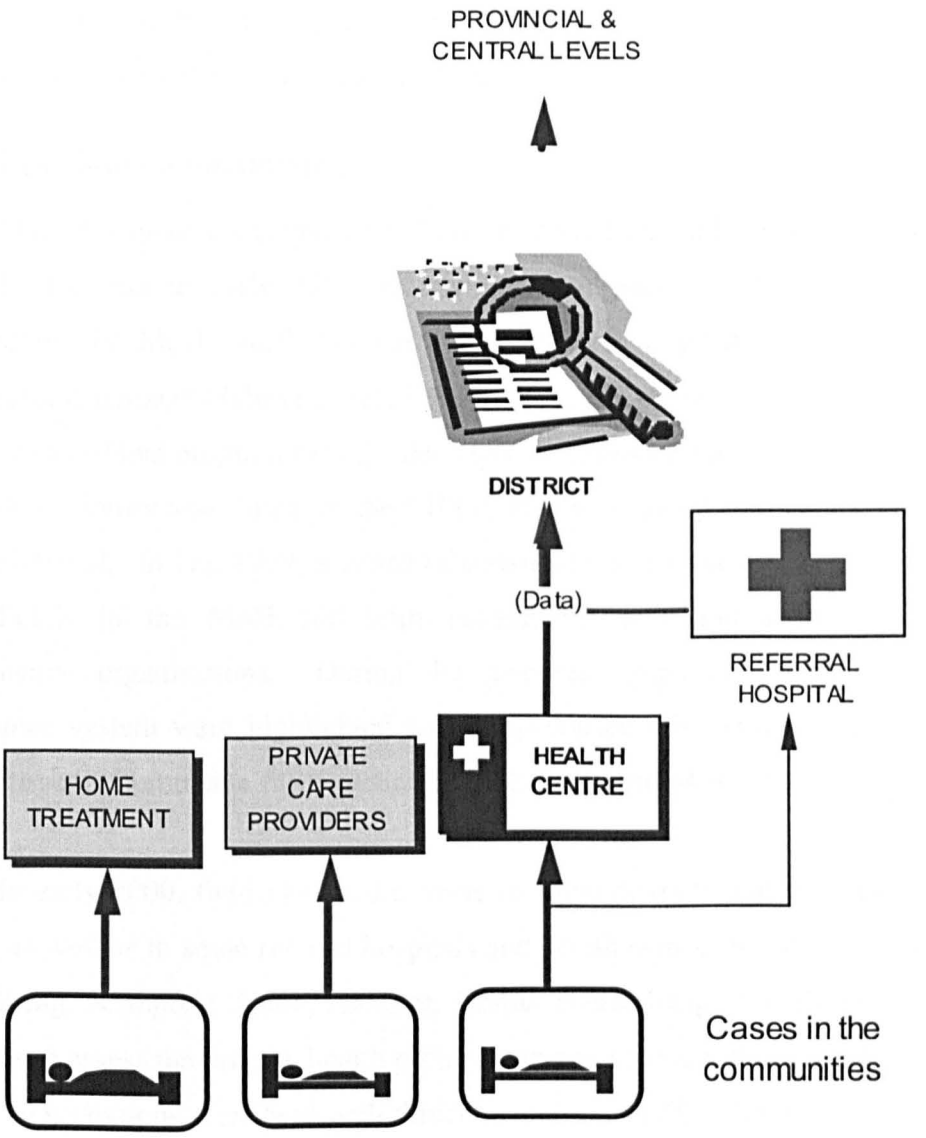


Figure 4 Under reporting of health facility-based disease surveillance system

3.4 Steps in the development of the Cambodia Rural CBS system

The Cambodia Rural CBSS intended (1) to detect early clustering of cases of major infectious diseases in the implementation communes in order to ensure effective control of outbreaks; and (2) to monitor vital events and priority infectious diseases in these communes in order to effectively control, reduce, and prevent the occurrence of these diseases. Its development followed different steps including assessing its feasibility, selecting events to be reported, defining flow of information, developing reporting forms, and providing material and financial support.

3.4.1 Feasibility assessment

The CBS system was drafted in London at the London School of Hygiene and Tropical Medicine in early 1999, refined in Cambodia in early 2000, and was approved by the MoH shortly thereafter. It received a grant from the European Commission-Regional Malaria Control Programme (EC-RMCP) for implementation in some areas of that programme's Border Malaria Control Project.

A feasibility assessment of the CBS system was undertaken before the system was field-tested. In late 1999, a series of consultations and meetings was held with key officials in the MoH and with consultants from international and non-governmental organisations. During the meetings, gaps in the routine disease surveillance system were highlighted and the proposed CBS system was presented and discussed. Comments from participants of the meetings were used to refine the system.

In early 2000, field visits were made to some districts and communes of the country as well as to some referral hospitals and health centres in Pursat, Siem Reap, Stung Treng, Kompong Thom, Kampot, Kratie, Battambang, and Kompong Cham provinces to assess the priority health problems in rural areas and the feasibility of the project. Discussions were held with directors and key staff at the provincial, district and health centre levels in these provinces on the need, usefulness and feasibility of the proposed CBS system in rural areas.

The draft CBS system was widely discussed with relevant officials and staff, reviewed, refined and eventually finalised during its implementation with VHVs and local health staff.

3.4.2 Selection of events to be reported

The selection of events to be reported by the CBS system was carried out during the first meeting of health staff and VHVs at the commune level. At the meeting, health staff and VHVs first discussed in small groups priority health problems in their communities then discussed their findings at a plenary session. They then selected a list of events to be reported based on their public health importance, severity and potential for an outbreak as well as the existence of a control programme (Table 5).

Table 5 Selected diseases to be reported by the Cambodia Rural CBSS

Diseases	Severity	Frequency in rural areas	Preven-tability	Treata-bility (health centre)	Control programme target
Measles	Medium	Epidemic potential	High	Medium	EPI programme
Malaria	Medium to high	Epidemic potential	Medium	Medium	Malaria control programme
Cholera	High	Epidemic potential	Medium	Low	Cholera control programme
Tuberculosis	Medium	Medium to high	Medium	Low	Tuberculosis control programme
Neonatal tetanus	Very high	Relatively high	High	None	EPI programme
DHF	High	Epidemic potential	Medium	Low	DHF control programme

Malaria and tuberculosis were selected because of their prevalence and severity in rural areas; cholera, measles and DHF were selected because of their epidemic potential and high lethality due to population's poor personal hygiene, low children's vaccination coverage, and difficult access to the nearest referral hospital. Neonatal tetanus was selected because of its severity and prevalence in rural settings where most women deliver at home with an untrained midwife. All diseases selected were targeted priority diseases for control by the MoH. The inclusion of data on vital events in the system was intended to better plan for effective prevention and control of communicable diseases in those areas where registers of births and deaths were unavailable.

3.4.3 Defining information flow

The flow of information within the system was intended to (1) allow participation of local health staff and VHVs at different stages of the system; (2) enable local use of data; (3) detect outbreaks quickly; (4) facilitate monitoring of follow-up action; and (5) provide instant feedback to participants. It had been drafted based upon lessons learned through experiences from other countries, was refined through discussions with key staff at provincial and peripheral levels during preliminary field visits, and was finalised during meetings with health staff and VHVs.

Figure 5 illustrates the adopted flow of information. Data collected by VHVs are reported in person by the latter at the monthly meeting with health staff. A simple form is used by each VHV both for recording and reporting of village-based data and a commune register book is to be used by health center staff to aggregate data from all project villages. The monthly meeting is to be held at the area's health center or at any convenient place near the health center. Data checking, collation, presentation, analysis, and feedback are done during the one-day meeting, which should end up with discussions on major issues identified and decisions on remedial actions. All participants can monitor responses to the information generated by the system at the following meeting.

Clustering of similar cases of infectious diseases in the village and any death related to acute diarrhea have to be reported as soon as possible to the heath center for immediate investigation and intervention.

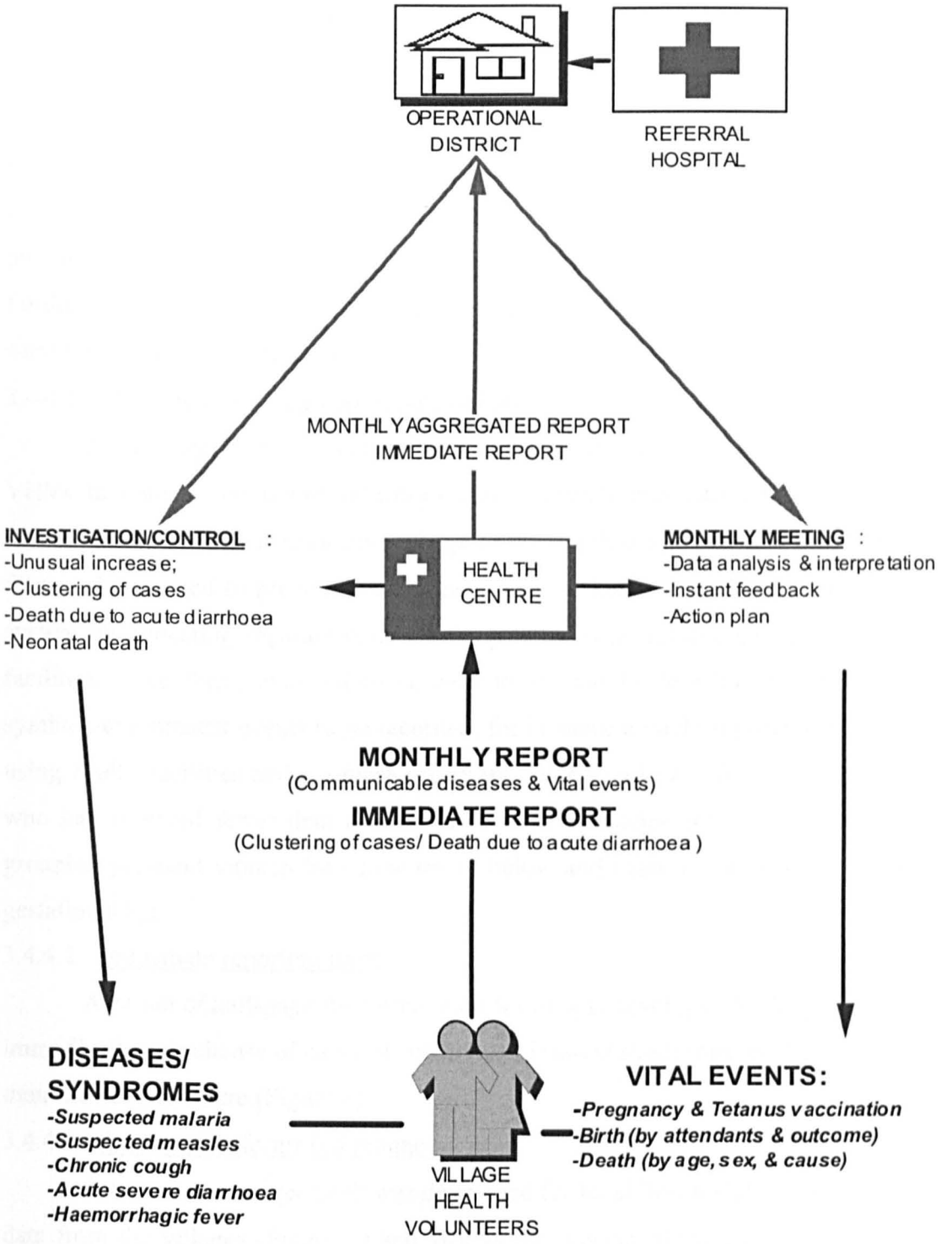


Figure 5 Flow of information within the Cambodia Rural CBSS, 2000-2002

3.4.4 Developing recording, reporting and investigation forms

Recording and reporting forms were drafted to be easy-to-fill in, short but able to gather necessary information required by the system. They were inspired from forms used by CBS systems elsewhere including from WHO (WHO 1978). The forms were discussed, adapted, and tested during the first months of the system's operation, subsequently refined, and eventually finalised. In addition, forms were developed for the investigations of measles, acute severe diarrhoea, and neonatal tetanus. Furthermore, training materials had been developed for health staff in disease surveillance and field epidemiology.

3.4.4.1 Monthly Recording and Reporting form

A two-page monthly village-based data recording form was developed for VHVs to collect and report infectious diseases/syndromes and vital events on a monthly basis from their respective village to the health centre (Figures 6 and 7). The form was designed to prevent double counting with the routine disease surveillance system by allocating separate columns for patients who did and did not use health facilities. The form, intended to be easy to fill out by less literate VHVs, used symbols to represent events to be recorded, for instance a circle represented a patient using health facilities and a square otherwise. It also allowed for flagging women who had received fewer than two doses of tetanus vaccine for remedial action by grouping pregnant women into columns of below and equal to or over 7 months of gestational age.

3.4.4.2 Immediate reporting form

A carnet of half-page A4 format alert forms was developed for VHVs to report immediately any cluster of cases of infectious diseases/ syndromes in their village to their area health centre (Figure 8).

3.4.4.3 Aggregation forms (commune register)

A commune register book was developed for local health staff to aggregate all data from the villages (Figures 9 and 10). In the register, there are four aggregated forms for each reported month. In each form, the first two columns are pre-printed codes and the names of villages covered by each health center in the project area. The other columns give corresponding data for each specific form, including data on pregnancies and tetanus vaccination doses (Aggregation Form 1); deliveries by outcome, place and attendants (Aggregation Form 2); deaths by sex, age group, place

and presumed cause (Aggregation Form 3); and targeted diseases/ syndromes by place of treatment (Aggregation Form 4).

3.4.4.4 Reporting form for monthly meetings

A 2-page form was developed to report the minutes of the VHV and health staff monthly feedback meetings. The form's first page was designed to monitor health staff activities of the past month including training, outbreaks investigation and control as well prevention activities (Figure 11). It also records VHVs' activities during the previous month including frequencies of data collection, immediate reports, and the number of referrals. The form's second page documents major issues raised during information feedback, what the participants decide to do to address these issues and who will be assigned to take action (Figure 12).

3.4.4.5 Investigation forms

Specific investigation forms were developed for health staff to investigate neonatal deaths and deaths caused by acute diarrhoea. In addition, different investigation forms and line listing sheets were developed for local health staff to use in disease outbreak investigations.

REPORTING MONTH: .....

Village ---------- Commune ---------- O D:: ----------

I. VITAL EVENTS/

1. Pregnancies (☑ =No TT vaccination recieved; ① =Received one dose of TT vaccination; ② =Received at least 2 doses of TT vaccination)

< 7 months gestational age	7-9 months gestational age	Total
□ □ □ □ □ □ □ □ □ □ O O O O O O O O O O	□ □ □ □ □ O O O O O	

2.Newborns (Delivered at: ☑ =Home and by TBA; ④ =Public Health Facilities ; (□) =Home and by trained Midwife)

Alive	Died within a week	Stillbirth	Total
□ □ □ □ □ □ □ □ □ □ O O O O O O O O O O	□ □ □ O O O	□ □ □ O O O	

3.Deaths

Name	Sex (Circle)	Age*	Place (tick)		Presumed Cause**	
			Public Hospital	Home/Other	Principal syndromes preceding deaths (specify)	Maternal Death (tick)
	M/F					
	M/F					
	M/F					
	M/F					

* Age: In Days if under a month; In Months if under a year; In Years if 1 year and above.
**Immediate Report if Death due to Acute Diarrhoea

Figure 6 Monthly recording and reporting form: (1) pregnancies, births and deaths

II. COMMUNICABLE DISEASES

AGE (years)	Chronic Cough (Cough more than 21 days)	Acute Severe Diarrhoea (Acute watery diarrhoea and severe dehydration)	Suspected Malaria (High and intermittent fever and chills)	Hemorrhagic Fever (High fever of abrupt onset with Rash and petechiae/ ecchymoses /purpura or gum bleeding/bloody stool)	Suspected Measles (Fever and maculopapular rash and cough/ runny nose/ red eyes)
0-4			□□□□□□□□□□ ○○○○○○○○○○	□□□□□□□□□□ ○○○○○○○○○○	□□□□□□□□□□ ○○○○○○○○○○
5-14	□□□□□□□□□□ ○○○○○○○○○○	□□□□□□□□□□ ○○○○○○○○○○	□□□□□□□□□□ ○○○○○○○○○○	□□□□□□□□□□ ○○○○○○○○○○	□□□□□□□□□□ ○○○○○○○○○○
15+	□□□□□□□□□□ ○○○○○○○○○○	□□□□□□□□□□ ○○○○○○○○○○	□□□□□□□□□□ ○○○○○○○○○○		
Total					

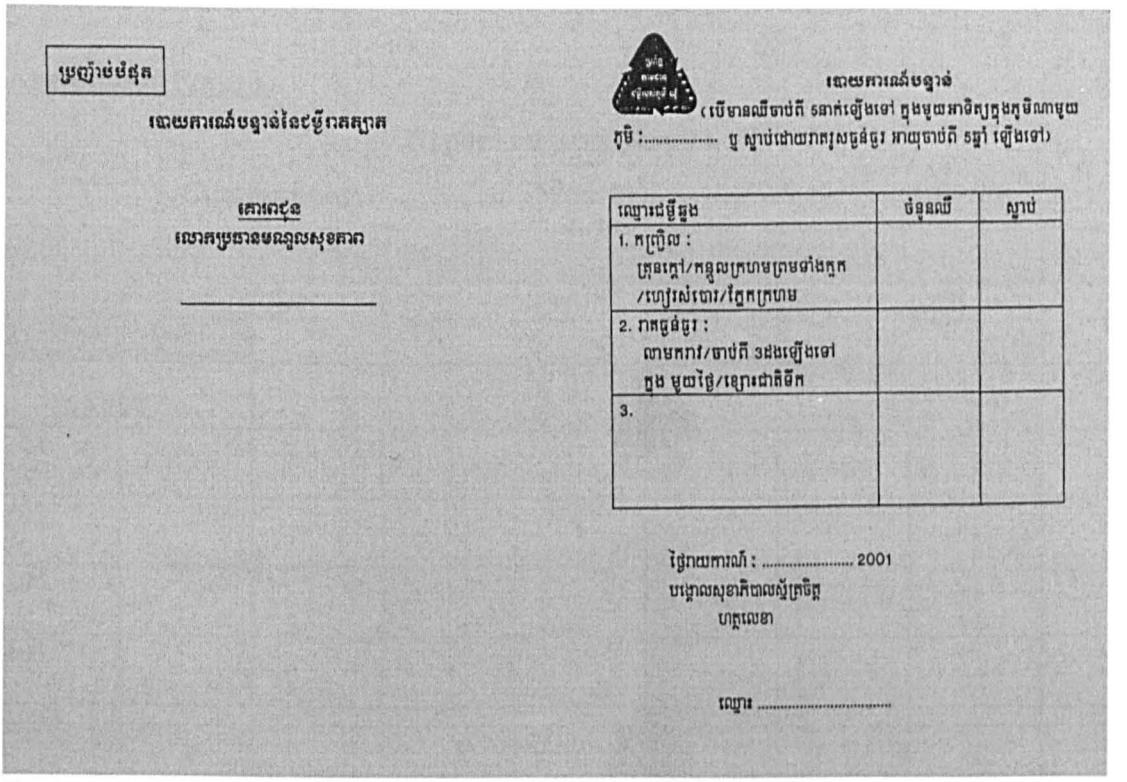
LEGEND: ☑ = 1 Case NOT treated at any public health facilities
○ = 1 Case treated at any public health facilities (health centre, Referral or National Hospital)

NOTE: Immediate report to health centre if: Clustering of cases (i.e. more than 5 similar cases) in a village within a week period.

Remarks: .....

Date: ...../...../..... Name of the VHV:..... Signature:. .....

Figure 7 Monthly recording and reporting form: (2) diseases and syndromes



ប្រញាប់បំផុត

ដោយការឆ្លើយឆ្លងនៃជម្ងឺរាគរូសាត

គោរពជូន
លោកប្រធានមណ្ឌលសុខភាព

ដោយការឆ្លើយឆ្លង

(បើមានឈឺចាប់ពី ៥នាក់ឡើងទៅ ក្នុងមួយអាទិត្យក្នុងភូមិណាមួយ ភូមិ :..... ឬ ស្លាប់ដោយរាគរូសធ្ងន់ធ្ងរ អាយុចាប់ពី ៥ឆ្នាំ ឡើងទៅ)

ឈ្មោះជម្ងឺធ្ងន់	ចំនួនឈឺ	ស្លាប់
1. កញ្ជ្រឹល : ក្រុនក្តៅ/កន្ទួលក្រហមទ្រមទាំងក្អក /ហៀរសំបោរ/ភ្នែកក្រហម		
2. រាគធ្ងន់ធ្ងរ : លាមកការ/ចាប់ពី ៣ដងឡើងទៅ ក្នុង មួយថ្ងៃ/ខ្សោះជាតិទឹក		
3.		

ថ្ងៃរាយការណ៍ : 2001
បង្គោលសុខាភិបាលស្ម័គ្រចិត្ត
ហត្ថលេខា

ឈ្មោះ .....

Urgent **Immediate Report**

Immediate Report of Outbreak (Clusters of cases/ death due to diarrhoea)

TO:

Head of health centre:
.....

Village: .....

Disease:	Cases	Deaths
1.Measles:	.....	.....
2. Severe diarrhoea:	.....	.....
3.	.....	.....

Date of the report: 2001

VHV's name & signature .....

Figure 8 VHV's immediate reporting form for observed clusters of cases (from 5 similar cases in the village per week) or any death due to acute diarrhoea

Aggregation Form 1:

Report on pregnancies

Commune:…….. Month:……..Year: …….

Code	Village	< 7 month gestation			7-9 months gestation			Total
		☑	①	②	☑	①	②	
101								
102								
103								
104								
105								
106								
Total								

Aggregation Form 2:

Report on births

Commune XXX, Month: ……Year: …….

Code	Village	Alive			Died within a week			Stillborn			Total
		☑			☑			☑			
101											
102											
103											
104											
105											
106											
Total											

Figure 9 Aggregation forms 1 and 2 of the commune register book

Aggregation Form 3:

Report on deaths

Commune XXX, Month: .....Year: .....

Code	Village	Sex		Age					Place		Cause	Tot
		M	F	<1m	1m-<1 yr	1-4yr	4-14yr	15+ yr	☑	✓		
101												
102												
103												
104												
105												
106												
Total												

Aggregation Form 4:

Report on diseases/ syndromes

Commune XXX, Month: .....Year: .....

Code	Village	C. Cough		Diarrhoea		S. Malaria		Hem Fever		Measles	
		☑	✓	☑	✓	☑	✓	☑	✓	☑	✓
101											
102											
103											
104											
105											
106											
Total											

Figure 10 Aggregation forms 3 and 4 of the commune register book

Minutes of monthly feedback meeting

Commune: .....

Date of the meeting: ..... Place: .....

Chairperson: ..... Signature: .....

1. Participants:

	Health staff	VHVs
Present (number)	.....	.....
Absent (Names & cause)	.....	.....

2. Training contents

Health staff	VHVs

3. Feedback on past month's activities

3.1 Health staff

Activities	Details	Village/ commune
a. Investigation	.....	.....
b. Prevention	.....	.....
c. Control	.....	.....

3.2 VHVs

a. Data collection (frequency of household visits):

Once: ..... Villages Twice: ..... villages

3 times: ..... Villages 4 times: ..... villages

b. Immediate report

Disease: ..... Village: ..... Date: .....

....

Figure 11 Reporting form for the monthly feedback meeting: page 1

c. Referrals:

No VHVs having had referred patients: .....

No patients:

-Referred by VHVs during last month: .....

-Referred and went to health facilities: .....

-Referred and treated by health facilities: .....

d. Others activities:

.....

4. Feedback information: issues and solutions

Major Issues	Solutions adopted	Responsible	Supervisors
1.			
2.			
3.			

5. Next meeting

5.1 Date (proposed): .....

5.2 Training topics:

-Health staff:

.....

-VHVs:

.....

5.3 Suggestions/ Requests: .....

Figure 12 Reporting form for the monthly feedback meeting: Page 2

3.4.5 Logistics and support

3.4.5.1 Materials

All forms and materials were developed, tested, finalised and printed in sufficient copies for use by health staff and VHVs. Each VHV was provided in advance with a bound register made from 12-month copies of recording forms; separate forms for monthly reporting; immediate reporting sheets, and patient referral sheets. Health education materials, including leaflets, posters and videotapes were also made available for VHVs' social mobilisation activities.

With regards to health staff, CBS commune registers were provided to both the health centre and OD, in addition to investigation and verbal autopsy forms and training materials. A calculator was distributed to each health staff for use in the training, data collation and analysis.

A name badge was also provided to every VHV and a photo album of CBS team members to all participants. Additionally, a bag, T-shirts and stationery were given to each participant during the initial training.

3.4.5.2 Budget

VHVs and health staff received a small per diem and travel cost for their participation in the monthly feedback meeting, where refreshment and lunch were also provided. Transportation costs of VHVs for immediate reporting and those of health staff for outbreak investigations were also reimbursed. The budget for the operation of the Cambodia Rural CBSS was on average US$500 a month for the entire project sites. This budget did not include living allowance and travel costs of NIPH staff doing field supervision and training. The annual NIPH budget for the first year implementation of the system was about US$14,000.

4 IMPLEMENTATION OF THE CAMBODIA RURAL CBSS

4.1.1 Population under surveillance

Implementation of the system began in July 2000 in four border communes of three provinces of Cambodia namely Chan Mul and Choam communes located in Kompong Cham province along the Vietnam border with Cambodia; Pir Thnu located in Kratie province along the Vietnam border; Preah Rumkel located in Stung Treng province along the Lao border. In September 2000 the system was implemented in three other communes, namely Trang, Tasen and Boeng Raing located in Battambang province along the Thai border with Cambodia (Figures 13, 14, 15, 16 & 17).

The seven communes comprised 52 villages and had a total population of about 30,000 inhabitants in the year 2000 (Table 6).

Table 6 Population of communes in the Cambodia Rural CBSS, 2000

Province	**Operational District**	**Health Centre**	**Communes**	
			Name	Population (No. of villages)
Battambang	Sampov Lun	Trang	-Trang -Tasen -Boeng Raing	11,138 (15)
Kompong Cham	Memot	Chan Mul	-Chan Mul -Choam	9,696 (22)
Kratie	Chlong	Snuol	-Pir Thnu	4,454 (7)
Stung Treng	Stung Treng	Preah Rumkel	-Preah Rumkel	4,146 (8)
Total	4	4	7	29,434 (52)

Sources: PHD Kompong Cham, Kratie, Stung Treng and Battambang, 2000

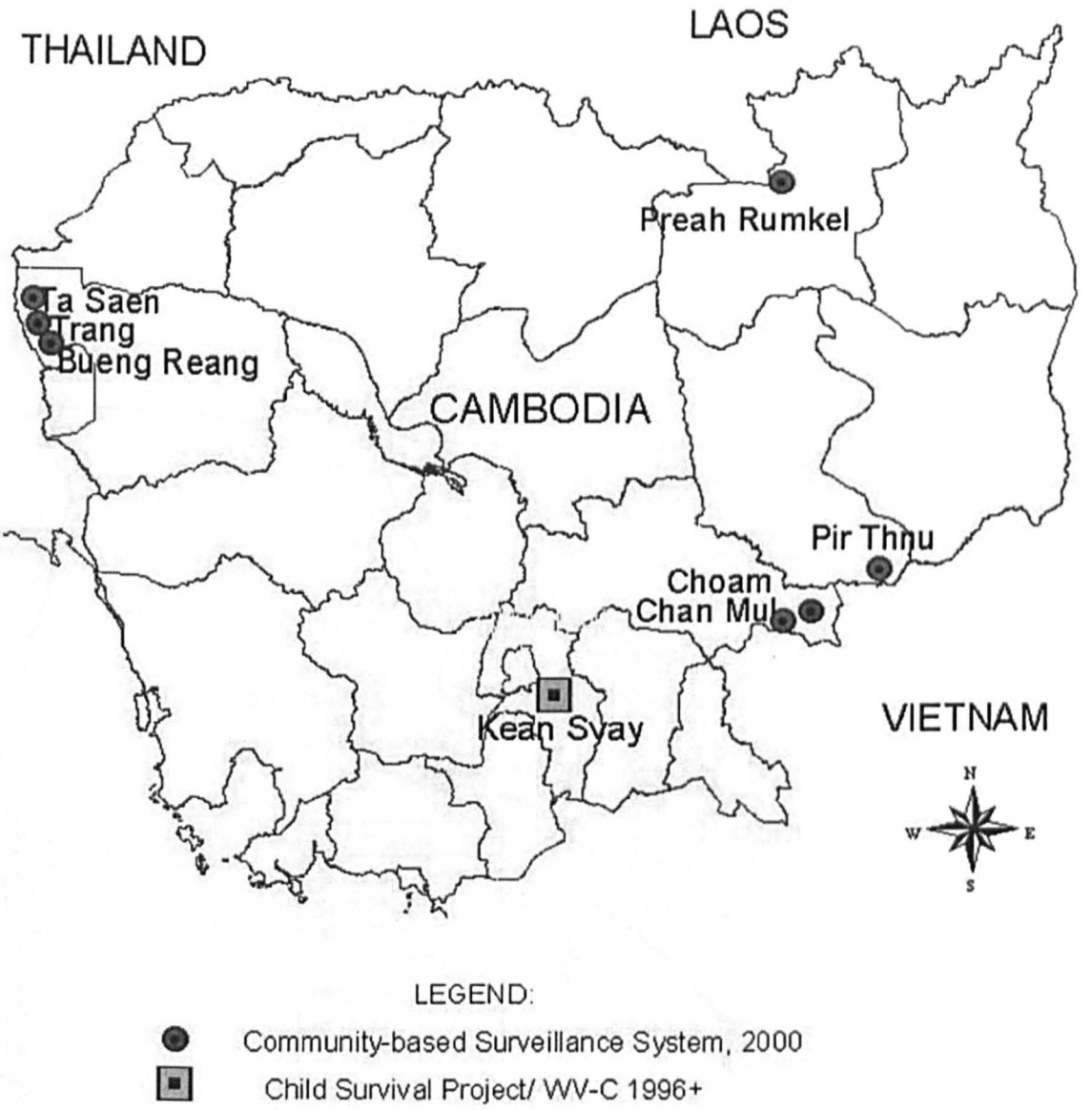


Figure 13 Location of the Cambodia Rural CBSS communes, 2000-2002

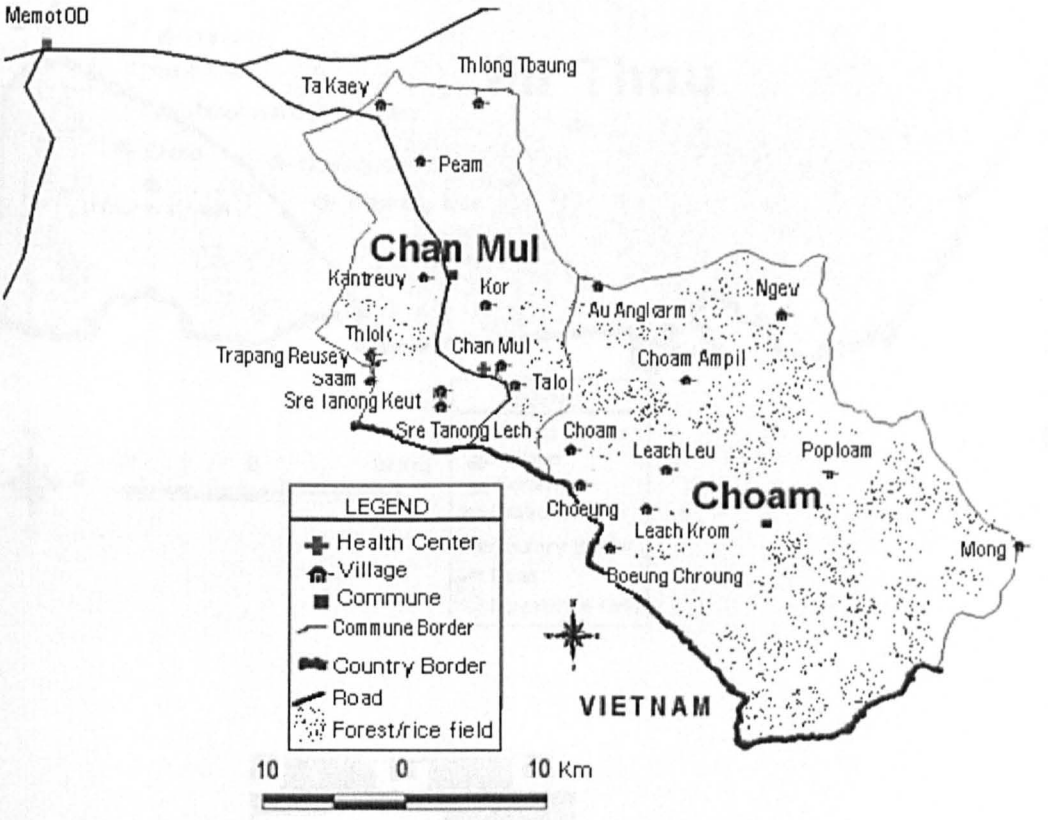


Figure 14 Map of Chan Mul and Choam communes, Kompong Cham province (Villages=22; land area=88 km^2; population density=110/ km^2)

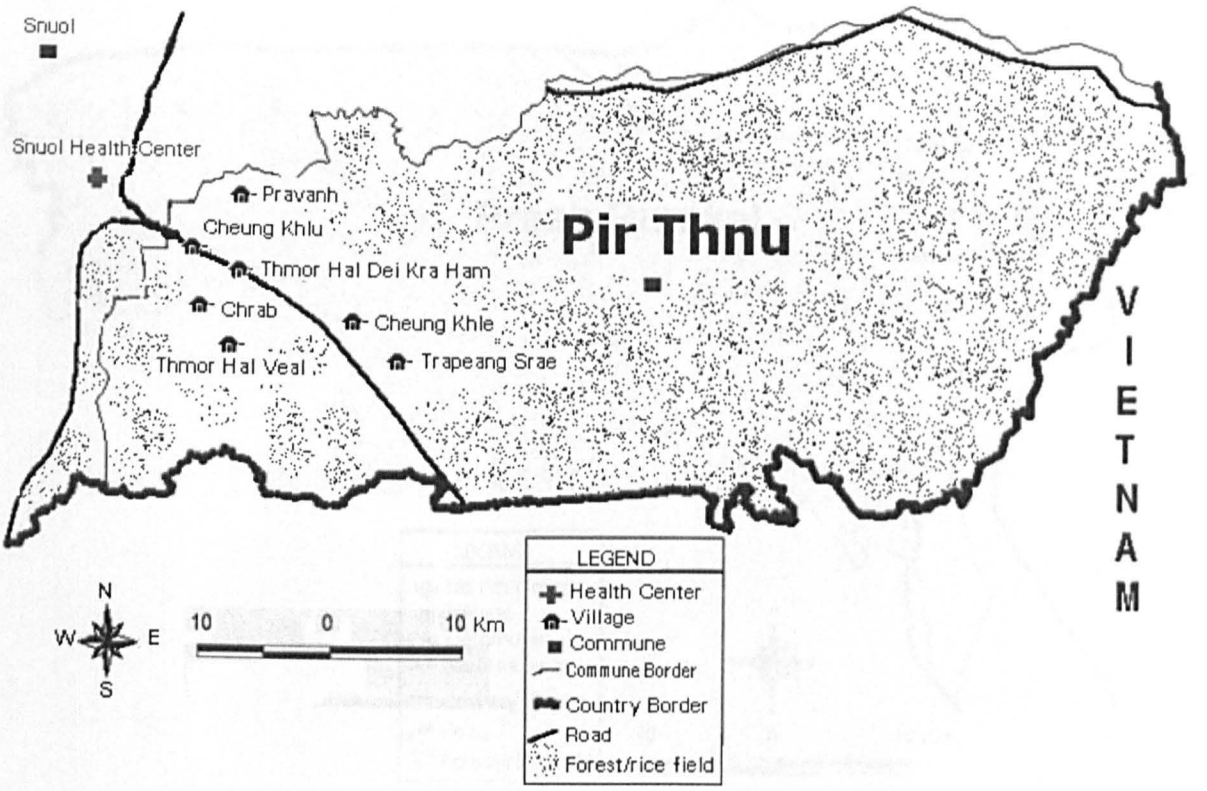


Figure 15 Map of Pir Thnu commune, Kratie province
(Villages=7; land area=545 km^2; population density=8/ km^2)

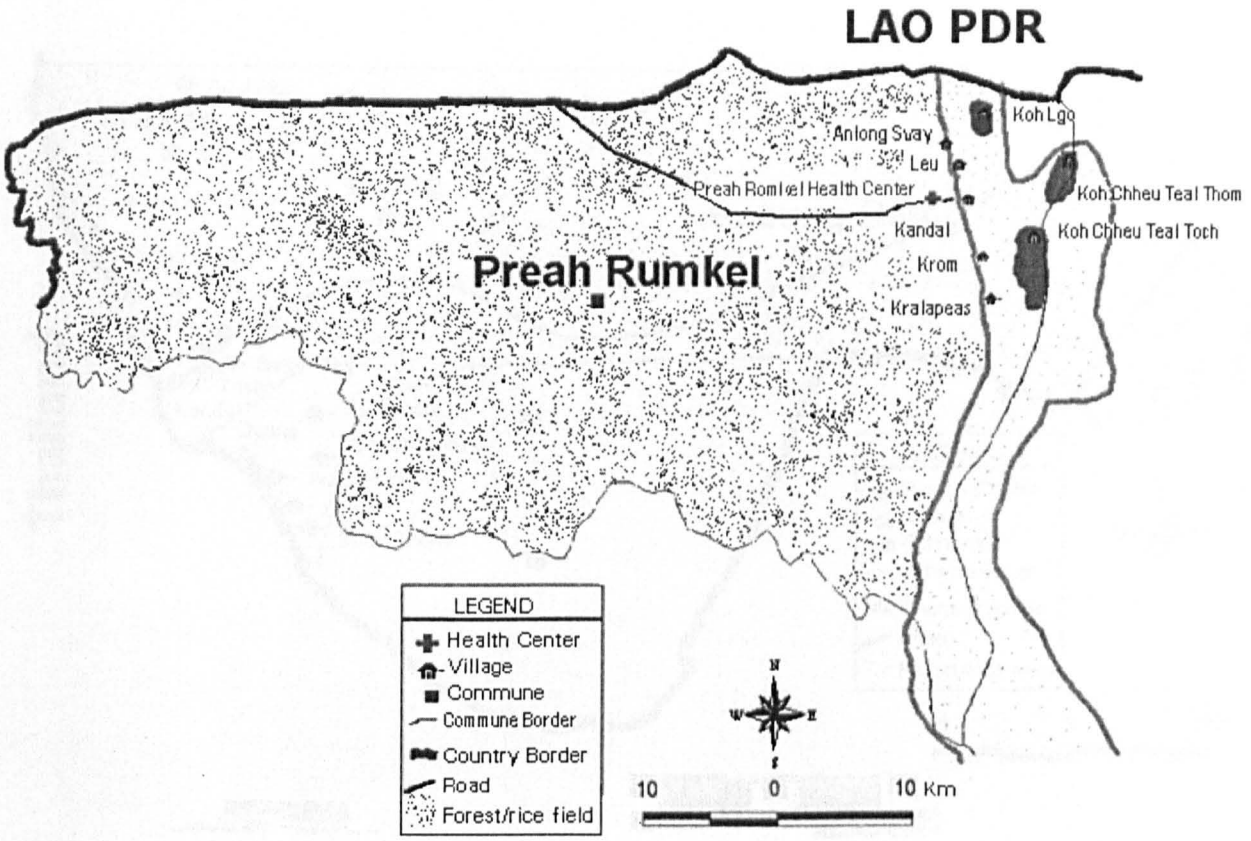


Figure 16 Map Preah Rumkel commune, Stung Treng province (Villages=8; land area=327 km^2; population density=12/ km^2)

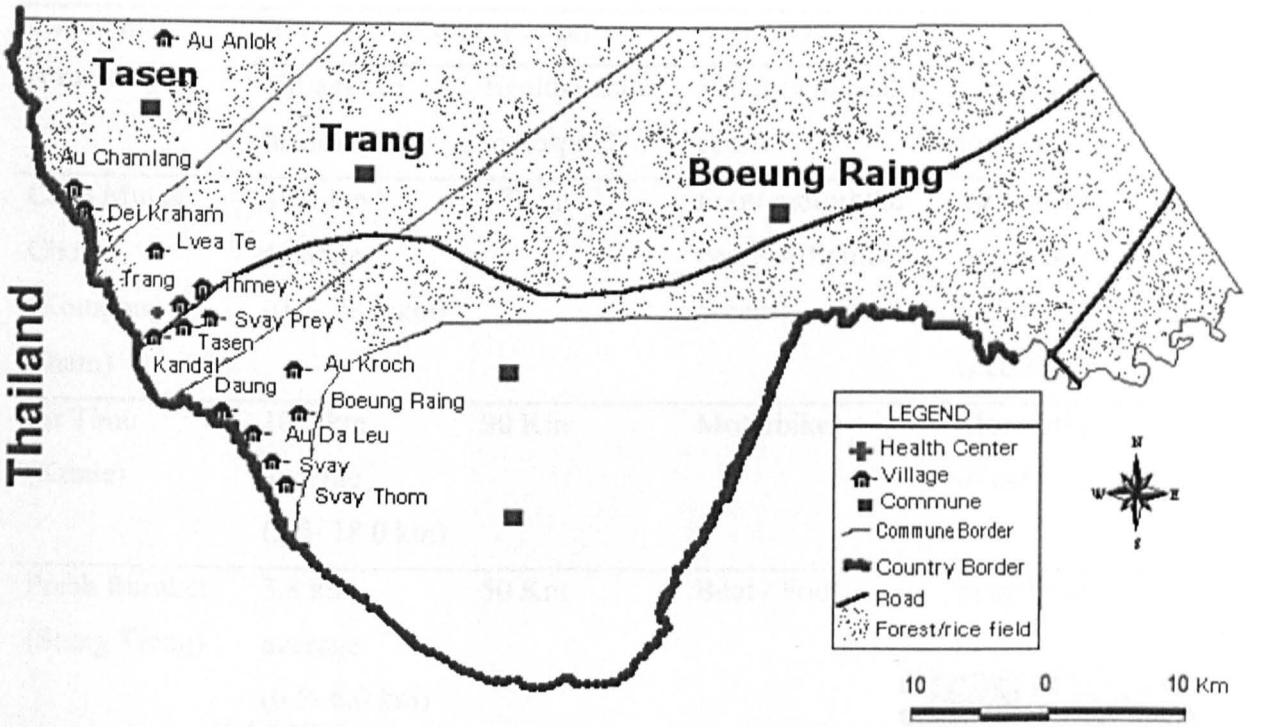


Figure 17 Map of Tasen, Trang and Boeng Raing communes, Battambang province (Villages=15; land area=476 km^2; population density=23/ km^2)

These communes are among the most remote in the country and access is difficult year round, which partly explains the low use of public health services. For instance, the distance from villages to the nearest health centre ranges on average from 4 to 11 kilometres, and up to 28 kilometres for some villages in Choam commune. The nearest referral hospital is far from each health centre and/or difficult to access due to bad roads and limited means of transportation (Table 7).

Table 7 Distance and accessibility from villages to nearest health facilities

Communes (Province)	Average Distance (Range)		Accessibility	
	Villages to health centre	Health centre to hospital	Villages to health centre	Health centre to hospital
Chan Mul & Choam (Kompong Cham)	10.2 km average (0.5- 28.0 km)	17Km	Foot/ motorbike (very difficult access)	Motorbike or car (very difficult access)
Pir Thnu (Kratie)	10.7 km average (3.0- 18.0 km)	90 Km	Motorbike	Motorbike or car
Preah Rumkel (Stung Treng)	3.8 km average (0.5- 6.0 km)	50 Km	Boat / Foot	Speedboat (3-5 h)
Trang, Tasen & Boeng Raing (Battambang)	4.8 km average (0.5- 10.0 km)	50 Km	Motorbike/ car	Motorbike or car

Sources: Health centre staff, CBSS communes

The majority of the populations living in these communes were farmers, and many of them had their rice field or fruit gardens far from the village, at the forest rim. In Preah Rumkel commune, some of the populations were fisherman. Population movements into the forest and crossing the border with neighbouring countries were high, which put these villagers at increasing risk of infectious diseases including malaria, diarrhoeal diseases, measles, DHF, tuberculosis, and acute

respiratory infection. Neonatal tetanus was also thought to be a major public health problem as most women delivered at home with traditional birth attendants (TBAs).

The population of each of these communes was served by four health centres, located at the commune level, and by four Referral Hospitals located at the (Operational) District level. Other providers of health care are traditional healers, private practitioners, TBAs and drug sellers.

4.1.2 Selection of health staff and VHVs

Many visits were made to the selected provinces during which meetings were held with the director and/ or deputy-directors of PHD, OD, and Health Centre to introduce the CBSS and discuss its feasibility, as well as to define criteria for the selection of health staff and health volunteers.

The selection of volunteers was handled by health staff. In Pir Thnu commune, the health centre organised the election of VHVs by the population in the village. In other communes, health staff selected their VHVs by using pre-defined criteria including ability to read and write, willingness to work in disease surveillance, and followed a process in which existing volunteers were given priority following by TBAs, traditional healers/ drug sellers and village committee members (Figure 18).

In general, one VHV was selected per village, and overall there were 56 VHVs for the 52 villages of the seven communes. The average age, sex, and occupation of VHVs varied from one commune to another, ranging from VHVs in Preah Rumkel commune who were all female and TBAs, to VHVs in Chan Mul and Choam who were all male, and many of them village leaders (Table 8).

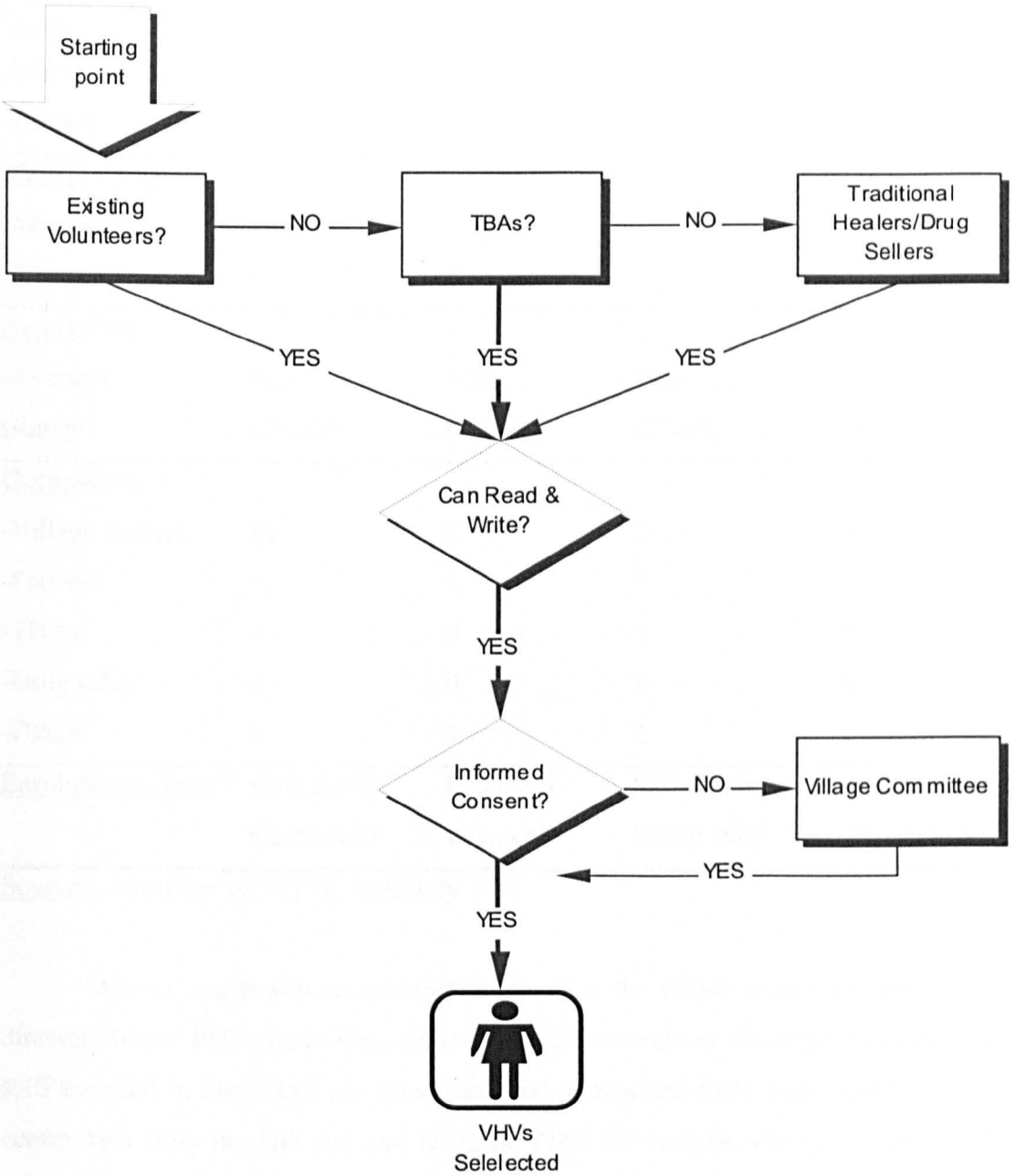


Figure 18 Process used by health staff in the selection of VHVs in Chan Mul, Choam, Preah Rumkel, Trang, Tasen and Boeng Raing communes

Table 8 Characteristics of VHVs by communes

VHVs	Chan Mul and Choam	Pir Thnu	Trang, Tasen & Boeng Raing	Preah Rumkel
Number	26	7	15	8
Gender :				
-Male	26	4	6	0
-Female	0	3	9	8
Marital status:				
-Married	26	7	13	7
-Widowed	0	0	2	1
Age (years):				
-Average	41.5	42.0	39.0	48.5
(Range)	(32-62)	(21-70)	(27-44)	(36-56)
Occupation:				
-Village leaders	14	0	2	0
-Farmers	12	6	7	0
-TBAs	0	0	3	8
-Drug seller	0	0	1	0
-Others	0	1	2	0
Enrolment process	Selected by health staff	Elected by villagers	Selected by health staff	Selected by health staff

Sources: Interview of VHVs, June-July 2001

District and health centre staff involved in the CBSS were appointed by the directors of the PHDs and ODs respectively. There were at the beginning six health staff enrolled in the CBSS per province. They comprised three staff from the health centre, two from the OD and one from the PHD for each province. A few months later, two staff in Kompong Cham province dropped out but one staff in Stung Treng province was added in. Their professional background varied from province to province, ranging from nurses to medical doctors (Table 9).

Table 9 Profiles of health staff involved in the Cambodia Rural CBSS

Health staff	Province			
	Kompong Cham	Kratie	Battambang	Stung Treng
Number:				
2000 (2001)*	6 (4)	6 (6)	6 (6)	6 (7)
Background:				
-Dr/ Medical assistant	1 (0)	5 (5)	3 (3)	3 (3)
-Nurse	5 (4)	1 (1)	3 (3)	3 (4)
Post location:				
-Province	1 (0)	1 (1)	1 (1)	1 (1)
-District	2 (1)	2 (2)	2 (2)	2 (2)
-Health centre	3 (3)	3 (3)	3 (3)	3 (4)

* Numbers in brackets refer to the number of health staff in 2001

4.1.3 Training

4.1.3.1 Initial training:

A series of initial training workshops was successively organised during the third and fourth week of June 2000 for participants in Kompong Cham and Kratie provinces respectively. It was repeated in Stung Treng province during the first week of July and in Battambang province during the fourth week of September. The training were held at the commune health centre of each provincial project site and lasted 3 days each. The timetable and contents of the training are summarised in Table 10.

The morning of the first day of training started with the introduction of participants and objectives of the training, followed by identification of priority health problems of the participants' areas through group discussions and plenary presentation, and ended with discussion of strengths and weaknesses of disease surveillance in the country and province. The CBSS project was introduced in the

afternoon session, followed by discussion of information flow and reporting forms and practices.

On the second day of training, VHVs used recording forms to collect data from their respective village through household visits. Health staff, on the other hand, learned elementary epidemiology including how to measure disease frequencies and present data.

The morning of the third day training started with VHVs' feedback on data collection and correction of mistakes in data recording, followed by health staff data collation and preparation for presentation, and then by VHVs training on disease recognition. During the afternoon session, health staff presented information generated from data collected by VHVs and discussed with them practical ways to implement the system in their village, beginning the following month.

Table 10 Timetable and contents of initial training workshops

Day	Morning	Afternoon
1	(i) Plenary (Staff +VHVs): -Aims and objectives of the workshop; (ii) Group discussion: community diagnosis (iii) Plenary (health staff & VHVs): -Presentation of the results of group discussion. -Disease surveillance in Cambodia	(i) Plenary (staff +VHVs): -CBSS: introduction, discussion; practical exercises.
2	(a) VHVs: collection of data in the village. (b) Health staff: training on data analysis & presentation	
3	(a) VHVs: Feedback and discussion on data collection; discussions. (b) Health staff: preparation for presentation of data collected by VHVs.	-Presentation of information drawn from data collected by VHVs (by health staff). -Discussions. -Recommendations for the implementations of CBSS.

4.1.3.2 Monthly training of VHVs

VHVs received ongoing half-day training every month during their monthly meeting with health staff. The training focused on disease recognition as well as on methods for prevention. Slides and videocassettes were used to enable VHVs to accurately recognise and report diseases and events, as well as better contribute to disease prevention and control.

4.1.3.3 Further training of health staff

Health staff in Kompong Cham, Kratie and Stung Treng provinces received further training on data analysis and presentation as well as on outbreak investigation and control during the monthly supervision visit of the investigator, whereas health staff from Battambang province received this further training during a one-week workshop organised in their province.

Furthermore, key participants from the Kompong Cham, Kratie and Stung Treng provinces attended a special two-week intensive training on field epidemiology during the first half of 2001, together with key staff from national programmes and MoH Departments. The training was given by the investigator with financial support from the Rockefeller Foundation and was part of the Mekong Basin Disease Surveillance Project, which aimed to strengthen the capability of national level staff in disease surveillance and control. The training was also an opportunity to improve CBSS participants' collaboration with colleagues from the national level.

4.1.4 System operation

4.1.4.1 Events under surveillance

Events to be reported in the CBSS included infectious diseases/ syndromes and vital events.

Infectious diseases were to be reported by age group and by place of treatment on a monthly basis. They included (suspected) malaria, haemorrhagic fever syndrome, (suspected) measles, severe acute diarrhoea and chronic cough.

In addition to the monthly report, VHVs were also requested to *report immediately* any death due to diarrhoea among adults and children aged 5 and above, and any *clustering of cases* of infectious diseases in their village.

Vital events to be reported included (1) pregnancies, by tetanus vaccination status; (2) deliveries, by place, birth attendants and outcome; and (3) deaths, by place and main cause.

4.1.4.2 Case definition

A standard case definition was used throughout the system to collect data at the village level. It was adapted from case definitions used at the health centre level.

> ***Suspected malaria:*** Any person with high and intermittent fever associated with chills and headache.
>
> ***Suspected measles:*** Any child (under 15 years) with fever and red rash and any of the following: cough runny nose or red eyes.
>
> ***Severe acute diarrhoea:*** Any person aged five years or more with acute watery diarrhoea of more than three times a day and severe dehydration characterised by sunken eyes and intense thirst.
>
> ***Hemorrhagic fever:*** Any child with high and persistent fever of abrupt onset, associated with red rash or mouth/rectal bleeding.
>
> ***Chronic cough:*** Any person with cough for more than 21 days
>
> ***Cluster of cases:*** A group of five or more cases occurring unusually closely together in any village within a week.

Data collection

VHVs recorded the number of cases and vital events in their villages based on what they heard and observed. They got their data from different sources and different methods depending on the type of events being reported (Table 11). For instance (1) death events could be noted through participating at rituals and ceremonies (including mourning music loudly played), asking Monks, village leaders, or TBAs (for infant death); (2) information on pregnant women and deliveries could be obtained during household visits and through contact with TBAs; and (3) data on targeted infectious diseases and syndromes could be obtained from home visits; patients' relatives, traditional healers and private care providers.

Table 11 Sources of data and methods of data collection

Data	Methods	Sources
-Pregnancies & tetanus vaccination -Deliveries	-Household visits -Contacts	-Pregnant women -TBAs -Health staff
-Death	-Household visits -Contacts	-Relatives of deceased -Village headman/ Monks -TBAs (maternal and infant death)
-Infectious diseases/ syndromes	-Household visits -Contacts	-Patients & relatives -Health care providers (public/ private) -Traditional healer/ drug seller

Source: VHVs interview June-July 2001

Identical forms were used by VHVs to record and report data from their villages, which likely helped to minimise errors in data reporting. In fact, VHVs recorded monthly data of diseases/ syndromes and vital events in duplicate, one copy for handing over to health staff and another, bound in a 12-month VHVs' village register book, for their archives. In the case of a suspected outbreak in the village, VHVs filled in an alert form and either sent it by "motorbike taxi" or brought it in person to the health centre. In some villages, especially in the former "Khmer rouge" areas they alerted the health centre through radio communication. In either way, VHVs recorded the number of cases so reported in their monthly reporting form.

4.1.4.3 Data reporting

Monthly data were handed over by VHVs in person to health centre staff on the very morning of their monthly feedback meeting, which were held in the commune health centre or a place nearby at the beginning of each month. These data were crosschecked by the health centre staff for errors before aggregating them into the CBSS commune register. VHVs who could not come to the meeting usually managed to send their monthly report through other VHVs living in the village nearby.

4.1.4.4 Collation and management of data

Health centre staff aggregated data from the village level into the CBSS commune register and made appropriate tables and charts for presentation and analysis. For instance, line graphs were used to monitor the trends of malaria and chronic cough while histograms were used to draw epidemic curves for measles, severe diarrhoea and haemorrhagic fever. Pie charts were also used to present the proportion of women who had received different doses of tetanus vaccines along with line graphs to follow the trend of 2-dose tetanus vaccination in women of 7-9 months gestational age. Finally, pictograms were used to represent deliveries by outcome, place and birth attendants. These charts were developed and tested for ease of comprehension by health staff in the different CBSS communes before they were adopted for use by all participating communes in the four provinces (See Appendix 4.4).

4.1.4.5 Feedback

The monthly feedback session took place soon after lunch break, when health centre staff presented to all participants data aggregated by village and commune and commented on the trends and patterns of diseases and vital events observed (See Appendix 4.4). Errors in data reporting and aggregation, if any, would be spotted by health staff and VHVs during data presentation to the monthly feedback meeting and immediately corrected.

The feedback meetings were conducted during the first week of each month. The training of VHVs took one half-day a month, on the morning of the feedback meeting. The timetable for the meeting day is shown in Table 12.

4.1.4.6 Decision-making and action-taken

The monthly feedback meeting was an opportunity for its participants to discuss major issues they have identified during the data presentation and to decide what remedial action was to be taken and by whom and how. For instance, if two or more doses of tetanus toxoid (TT2+) coverage was found to be decreasing in any village or commune, the participants tried to identify the causes of the problem and look for a strategy to address that problem. Health centre staff may commit to undertake outreach immunisation activities in the following weeks, OD staff may promise to send required vaccines to the health centre on time and VHVs may volunteer to spread health education messages on tetanus prevention and to mobilise women and children for vaccination on the day agreed upon with the health centre.

Table 12 Timetable of the monthly feedback meeting

Time	Activities	Responsible
Morning	(1).Collection and cross-checking of VHVs' reporting forms. (2).Data aggregation and chart drawing (3). Training of VHVs (In parallel session with data collation)	(1). Health centre and OD staff (2). Health centre staff (3). OD staff
Noon	Lunch break	
Afternoon	(4). Data presentation (plenary) (5). Discussions & decision-making on follow-up actions (plenary) (6). Date and agenda for next meeting (7). Writing up minutes of the meeting	(4). Health centre staff (5). All participants (6). All participants (7). OD staff

4.1.5 Follow-up actions

4.1.5.1 Health staff

Investigations of suspected outbreaks following reports received from VHVs or unusual trends detected through data analysis were usually carried out by health centre staff and reported to the OD and PHD levels. Verbal autopsies were also conducted by health centre staff upon notification of infant deaths for fear of neonatal tetanus, and on deaths due to acute diarrhoea of person aged above five years for fear of cholera. In addition, on once occasion, health staff in Chan Mul commune investigated the death of a child who died three days after receiving EPI vaccination.

4.1.5.2 VHVs

VHVs' responses to information generated by the CBSS included social mobilisation, health education and referrals. VHVs responded to low or decreasing coverage of tetanus vaccination or any case of neonatal tetanus in their village by spending effort to convince women to get at least two doses of tetanus vaccination during their pregnancy and to deliver at health facilities or get help from trained staff. In response to high proportions of chronic cough not treated at health facilities VHVs usually tried to persuade families to bring patients to the health centre or referral hospital. In Preah Rumkel commune, some VHVs even volunteered to themselves accompany pregnant women having labour difficulties to the health centre or referral

hospital. Some VHVs also accompanied severely ill patients to the health centre. The CBSS team leader in Kompong Cham province, who is also the Deputy-Director of the Memot OD, acknowledged that VHVs helped his staff enormously in mobilising women and children for vaccination and health education during his staff's outreach activities.

VHVs used audiovisuals to educate people in their community. Two copies of videotapes on malaria, diarrhoea, DHF, and other health problems were distributed to VHVs in each commune. VHVs passed around the tapes and asked anyone in their village who owned video player to show the video spots to the audience before playing their video movies. VHVs claimed that this method had great effect in educating the population in their village on disease prevention as well as on health protection and promotion.

VHVs' feedback on patients who actually went to the health facilities and were not treated because of drug shortage or unavailability of health staff forced health staff at all levels to take remedial actions to improve the quality of health services in their catchment's areas.

4.1.6 Supervision and backup support

CBSS teams at the health centre and community levels received backup support from the OD and PHD levels as well as from the investigator and the NIPH. Key staff from the OD regularly participated in the monthly feedback meeting held at the commune level. They provided continuous training to VHVs on targeted diseases and health problems but also on other problems upon the request of the VHVs. In one instance, a staff from Stung Treng OD taught VHVs in Preah Rumkel commune clinical signs and prevention of vaginal discharges at the request of these VHVs, who were all TBAs in their village. In other instances, epidemiological and clinical features as well as prevention measures concerning STDs, HIV/AIDS, typhoid fever, dysentery, hepatitis, and other diseases were presented to VHVs by OD staff.

PHD staff joined with the investigator in the field supervision of commune CBSS teams once a month during the first six-month of project implementation, and every 3 months thereafter. During the visits, ways to improve the CBS System were discussed with VHVs and local health staff, and recommendations were made to improve the communication and analytical skills of health staff and VHVs.

4.1.7 Motivation of VHVs

Motivational mechanisms to maintain VHVs' voluntary work included travel costs, per diem and food given to VHVs who attended their monthly feedback meetings with health staff at the health centre, free medical care to VHVs and their family, training, supportive supervision, appropriate recognition, as well as early and effective responses by health staff to the information reported by VHVs, and "instant" feedback of information to VHVs (Figure 19).

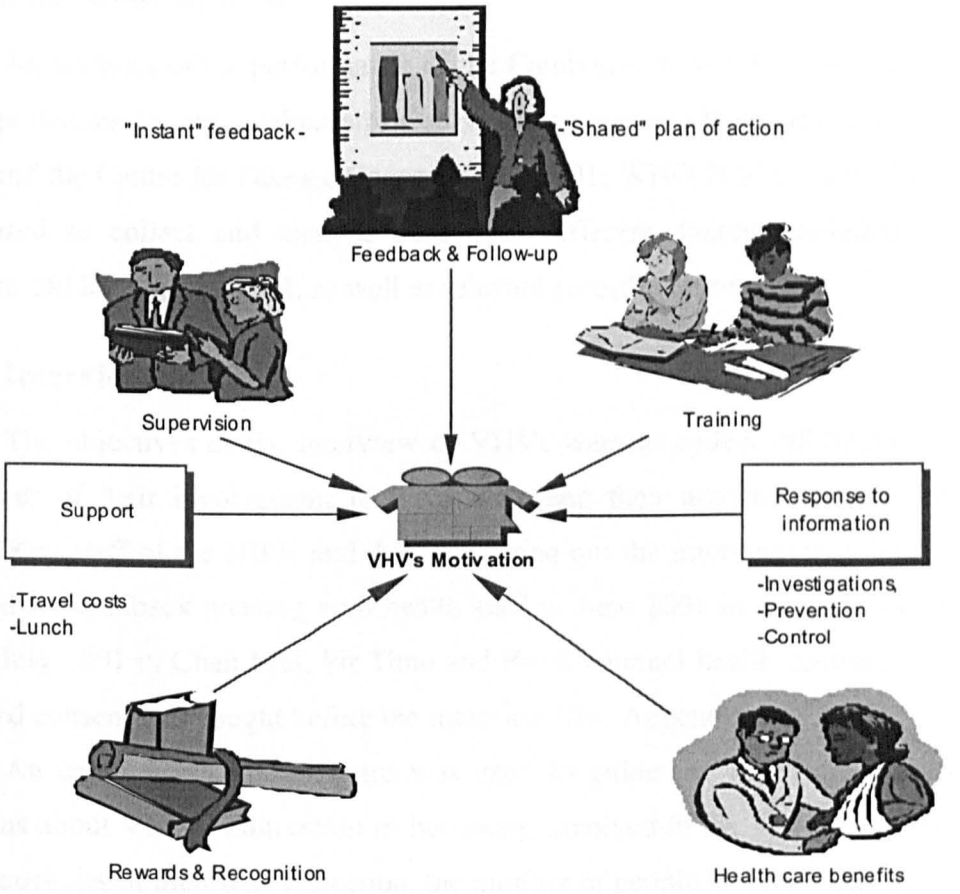


Figure 19 Mechanisms to sustain VHV's motivation in the Cambodia Rural CBSS

5 EVALUATION OF THE CAMBODIA RURAL CBSS

This section presents attributes and indications of the usefulness of the Cambodia Rural CBSS within a year of its implementation as well the methods used to measure this performance.

5.1 Assessment methods

An analysis of the performance of the Cambodia Rural CBSS was carried out using guidelines for the evaluation of surveillance systems that were issued by the WHO and the Centre for Disease Control (CDC 2001; WHO 2001). Several methods were used to collect and analyse data from different sources including VHVs, villagers and local health staff, as well as relevant records and reports.

5.1.1 Interview of VHVs

The objectives of the interview of VHVs were to collect information on the modalities of their involvement in the system and their activities during the past month. Key staff of the NIPH and the OD carried out the interview with VHVs who attended the feedback meeting with health staff in June 2001 in Trang health centre, and in July 2001 in Chan Mul, Pir Thnu and Preah Rumkel health centres. A written informed consent was sought before the interview (See Appendix 2.3).

An open-ended questionnaire was used to guide the interview. It included questions about VHVs' motivation in becoming involved in the system, the methods and frequencies of their data collection, the number of people to whom they passed on messages on disease prevention and the number of patients they had advised to seek treatment at health facilities (See Appendix 2.4).

Overall, 54 (96%) of 56 VHVs in the seven communes were interviewed. Data collected from the interview were coded and entered into a microcomputer using an EpiInfo 2000 programme by the investigator and validated for analysis.

5.1.2 Household survey

The primary objective of the survey was to obtain village-based data to validate VHVs' case reports of diseases and other health-related events during the month and year prior to the survey. The second objective of the survey was to assess VHVs' activities during the past month and to gauge villagers' perceptions concerning their VHVs.

5.1.2.1 Sample design and selection

The two communes in Stung Treng and Kratie provinces namely Preah Rumkel and Pir Thnu were selected for the survey. In addition, one of the two communes in Kompong Cham province, namely Chan Mul was randomly selected. These communes had had the CBSS implemented since July 2000. Project communes in Battambang province were excluded from the survey because the CBSS had operated there for a period of less than twelve months in July 2001. All households in every village of the three selected communes were included in the survey to allow a computation of the sensitivity and specificity of VHVs' reports.

The selection of the survey population was based first on communes where the CBSS has been implemented for at least a year to allow computation of the CBSS attributes of death reports during a twelve-month period; and second on different characteristics of the three communes with regards to their population, VHVs, and health centre. For example, VHVs in Preah Rumkel communes were all females, less literate, and all were TBAs in their village. In contrast, VHVs in Chan Mul commune were all males, relatively more literate, and mostly village headmen. VHVs in Pir Thnu were of both sexes, all farmers, and were elected by their villages. Additionally, the socio-economics and geography of the three villages were different- for instance Preah Rumkel commune was the only commune situated along the Mekong River. Furthermore, health centres serving these communes use different financial schemes. For instance, people from Chan Mul commune benefit from free medical services whereas people in the others have to pay a small charge for their health care (See Appendix 2.5).

5.1.2.2 Survey Instruments

For the interview, an open-ended questionnaire was used to record data about diseases and vital events any member of the household had experienced during the month and year prior to the survey, the nature and frequency of their contact with the

VHVs and their feelings about VHVs' activities (See Appendix 2.6). The questionnaire was initially designed by the principal investigator in April 2001, field-tested and revised by survey team members in May, and finalised in June.

A chart was used to convert the Khmer to the Gregorian calendar with clear demarcation of "past month" for disease events and "past year" for death events because Cambodian people in the countryside generally use the Khmer calendar in their daily lives (See Appendix 2.7). In addition, survey teams used colour pictures of skin rash to help respondents to differentiate between different types of rashes their children might experience for diagnosing measles and haemorrhagic fever.

Written instruction were given to the survey team on how to ensure data quality and how to proceed in identifying and interviewing all households in the villages (See Appendices 2.8. and 2.9). Survey instruments were all written in the Khmer language, produced at the NIPH and distributed to each survey team in sufficient quantity before the commencement of the survey. Team leaders were given a microcomputer with survey questionnaire forms written in English for the EpiInfo 2000 programme as well as preliminary data analysis programmes for data entry and analysis during the period of data collection.

5.1.2.3 Survey Teams

Survey teams were composed of staff from the NIPH, OD, health centre, and the Communicable Disease Control Department of the MoH (See Appendix 2.10). They were trained in the field regarding interview techniques both during field-testing of the questionnaire and prior to the commencement of the survey.

Survey team leaders comprised key OD staff and CBSS team leaders who were former participants of a two-week field epidemiological training in March and April 2001 where they also learned how to use EpiInfo 2000 for data processing and analysis. Before the commencement of the data collection they received additional three-day training on survey management including practice in using the EpiInfo programme to enter dummy data from the questionnaires that were developed for the survey, as well as to develop a preliminary analysis programme for the survey.

5.1.2.4 Data collection

Household surveys in the three selected border communes were simultaneously carried during the first weeks of July 2001, immediately after the monthly feedback meetings between VHVs and health staff, and lasted ten to twelve days. In each selected commune, all villages were investigated and efforts were taken

to interview all households in each village. Two to three trips were made to each village to interview households who were absent during the previous visit of the survey team. Survey teams sometimes had to walk to rice fields located miles away from the village to interview households who had moved temporarily during rice planting season. In each village the head of the household or, in his or her absence another adult present in the house during the survey period was approached and given an explanation of the objectives of the survey. The interview was started after a verbal informed consent was requested and obtained.

Overall, 2329 households were identified and interviewed, which represented 96% of all households reported by local administration in the three communes (Table 13). Practically all households were interviewed in Chan Mul and Pir Thnu communes. However, 79 (10%) households were missed in Preah Rumkel commune because some of them visited relatives in Lao and the others moved to their rice fields a very long distance from their village, which proved to be inaccessible by the survey team for reasons of distance, transportation and security.

Table 13 Response rates, household survey July 2001

Commune (Province)	**No. of households reported by local administration***	**No. of households identified and interviewed**	**Households response rate (%)**
Chan Mul (Kompong Cham)	905	905	100.0
Pir Thnu (Kratie)	758	742	97.9
Preah Rumkel (Stung Treng)	761	682	89.6
Total	2,424	2,329	96.1

* As of January 2001

5.1.2.5 Data Processing and Analysis

Data were cross-checked for completeness and errors by team leaders at the end of each data collection day and entered into a microcomputer separately for each commune. Once data were collected from all households in the commune, they were cross-checked with VHVs to identify cases and vital events that matched with the VHVs' reports (True Positive) in order to compute the CBSS attributes.

Data from all surveyed communes were reviewed at the NIPH by survey team leaders and the investigator for final classification of cases, and checking of errors, during the third week of July. They were then preliminarily analysed and presented to participants from different departments and institutions of the MoH as well as international and non-governmental organisations in July 25, 2001. The validation and cleaning of data was later performed by the principal investigator from a second data entry made by a NIPH staff. Subsequent steps in the household survey are summarised in Appendix 2.11.

5.1.3 Review of records and reports

A review of the CBSS data and monthly feedback meeting minutes as well as investigation reports during the preceding twelve months was made in the project communes to get additional background information on the system.

5.1.4 Analytical Techniques

CBSS data were compared with data from the household survey and investigations, if any, to measure the sensitivity and PPV of VHVs' reports on diseases/syndromes and vital events for the same corresponding period. The later was a month prior to the survey, that is June 2001 and was refereed to as "past month", or a year prior to the survey, that is from July 2000 to June 2001 and referred to as "past year", and corresponding reporting months for investigation data.

Survey and field investigation data were taken as the referent value. Cases reported by VHVs that matched with those detected by household survey or outbreak investigation were considered as "true positive" for the estimation of the sensitivity and PPV of the CBSS (See Appendix 2.12). Criteria for case classification used in the survey and outbreak investigations are presented in Table 14.

Table 14 Case classification used in the survey and investigations

Event	Case definition
Malaria (clinical)	Any person with high and intermittent fever associated with chills and headache without any evident symptoms of other disease
Measles (clinical)	Any children with fever and maculo-papular (non-vesicular) rash and any of the following: cough, coryza, or conjunctivitis (red eyes).
Chronic cough	Any person with cough for more than 21 days.
Acute severe diarrhoea	Any person aged 5 years or more with acute watery diarrhoea of more than 3 times a day and severe dehydration characterised by very sunken eyes, mouth and tongue very dry, skin pinch goes back very slowly and intense thirst.
Haemorrhagic fever	Any children with high and persistent fever of abrupt onset, associated with red rash or mouth/rectal bleeding.
Neonatal tetanus	Any neonate with a normal ability to suck or cry during the first two days of life, and who between 3 and 28 days of age cannot suck normally, and becomes stiff or has convulsion or both.
Maternal death	Any woman who died during pregnancy or within 6 weeks of the end of pregnancy

The findings of the evaluation of the Cambodia Rural CBSS during the first year of its implementation are presented in the following sequence: the system's usefulness, attributes, and cost and effectiveness.

5.2 Level of usefulness of the Cambodia Rural CBSS

Data from the household survey and from review of records and reports show that the CBSS has contributed significantly to the prevention and control of major infectious diseases in the project areas.

5.2.1 Detection of outbreaks

VHVs' immediate reports of clusters of cases in their village and regular disease trends' monitoring by health staff has enabled the Cambodia Rural CBSS to

rapidly detect outbreaks in the implemented communes. Figures 20, 21, 22 and 23 depict epidemic curves of measles in the four groups of communes as reported by VHVs. They show clusters of measles in Preah Rumkel and Pir Thnu communes in July-August 2000, followed by those in Pir Thnu commune at the end of 2000 and in Chan Mul and Choam communes in mid-2001. Only a few cases of measles were reported in Trang, Tasen and Boeng Raing communes in November and December 2000.

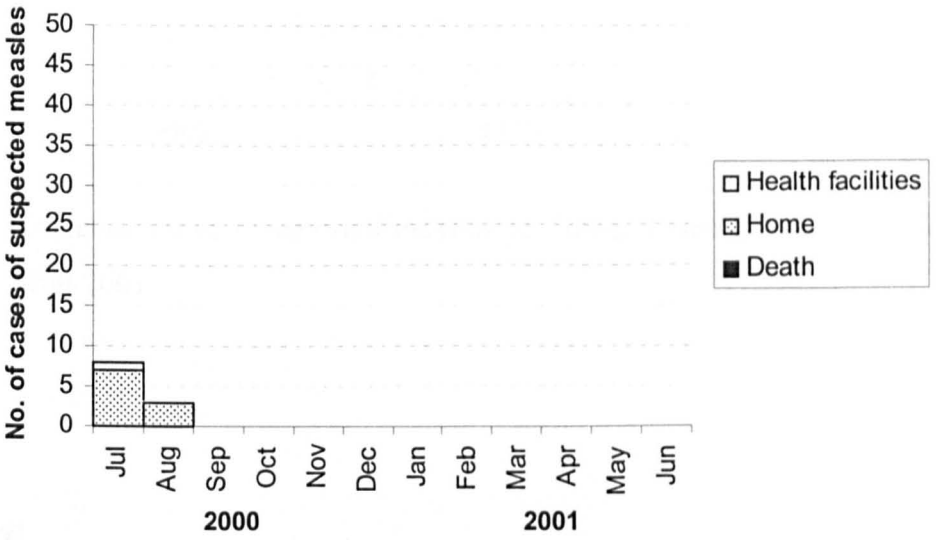


Figure 20 Epidemic curve of reported measles, Preah Rumkel commune 2000-2001

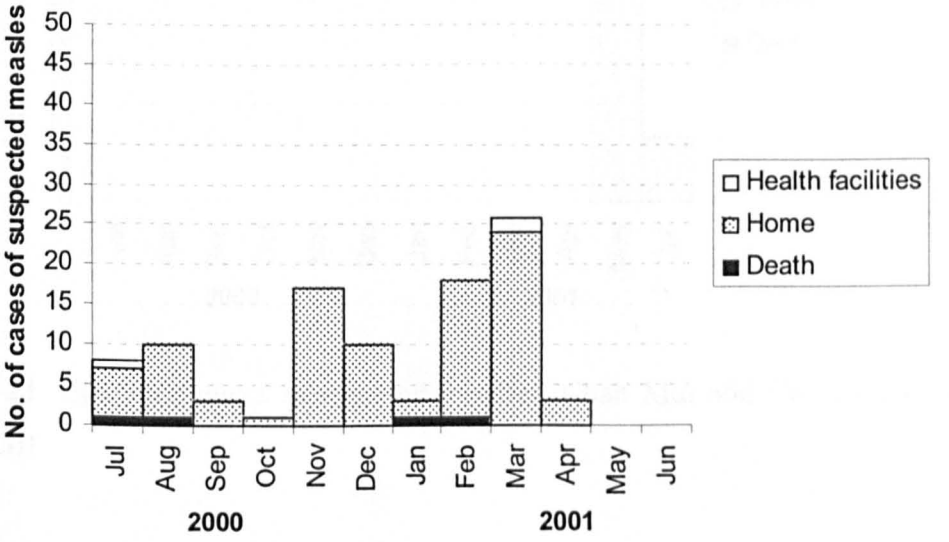


Figure 21 Epidemic curves of reported measles, Pir Thnu commune 2000-2001

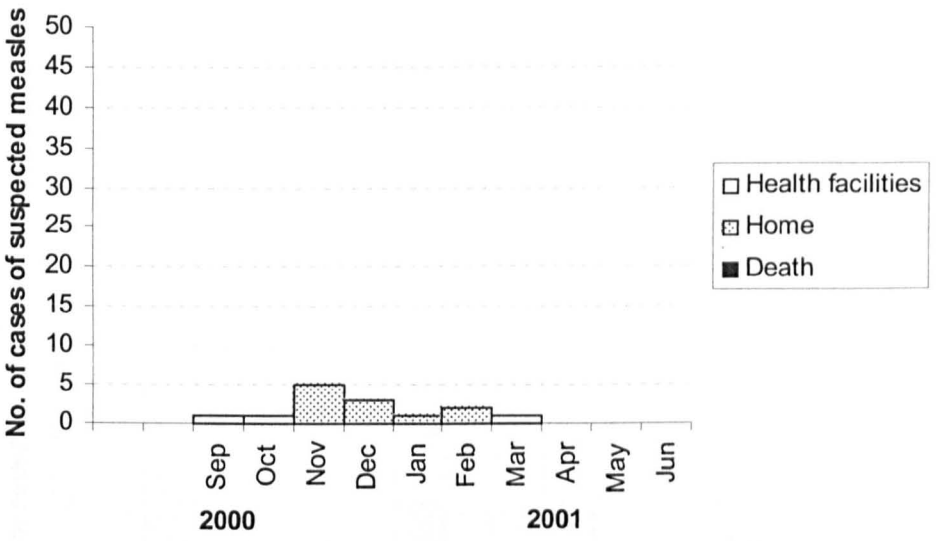


Figure 22 Epidemic curve of reported measles in Trang, Tasen and Boeng Raing communes, 2000-2001

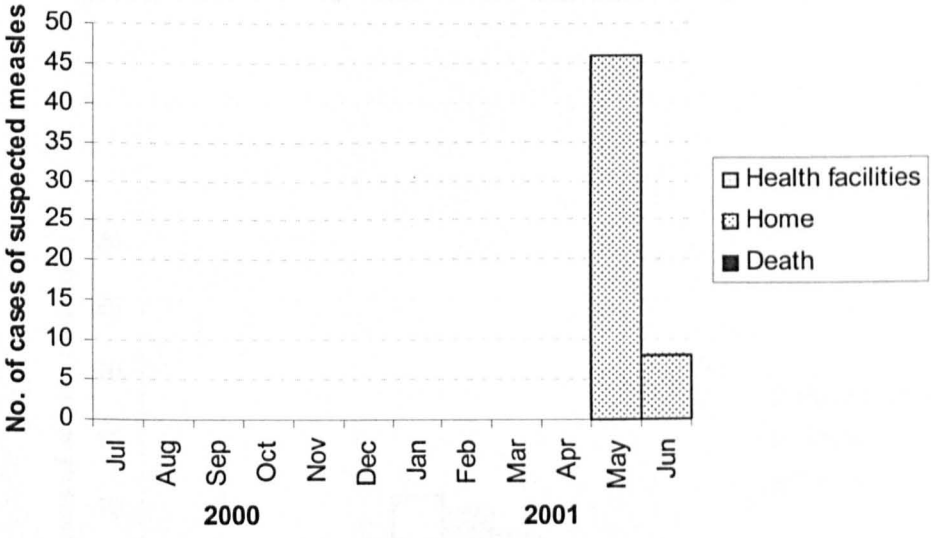


Figure 23 Epidemic curve of reported measles, Chan Mul and Choam communes 2000-2001

Figures 24, 25, 26 and 27, on the other hand, show that most of clusters of severe diarrhoea were reported in Pir Thnu commune, few in Preah Rumkel and Trang, Tasen and Boeng Raing communes and none in Chan Mul and Choam communes.

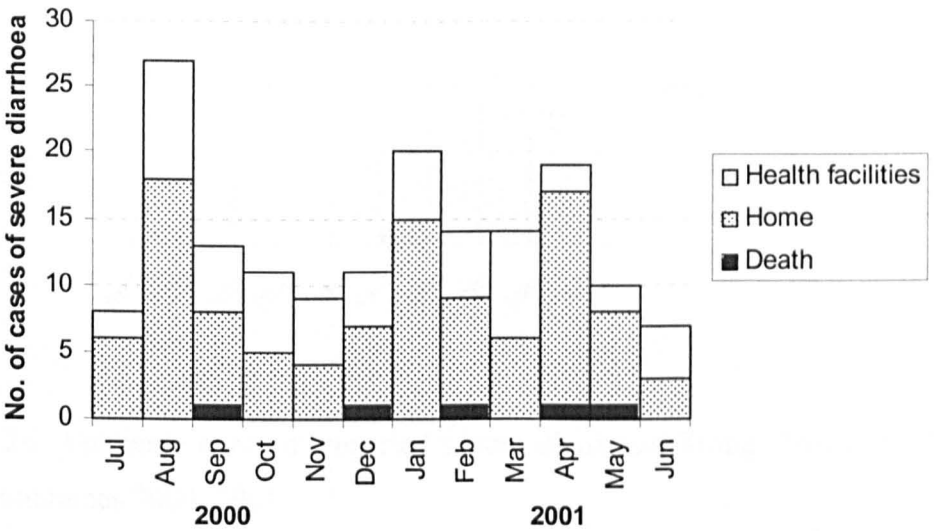


Figure 24 Epidemic curve of reported severe diarrhoea, Pir Thnu commune 2000-2001

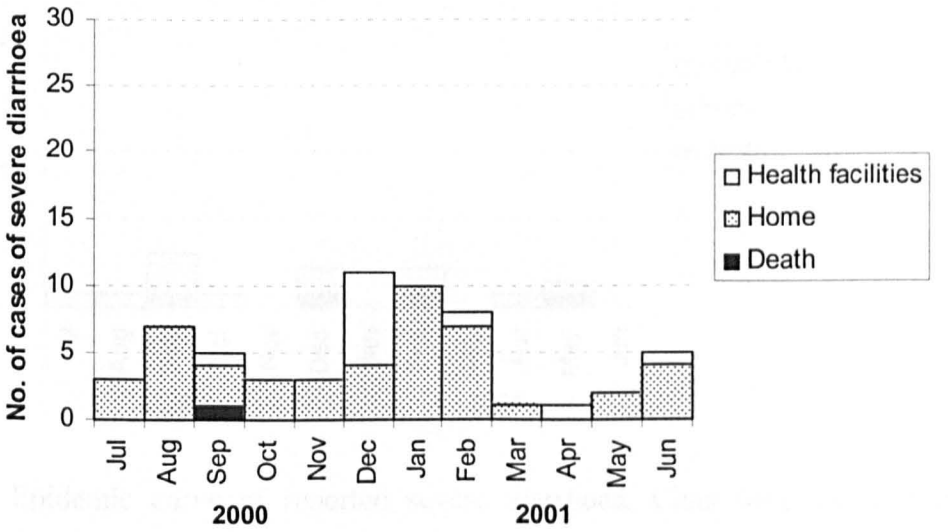


Figure 25 Epidemic curve of reported severe diarrhoea, Preah Rumkel commune 2000-2001

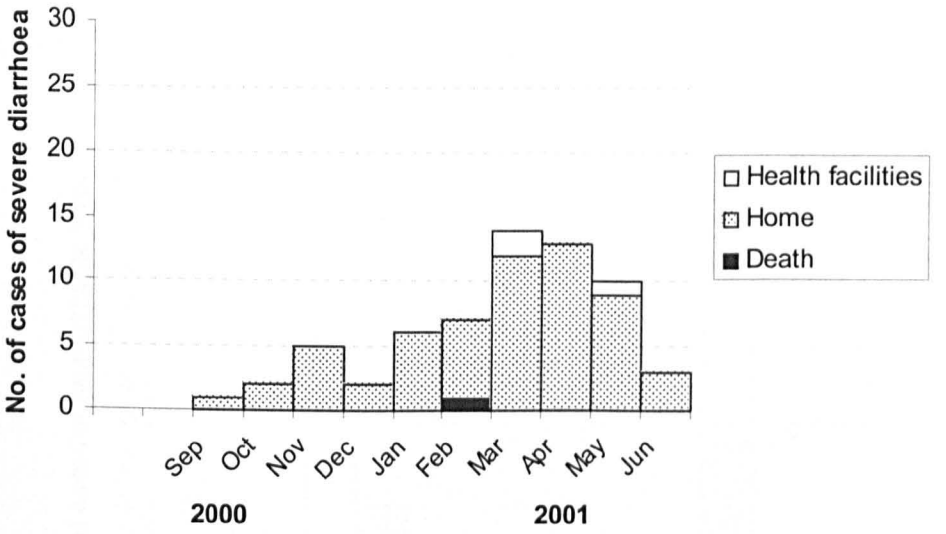


Figure 26 Epidemic curve of reported severe diarrhoea, Trang, Tasen and Boeng Raing communes 2000- 2001

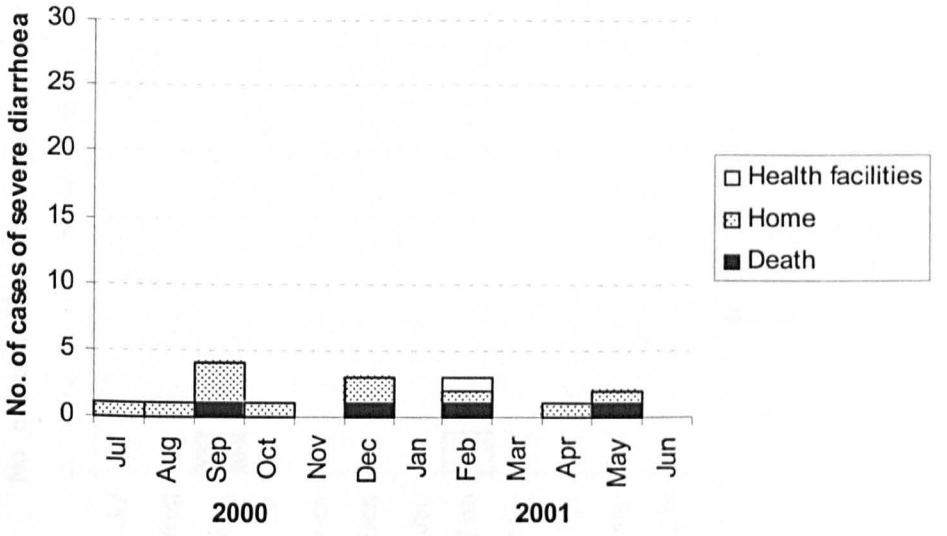


Figure 27 Epidemic curve of reported severe diarrhoea, Chan Mul and Choam communes 2000- 2001

Concerning haemorrhagic fever, only 8 cases of this syndrome were reported in Trang, Tasen and Boeng Raing communes in June 2001 (Figure 28). Few cases of hemorrhagic fever were reported in Chan Mul and Choam and Pir Thnu communes (Figures 29 & 30) and no case in Preah Rumkel commune.

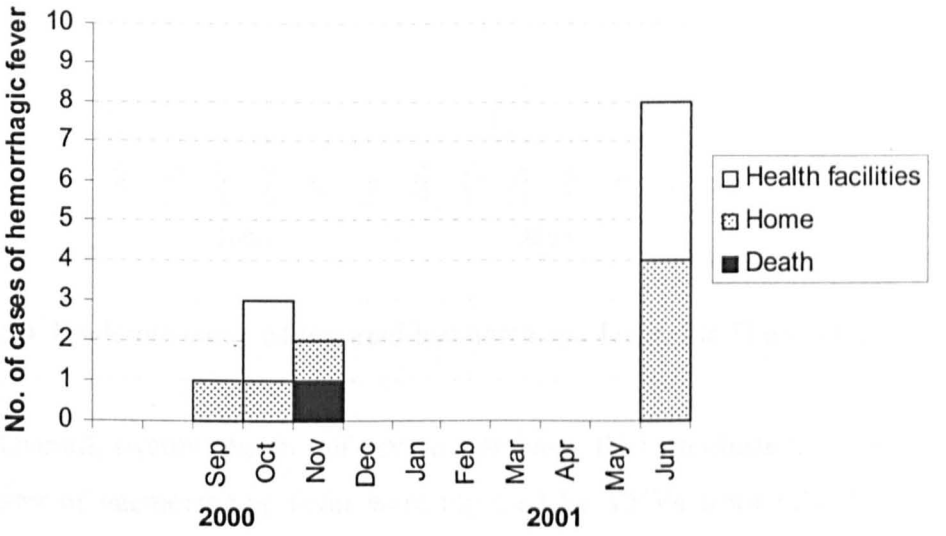


Figure 28 Epidemic curve of reported hemorrhagic fever, Trang, Tasen and Boeng Raing communes, 2000- 2001

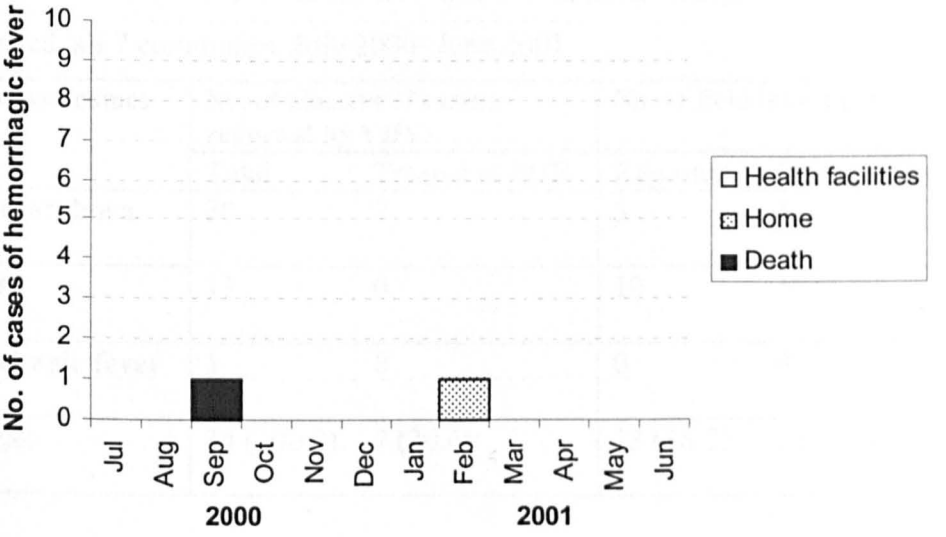


Figure 29 Epidemic curve of reported haemorrhagic fever, Chan Mul and Choam communes 2000- 2001

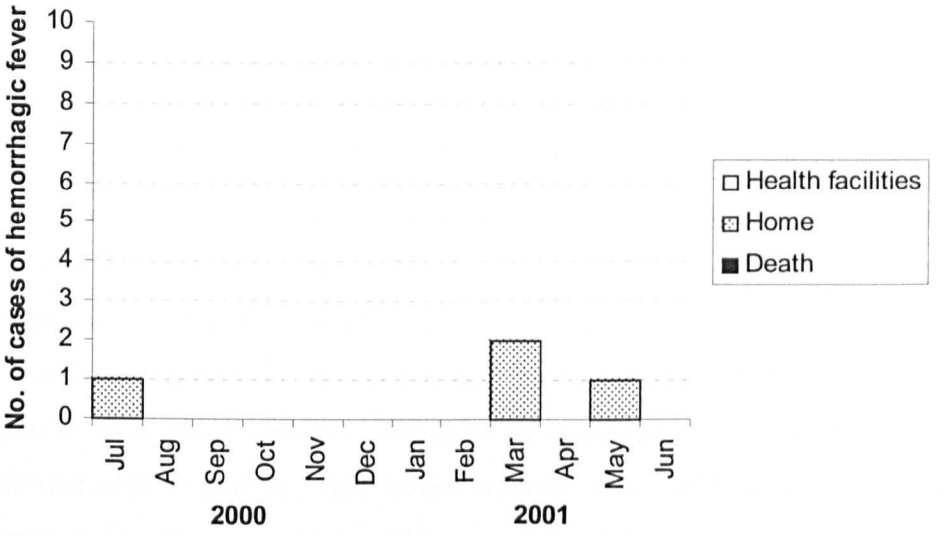


Figure 30 Epidemic curve of reported haemorrhagic fever, Pir Thnu commune 2000-2001

Overall, twenty clusters of severe diarrhoea, thirteen clusters of measles and one cluster of haemorrhagic fever were reported by VHVs from July 2000 to June 2001 in the seven border communes. Of these, patients from only seven clusters of severe diarrhoea sought treatment at the health centre or referral hospital and would therefore have been detected by the formal disease surveillance system (Table 15).

Table 15 Clusters of severe diarrhoea, measles and haemorrhagic fever reported and investigated, all 7 communes, July 2000- June 2001

Diseases/syndromes	No. of clusters of cases reported by VHVs		No. of field investigations	
	Total	Treated at PHF	Reported	Documented
Severe diarrhoea	20	7	3	1
Measles	13	0	10	10
Hemorrhagic fever	1	0	0	0
Total (%)	34 (100.0)	7 (20.6)	13 (38.2)	11 (32.4)

However, Table 15 shows that of the overall 34 clusters of severe diarrhoea, measles and haemorrhagic fever detected by the Cambodia Rural CBSS, only 13 (38%) were investigated (i.e. reported in the minutes of the feedback meeting) and only 11 (32%) were documented (i.e. using proper investigation forms).

The information obtained by the Cambodia Rural CBSS led to disease outbreaks investigation and responses from local health staff. For instance, when VHVs alerted the health centre by radio about a cluster of diarrhoea and vomiting cases in a village in Trang commune during 2000, the health team undertook field investigation a day later, during which treatment was provided to the patients and health education was given to their relatives and neighbours. In Pir Thnu commune, information on suspected outbreaks of measles and severe diarrhoea was often brought to the attention of the commune health centre by VHVs in person. Investigations took place within a couple of days during which health centre staff provided treatment to patients, distributed vitamin A to children and also educated their parents on health prevention. This was followed by intensified EPI outreach vaccination activities. In Chan Mul commune, vaccination was administered to young children in two villages during a measles outbreak investigation following a report from VHVs in April 2001.

Measles outbreak investigations during the past year have provided valuable information to health staff and VHVs in the control and prevention of this disease for the future. For instance, the majority of cases were found among older children who were not immunised against measles (Figure 31).

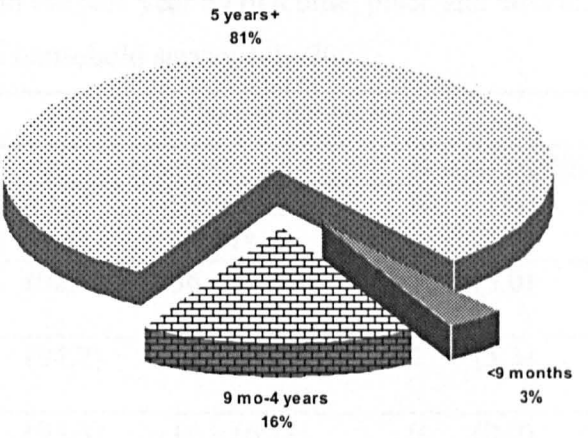


Figure 31 Distribution of investigated measles cases by age group, all communes, July 2000-June 2001

The national disease surveillance system or Alert system, which obtains its data from public health facilities, was unable to capture most of cases of measles, DHF and severe diarrhoea. For example, the Alert system received only five cases of measles reported from the CBSS project provinces in 2000 and 2001 (See Appendix 1). In contrast, the Cambodia Rural CBSS captured more comprehensive and

representative data for communicable diseases and detected disease outbreaks more rapidly than the Alert system.

5.2.2 Information on birth and deaths

5.2.2.1 Births

The CBSS allows health staff and VHVs to accurately document birth events in their communities for better planning of maternal and child health protection activities. Table 16 summarises distribution of deliveries by outcome, place and attendants as reported by VHVs from July 2000 to June 2001 in the four CBSS communes in Stung Treng, Kratie and Kompong Cham provinces and from September 2000 to June 2001 in the three CBSS communes in Battambang province. It shows that 820 (97%) of 845 reported deliveries took place at home -almost all attended by TBAs- and that 33 (4.0%) of all home deliveries were stillborn or ended up with infant death within a week after delivery. Information on delivery places generated by the CBSS is concordant with the findings of the National Health Survey in 1998 which estimated that 95.5 and 96.6 of women delivered at home in the remote and isolated provinces respectively (NIPH 1999).

Table 16 Deliveries in the past year by outcome, place and attendants, all 3 surveyed communes combined, household survey July 2001

Deliveries Outcome	Place of deliveries							
	Home				Health facilities		Total	
	By TBAs		By health staff					
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Alive	751	(92.6)	36	(4.4)	24	(3.0)	811	(100.0)
Stillborn	18	(94.7)	0	(0.0)	1	(5.3)	19	(100.0)
Perinatal death	14	(93.3)	1	(6.7)	0	(0.0)	15	(100.0)
Total	783	(92.6)	37	(4.4)	25	(3.0)	845	(100.0)

Information obtained through the CBSS enables the monitoring of birth events on a monthly basis, thus allowing health staff and VHVs to plan their monthly interventions in a cost-effective manner. Figure 32 is the photo of a pictogram used by health staff to present feedback information to VHVs in Preah Rumkel commune

(Stung Treng province) upon which discussions took place and decisions made on how to improve maternal and child health in their commune. For instance, EPI outreach sessions are given priority in villages where there have been many new-borns reported rather than conducted randomly in villages throughout the commune; villages with many deliveries ending up in infant death are investigated and TBAs trained as well as pregnant women advised to have antenatal care at the health centre.

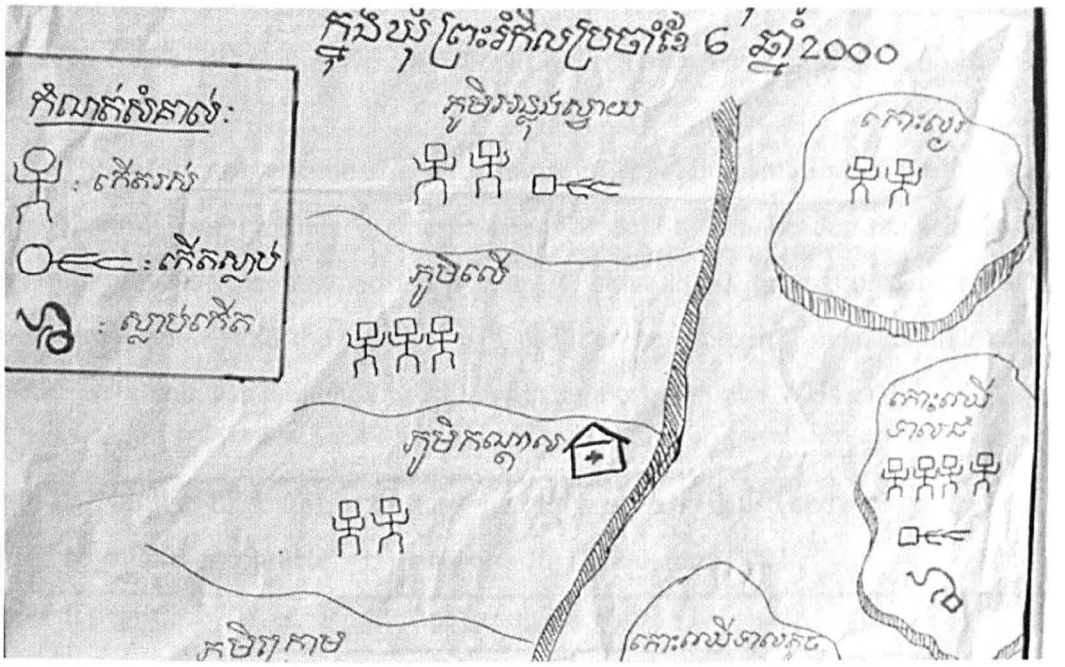


Figure 32 Pictogram of monthly distribution of deliveries by village and outcome (Infants lying down and upside down represent stillborn and infants that died within a week after delivery respectively. Squared head infants represent deliveries at home and assisted by TBAs. House with cross indicates the location of the health centre)

5.2.2.2 Deaths

The CBSS provided information on death events in the project communes where, like the rest of the country, there is no death register at all. Overall, 227 deaths were reported from the four communes in Stung Treng, Kratie and Kompong Cham provinces and from the three communes in Battambang province during the twelve and ten months since the CBSS was implemented in these communes, respectively. All deaths occurred at home and almost half of them were children below fifteen years old. Forty and thirty percent of all deaths were children below five and one year

respectively (Table 17). Computed together with the number of deliveries during the same period gives an infant and under-five child mortality rate of 84 and 112 per 1000 live births respectively.

The CBSS also provided information on the distribution of deaths by cause. Table 17 shows that among the 227 reported deaths in the seven communes, 46 (20%) were likely caused by CBSS targeted diseases/syndromes including malaria, chronic cough, acute severe diarrhoea, measles, haemorrhagic fever and neonatal tetanus. Fifteen percent of all deaths were attributed to unknown fever, a proportion of which could be malaria as well.

The information on death events is useful for the evaluation of the impact of disease control programmes in these areas, especially the border malaria control programme that has been supported by the EC since 2000, the national tuberculosis control programme, and the national EPI programme including measles and tetanus elimination which was launched in 2001 with support from the WHO.

Table 17 Number of deaths in the past year by presumed cause and age group, all 7 CBSS communes combined, VHVs reports July 2000-June 2001

Causes of death	Age group (in years)				Total	
	< 1	1-4	5-14	15+	No.	(%)
Malaria	1	2	3	10	16	(7.0)
Diarrhoea	3	3	0	5	11	(4.8)
Chronic cough	0	0	0	9	9	(4.0)
Measles	1	3	0	0	4	(1.8)
Haemorrhagic fever	1	1	0	0	2	(0.9)
Neonatal tetanus	4	0	0	0	4	(1.8)
Perinatal death	15	0	0	0	15	(6.6)
Maternal death	0	0	0	2	2	(0.9)
ARI	4	2	0	1	7	(3.1)
Accident	0	5	2	14	21	(9.2)
Fever	18	4	7	6	35	(15.4)
Others	21	2	7	71	101	(44.5)
Total (%)	68 (29.9)	22 (9.7)	19 (8.4)	118 (52.0)	227	(100.0)

Sources: VHVs' reports, all communes, July 2000-June 2001

5.2.3 Detection of trends of infectious diseases

Figure 33 shows that reported malaria incidence in general substantially decreased in all but Pir Thnu commune from July 2000 to June 2001, despite seasonal variations during the rain and rice planting period. Availability of malaria drugs at health centres and increased use of impregnated bed nets are thought to have played a major role in this decrease, in spite of the fact that population movements across the border and in the forest remained high. Figure 34, on the other hand, shows that the prevalence of chronic cough was not decreasing in any communes during the same period. This was mainly due to long cure for tuberculosis (TB), unavailability of treatment at the nearest health centre, and TB patients remaining at home due to their reluctance to stay many months at the referral hospital far away from their village.

Clearly, one year period is too short a period to detect trends in disease occurrences. Nevertheless, the Cambodia Rural CBSS has in the long run the potential to detect disease trends and therefore assess the impact of intervention programmes. In the meantime, by monitoring diseases and health-related events, VHVs and health staff are able to discuss the underlying causes of the health problems detected and agree upon corrective measures. Follow-up actions have been taken by both parties, and for health staff this included improvement of coverage and quality of health care services both at the health facilities and in the villages. VHVs, on the other hand, spread messages on health protection and disease prevention, mobilised women and children for immunisation, and convinced households to use health facilities for the treatment of their family members.

The monthly feedback meetings are central in the CBSS because they provide health staff and VHVs the occasion to regularly monitor together diseases and other health-related events trends in their communities, to assess progress made in disease control, and to plan for follow-up action.

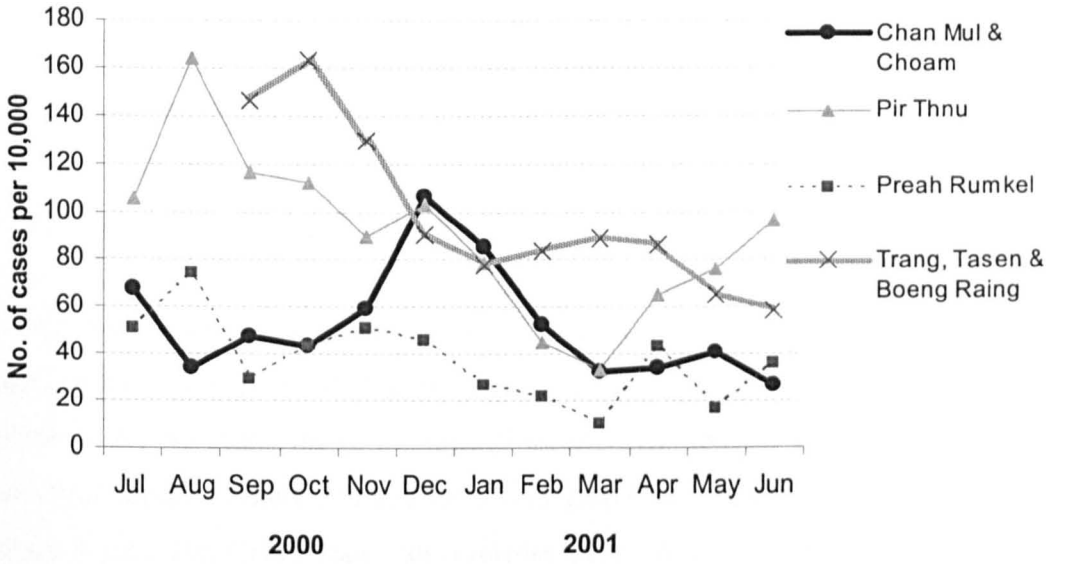


Figure 33 Incidence of reported malaria by commune, 2000-2001

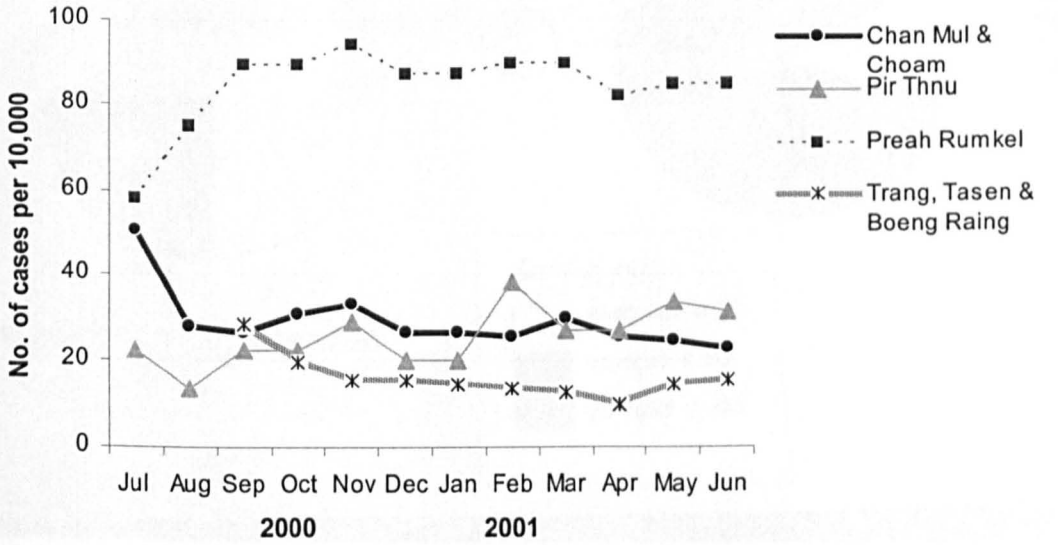


Figure 34 Prevalence of reported chronic cough by commune, 2000-2001

5.2.4 Assessment of control programme

Apart from enabling appraisal of infectious disease control programmes at the community level through the monitoring of disease trends, the CBSS also very efficiently allows regular assessment of the impact of tetanus vaccination among pregnant women. Through the monthly reporting of the number of doses of tetanus vaccine received by pregnant women grouped according to below and equal/above seven months gestation, the system allows not only health staff and VHVs to monitor the vaccine coverage trends but more importantly to gradually improve coverage. By showing on pie charts the proportion of women with tetanus vaccination doses in the previous month (Figure 35) and on a line graph the trends of this vaccination over time (Figure 36), CBSS team can prioritise their follow-up activities to vaccinate the women closer to delivery while increasing vaccination coverage of the other group.

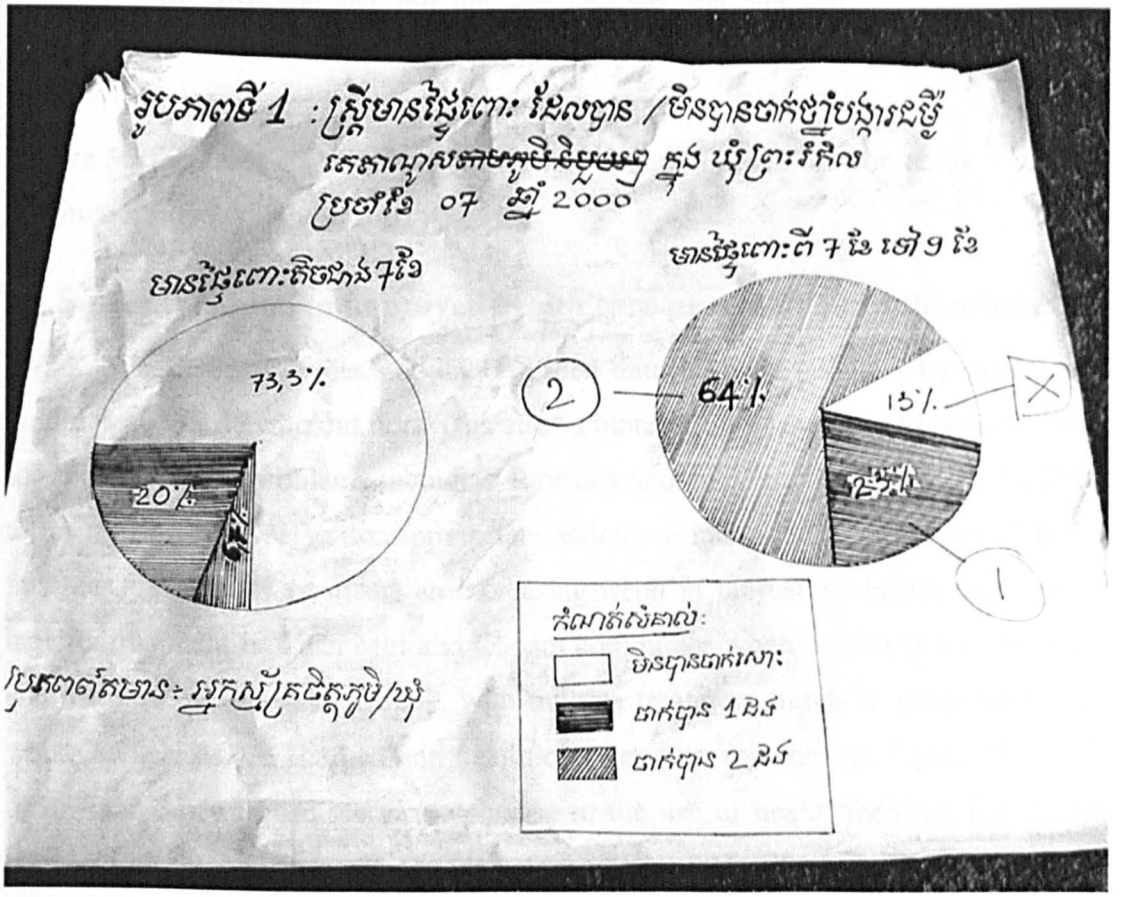


Figure 35 Tetanus vaccination coverage among pregnant women under 7 months of gestation (left) and from 7 months of gestation (right) in a given month in a commune

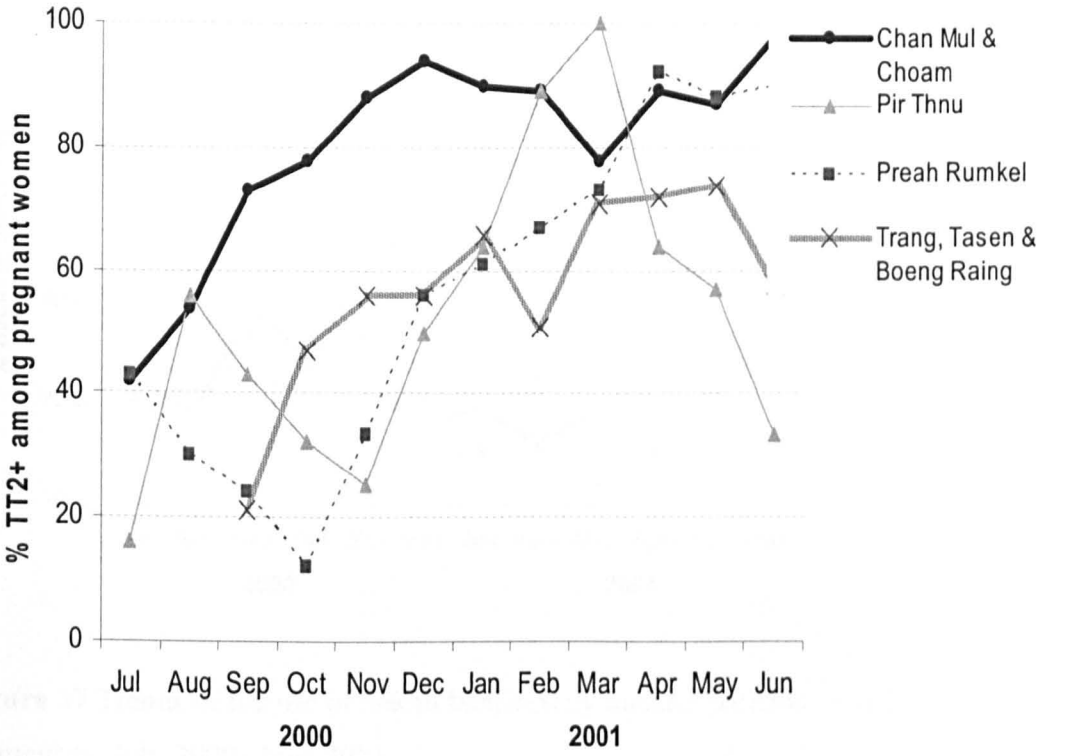


Figure 36 Trends of TT2+ coverage among 7-9 month gestation women by commune, July 2000-June 2001

5.2.5 Contribution to improved health care provision and utilisation

The CBSS provides population-based data both on people who used health facilities and those who did not. This allows monitoring of the use of health facilities for specific health problems including illnesses and deliveries and provides feedback to health staff and VHVs for appropriate actions to increase the utilisation of health facilities. Figure 37 contrasts an increasing trend in the use of health facilities for malaria treatment in Chan Mul and Choam communes where health services are free and available seven days a week, with malaria treatment trends in other communes where some fees are charged and health care services are uneven. Figure 38, on the other hand, shows no discernible increase in the use of health facilities for chronic cough in all the communes from July 2000 to June 2001. This was mainly because tuberculosis drugs were not available at the nearest health facilities in the case of Chan Mul, Choam and Preah Rumkel communes or the health services were not reliably available even if the drugs were available and free, such as the case of Pir Thnu commune.

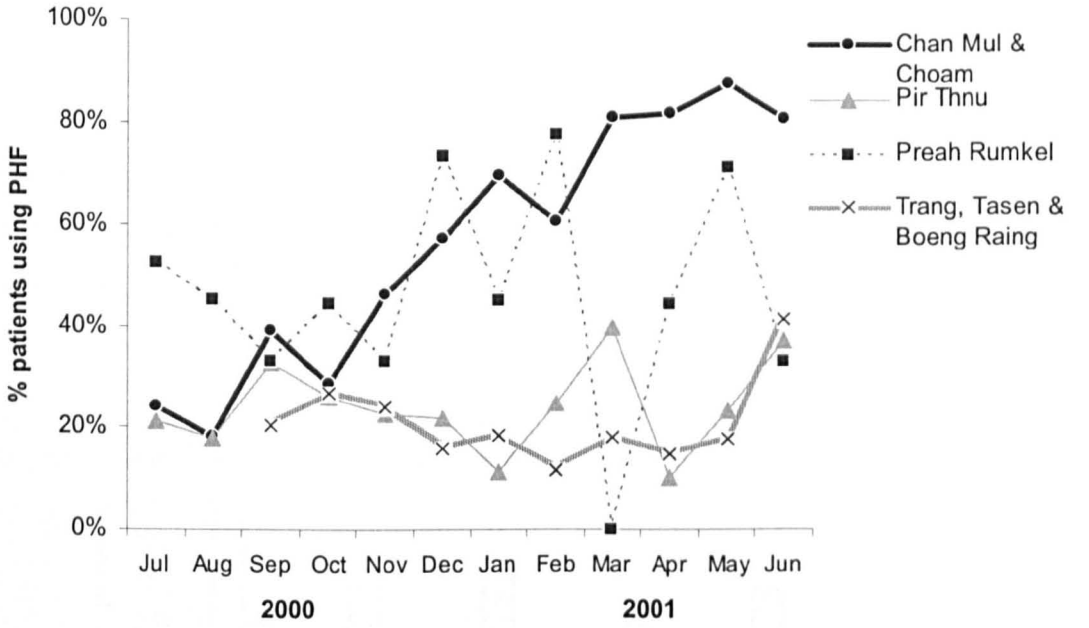


Figure 37 Trends of the use of health facilities by malaria patients in different communes, July 2000- June 2001

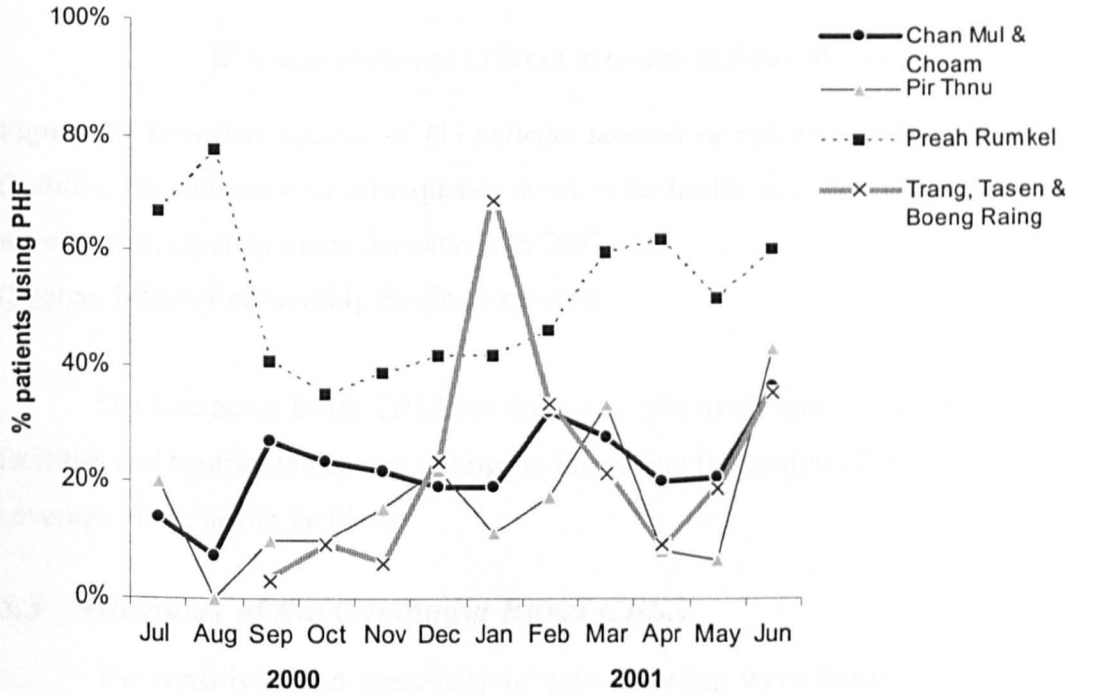


Figure 38 Trends of the use of health facilities by chronic cough patients in different communes, July 2000- June 2001

Furthermore, VHVs' feedback on patients whom they referred to the health facilities contributes to improvement of the behaviour of health staff (Figure 39). For instance, when VHVs reported at their monthly feedback meeting with health staff that some patients complained not receiving any care when they came to the health centre, participants from the OD or PHD then had to clarify these issues with health centre staff and recommended measures to address them.

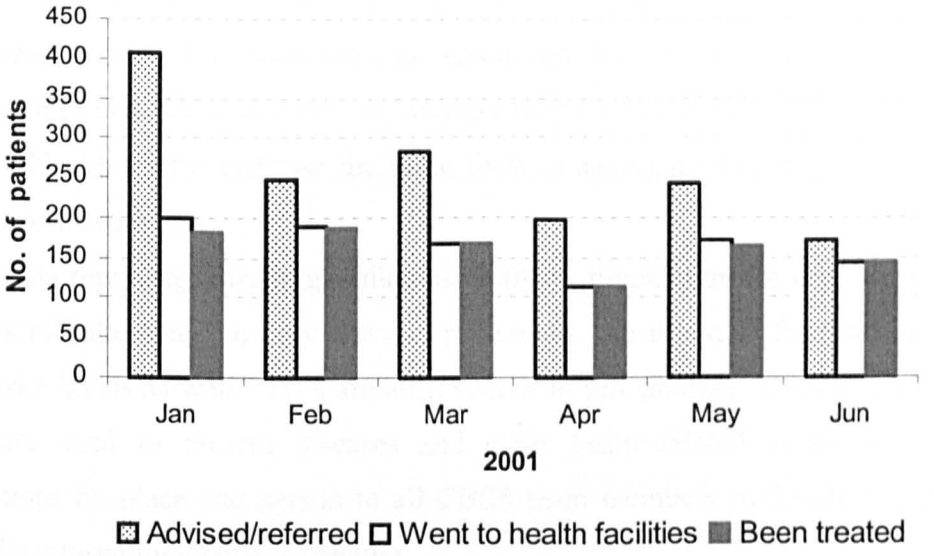


Figure 39 Reported number of (1) patients advised or referred by VHVs to health facilities, (2) patients who subsequently went to the health facilities and (3) those who were treated, all communes, January-June 2001
(Source: Minutes of monthly feedback meetings)

The Cambodia Rural CBSS can therefore effectively monitor the use of health facilities and contribute in some settings to improving the quality of services and coverage of the health facilities.

5.3 Attributes of the Cambodia Rural CBSS

The sensitivity and specificity of case reporting were found to be relatively high for targeted diseases/syndromes; the system was reported to be able to detect outbreaks in the communities in a timely fashion and was felt to be quite comprehensive.

5.3.1 Simplicity

The structure and the operation of a surveillance system reflect its simplicity or complexity (CDC 2001). The CBSS has been designed to capture major infectious diseases in the communities based on syndromes such as chronic cough instead of pulmonary tuberculosis, acute severe diarrhoea instead of cholera, hemorrhagic fever instead of DHF; or diseases that are well-known and relatively easily identified by lay people such as measles and malaria. The system also collects data on births and deaths, which can be easily identified because most people in the village generally share these events. The form used to record data by VHVs is only two pages in length, is the same for data reporting, and use tally sheets to record all events except deaths. Health centre staff use the same form to aggregate data from village level and to report to the OD.

Data reporting, checking, collation, analysis, preparation for presentation, and feedback all take place on only one day per month. Health staff from health centre and district levels as well VHVs are all involved in this process. Easy-to-understand charts are used to present diseases and other health-related events trends and distributions by place and person to all CBSS team members by health centre staff during their monthly feedback meeting.

By reporting cases separately for those using and not using public health facilities the CBSS has been prepared for a possible integration with the formal health facility-based disease surveillance system.

5.3.2 Flexibility

Flexibility refers to the ability of a surveillance system to "adapt to changing information needs or operating conditions with little additional time, personnel, or allocated funds" (CDC 2001). The Cambodia Rural CBSS was designed to allow for easy adaptation. To include a new disease/syndrome in the CBSS, for example one of high local priority, it is sufficient to simply replace one of the case reporting columns by the new event to be collected, enter the new case definition and train VHVs and health staff. For example, it happened that haemorrhagic fever syndrome was dropped and replaced by a "syndrome of big belly" to monitor schistosomiasis in Preah Rumkel commune where this parasitic disease is endemic. This change was made at the request of local health authorities and consisted of only replacing the hemorrhagic fever column by the new syndrome column in the recording/reporting

form and in the CBSS commune register, and training the VHVs in that commune to recognise the new syndrome.

5.3.3 Acceptability

Acceptability refers to the "willingness of individuals & organisations to participate in the surveillance system" (CDC 2001). Persons on whom the CBSS depends for provision of accurate, consistent, and timely data are VHVs, local health staff and the people in the communities.

5.3.3.1 Village Health Volunteers

VHVs were willing to travel quite frequently and considerable distances to collect data in their own village, usually by foot. The survey found that the average number of VHV visits to households during June 2001 ranged from two times in Pir Thnu to three and five times in Preah Rumkel and Chan Mul communes respectively. Some VHVs in Chan Mul and Choam communes walked over ten kilometres from home to their monthly feedback meetings.

In addition, VHVs were actively involved in spreading health education messages to the population in their own village and mobilising women and children to receive immunisation. VHVs advised many patients to use health facilities and some even accompanied severely ill patients to the health centre. On many occasions, VHVs challenged health staff to undertake outreach activities for EPI while they promised to mobilise women and children for the immunisation sessions.

5.3.3.2 Health staff

Health centre, OD and provincial staff were keen to learn basic field epidemiology for collating, analysing and interpreting data as well as for doing field investigations. Many staff were found to be quite interested in using the surveillance data locally, which they had previously only forward to the upper levels of the health system.

OD and provincial supervisors were keen to regularly travel many hours to the commune level and stay there overnight not only to facilitate the feedback meetings but also to train VHVs and health centre staff.

The CBSS team leader in Kratie province scored amongst the best in a two-week field epidemiology training he attended with national level staff. He thereafter used his skills quite remarkably in analysing data in the household survey he

supervised in Pir Thnu commune, and later on he initiated changes in the recording of data to improve its accuracy (See Appendix 3).

The enthusiastic CBSS team leader in Kompong Cham province received full support from the director of Memot OD and approval from Save the Children Australia, an international NGO contracted to run the health service in that district, to gradually extend the system to the other communes of the district in 2001.

The deputy-director of Stung Treng PHD involved herself actively in the development, implementation and supervision of the CBSS in Preah Rumkel commune, despite her other commitments and difficult access to that commune.

5.3.3.3 Population perception

The survey in the three communes indicated that 52% to 96% population interviewed found that VHVs were useful in providing health education and/or helping women and children for immunisation, and/or referring patients to the health facilities. This proportion was highest in Chan Mul commune where villages are small and VHVs can easily reach most of the population in their village (Table 18).

Table 18 Perception of the population vis-à-vis VHVs, household survey July 2001

Commune	Useful		Not useful		Don't know		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Chan Mul	867	(95.8%)	3	(0.3%)	35	(3.9%)	905	(100.0%)
Preah Rumkel	553	(81.1%)	1	(0.1%)	128	(18.8%)	682	(100.0%)
Pir Thnu	388	(52.3%)	61	(8.2%)	293	(39.5%)	742	(100.0%)
Total	1,808	(77.6%)	65	(2.8%)	456	(19.6%)	2,329	(100.0%)

5.3.4 Sensitivity and specificity of case reporting

Sensitivity (S) refers to the "proportion of cases of a disease (or other health-related event) detected by the surveillance system", as well as to the "ability (of the system) to detect outbreaks, including the ability to monitor changes in the number of cases over time" (CDC 2001). Positive predictive value (PPV), on the other hand, refers to the proportion of persons reported as having a disease or other health-related event who have actually experienced that disease or event (CDC 2001). The

sensitivity and PPV of cases reported by VHVs during the month prior to the survey were estimated by taking the survey's findings as the gold standard.

5.3.4.1 Malaria

Surveys shows that the sensitivity of VHVs' reporting on malaria was found to be similar across the three communes surveyed, with about two-third of malaria cases surveyed in the population being reported by the CBSS. However, the PPV of the VHVs' reports differed from commune to commune and ranged from 73% in Preah Rumkel to 86% in Chan Mul and 93% in Pir Thnu (Table 19).

Malaria cases missed by VHVs' reports were mainly found in households not covered by VHVs' previous month data collection, especially in Pir Thnu commune. The lower specificity of VHVs' reports on malaria could be explained by the more specific case definition used in the survey. VHVs' case definition for "suspected malaria" referred to any patient having "high and intermittent fever associated with chills and headache", while the survey case definition for "clinical malaria" used the same case definition but in addition "excluded patients with any evident sign of other disease". However, there was no laboratory confirmation of the malaria cases taken as gold standard in this evaluation.

Table 19 Sensitivity and PPV of malaria case reporting, June 2001

Commune	**Cases of malaria detected by:**				
	Household survey	VHVs (June 2001)*			
		No.	TP	S	PPV
Chan Mul	9	7	6	66.7%	85.7%
Pir Thnu	63	43	40	63.5%	93.0%
Preah Rumkel	16	15	11	68.8%	73.3%
Total	88	65	57	64.8%	87.7%

* TP: True Positive; S: sensitivity; PPV: positive predictive value

5.3.4.2 Chronic cough

The sensitivity of chronic cough reported by VHVs was overall 75%, and ranged from 72% in Pir Thnu commune to 75% in Preah Rumkel commune, and 80% in Chan Mul commune. On the other hand, the PPV of VHVs' reports on chronic

cough was higher overall than their sensitivity with approximately 9 out of 10 cases being correctly reported (Table 20).

Table 20 Sensitivity and PPV of chronic cough case reporting, June 2001

Commune	Cases of chronic cough detected by:				
	Household survey	VHVs (June 2001)*			
		No.	TP	S	PPV
Chan Mul	15	13	12	80.0%	92.3%
Pir Thnu	18	14	13	72.2%	92.9%
Preah Rumkel	40	35	30	75.0%	85.7%
Total	73	62	55	75.3%	88.7%

* TP: True Positive; S: sensitivity; PPV: positive predictive value

The PPV below 100% of chronic cough reporting by VHVs can be explained by the fact that a more specific case definition was used in the survey, i.e. in addition to the VHVs' case definition of "cough more than 21 days" any cases with evident signs of asthma were excluded.

5.3.4.3 Acute severe diarrhoea

Overall, both the sensitivity and PPV of case reporting on severe diarrhoea were 83% (Table21).

Table 21 Sensitivity and PPV of severe diarrhoea case reporting, June 2001

Commune	Cases of acute severe diarrhoea detected by:				
	Household survey	VHVs (June 2001)*			
		No.	TP	S	PPV
Chan Mul	1	0	0		
Pir Thnu	6	7	5	83.3%	71.4%
Preah Rumkel	5	5	5	100.0%	100.0%
Total	12	12	10	83.3%	83.3%

* TP: True Positive; S: sensitivity; PPV: positive predictive value

There were misclassifications in the severity of some cases of reported severe diarrhoea, but the number of cases of severe diarrhoea was too small to accurately judge the accuracy of the VHVs report.

5.3.4.4 Measles

Table 22 shows the sensitivity and PPV of VHVs' case reporting on measles by comparing cases found during the investigations and household survey with those reported by VHVs during the corresponding months. It was found that the sensitivity and PPV of VHVs' case reporting were overall very high for measles, a disease well known to many people.

Table 22 Sensitivity and PPV of measles case reporting, June 2001

Commune	Cases of measles detected by:				
	Survey & investigations	VHVs (Corresponding months)*			
		No.	TP	S	PPV
Chan Mul	59	54	53	91.5%	98.1%
Pir Thnu	33	38	33	100.0%	86.4%
Preah Rumkel	0	4	0	...	...
Total	92	96	86	93.5%	89.6%

* TP: True Positive; S: sensitivity; PPV: positive predictive value

The CBSS was able to detect all outbreaks of measles and acute severe diarrhoea in the seven implemented border communes. For instance, the minutes of monthly feedback meetings recorded 18 immediate reports of clusters of cases of measles and severe diarrhoea from 11 and 7 villages respectively during the past twelve months. Meanwhile, 14 field investigations were made by local health staff but only a few of them were properly documented. "False alert" was found on one occasion when four cases of unknown rash were misreported as suspected measles in a village of Preah Rumkel commune in May 2001.

5.3.4.5 Haemorrhagic fever

No case of haemorrhagic fever was either detected by household survey or reported by VHVs in June 2001 in Chan Mul, Pir Thnu and Preah Rumkel communes, which therefore gives credibility to VHVs case reporting for haemorrhagic fever in these communes. However, no investigation was made to look into VHVs' reports in

Trang, Tasen and Boeung Raing communes where eight cases of haemorrhagic fever were reported in June 2001. Therefore the sensitivity and PPV value of the Cambodia Rural CBSS for haemorrhagic fever could not be estimated.

5.3.4.6 Pregnancies and deliveries

The proportion of 7-9 months gestation pregnant women reported by the CBSS in June 2001 was overall 76.5% of those identified by the survey and ranged from 58.1% in Pir Thnu to 80.6% in Preah Rumkel to 100% in Chan Mul communes (Table 23). Two pregnant women of 6 months gestation were misclassified as 7 months gestation by VHVs in Chan Mul commune. Concerning deliveries, the sensitivity of VHVs' reports in June 2001 was overall 82.4% in the three communes surveyed, and ranged from 70% in Pir Thnu to 100% in Chan Mul and Preah Rumkel communes (Table 24).

Table 23 Number of 7-9 months gestation women detected by household survey and VHVs, June 2001

Commune	7-9 months gestation women detected by:				
	Household survey	VHVs (June 2001)*			
		No.	TP	S	PPV
Chan Mul	18	20	18	100.0%	90.0%
Pir Thnu	31	18	18	58.1%	100.0%
Preah Rumkel	36	29	29	80.6%	100.0%
Total	85	67	65	76.5%	97.0%

* TP: True Positive; S: sensitivity; PPV: positive predictive value

Table 24 Number of deliveries detected by household survey and VHVs, June 2001

Commune	Deliveries detected by:				
	Household survey	VHVs (June 2001)*			
		No.	TP	S	PPV
Chan Mul	6	6	6	100.0%	100.0%
Pir Thnu	20	14	14	70.0%	100.0%
Preah Rumkel	8	8	8	100.0%	100.0%
Total	34	28	28	82.4%	100.0%

* TP: True Positive; S: sensitivity; PPV: positive predictive value

5.3.4.7 Deaths

The numbers of deaths reported by VHVs and identified by the survey in the 3 surveyed communes from July 2000 to June 2001 are shown in Table 25. Assuming that VHVs' reports and the survey missed death events independently, we can assume that about 5 deaths (4%) would have been missed by both the survey and the CBSS and that the sensitivity of the CBSS was 91% (See Appendix 2.13).

Table 25 Overall number of deaths in the three surveyed communes during the past year as detected by CBSS and household survey

		VHVs' reports		
		Deaths detected No. (%)	Deaths not detected No. (%)	Total No. (%)
Household survey	Deaths detected	61 (53.0)	6 (5.2)	67 (58.3)
	Deaths not detected	48 (41.7)	?	
	Total	109 (94.8)		115 (100.0)

The 48 deaths reported by the CBSS in the three communes surveyed but missed by the survey included 20 (42%) who died below one year including 8 died within the first week of life; 7 (15%) died between 1-4 years of age; 6 (12%) died between 5 and 14 years old; and 15 (31%) died at 15 years and above. The lower sensitivity of the survey in detecting death events might be explained in part by recall bias and high population movement in the border communes for economic reasons. It is also plausible that the respondents may deliberately omit mention of deaths, especially in very young children.

5.3.4.8 Tetanus vaccination

VHVs' reports of at least two doses of tetanus vaccination coverage among 7-9 month gestational age pregnant women (PW) in the three communes surveyed were found to be 12% to 22% higher than the survey's findings (Table 26). This discrepancy may be explained by the fact that (1) pregnant women not captured by the VHVs were less likely to be vaccinated; and (2) there were problems in confirming

vaccination status of women in some of these communes where the proportion of cards lost was quite high, especially in Preah Rumkel commune.

Table 26 TT2+ Coverage among 7-9 months gestation pregnant women

Commune	Survey findings			VHVs' reports	
		TT2+ Among PW			TT2+ Among PW
	No. of PW	Reported* No. (%)	Card only No. (%)	No. of PW	No. (%)
Chan Mul	18	14 (77.8)	13 (72.2)	20	20 (100.0)
Pir Thnu	31	6 (19.4)	5 (16.1)	18	6 (33.3)
Preah Rumkel	36	28 (77.8)	13 (36.1)	29	26 (89.7)
Total	85	48 (56.5)	31 (36.5)	67	52 (77.6)

* TT2+ reported by women with or without vaccination card; PW: pregnant women

Concerning women who delivered in June 2001 (i.e. "past month"), the survey found an overall TT2+ coverage of 52.9% and 41.2% in the three communes surveyed as reported by mothers and certified by vaccination cards respectively (Table 27). The TT2+ coverage of over 80% among mothers was found for Chan Mul and Preah Rumkel communes, which was close to VHVs' reports for pregnant women (See Table 26).

Table 27 TT2+ coverage among women who delivered during last month

Commune	Number of deliveries	Tetanus vaccination: at least 2 doses	
		Mothers response No. (%)	Vaccination card No. (%)
Chan Mul	6	5 (83.3)	5 (83.3)
Pir Thnu	20	6 (30.0)	4 (20.0)
Preah Rumkel	8	7 (87.5)	5 (62.5)
Total	34	18 (52.9)	14 (41.2)

5.3.4.9 Overall sensitivity and PPV by commune

The sensitivity of VHVs' reporting of all cases of communicable diseases/ syndromes monitored by the CBSS was overall 80%, and was not significantly different amongst the three communes surveyed (P-value=0.28) (Table 28).

Table 28 Sensitivity of VHVs' reports on communicable diseases/syndromes by commune, household survey and outbreak investigations

Commune	Cases reported by VHVs	Cases missed by VHVs	Cases detected by survey & investigations
	No. (%)	No. (%)	No. (%)
Chan Mul	71 (84.5)	13 (15.5)	84 (100.0)
Pir Thnu	91 (75.2)	29 (24.5)	120 (100.0)
Preah Rumkel	46 (82.1)	10 (17.9)	56 (100.0)
Total	208 (80.0)	52 (20.0)	260 (100.0)

Chi-square= 2.54, degree of freedom=2; P-value=0.28

The sensitivity of VHVs' reporting on vital events in June 2001 was overall 78% but differed significantly between communes (P-value=0.0006), with all pregnancies and deliveries reported in Chan Mul commune, eight out of ten vital events reported by VHVs in Preah Rumkel commune, and fewer than two-thirds reported by VHVs in Pir Thnu commune (Table 29).

Table 29 Sensitivity of VHVs' reports on pregnancies (7-9 months gestation) and deliveries by commune, June 2001

Commune	Events detected by VHVs	Events not detected by VHVs	Events detected by household survey
	No. (%)	No. (%)	No. (%)
Chan Mul	24 (100.0)	0 (0.0)	24 (100.0)
Pir Thnu	32 (62.7)	19 (37.3)	51 (100.0)
Preah Rumkel	37 (84.1)	7 (15.9)	44 (100.0)
Total	93 (78.2)	26 (21.8)	119 (100.0)

Chi-square= 14.7, degree of freedom=2; P-value=0.0006

On the other hand, the PPV of VHVs' reporting of all cases of communicable diseases/syndromes monitored by the CBSS was overall 88.5%, highest in Chan Mul and lowest in Preah Rumkel commune but the difference was not statistically significant (P-value=0.052) (Table 30).

Table 30 PPV of VHVs' reports on communicable diseases/syndromes by commune, household survey and outbreak investigations

Commune	Cases classified as "True positives"		Cases classified as "False positives"		Total cases reported by VHVs	
	No.	(%)	No.	(%)	No.	(%)
Chan Mul	71	(95.9)	3	(4.1)	74	(100.0)
Pir Thnu	91	(89.2)	11	(10.8)	102	(100.0)
Preah Rumkel	46	(78.0)	13	(22.2)	59	(100.0)
Total	208	(88.5)	27	(11.5)	235	(100.0)

Chi-square= 10.5, degree of freedom=2; P-value=0.052

5.3.5 Representativeness

Representativeness refers to the capability of a surveillance system to correctly portray a disease or other health-related event by time, place and person (CDC 2001). The CBSS provided highly representative information on vital events in many communes during the preceding year. Whereas almost all deliveries and deaths which occur at home in the rural area and are missed by the formal HIS, the CBSS can provide a good estimate of births and deaths in the communities. For instance, the infant and under-five child mortality rates calculated from data reported by the CBSS in the seven communes from July 2000 to June 2001 were 84 and 112 per 1000 live births respectively. These figures are close to those of the National Health Survey that estimated an infant and child mortality rate of 89 and 115 per 1000 live births respectively in 1998 (NIPH 1999). Likewise, information on delivery places generated by the CBSS is concordant with the findings of the National Health Survey.

The CBSS was found to provide quite representative data on major infectious diseases in two out of the three communes surveyed. The survey found in the three communes that during June 2001 around one-third of patients surveyed had used

health facilities for their treatment, and were therefore included in reports by the formal disease surveillance system (Table 31). The CBSS, for its part, had captured around 80% of all cases of specific infectious disease detected by the survey (See Table 28). VHVs, however, did not reach all the population in their catchment's area, especially in Pir Thnu commune where households are widely spread. In Preah Rumkel commune some households which temporarily moved to their rice fields during the rainy season were beyond VHVs' reach; nevertheless, they generally came back to the village when ill and for deliveries.

Table 31 Uses of public health facilities, household survey July 2001

Commune	All cases (1)		CBSS target diseases(2)*	
	Total No. cases	Cases using PHF No. (%)	Total No. of cases	Cases using PHF No. (%)
Chan Mul	161	98 (60.9)	38	23 (60.5)
Preah Rumkel	161	54 (33.5)	64	28 (43.8)
Pir Thnu	297	42 (14.1)	87	12 (13.8)
Total	619	194 (31.3)	189	63 (37.3)

(1): Chi-square=106.4, degree of freedom=2, P-value<0.001;

(2): Chi-square=30.7, degree of freedom=2, P-value<0.001; * CBSS target diseases: Malaria, measles, chronic cough, acute severe diarrhoea and hemorrhagic fever.

5.3.6 Timeliness

Timeliness refers to "the speed between different steps in a public health surveillance system" (CDC 2001). The CBSS was designed to reduce as much as possible delays between its different steps, with the main objective of facilitating rapid detection of outbreaks in remote communities by local people (VHVs) and to timely responses to the outbreaks by local staff. Although the CBSS collects data on a monthly basis, suspected outbreaks are to be immediately reported. For data to be collated, analysed and fed back to all key stakeholders of the system and decisions made to respond based on the information, it took only one day a month, the same day that health centre and OD staff received the VHVs' reports and met with them

(monthly meeting). There are therefore practically no delays between data reporting, collation, analysis, feedback and decision-making.

Among measles outbreak reports investigated and documented during the prceding year, the period from rash onset to reporting was on average five to six days. Investigations of outbreaks by local health staff took place one to two days after their receiving the report (Table 32). With regard to acute severe diarrhoea, the delay from onset to reporting was on average three days and from reporting to investigation one to two days. Treatment was provided during the investigations but no stool specimens were taken for laboratory testing.

Table 32 Delays in the reporting and investigation of measles, Cambodia Rural CBSS, 2000-2001

Commune	Cases detected by investigations	Average delays (in days) of:	
		Reporting (VHVs)	Investigation (Staff)
Chan Mul	46	5.5	1.0
Pir Thnu	33	4.9	1.6

Source: Investigation reports, Cambodia Rural CBSS, July 2000-June 2001

5.3.7 Stability

The stability of a public health surveillance system refers to its "reliability (i.e. the ability to collect, manage, and provide data properly without failure) and availability (the ability to be operational when it is needed)" (CDC 2001).

During its first year of operation, only 1 (2%) out of 56 VHVs were replaced for reasons of advanced pregnancy, and all staff at the health centre level and most staff at the OD level remained active. Also apart from a staff from Kompong Cham province who became unavailable during 2001 because of other commitments, all participants from the PHD have been regularly involved in the supervision and support of the CBSS team at the commune level.

Monthly feedback meetings have been regularly held every month in all project sites without disruption, including VHVs' training. Supervision by the NIPH and PHD staff was conducted as planned, that is every month during the first 6 months of the implementation of the system and in every quarter subsequently.

5.4 Cost and effectiveness

Walt (1988) pointed that, "While the effectiveness of a CHW programme might be best assessed by changes in mortality and disease prevalence in the community, it is notoriously difficult to design evaluations that can demonstrate causal relationships between CHW inputs and decreases in mortality and morbidity". In addition, it is difficult to evaluate the cost and effectiveness of any project without comparing areas with and without the interventions involved. Nevertheless, in the absence of valid data from communes similar to the project communes, an attempt has been made to cost data that was gathered by the CBSS but missed by the existing formal disease surveillance and HIS in place.

5.4.1 Cost

Table 33 presents the cost of the CBSS by category of expense. The cost of the Cambodia Rural CBSS was approximately US$14,000 during the first year of its implementation, including initial costs of the development of the system, such as the feasibility study, selection of staff and volunteers, and initial training as well as costs related to the implementation of the system from July 2000 to June 2001 inclusive.

Table 33 Cost of the Cambodia Rural CBSS broken down by category of expense, 2000- 2001

Category	Description	Unit	Unit cost (US$)	Annual cost (US$)
Feedback meeting	Per diem, including travel cost for VHVs & health staff	Month	500	6,000
Materials and supplies	Forms, registers, stationery, travel cost for immediate report and field investigations	Month	100	1,200
Supervision	NIPH and provincial staff: monthly in the first 2 quarters then every 3-month (8 trips a year)	Trip	600	4,800
Develop-ment	Feasibility study, selection of staff and VHVs, initial training	Quarter 2-3, 2000		2,000
Total				14,000

Table 34 shows workloads and sources of funding of the Cambodia Rural CBSS, in which VHVs spend around three days a month doing data collection, health education and promotion in their village as well as attending the feedback meeting at the commune health centre. VHVs were paid only for their attendance at the monthly feedback meetings. Apart from the cost of sending immediate reports, if any, to the health centre, activities undertaken at the village level, including household visits for data collection and health education, were voluntary.

Table 34 Workloads and sources of funding for VHVs activities in the Cambodia Rural CBSS, 2000-2001

Activities	Workload	Cost	Resources
Data collection	1-2 day/ month (Household visits: 2-4 times of half-day each)	(VHVs' time)	VHVs (Voluntary work)
Feedback & training meeting	1 day / month	-Travel and food -Forms and stationery	Project (EC)
Immediate report of outbreaks	Occasional	-Sending alert form (Transportation)	Project (EC)
Health education, social mobilisation, referrals	Half-day/month (Health staff outreach activities) and while collecting data	(VHVs' time)	VHVs (Voluntary work)

5.4.2 Effectiveness

Tables 35 and 36 show the frequency of disease cases and vital events which remained at home and those that had been in contact with the health facilities as reported by VHVs in the project communes from July 2000 to June 2001. The total number of cases reported by VHVs as remaining at home was 2,769; when multiplied by an overall estimated 88.5% PPV 2,450 cases remained at home as true cases. These cases when added to 227 deaths and 820 deliveries reported to have taken place at home make a total of 3,497 cases of diseases and vital events which remained at

home that were captured by the CBSS in addition to the 1,174 (i.e. 1,149 cases and 25 deliveries) that were in contact with and reported by health facilities.

Table 35 Cases reported by VHVs by place of treatment, July 2000- June 2001

Events	Place of treatment		
	Health facilities	Home	Total
	No. (%)	No. (%)	No. (%)
Malaria	785 (32.5)	1,633 (67.5)	2,418 (100.0)
Chronic cough	364 (33.8)	712 (66.2)	1,076 (100.0)
Measles, Neonatal tetanus, Severe diarrhoea, Haemorrhagic fever	0 (0.0)	423 (100.0)	423 (100.0)
Total	1,149 (29.3)	2,768 (70.7)	3,917 (100.0)

Source: VHVs' monthly reports, all CBSS communes, July 2000- June 2001

Table 36 Vital events reported by VHVs by place, July 2000-June 2001

Vital events	Place of occurrence		
	Health facilities	Home	Total
	No. (%)	No. (%)	No. (%)
Deaths	0 (0.0)	227 (100.0)	227 (100.0)
Deliveries	25 (3.0)	820 (100.0)	845 (100.0)
Total	25 (2.3)	1,047 (97.7)	1,072 (100.0)

Source: VHVs' monthly reports, all CBSS communes, July 2000- June 2001

5.4.3 Cost-effectiveness Analysis

The cost-effectiveness ratio used for this analysis had a numerator representing the sum of all costs associated with developing and implementing the CBSS in the seven border communes of Cambodia and a numerator representing the numbers of health events detected by the system. Compared with a total annual cost of about US$14,000 for the implementation of the project in the seven communes,

this will give an estimate of US$4.0 (14,000/3,497=4.0) per extra case of events captured by the system.

It is important to mention that costs for buildings and their maintenance, furniture, and utilities as well as the cost of referral trips to hospital were not included in these calculations. In addition, salaries of health staff as well the value of VHVs' voluntary work in their village were not included.

On the other hand, monthly supervision trips undertaken by the investigator and provincial staff alone cost as much as the monthly operational cost of the system run by local health staff and the VHVs due to the very remote location of the four project sites from Phnom Penh where the investigator lives. In the following years, without initial development cost and with reduced trips for supervision from the provincial and central levels the operational cost of the CBSS in the same seven communes would be reduced to below US$10,000 a year. In addition, the overall costs of the system would be much lower if the system was implemented on a large scale in rural Cambodia because transportation costs would be lower as the remainder of the country is less or no more remote than the areas in the CBSS project, and the system is so flexible that it can be adapted for use in other rural areas with little additional cost. However, complex judgements may be required in the partition of overheads.

Finally, the CBSS was more cost effective than the survey conducted in the three communes, which cost about US$ 4,000 and detected 224 cases of diseases and vital events that were not reported by health facilities. Hence, the cost for an extra case detected by the survey was thus about US$17.90, with is four times higher than the cost under the CBSS for each extra case detected. In addition to high costs, surveys could not effectively detect outbreaks, monitor disease trends, or provide health education to the population compared with the CBSS (Figure 40).

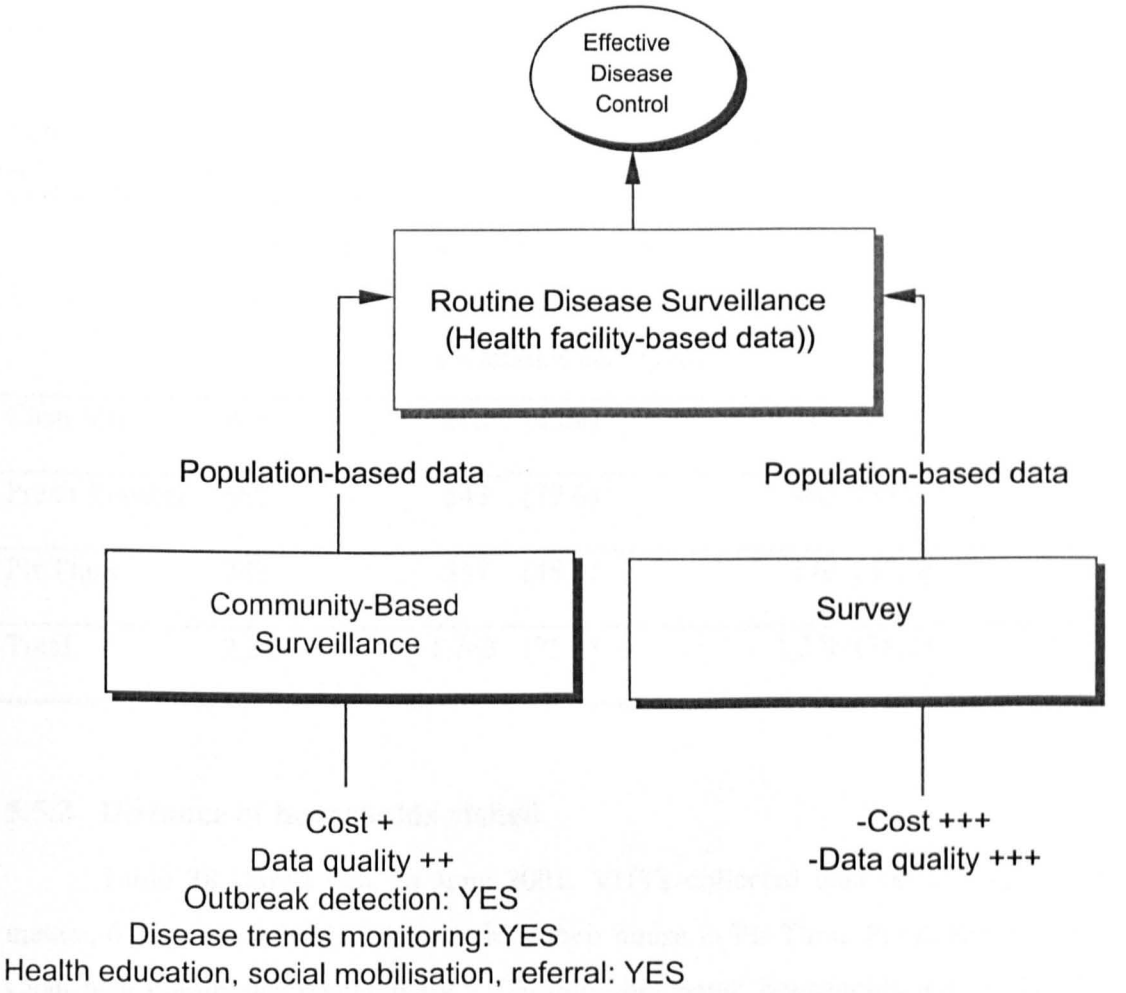


Figure 40 Cost and effectiveness of CBS and survey as complements to the routine surveillance system for strengthening effective disease control and prevention

5.5 Performance of VHVs in the Cambodia Rural CBSS

The performance of VHVs in the Cambodia Rural CBSS varied between communes and within VHVs, with some VHVs more active than others and some villages less accessible than others.

5.5.1 Frequency of data collection

VHVs revealed that in general they visited households on average two to three times a month. The survey conducted in July found that over all communes surveyed 76% of all households investigated had been visited by VHVs in the month prior to

the survey. Among households visited, 78 % were visited at last two times. More complete and frequent data collection was observed in Chan Mul and Preah Rumkel communes than in Pir Thnu commune (Table 37).

Table 37 Frequency and coverage of data collection, households survey July 2001

Commune	Total No. of households surveyed	VHVs' visits during June 2001	
		No. of households visited (% total households surveyed)	Households visited at least twice a month No. (%)
Chan Mul	905	863 (95.4)	743 (86.1)
Preah Rumkel	682	543 (79.6)	465 (85.6)
Pir Thnu	742	357 (48.1)	170 (47.6)
Total	2,329	1,763 (75.7)	1,378 (78.2)

5.5.2 Distance of households visited

Table 38 shows that, in June 2001, VHVs collected data on average 1,100 meters, 620 metres, and 260 meters from their house in Pir Thnu, Preah Rumkel, and Chan Mul communes respectively. On the other hand, households not reached by VHVs during that month were most remote in Pir Thnu commune where three-quarter of them lived up to five kilometres from the VHV's house. Table 38 also shows that almost households in Chan Mul commune were very close to VHVs' house, which may partly explain why most households were covered by the VHVs' data collection in June 2001. On the contrary, many households in Pir Thnu commune were very far away from the VHV's house, which would have inhibited VHVs collecting data from all households in the commune.

Table 38 Estimated distance of from VHV's house of households visited and not visited by VHVs during June 2001, household survey July 2001

Commune	Estimated distance from VHV's house of households:		
	Visited by VHVs	Not visited by VHVs	Total
Chan Mul	Mean= 260m Median= 130m 75%= 300m	Mean= 500m Median= 300m 75%= 900m	Mean= 270m Median= 130m 75%= 300m (Max. 2,000m)
Preah Rumkel	Mean= 620m Median= 350m 75%= 1,000m	Mean= 1,000m Median= 700m 75%= 1,500m	Mean= 700m Median= 400m 75%= 1,000m (Max. 5,000m)
Pir Thnu	Mean= 1,100m Median= 250m 75%= 700m	Mean= 3,000m Median=1,100m 75%= 5,000m	Mean= 2,100m Median= 500m 75%= 5,000m (Max.= 10,000m)

5.5.3 Referral of patients

Table 39 shows that, in June 2001, about two-third of all patients, regardless of cause or age group, who came to PHF in Preah Rumkel and Chan Mul communes were referred by VHVs compared to about only one-third in Pir Thnu commune.

Table 39 Distribution of patients ever treated at PHF during June 2001 by type of their referee/ advisor, household survey, July 2001

Commune	Cases ever treated at PHF and advised/referred to by:		
	VHVs No. (%)	Others No. (%)	Total No. (%)
Chan Mul	65 (65.7)	34 (34.3)	99 (100.0)
Preah Rumkel	36 (66.7)	18 (33.3)	54 (100.0)
Pir Thnu	16 (38.1)	26 (61.9)	42 (100.0)

(Chi-square test= 10.72, degree of freedom=2, p value=0.004)

5.5.4 Characteristics of VHVs:

Elected VHVs in Pir Thnu commune collected data through household visits apparently less frequently than non-elected VHVs in other communes (See Table 37). Also, patients using PHF were referred by elected VHVs significantly less often than by non-elected ones (See Table 39).

Female VHVs in Preah Rumkel commune performed CBS activities relatively well compared to their male colleagues in Chan Mul commune including data collection and reporting, and patients' referrals (See Tables 37-39).

Finally, *VHVs' occupation* was not found to make any difference to their CBS activities. TBAs in Preah Rumkel commune performed quite well in the CBSS as did farmers in Chan Mul commune (See Tables 37-39); and VHVs who were village headmen in Chan Mul commune did not perform better than their farmer colleagues in frequency of data collection and in referrals of patients to PHF (Tables 40 and 41).

Table 40 Frequency of data collection in Chan Mul commune by different category of VHVs, household survey July 2001

Villages in Chan Mul commune where VHVs were:	Frequency of data collection during the past month					
	3 times and more		Less than 3 times		Total	
	No.	(%)	No.	(%)	No.	(%)
Headman	423	(68.4)	195	(31.6)	618	(100.0)
Farmer	182	(74.3)	63	(25.7)	245	(100.0)

(Chi-square test= 2.85, degree of freedom=1, p value=0.091)

Table 41 Distribution of patients ever treated at PHF in Chan Mul commune during June 2001 by types of their referees/ advisors, household survey July 2001

Villages in Chan Mul commune where VHVs were:	Cases ever treated at PHF and referred to by:					
	VHVs		Others		Total	
	No.	(%)	No.	(%)	No.	(%)
Headman	48	(64.0)	27	(36.0)	75	(100.0)
Farmer	17	(70.8)	7	(29.2)	24	(100.0)

(Chi-square test= 0.38, degree of freedom=1, p value=0.539)

6 DISCUSSION

The study attempted to demonstrate that a CBS system, when appropriately designed, could fill significant gaps in the current disease surveillance system in providing adequate, representative and timely information on important infectious diseases and vital events in rural communities for effective disease and outbreaks control and prevention. It was anticipated that empowered peripheral health staff together with local people would be able and willing to collect, analyse, and use data to effectively monitor and address priority health problems in their communities.

This section will review the performance of the system, give possible explanations about the underlying factors, examine the cost and sustainability of the system, identify its implications, and propose some recommendations for future research and practical application.

6.1 Nature and use of CBS

There are many approaches to CBS ranging from those action-oriented to those information-oriented. At one extreme, CBS is used as a means to involve local people in community-based actions to protect and promote the population's health and prevent and control diseases and other health-related problems in the community. In this situation, VHVs and sometimes the whole community participate with local health staff in data analysis and/ or interpretation as well as in decision-making and follow-up action. Data quality is less important than community action. For instance, the SECI project in Bolivia involved VHVs, community members and local health staff in the analysis and use of community and health facility-based data to improve health services and the population's health behaviours; and the Tanzania maternal and perinatal surveillance system also involved village leaders and health staff in data review and action planning (Howard-Grabman 2000; Kilonzo *et al.* 2001).

At the other extreme, CBS may be designed to obtain adequate and accurate community-based information needed for proper monitoring and evaluation of interventions or projects implemented and run by national programmes or NGOs. Data collected by local people are compiled and analysed by skilled project or

programme staff at regional or central level. Community members including VHVs and even local health staff are not involved at all in data analysis and decision-making. This situation is seen in vertically run programmes such as guinea worm eradication in Africa, and malaria control in Latin America and Southeast Asia (Cairncross *et al.* 1996; Okanurak and Sornmani 1992; RuebushII *et al.* 1994).

The Cambodia Rural CBSS, however, focuses on both data quality and community action to provide adequate and valid community data in a timely fashion that otherwise cannot be obtained by routine disease surveillance and the HIS. More expensive periodic population surveys can also provide community data but cannot provide timely information on clustering of cases in order to early detect outbreaks, as can the CBSS. The ultimate objective of the Cambodia Rural CBSS is to obtain both community level health information as well as remedial action through informed community participation. The Cambodia Rural CBSS therefore uses locally collected information to drive community action by local health staff and people. Its approach is quite different from the one used in many projects and programmes in which VHVs are trained to undertake pre-defined activities or services in the community, such as health education, family planning, mobilisation of women and children for immunisation etc., or presumptive treatment of common illness such as malaria.

6.2 System performance

6.2.1 Usefulness

The Cambodia Rural CBSS has provided rapid information on time-space clustering of major communicable diseases, thus enabling health staff to rapidly detect outbreaks of these diseases. In addition, the system has enabled health staff and VHVs to regularly monitor the occurrence and distribution of major infectious diseases and vital events in the communities, tetanus immunisation coverage among pregnant women, and in addition the use of health facilities by the population. Cutts *et al.* (1993) underlined that "the immediate analysis and use of information at the most peripheral level is characteristic of a useful information system", which is the case of the Cambodia Rural CBSS in which data were rapidly fed back and used by local health staff and VHVs.

Other CBS systems reviewed were reported to be more or less achieving their objective in significantly contributing to the eradication or control of diseases or malnutrition. Ruebush *et al.* in 1992 reported that the VHVs of Latin America accounted for the majority of malaria cases detected and treated. In addition, Okanuak *et al* (1996) reported a 30-fold reduction of the number of malaria cases within 13 years of the operation of the VHVs in El Savador. However, it should be noted that none of the CBS Systems reviewed was able to give information on the utilisation of health services. This is important for any health project intended to boost the quality and coverage of public health facilities. NGOs usually address this issue through cross-sectional surveys, which are expensive, time consuming and in any case unable to monitor the trends of health services utilisation on a regular basis for prompt corrective action.

Most importantly, the Cambodia Rural CBSS has successfully triggered prompt corrective actions from both local health staff and VHVs, which have resulted, for example, in the increased use of health services, higher vaccine coverage, and in effective control of outbreaks. For instance, coverage of tetanus toxoid, which can confer protection for mother and children with just two doses, was increased two to three fold in all but Pir Thnu commune within less than one year of the implementation of the Cambodia Rural CBSS. This coverage, around 70% in June 2001, clearly exceeded the average national coverage of 31% of pregnant Khmer women who had two immunisations against tetanus (UNICEF 1998) and is on it way to reaching even higher coverage rates and maternal and neonatal tetanus in these areas can be expected to drop significantly even though most women still deliver at home with untrained birth attendants. Furthermore, the increase noted in the proportion of malaria patients using health facilities in several communes can also be partly attributed to VHVs' efforts to improve the population's health seeking behaviour and to health staff's efforts in improving the quality of their services in response to information generated by the CBS system. In contrast, in many CBS systems corrective actions are delayed because they have to be initiated by national programme staff who analyse data and make decisions at a higher level in the health system.

6.2.2 Timeliness

In the Cambodia Rural CBSS, there are practically no delays between data reporting, collation, analysis, feedback and decision-making. All of these processes take place in one day, at the monthly feedback meeting. For outbreaks detection, clusters of cases are to be immediately reported. Last year, measles outbreaks were reported within a week from rash onset and clusters of acute severe diarrhoea within 3 days.

In the other CBS systems reviewed, the frequency of data reporting ranged from one week to 2-3 months, and information feedback took 1-2 months or longer. VHVs in the KSCSP in Cambodia, however, reported measles outbreaks to the project on average 5 days after rash onset, slightly shorter than reported by the Cambodia Rural CBSS (Oum 2000a).

6.2.3 Representativeness

The information generated by the Cambodia Rural CBSS during the first year of its operation was quite representative of the health situation in rural and remote Cambodia with respect to occurrence over time and distribution by village and person characteristics. The infant and under-five mortality rates were found to be similar to the findings of the National Health Survey for isolated areas for 1998. Data from all villages were regularly reported, no matter how far they were from the health centre and no matter whether people used public health care facilities. Data on people too far from the VHVs' home were missed, however, especially in Pir Thnu commune where villages are large and households widely spread.

6.2.4 Sensitivity

6.2.4.1 Diseases

The proportion of cases reported by VHVs in June 2001 as evaluated by the survey was overall 80% and ranged on average from 66% for clinical malaria to 75% for chronic cough to 83% for acute severe diarrhoea, and to over 90% for measles. The sensitivity of case reporting for each disease also varied by commune, with in general the highest proportion of cases in the community reported in Chan Mul commune, followed by Preah Rumkel and by Pir Thnu commune.

The sensitivity of case reporting in the Cambodia Rural CBSS is lower than that of the CBS system in tribal areas in Tamil Nadu, India where 99% of chest

symptoms were detected by VHVs (Balasubramanian *et al.* 1995). However, it is higher than the KSCSP in Cambodia, where only 61% of cases of measles were reported by VHVs; and much higher than CBS systems in the Philippines and Thailand where only 9% and 24% of malaria cases were detected by VHVs respectively. (Lariosa 1993; Okanurak and Ruebush 1996; Oum 2000a) The very high sensitivity of chest symptoms reporting in tribal India appears to be linked with remote areas, small size of the hamlets and active surveillance (Balasubramanian *et al.* 1995). The lowest sensitivity for malaria, in Thailand and the Philippines, can be attributed to passive surveillance in which VHVs only report malaria cases that come to them for treatment as well as larger scale implementation of the surveillance system in these countries. In the Cambodia Rural CBSS, large villages and wide spread of households in Pir Thnu commune may explain the relatively low sensitivity of case reporting in this commune due to the difficulty for VHVs to reach households distant from their house.

6.2.4.2 Vital events

Concerning the sensitivity for vital events reporting, VHVs in two of the three communes surveyed, namely Preah Rumkel and Chan Mul communes, reported almost all pregnant women and deliveries in June 2001. VHVs in Pir Thnu commune, however detected only 58% of pregnant women and 70% of deliveries in their commune during the same period, because households are widely spread out in geographically large villages. There is no information available for comparison purpose on the sensitivity of VHVs' reporting on pregnancies and deliveries in other CBS systems reviewed.

The sensitivity of death reporting in the Cambodia Rural CBSS was overall around 90%. A similar sensitivity for reporting of deaths by VHVs was seen in the KSCSP project in Kean Svay district where every death was investigated by the project team within an average of two weeks. In that district, it was found that 392 (91%) of the total 431 deaths of children under five occurring from 1997 to mid-2000 were reported by the project VHVs, while the remaining 39 deaths (9%) were reported by others including health staff (Oum 2000a).

6.2.5 Positive predictive value

The overall PPV in the Cambodia Rural CBSS was found to be 88.5%, ranging from over 80% for severe diarrhoea, almost 90% for malaria and chronic cough, and 90% for measles. However, a slightly higher PPV was reported in other CBS systems: 98% PPV for measles in KSCSP, Cambodia; and 94% PPV for chest symptoms in the tribal area of Tamil Nadu, India (Balasubramanian *et al.* 1995; Oum 2000a).

6.3 Underlying factors of the system performance

The performance of the Cambodia Rural CBSS is linked to the importance of events monitored, the system design and its key players.

6.3.1 Events under surveillance

Events monitored by the Cambodia Rural CBSS were multiple, important, needed and relatively easy for local people to identify. The diseases/ syndromes to be reported were the main important communicable diseases in the rural areas in terms of severity, burden and/or epidemic potential. These diseases/ syndromes are all targets of national control programmes. Births and deaths on the other hand constitute much needed information for appropriate planning of disease control and prevention activities. All these events have greatly drawn the interest of health staff and VHVs who are the end users of the data they collect.

6.3.2 System design and management

The system design, including two-way flow of information, instant feedback, local use of data, and simplicity as well as its decentralised management contributed extensively to the success of the operation of the CBSS in the border communes of Cambodia. The monthly feedback meeting is a unique feature of the Cambodia Rural CBSS and is crucial for its success (Figure 41). It enables information to be fed back to all participants of the system and decisions to be made to address identified issues within the same day of data reporting and minimises health staff's related workload as well. This process has challenged all participants to together take necessary remedial action, the results of which can be closely monitored by them at the next monthly feedback meeting. The system has therefore overcome constraints that have

hampered many previous CBS systems including delayed feedback and non-participation of local health staff and communities in data analysis, decision-making and action-taking. Additionally, the feedback meeting provides opportunity for continuing training of VHVs and health staff, thereby contributing to the improvement of the system.

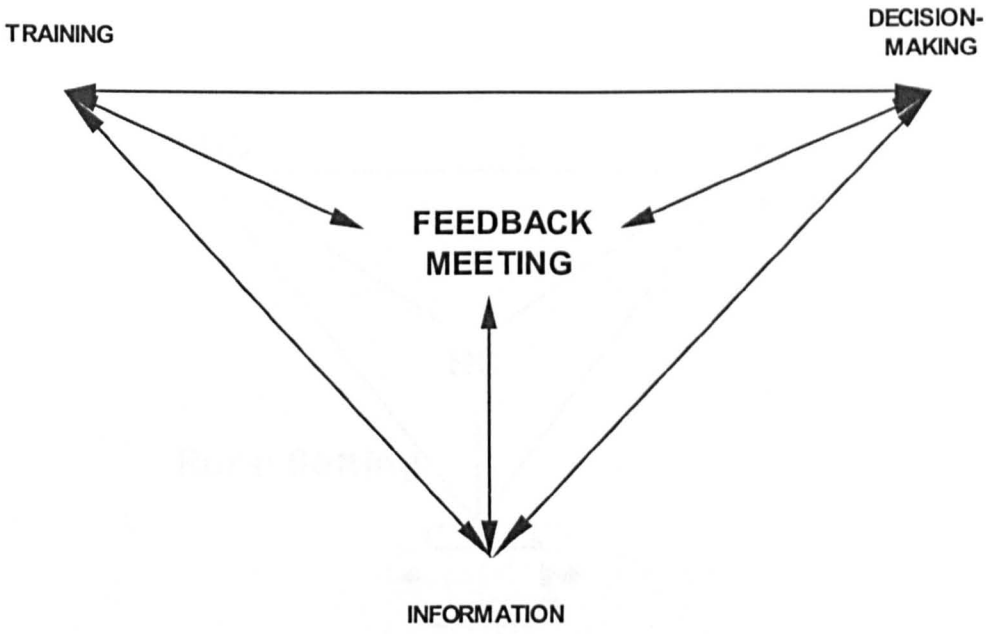


Figure 41 Roles of feedback meetings in the Cambodia Rural CBSS

The Cambodia Rural CBSS and other CBS systems in which data are actively collected through periodic home visits yield a higher proportion of cases reported than passive data collection surveillance systems. The use of tally sheets to record and report events is most appropriate for semi-literate VHVs in remote areas and helps to reduce errors in data collection. Furthermore, a CBS system which is developed with local participation and locally managed is likely to be more effective than vertically-run programmes and projects developed and implemented by national, international or non-governmental organisations. For example, in Nigeria "fake" reports on Guinea worms cases were discovered and local participation and compliance were such that only two-third of villages regularly sent the surveillance report on guinea worm to the MoH (Brieger *et al.* 1996).

6.3.3 Key players

VHVs as well as OD and health centre staff - with technical support from the NIPH and PHD- played the central role in the operation and management of the Cambodia Rural CBSS. The interaction between these key players led to an effective CBS system in the rural setting (Figure 42).

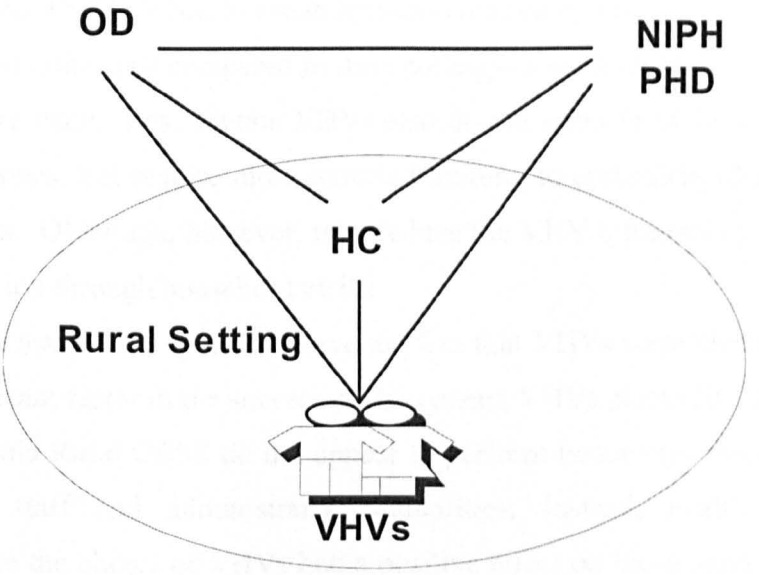


Figure 42 Key players and their interaction within the Cambodia Rural CBSS

6.3.3.1 VHVs

VHVs play a tremendous role in the Cambodia Rural CBSS by acting as the 'eyes and ears' for the health centre in the community as well as by helping health staff in disease prevention and control in their community. They have shown great ability to accurately identify health events to be reported, as illustrated by the high PPV of the data of many diseases/syndromes. They have proved willing and active in both data collection and outbreak reporting, and enthusiastic in undertaking educative and promotive actions to improve the population's health. In other CBS systems, the willingness and performance of volunteers varied. In Thailand, Malaysia and the Philippines many VHVs initially involved in nutritional surveillance later either dropped out or became inactive (Manderson 1992a; Okanurak and Ruebush 1996). In contrast, the dropout rate of VHVs in Tigray, Ethiopia, was minimal (Lariosa 1993).

In the Cambodia Rural CBSS only one (2%) out of the initially trained 56 VHVs was replaced within one year of the system operation.

VHVs' personal characteristics and personality were critical factors affecting the success of CBS systems reviewed. For instance, some *occupations* are likely to perform better than others in data collection and community development. In the Cambodia Rural CBSS, however, there was no significant difference between VHVs who were TBAs, village headmen or farmers in the frequency of data collection or health education/social mobilisation. Similarly, *Gender* was found not to be an issue in the Cambodia Rural CBSS. In Preah Rumkel commune, VHVs were all female and they performed quite well compared to their colleagues in Chan Mul commune where all VHVs were male. Less literate VHVs also do not seem to be less effective than more literate ones, but require more repeated training to accurately identify diseases and conditions. Older age, however, may reduce the VHV's frequency and coverage of data collection through household visits.

Unlike many CBS systems where the fact that VHVs were elected was found to be an important factor in the success of the system, VHVs elected by the population in the Cambodia Rural CBSS do not appear to perform better than those selected by local health staff and administrative authorities. Instead, health centre staff participating in the choice of VHVs had a positive effect on these latter because they must work with and support them in the implementation of a CBS system for which they are accountable.

Like most CBS systems reviewed, VHVs in the Cambodia Rural CBSS are all *resident* in the village where they serve and many are also well known and well liked such as TBAs in Preah Rumkel commune; these tend to be more active in data collection and more powerful in creating local awareness of communicable disease issues among villagers.

Most importantly, the way VHVs are involved in the CBS system had a great influence on their motivation and performance. VHVs who are requested to collect and report data to health staff are likely to do it poorly if they do not see the meaning of their activities. This problem was reported in some CBS systems such as in Saradidi, Kenya, where many VHVs did not regularly submit their reports because they "did not clearly understand the use of the information on which they were supposed to report" (Kaseje *et al.* 1987b), and in Nigeria where one third of VHVs did not send regularly their report (Brieger and Kendall 1992). On the contrary, the

success of the CBSS in Cambodia and other countries such as Bolivia can be attributed mainly to the fact that VHVs not only participate in the analysis of data they collect, but also in deciding on follow-up action to take (Howard-Grabman 2000). In these CBS systems, VHVs do not only 'see' the meaning of data they collect but 'use' the information drawn from their data to improve the health status of their community members.

6.3.3.2 Health staff

Local health staff have a very important role in data management, analysis and feedback as well as in outbreak investigation and control. In the Philippines CBDDS system, health centre staff are expected to investigate outbreaks of EPI target diseases as well as give feedback to the community (Kalter 1999). Local health staff have positively influenced VHVs' work in the CBS systems in Cambodia and elsewhere through their supportive supervision and commitment (Okanurak and Ruebush 1996).

In the Cambodia Rural CBSS, OD and health centre staff have shown great ability in disease surveillance. They are keen and able to learn and apply basic epidemiology in data collation and analysis as well as in field investigations. Professional backgrounds of staff seem not to be a decisive factor for an effective CBS system. The health centre team in Pir Thnu commune, led by a doctor, appears not to perform better than other health centres' staff led by nurses. Nurses and medical assistants at decentralised levels have proved that they are able to learn and apply epidemiology as well as those with higher medical qualifications from the MoH or national programmes. In the two-week field epidemiology training with national level participants in March and April 2001, it was amazing to observe that OD staff obtained higher scores than many national programme staff. Furthermore, OD and health centre staff are very proud to be able to make use of surveillance data locally, when previously they had only forwarded it to the upper levels of the health system.

Health centre staff play an essential role in the system through data management, analysis and presentation as well as through disease, death and outbreak investigations. OD staff, on the other hand, have a pivotal role in the management of the system including supervision and support to the health centre team. They acknowledge the contribution of VHVs in disease surveillance, control and prevention and are eager to listen to them to improve the quality and coverage of their health services.

6.3.3.3 Institutes and PHC projects

An important factor for the success of some CBS systems is their linkage with national institutes or universities for technical support and backup (O'Neil 1993). The CBS system in Saradidi, Kenya, for instance was linked to the African Medical Research Foundation for technical guidance and advice during the initiation process as well as for the training of trainers (Kaseje *et al.* 1987b). Likewise, the NIPH provides the Cambodia Rural CBSS with training and supervisory support. The integration of the CBSS with the EC-RMCP, on the other hand, provides ongoing financial assistance for malaria control interventions.

6.3.4 Constraints

There were some constraints for the Cambodia Rural CBSS to achieving greater results. On the one hand, VHVs were not be able to collect data from people living too far away from their house, especially those temporarily moving to the farm land during rice planting and harvesting seasons. Also, health staff response to the information generated by the Cambodia Rural CBSS was not yet optimal in many project communes, as reflected by inadequate outbreak investigations and corrective measures in these areas. Low salaries and inadequate funding for health services in general hamper staff motivation and limits the quality and coverage of the services they perform, especially in public health.

6.4 Costs and sustainability

6.4.1 Costs

It is difficult to compare the costs of different CBS systems because of the differences in the types and number of events monitored by different systems, the variety of interventions undertaken by each project in which the CBS system is an integral part, as well as inconsistency of the available cost data. The cost of the Cambodia Rural CBSS was US$0.47 per capita during the first year of its implementation including initial training and development. This cost would be lower by half when the system is operated by the OD alone. It appears to be lower than that of many similar systems running in developing countries to date, including the KSCSP in Cambodia, because of its use of existing health infrastructure and staff,

which costs much less than projects run by NGOs where additional staff and facilities have to be funded. For instance, the cost of the KSCSP was reported to be US$120,000 per year for a population of 100,000 or an equivalent of US$1.20 per capita. Similarly, the annual per capita cost of the CBS in Ceara, Brazil, was about US$ 1.20 (O'Neil 1993). In Guinea worm eradication Cairncross *et al.* (1996) reported that the CBS project cost US$100-200 per village per annum, which would be equivalent to US$0.20-0.40 per capita if the size of the village was about 500 inhabitants. However, the surveillance of tuberculosis by tribal volunteers in Tamil Nadu, India, was reported to bear "no additional cost" (Balasubramanian *et al.* 1995).

In any case, the cost for an extra case detected by the Cambodia Rural CBSS, like other CBS systems reviewed, was by far lower than that of survey or active case search by health staff.

6.4.2 Sustainability

Experiences from other CBS systems revealed that their success and sustainability depended largely on external agency assistance or government support, or both. The guinea worm eradication in Africa, the CBS in Bolivia, the CBDD system in the Philippines, the KSCSP in Cambodia for instance depend on financial support from outside the communities (Cairncross *et al.* 1996; Howard-Grabman 2000; Katler 1999; Oum 2000a). Walt (1988) who reviewed community health worker programmes worldwide reported that "many rural communities are too poor to sustain regular payment to CHWs" and "almost no example exists of sustained community financing of CHWs." Services and financial sustainability have been major issues for CBS systems.

The Cambodia Rural CBSS has many attributes that could make it more viable-i.e. sustainable- than other CBS systems currently in place in Cambodia and elsewhere. First, VHVs and health staff have the capability to run and manage the system by themselves, with little technical or supervisory support from the central level. Up until the present, the system continues to run quite well despite the fact that supervision from the NIPH and PHD has been reduced from a monthly basis in 2000 to a quarterly basis in 2001. Second, the system is built on the existing health system and resources, following the MoH policy and strategy to strengthen the OD structure. It gives the OD and health centre a mechanism for fulfilling their role in disease prevention and control in the communities. Third, the linkage with the NIPH, which

provided technical back-up for the system, could continue permanently as supporting provinces and districts in their implementation of MoH policies and strategies is an important part of NIPH's core mandate. Fourth, the CBSS comprises mechanisms to maintain VHVs' motivation to continue the CBSS. The mechanisms include continuous training, supportive supervision, health care benefits, work recognition, "instant feedback", and involvement in data analysis and decision-making.

Nevertheless, the Cambodia Rural CBSS requires some degree of extra funding to cover its operational costs especially per diem and travel costs for VHVs and health staff attending the monthly feedback meeting. This funding has been provided to date by the EC-RMCP and will last until end of 2002. To continue the project beyond 2002 ongoing financial inputs are required whether they come from donor organisations, the government or the community. The MoH might be able to take care of costs related to health staff activities including supervision and field investigations, but is less likely to assume the cost related to VHVs. Requesting VHVs who have already volunteered their time for activities in the villages such as data collection, health education and social mobilisation to also bear the cost of food and transportation for attending the monthly feedback meeting would be unrealistic. Likewise, remote rural communities are too poor to finance VHVs.

"Feedback Groups" have recently been promoted by the MoH to improve the services of commune health centres would be an alternative to the implementation of the CBSS in rural Cambodia without external financial assistance. Each Feedback Group is composed of two representatives from each village in the commune and three health centre staff. Village representatives are elected by the population, need to have their own means of transportation, must attend a monthly meeting at the commune health centre and are expected to perform several functions including (1) giving information on the perception by the community of the health centre services; (2) providing information on health issues in their village; (3) providing information on new-borns and deaths including maternal deaths; (4) promoting the health centre services with villagers; (5) arranging the dates of outreach services with the village chiefs; (6) arranging with village chiefs for health education material to be distributed with the village chief; and (7) identifying the poor in their village for fees exemption (MoH 2001). However, Feedback Groups have not yet had a chance to be thoroughly field tested; "passing on the burden of payment to communities has not been so far

successful" (Walt 1988); and drop out rates and inactivity may be high, which would lead to incomplete or irregular reports and an ineffective surveillance system.

6.5 Limitations of the study

There are three main limitations of the study. First, a twelve-month period is too short to adequately assess the system's impact on morbidity and mortality as well as the system's sustainability; in any community project several years may be required following the end of the project to accurately assess its sustainability. Second, although health staff and VHVs were sufficiently skilled to run the system after initial technical inputs from the investigator, the continuation of the system's operation depends on some continuing external financial support, from either a donor or the government. Third, the performance of the Cambodia Rural CBSS was assessed using survey findings as gold standard and is therefore subject to survey biases. They include:

-Recall biases and unwillingness to report: (Kroeger 1985) in reviewing interview surveys in developing countries concluded that a recall period longer than two weeks, a non-severe illness, or "social and psychological barriers" could lead to inaccurate findings. In the Cambodia Rural CBSS a one month recall period for illness reporting was used in the survey to validate VHVs monthly reporting of diseases/syndromes, births and VHVs' activities in their village. This recall period seems to be too long to obtain accurate information on illness, which can subsequently under or over estimate the sensitivity and PPV of VHVs illness reporting compared with the survey's findings. Nevertheless, illnesses reported by VHVs and targeted by the survey are significantly severe and are therefore less likely to be rapidly forgotten by respondents. In addition, major life events reported during the month prior to the survey such as deliveries and pregnancies were unlikely to be affected by recall bias. However, recall bias and unwillingness to report were evident in the twelve-month recall on fatal events, where the number of deaths detected by the survey was far lower than that reported by VHVs. The under-reporting of deaths by household survey has also been mentioned elsewhere; a re-interview survey in Liberia found 28% deaths missed by the original mortality survey (Becker *et al.* 1993).

-Misclassification and under reporting: The survey findings that were used to validate VHVs reports were based on reports of illness of household members by the

head of household or an adult member. This was subject to misclassifications because proxy reporting is less likely to be accurate than self-reporting (Kroeger 1985). (Belcher *et al.* 1976) compared morbidity interviews with a heath examination survey in rural Africa and found that "significant heath problems including malaria, malnutrition, intestinal parasites and diarrhoea were seriously under-reported". In addition, the classification of cases reported by respondents in the interview survey was validated neither by health examination nor by laboratory tests, which therefore "precludes definitive diagnosis" (Kalter 1992). This was, however, less likely to be an issue in the evaluation of the Cambodia Rural CBSS attributes because comparisons between VHVs reports of cases and survey findings were based on syndromes and not on confirmed diagnosis.

-Non-respondents: The survey used in the evaluation in the Cambodia Rural CBSS aimed to investigate all households in the three selected communes, in order to compare its findings with VHVs' reports. This method has also an advantage to avoid selection bias in the choice of household in sample surveys (Macintyre 1999). However, about 4% of households were missed by the survey as most of them temporarily moved to living nearby rice fields far away from their village at the time of the survey. This particular group of people was more likely to suffer morbidity and mortality from infectious disease because of their poverty and their proximity to forest fringe malaria. This situation could lead to some cases and deaths being missed by the survey and subsequently lead to an over-estimation of the sensitivity of VHVs' case reporting, especially in respect to illness.

-Interviewer's biases: The use of health personnel as interviewers in population surveys was reported to cause biases especially on questions related to the use of non-formal health services (Kroeger 1983). In the Cambodia Rural CBSS this seems less likely to have been the case because private practices are widespread and well accepted in Cambodia. In addition, almost interviewers were local health staff (i.e. from the same commune and district), and were therefore unlikely to have significant cultural and communication problems with the respondents.

-Internal evaluation issues: Survey teams were all MoH staff, and about half of them CBSS team members. This may limit the credibility of the survey, and therefore the credibility of the CBSS itself, as internal evaluators are less likely to be objective than external ones (UNICEF 1990). However, precautions were taken to avoid interviewer's biases including cross-checking with VHVs those cases detected

by the survey as having the same illnesses and survey team leaders being taught to compute the sensitivity and PPV of VHVs' case reporting only after the completion of field data collection. The internal and participatory nature of the Cambodia Rural CBSS, on the other hand gave it the advantage of easy acceptability to the CBS system's stakeholders, who also learned from the survey and were keen to make changes to improve the system.

-Lack of comparison over times and places: The lack of data preceding the implementation of the CBSS and from similar communes where the system was not implemented made it very difficult to ascertain any impact of the CBSS on the population's morbidity and mortality (Gordis 1996).

6.6 Conclusions

The Cambodia Rural CBSS contributes another example of how lay people and local health staff can be empowered to monitor and address communicable diseases in their own community. It demonstrates that the CBS system is able to detect outbreaks early; monitor disease trends on a monthly basis; periodically update information on vital events in the rural areas; and thus successfully fill the gaps in the current health facility-based disease surveillance system. In addition, the CBS system can trigger effective responses from both health staff and VHVs in outbreak and disease control and prevention, thereby addressing concerns about equity in health services for under-served populations, and at the same time increasing the effectiveness of programmes. Furthermore, the system has been successfully implemented in the remotest and most difficult rural areas of the country by local health staff and communities and effectively managed by the OD, and thus its replication or adaptation for use in other rural areas would be likely feasible and relatively cost-effective. It should be noted in this connection that all the study sites were in remote and difficult areas of the country, and that though Pir Thnu may have performed worse than the other sites, the CBS there was still far more sensitive than passive health facility based reporting.

A salient feature of the Cambodia Rural CBSS was its monthly feedback meeting between VHVs and local health staff during which data collected by VHVs were immediately collated by HC staff and presented to the meeting participants by using easy-to-understand graphs and pictograms. This "instant and graphically

feedback" of information allow key stakeholders to analyse data and make decision on corrective measures they will together carry out during the coming month and monitor their achievements at subsequent feedback meetings.

Furthermore, a CBSS which is targeted on multiple-health events and developed, operated, and managed by local heath staff and people appears to be more cost-effective and sustainable than periodic population surveys or any CBSS that focuses on only a single event and/or is managed vertically.

VHVs' voluntary work can be maintained through motivational mechanisms such as free medical care, supportive supervision, training, and appropriate recognition. The MoH may be able to bear some of the costs related to health staff activities in the future; however, ongoing funding is likely needed from external sources for those costs related to VHVs, including monthly feedback meetings, for the near future.

National programmes and their supporting agencies would benefit from the CBS system's ability to monitor trends in infectious diseases of particular interest to each programme/agency as well as its ability to trigger effective responses by local health staff in areas where access is difficult and diseases are prevalent, thus helping national programmes to achieve their objectives cost-effectively.

6.7 Recommendations

6.7.1 Future research

It might still be too early to accurately evaluate the system. Further evaluations should be carried out when the system concludes its second or third year of operation. Both external and internal evaluators should be involved in the next evaluation, which should also assess as systematically as possible the cost-effectiveness of the system. In the meantime it would be worthwhile to implement the CSB system in a cluster of rural communes where the Feedback Groups initiated by the MoH and UNICEF appear to be functioning in order to study how the CBS system performs without external funding.

6.7.2 Improvement of the system

Improvements can be made to render VHVs' case reporting more accurate and comprehensive and the system more effective. First, to enhance the PPV of the system, the two-page recording forms may need to be revised to enable VHVs to more accurately collect data from their village. The recommended revised recording forms would consist of the following: (1) separate monthly line listings of cases by week for suspected malaria, suspected measles, haemorrhagic fever and acute severe diarrhoea; and (2) separate annual line listings of cases by month for chronic cough, pregnancies, births and deaths (See Appendix 3.1-3.8).

Second, to increase the sensitivity of the system the number of VHVs should be increased to more than one in villages that are large and spread out, which is characteristic of many villages in Pir Thnu commune. In Preah Rumkel commune a mechanism should be sought to obtain information from groups of people moving temporarily to their very distant farmlands during rice planting season.

Third, to extend community participation beyond VHVs it is advisable to hold feedback meetings with the population in each village every three to six months according to availability of funding. During the meeting, disease trends and patterns as well as major health problems identified by the CBSS should be presented by health centre staff and VHVs using easy-to-understand charts, and discussion and decision-taking would involve all community members in their own health protection as well as the prevention of diseases and outbreaks in their village.

Fourth, the OD should ensure that all field investigations and interventions undertaken in response to VHVs' reports are systematic, timely and documented (See Proposed guideline for outbreak investigations in Appendix 3.9).

Fifth, the MoH and PHD should allocate adequate resources for disease investigation and control to the OD and health centre levels, and make the resources readily available for use at any time, as required.

6.7.3 Integration, replication, and expansion

The Cambodia Rural CBSS can be fruitfully combined with the EWORS, which is a hospital-based early warning outbreak system currently implemented in the capital city and some provinces in Cambodia, to form a comprehensive sentinel surveillance system for the country. The two systems share some similarities in their approach, including the use of a syndromic approach in data collection, their ability to

provide real time data, and their direct linkage with the NIPH. Concerning scope of coverage, the EWORS' capability lies in the detection of outbreaks in the urban areas while the CBS system' capability lies in doing the same in the rural areas.

Furthermore, the Cambodia Rural CBSS can be easily integrated with the existing routine disease surveillance system because the CBSS has been designed to avoid double counting of cases that use health facilities. The CBSS and the routine disease surveillance systems would complement each other very well and the resulting "integrated" surveillance system would be considerably more powerful and effective than the country's present disease control system.

The CBS system is highly recommended for consideration by NGOs working in rural areas and looking for a system that assures both effective monitoring of their health project's progress as well as active community participation, and in addition involves a reasonably sustainable structure for producing ongoing improvements in community health. For instance, the system is already being expanded to other communes of Memot OD, Kompong Cham province by the OD and Save the Children Australia. In addition, World Vision-Cambodia planned to adapt the system for use in Kean Svay District within the KSCSP in 2002.

The Cambodia MoH may consider replicating or adapting the CBSS for use in other remote rural areas of the country, for instance by requiring NGOs and bilateral agencies to incorporate the CBSS in their projects, and by including it in the next five year UNICEF Country Programme.

Developing countries in the region, especially those bearing a high burden of infectious diseases and having serious limitations to their formal disease surveillance system, may be interested in learning about and adapting the Cambodia Rural CBSS for use in their own country. Also, adaptation of the CBSS to incorporate the surveillance priorities of national/vertical programmes would be an ideal project for donor funding under "Sector Wide Approaches" as a combined CBS system would serve to rationalise and integrate previously separate activities, thus contributing positively to health sector reform, and the rationalisation of services or costs.

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APPENDIX 1
ALERT REPORTS, 2000-2001

Appendix 1.1 Alert Report for DHF Cases, 2000-2001

Year	Month	Battambang	Kompong Cham	Kratie	Stung Treng	Whole Country
2000	Jan	0	12	0	0	82
	Feb	0	9	1	0	78
	Mar	0	10	3	12	109
	Apr	6	12	0	19	190
	May	9	12	2	24	520
	Jun	35	46	10	0	92
	Jul	1	29	0	0	373
	Aug	0	12	1	0	138
	Sep	0	0	0	0	61
	Oct	16	0	0	0	31
	Nov	0	0	0	0	2
	Dec	0	0	0	0	31
2001	Jan	0	0	0	0	73
	Feb	0	0	0	0	73
	Mar	1	3	0	0	140
	Apr	15	48	0	0	271
	May	3	21	1	0	515
	Jun	0	185	9	0	1427
	Jul	17	131	7	0	842
	Aug	40	118	9	0	762
	Sep	26	50	0	0	658
	Oct	1	0	0	0	81
	Nov	0	0	0	0	0
	Dec	0	0	0	0	0

Sources:
Year 2000: Department of Planning and HIS; MoH Cambodia
Year 2001: Department of Communicable Disease Control, MoH Cambodia

Appendix 1.2 Alert Report for Measles Cases, 2000-2001

Year	Month	Battambang	Kimpong Cham	Kratie	Stung Treng	Whole Country
2000	Jan	0	0	0	0	0
	Feb	0	0	0	0	0
	Mar	0	0	0	0	0
	Apr	0	0	0	0	0
	May	0	0	0	0	0
	Jun	0	0	0	0	0
	Jul	0	0	0	0	0
	Aug	0	0	0	0	0
	Sep	0	0	0	0	0
	Oct	0	0	0	0	0
	Nov	0	0	0	0	0
	Dec	0	0	0	0	0
2001	Jan	0	0	0	0	9
	Feb	0	0	0	0	85
	Mar	0	2	0	0	72
	Apr	0	0	0	0	110
	May	0	1	0	0	33
	Jun	0	0	0	0	50
	Jul	0	2	0	0	34
	Aug	0	0	0	0	6
	Sep	0	0	0	0	0
	Oct	0	0	0	0	18
	Nov	0	0	0	0	0
	Dec	0	0	0	0	0

Sources:
Year 2000: Department of Planning and HIS; MoH Cambodia
Year 2001: Department of Communicable Disease Control, MoH Cambodia

Appendix 1.3 Alert Report for Cholera cases, 2000-2001

Year	Month	Battambang	Kimpong Cham	Kratie	Stung Treng	Whole Country
2000	Jan	0	0	0	0	0
	Feb	0	0	0	0	0
	Mar	0	0	0	0	0
	Apr	0	0	0	0	0
	May	0	0	0	0	0
	Jun	0	0	0	0	0
	Jul	0	0	0	0	0
	Aug	0	0	0	0	0
	Sep	0	0	0	0	0
	Oct	0	0	0	0	342
	Nov	0	0	0	0	36
	Dec	0	0	0	0	0
2001	Jan	0	0	0	0	10
	Feb	0	0	0	0	5
	Mar	0	0	0	0	2
	Apr	0	0	0	0	0
	May	0	0	0	0	2
	Jun	0	0	0	0	34
	Jul	0	0	0	0	0
	Aug	0	0	0	0	0
	Sep	0	0	0	0	0
	Oct	0	0	0	0	0
	Nov	0	0	0	0	0
	Dec	0	0	0	0	0

Sources:
Year 2000: Department of Planning and HIS; MoH Cambodia
Year 2001: Department of Communicable Disease Control, MoH Cambodia

APPENDIX 2
EVALUATION OF THE CAMBODIA RURAL CBS SYSTEM

Appendix 2.1 Ethical clearance

LONDON SCHOOL OF HYGIENE
& TROPICAL MEDICINE

ETHICS COMMITTEE

APPROVAL FORM
Application number: **775**

Name of Principal Investigator **Sophal Oum**

Department **Infectious and Tropical Diseases**

Head of Department **Professor Peter Smith**

Title **Community-based surveillance system in rural Cambodia: Evaluation**

Approval of this study is granted by the Committee.

Chair Andy Haines

(Professor Andrew Haines, Dean)

Date 12 June 2001

Comments from the Committee:

Appendix 2.2 Survey information sheet (translation)

KINGDOM OF CAMBODIA
NATION, RELIGION, KING

MINISTRY OF HEALTH
NATIONAL INSTITUTE OF PUBLIC HEALTH

INFORMATION SHEET

STUDY TITLE: COMMUNITY-BASED SURVEILLANCE SYSTEM

A Community-Based Surveillance System has been developed and implemented in seven border communes of the Kingdom of Cambodia since July 2000 by the NIPH and Provincial Health Department of Kompong Cham, Kratie, Stung Treng and Battambang provinces, with financial support from the European Commission-Regional Malaria Control Programme.

The system aimed to contribute reducing the morbidity and mortality caused by infectious diseases among people living in remote rural areas through early detection of outbreaks and improvement of disease control and prevention based on information collected by VHVs.

The NIPH in collaboration with local health authorities is conducting an evaluation of the system including VHVs' activities through interview with villagers and VHVs, and through observation of the feedback meeting between VHVs and health staff.

We would like to request your participation in this evaluation. Your name will not be disclosed to anybody related to the information provided.

Appendix 2.3 VHVs' written consent form (translation)

CONSENT FORM

EVALUATION OF COMMUNITY-BASED SURVEILLANCE SYSTEM

"I have read the information sheet concerning this study and I understand what will be required of me if I take part in the study. The survey team has answered my questions concerning this study.

"I understand that any time I may withdraw from this study without giving any reason and without affecting my normal care and management".

"I agree to take part in this study".

Signed ..... Date 2001

(Name)

Appendix 2.4 Questionnaire used in the interview of VHVs (translation)

VHV QUESTIONNAIRE

VHV's name:	Village: .....
Age:	Sex: .....
Occupation:	Marital status: .....
Education:	
-Can read:	-Can write:
-Schooling years:	-Not finished primary school/ Finished primary school/ Not finished secondary school/ Finished secondary school

Question 1: Why do you accept to be VHV in the CBS system?

-.....

-.....

Question 2: Have you ever been involved in any health-related activities? Yes/ No

-If Yes, Specify: .....

Question 3: During last month, how did you collect data on diseases and vital events in your village?

No	Type of data collected	Sources of data	Frequency of data collection
1	Tetanus vaccination among pregnant women		
2	Deliveries		
3	Deaths		
4	Diseases		

Question 4: What was the coverage of your last month data collection?

-All households in the village/ about ..... % all households in the village

Question 5: Had you undertaken other health-related activities during last month? If yes, please specify:

5.1 Health education: Yes/ No

-If yes, how many households had you given health education? .....

5.2 Advise/ mobilise women for tetanus vaccination: Yes/ No

-If yes, how many women advised/ mobilised? .....

5.3 Mobilise children for vaccination: Yes/ No

-If yes: how many children mobilised? .....

5.4 Advise patients to go to public health care facilities: Yes/ No

-If yes: how many patients advised? .....

-How many advised patients who came to health facilities? .....

-How many of them who were treated? .....

5.5 Refer (using referral sheet) patients to health facilities: Yes/ No

-If yes: how many patients referred? .....

-How many of them who came to health facilities? .....

-How many of them who were treated? .....

Question 6: Is the CBSS useful to you? Why?

.....

Question 7: Is the CBSS useful to people in your village? Why?

.....

Date of the interview: .....

Interviewer's name ..... signature .....

Appendix 2.5 Characteristics of the communes selected for survey

Commune	Socio-economics & geography	VHVs profile	Health centre
Chan Mul	-Cambodia Vietnam border; -Fruit garden and rice planting	-All males, many village head, selected by health staff	-Free medical services, adequate drugs, regular
Pir Thnu	-Cambodia Vietnam border; -Fruit trees and rice planting	-Both sex, all farmers, elected by population	-Small charges, not regular, inadequate drug, headed by a doctor
Preah Rumkel	-Along Mekong River, Cambodia Laos border -Fishing and rice planting	-All females, TBAs, least literate, selected by health staff	-Small charges, not regular, inadequate drug

Appendix 2.6 Questionnaires used in the household survey (translation)

HOUSEHOLD QUESTIONNAIRE

Getting approval for interview:

First:

-Greet eligible respondent;

- Introduce yourself/ your team and explain the purpose of your visit

Then

-Request permission to interview:

-If refused, go to next house.

-If agreed, begin asking questions.

I. General information:

-Commune: ..... Village: ..... Household No..... .....

-Distance from VHV's house: approx..... metres

-Respondent's position in the household: wife/ husband/ mother/ father/ grandmother/ grandfather/ other (specify): .....

-Total persons in the household: ..... No. children (under 15): .....

-Name of head of Household: .....

-Date of the interview: .....July 2001

-Time at the commencement of the interview: .....

II. Questions on pregnancies and deliveries

Q1: Is there any pregnant woman in this household? Yes/ No

If NO, go to question 2

If YES: 1.1 What was her gestational age in the past month? .....

1.2 Has the woman received any tetanus vaccination? Yes/ No

If NO: Go to question 2

If YES (specify):

-How many TT doses she got? .....

-Does she have TT card? Yes/ No/ Unknown

If NO/Lost/Unknown: Got to question2

If YES: Date of last TT: .....

Q2: Had anyone delivered a baby last month? Yes/ No

If NO: Go to question 3

If YES (specify):

2.1 when she delivered the baby? .....

2.2 Has she received any TT vaccination? Yes/ No

If NO/Unknown: Go to question 3

If YES (specify): How many TT doses she has had? .....

Does she have TT card? Yes/ No/Lost/Unknown

If NO/ Lost/Unknown: Go to Question 3

If YES: Write the date of last TT: .....

III. Questions on diseases and deaths

Q3: Was anyone in the household ill last month? Yes/ No

If NO: Go to question 4

If YES: 3.1 How many was ill? .....

3.2 Complete a separate form for each patient

Q4: Was anyone died last year? Yes/ No

If NO: Go to question 5

If YES: 4.1 How many died? .....

4.2 Complete a separate form for each death

IV. Questions on VHV's activities

Q5. Do you know (VHV's name)? Yes/ No

If NO: Thank the respondent and go to next house.

If YES (Ask next question):

Q6: Have you ever meet (VHV's name)? Yes/ No

If NO: , thank the respondent and go to next house.

If YES (specify):

6.1 How many times did you meet (VHV's name) last month? .....

6.2 When did you recently meet (VHV's name)? .....

6.3 What was the purpose of the meeting?

.....

Q7: Do you think (VHV's name) activities are useful to your family and/or your village?

.....

V. End the interview and proceed to next house

Time at the end of the interview: .....Name and signature of interviewer: .....

PATIENT QUESTIONNAIRE

Household No: ..... Patient No: .....

1. Patient relation to household: Husband/ Wife/ Auntie/ Uncle/ Other: .....
2. Age: ..... years .....months
3. Sex: Male/ Female
4. Date of onset of illness: Day .....Month..... 2001
5. Major symptoms of the illness:

☐ Fever ☐ Diarrhoea ☐ Vomiting ☐ Abdominal cramp

☐ Cough ☐ Cough with blood ☐ Vomit with blood ☐ Convulsion

☐ Rash ☐ Swelling ☐ Other (specify): .....

6. Further questions about illness

6.1 If the patient had **fever** (specify):

6.1.1 Was the fever: High / moderate/ mild

6.1.2 Was the fever: Continuous / intermittent / Other (specify): .....

6.1.3 For how long? .....

6.1.4 Any chills? Yes/ No/ don't know

6.1.5 Any headache? Severe/ Moderate/ mild/ No

6.1.6 Any spleen enlargement? Yes/ No/ don't know

6.1.7 Urine –Quantity: Little/ Abundant/ little/ don't know

-Colour: .....

6.2 If the patient had **diarrhoea or vomiting** (specify):

6.2.1 Was the patient's eyes sunken? Yes/ No/ ?

6.2.2 If the patient had diarrhoea, specify:

(a). How many times a day? .....

(b). For how long: ..... Days

(c). Was the diarrhoea severe or mild?: Severe/ moderate/ mild/ ?

(d) What did the stool look like? Watery / loose / .....

(e). Any blood or mucus in the stool? Blood/Mucus/ No/ ?

6.2.3 Did the patient have abdominal pain? Yes / No / Don't know

6.2.4 Did the patient vomit? Yes / No / Don't know

If YES (specify):

(a) How frequent was the vomiting: Every day/ sometimes/ ?

(b) Was the vomiting: Severe/ moderate/ mild/ ?

(d) How many times a day? .....

6.3 If the patient had **a cough/ fast breathing** (specify):

6.3.1 Was the patient having severe chest in drawing? Yes / No / ?

6.3.2 Was the patient having a wheezing? Yes/ no/ ?

6.3.3 Was the patient grunting? Yes / No / ?

6.3.4 Did the patient cough: Yes/ No/ don't know

If YES (specify):

(a) How severe the cough was: severe/ moderate/ mild/ ?

(b) For how long did the cough last? .....Days

(c) Was the cough productive: Yes / No / ?

(d) Was the cough bloody: Yes / No / ?

6.3.5 Did the patient have fast breathing? Yes / No / ?

6.4 If the patient had **neck stiffness** (specify): For how long? .....

6.5 Did the patient have any change in the level of **consciousness**? Yes / No / ?

If "Yes", what was it? Confused/ unconscious/ other...../ ?

If unconscious: for how long? .....

6.6 If the patient had **convulsions** (specify):

6.6.1 How many times a day? .....

6.6.2 For how many days? .....

6.6.3 How was the convulsion? Severe/ moderate/ mild/ ?

6.6.4 Where was the convulsion? Face/ neck/ leg/ other: ...../?

6.6.5 Was the patient conscious between periods of convulsion? Yes/ No/ ?

6.7 If the patient had **a rash** (specify):

6.7.1 Where? Face/ neck/ arms/ leg/ body

6.7.2 Where the rash started first? Face/ neck/ arms/ leg/ body

6.7.3 For how long the rah last? .....

6.7.4 What was the colour of the rash? Red/ dark/ clear/ .....

6.7.5 What was the rash look like? Maculae/ vesicular/ purpura/ petechia/other: .....

6.7.6.Did the patient have running nose? Yes/ No/ ?

6.7.7 Did the patient have red eye? Yes / No / ?

6.8 If the patient **loose weight** (specify):

6.8.1 Since when? Before illness/ after/ ?

6.8.2 Was the weight lost serve? Severe/ moderate/ mild/ ?

6.9 If the patient was **swollen** (specify):

6.9.1 Since when? Before illness/ after/ ?

6.9.2 Which part of the body/ .....

6.9.3 Was it severe? Severe/ moderate/ mild/ ?

6.10 IF THE PATIENT IS A **BABY/ CHILD**, SPECIFY:

Was the baby/child immunised against measles? Yes/ No/ ?

If YES:

Did the baby/child have vaccination card? Yes/ No/ Lost

If YES: Write the date of the vaccination: .....

6.11 **Cause of illness** (according to the interviewer):

Diagnostic 1: .....

Diagnostic 2: .....

7. Treatment

7.1 Did the patient seek treatment at health facilities? Yes/ No

7.2 If YES (specify):

a. Date the patient went to the health facility: .....

b. Who advised/ referred to? .....

c. Why did the patient seek treatment at health facilities?

.....

.....

7.3 If NO (specify):

a. Where the patient was treated? Home/ Other (specify): .....

b. Treated by whom?

c. Why the patient did not go to health facilities?

.....

.....

7.4 How is the patient at present? Cured/ better/ still ill/ worst

VERBAL AUTOPSY QUESTIONNAIRE

Household No: ..... Deceased No: .....

1. Deceased relation to household: Husband/ Wife/ Auntie/ Uncle/ Other: .....
2. Age: ..... years .....months
3. Sex: Male/ Female
4. Date of death: Day .....Month..... 2001
5. Major symptoms during the period preceding death:

☐ Fever ☐ Diarrhoea ☐ Vomiting ☐ Abdominal cramp

☐ Cough ☐ Cough with blood ☐ Vomit with blood ☐ Convulsion

☐ Rash ☐ Swelling ☐ Other (specify): .....

6. Further questions about the deceased illness

6.1 If the deceased had **fever** (specify):

6.1.1 Was the fever: High / moderate/ mild

6.1.2 Was the fever: Continuous / intermittent / Other (specify): .....

6.1.3 For how long? ..... days

6.1.4 Any chills? Yes/ No/ don't know

6.1.5 Any headache? Severe/ Moderate/ mild/ No

6.1.6 Any spleen enlargement? Yes/ No/ don't know

6.1.7 Urine –Quantity: Little/ Abundant/ little/ don't know

-Colour: .....

6.2 If the deceased had **diarrhoea or vomiting** (specify):

6.2.1 Was the deceased's eyes sunken? Yes/ No/ ?

6.2.2 Did the deceased have diarrhoea (specify):

(a). How many times a day? .....

(b). For how long: ..... days

(c). Was the diarrhoea severe or mild?: Severe/ moderate/ mild/ ?

(d) What did the stool look like? Watery / loose /

(e). Any blood or mucus in the stool? Blood/mucus/ No/ ?

6.2.3 Did the deceased have abdominal pain? Yes / No / ?

6.2.4 Did the deceased vomit? Yes / No / ?

If YES (specify):

(c) How frequent was the vomiting: Every day/ sometimes/ ?

(d) Was the vomiting: Severe/ moderate/ mild/ ?

(d) How many times a day? .....

6.3 If the deceased had **a cough/ fast breathing** (specify):

6.3.1 Was the deceased having severe chest in drawing? Yes / No / ?

6.3.2 Was the deceased having a wheezing? Yes/ no/ ?

6.3.3 Was the deceased grunting? Yes / No / ?

6.3.4 Did the deceased have cough: Yes/ No/ ?

If YES (specify):

(a) How severe the cough was: severe/ moderate/ mild/ ?

(b) For how long did the cough last? ..... Days

(c) Was the cough productive: Yes / No / ?

(d) Was the cough bloody: Yes / No / ?

6.3.5 Did the deceased have fast breathing? Yes / No / ?

6.4 If the deceased had **neck stiffness** (specify): For how long? .....

6.5 Did the deceased have any change in the level of **consciousness**? Yes / No / ?

If "Yes", what was it? Confused/ unconscious/ other...../ ?

If unconscious: for how long? .....

6.6 If the deceased had **convulsions** (specify):

6.6.1 How many times a day? .....

6.6.2 For how many days? .....

6.6.3 How was the convulsion? Severe/ moderate/ mild/ ?

6.6.4 Where was the convulsion? Face/ neck/ leg/ other: ...../?

6.6.5 Was the deceased conscious between periods of convulsion? Yes/No/?

If the deceased had **a rash** (specify):

6.7.1 Where? Face/ neck/ arms/ leg/ body

6.7.2 Where the rash started first? Face/ neck/ arms/ leg/ body

6.7.3 For how long the rah last? .....

6.7.4 What was the colour of the rash? Red/ dark/ clear/ .....

6.7.5 What was the rash look like? Maculae/ vesicular/ purpura/ petechia/other: .....

6.7.6.Did the deceased have running nose? Yes/ No/ ?

6.7.7 Did the deceased have red eye? Yes / No / ?

6.8 If the deceased **loose weight** (specify):

6.8.1 Since when? Before illness/ after/ ?

6.8.2 Was the weight lost serve? Severe/ moderate/ mild/ ?

6.9 If the deceased was **swollen** (specify):

6.9.1 Since when? Before illness/ after/ ?

6.9.2 Which part of the body/ .....

6.9.3 Was it severe? Severe/ moderate/ mild/ ?

6.10 If the deceased age at death was 1 **month or older**, specify:

Was the deceased immunised against measles? Yes/ No/ ?

If YES:

Did the deceased have vaccination card? Yes/ No/ Lost

If YES: Write the date of measles vaccination: .....

6.11 If **age at death < 1 month**, ask the following questions:

a. Information on mother:

-Mother age: ..... Years

-Did she visit health facilities for ANC? Yes/ No/ ?

If YES (specify):

Where? .....

How many times? .....

-Did she receive any TT immunisation? Yes/ No/ ?

If YES (specify):

-Did she have TT card? Yes/No/Lost

-Number of TT doses received: .....

-Date of recent TT immunisation: .....

b. Baby's information

Place of delivery: Home/ health facility / clinic

Birth attendant: TBA/ health staff / Private staff/ other

Cord cutting:

By what: .....

c. Clinical history:

Was the baby normal at birth? Yes/ No/ ?

Was the baby suck/cry first 2 days? Yes/ No/ ?

Was the baby then stopped sucking? Yes/ No/ ?

Was the baby stiffness? Yes/ No/ ?

Did the baby have spasms or convulsions? Yes/ No / ?

Was the umbilicus red/swollen? Yes/ No/ >

Other symptoms (specify): .....

.....

6.12 **Cause of death** (according to the interviewer):

Diagnostic 1: .....

Diagnostic 2: .....

7. Treatment

7.1 Did the deceased seek treatment at health facility? Yes/ No

7.2 If YES (specify):

a. Date the deceased went to the health facility: .....

b. Who advised/ referred to? .....

c. Why did the deceased seek treatment at health facility?

.....

.....

7.3 If NO (specify):

a. Where the deceased was treated? Home/ Other (specify): .....

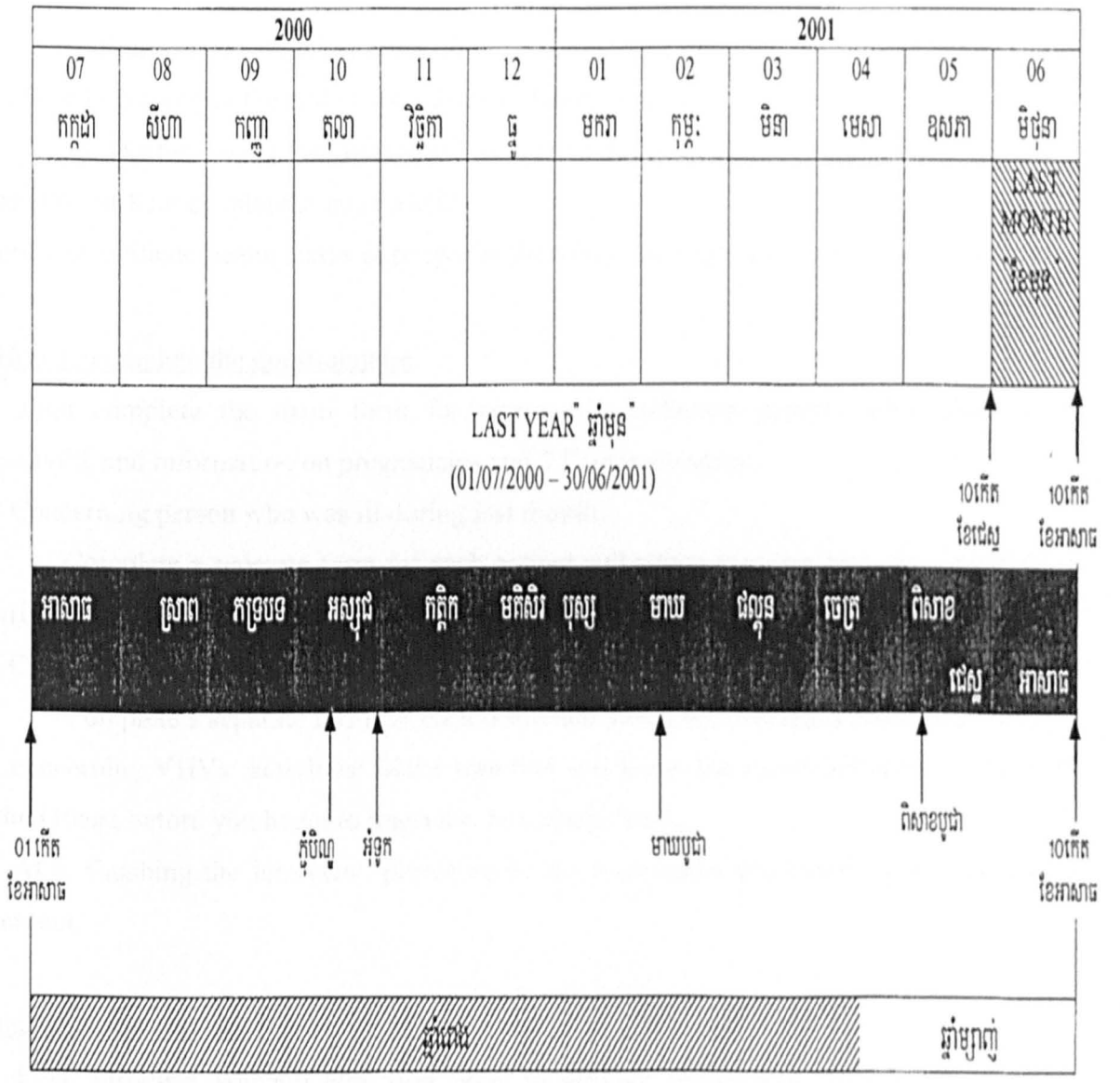
b. Treated by whom? .....

c. Why the deceased did not go to health facilities?

.....

.....

<u>Appendix 2.7</u> Converting chart (Khmer to Gregorian calendar)



Appendix 2.8 Instruction for survey team members (translation)

INSTRUCTION FOR THE INTERVIEWER

1. Objectives of the survey:

To collect data from all household in the village on the followings:

(i). Pregnancies, deliveries and illness of household members during the "past month" (i.e. from beginning to the end of June 2001 or Khmer calendar equivalent);

(ii). Deaths during the "past year" (i.e. from the beginning of July 2000 to the end of June 2001 or Khmer calendar equivalent)

in order to evaluate health status of people in the village as well as to assess VHVs' activities.

2. How to complete the questionnaire:

2.1 First complete the main form for household, including general information about household, and information on pregnancies and TT immunisation;

2.2 Concerning person who was ill during last month:

-Complete a separate form for each patient and attach it to the main household form. Verify the date of onset of illness with the converting Khmer/Gregorian chart provided;

2.3 Concerning death in the past year:

-Complete a separate form for each death and attach it to the main household form;

2.4 concerning VHVs' activities: Make sure that you know the name/nickname of the VHV in the village before you begin to interview household head..

2.5 After finishing the interview, please thank the respondent and offer her a small bag of detergent.

3. Interview procedures

3.1 First introduce yourself and your team to eligible respondent, inform her about the purpose of your study and ask permission to interview.

3.2 make sure that every household in the village are visited and interviewed. Record the name of household head in your questionnaire for any house that is closed or has no adult present during your visit. You should try to interview households that were missed through a second visit. Inform your team leader about this matter for assistance.

Appendix 2.9 Instruction for survey team leaders (translation)

INSTRUCTION FOR SURVEY TEAM LEADERS

INTERVIEW OF VHVS:

To be conducted during the morning of the feedback meeting, before the commencement of household survey

HOUSEHOLD SURVEY:

Day 1 (before data collection):

-Refresher training of interviewers, role-play;

-Practice completing questionnaire forms

-Preparation of materials and logistic for data collection

Day 2 and following days (data collection):

Morning:

-First inform village leader and get his approval for the survey in the village.

-Then proceed collecting data from house to house.

Noon: -Lunch-break (cross-check for incomplete questionnaires)

Afternoon:

-Data collection (continued)

-Before leaving each village:

-Cross-check between team members for incomplete or inappropriate forms.

If any, revisit households to complete questionnaire.

-Complete "Data collection: Field report" form provided

Evening:

-Classify cause of illness and death

-Enter data into the microcomputer provided

-Run programme to analyse data. Check for inconsistencies.

DATA COLLECTION: FIELD REPORT

(To be completed by team leader for each surveyed village)

General Information

Commune; ..... Village: .....

Number of population: ..... Number of households: .....

From the village to the nearest health facility:

Distance: ..... (kilometres) Travel time: ..... (hours)

Number of households interviewed

Team No	Morning	Afternoon	Total
1.....	.....	.....	.....
2.....	.....	.....	.....
3.....	.....	.....	.....
4.....	.....	.....	.....
5.....	.....	.....	.....
Total:	.....	.....	.....

Households missed during the 1st visit of survey team

Reason	Number of households	Action taken
1. House closed	.....	.....
2. No adult at home	.....	.....
3. Not agreed to interview	.....	.....
Total	.....	

COMMENTS:

.....

.....

Date of the survey: ..... Signature and name: .....

Appendix 2.10 Survey teams

Team 1:

Households survey in Preah Rumkel commune

(Data collection & crosschecking: 01-15/07/2001)

1. Mr Oum Sophal, MD, MTH, Nal Institute of Public Health, Team Leader
2. Mr En Sopheavith, MD, CDC Department, Ministry of Health
3. Mr Boun Chan Youtterong, MA, Deputy-head of Technical Office, Stung Treng PHD
4. Mr Po Ly, MA, Head of Communicable Disease Control, Stung Treng PHD
5. Mr Se Chhan, Nurse, Stung Treng OD
6. Mr Ou Bun Chop, Nurse, Preah Rumkel health centre

Team 2:

Households survey in Pir Thnu commune

(Data collection: 1-11/07/2001; data crosschecking: 16-21/07/2001)

1. Mr Chhneang Sovutha, MD, director of Chlong OD, Team Leader
2. Mr Khuon Sovannareth, MA, Head of malaria control pgm, Chlong OD
3. Ms Suon Dyvann, Midwife, Chlong OD
4. Mr Team Phanit, Nurse, Snuol health centre
5. Mr Keo Sichan, Nurse, Snuol health centre
6. Mr Eang Sam, Nurse, National Institute of Public Health

Team 3:

Households survey in Chan Mul commune

(Data collection: 3-14/07/2001; data crosschecking: 19-24/07/2001)

1. Mr Hy Sovann, Nurse, Deputy/Director, memot OD, Team Leader
2. Ms Kol Naren, Midwife, Head of MCH pgm, Memot OD
3. Mr Ouk sokhom, Nurse, Head of EPI pgm, Memot OD
4. Mr Bun Sokheang, Head of Chan Mul health centre
5. Mr Tep Sarun, Nurse, Chan Mul health centre
6. Mr Aim Sotha, MD, SCA Kompong Cham (Data entry)

Appendix 2.11 Time schedule of the household survey, 2001

Date	Activities	Location
February-April 2001	1.Development of survey protocol & design of questionnaires	NIPH
May	2.Training of Interviewers (1)	Chan Mul OD
	3.Pre-test of survey's questionnaires	A village in Chan Mul OD
June	4.Finalisation of survey protocol and questionnaires 5. Production of survey materials	NIPH
	6.Training of survey team leaders in data entry, analysis and survey management	NIPH
July	7.Observation of feedback meeting 8. Interview of VHVs 9.Training of interviewers (2) 10. Data collection 11. Data cross-checking with VHVs 12. First data entry	Preah Rumkel, Pir Thnu & Chan Mul communes
	13. Data analysis 14. Dissemination of preliminary results	NIPH
August-September	15. Second data entry	NIPH
October	16. Data validation & cleaning	London

Appendix 2.12 Estimation of sensitivity and PPV for the CBSS

		Reported by CBS system		
		Yes	No	Total
Detected by Survey (Gold standard)	Yes	A (True positive)	B (False negative)	A+B (Total cases detected by survey)
	No	C (False positive)	D (True negative)	C+D
	Total	A+C (Total cases reported by VHVs)	B+D	Grand total

Sensitivity of CBS system = A/ A+B

Positive predictive value of CBS system (PPV) = A/ A+C

Appendix 2.13 Estimation of the number of deaths missed by CBSS & survey

(Adapted from: Diallo *et al.* 1996)

Let x be the number of deaths missed by both CBSS and survey. Table 26, which presents the number of deaths during the past year in the 3 surveyed communes could then be presented as follows:

		VHVs report		
		Death	No Death	**Total**
Household survey	Death	61	6	67
	No Death	48	x	48 + x
	Total	109	6 + x	115 + x

If the probability that an event is missed by the CBSS is independent of the probability that is missed by the survey, and vice versa, then:

Probability (missed by CBSS and survey) = Probability (missed by CBSS) X (Probability (missed by survey).

These probabilities can then be estimated from Table (26) to obtain the following equation:

$x/(115 + x) = [(6 + x)/(115 + x)]\,[(48 + x)/(115 + x)]$

$x(115 + x) = (6 + x)(48 + x)$

$115x + x^2 = 288 + 54x + x^2$

$115x - 54x = 288$

$61x = 288$

$x = 4.7\ 5$

Therefore:

Total deaths = 115 + 5 = 120

Sensitivity of CBSS = 109/ 120 = 90.8%, and

Sensitivity of Survey= 67/ 120 = 55.8%

APPENDIX 3
PROPOSED REVISED RECORDING/REPORTING FORMS

Appendix 3.1 Proposed recording form for suspected malaria

Village: .....
List of cases of suspected malaria during *Month*: ..... *Year*: .....
[any patient with high and intermittent fever and chills]

No	Name	Age	Sex	Period of the month					Remarks
				1-7	8-14	15-21	22-28	29-31	
1				☐O	☐O	☐O	☐O	☐O	
2				☐O	☐O	☐O	☐O	☐O	
3				☐O	☐O	☐O	☐O	☐O	
4				☐O	☐O	☐O	☐O	☐O	
5				☐O	☐O	☐O	☐O	☐O	
6				☐O	☐O	☐O	☐O	☐O	
7				☐O	☐O	☐O	☐O	☐O	
8				☐O	☐O	☐O	☐O	☐O	
9				☐O	☐O	☐O	☐O	☐O	
10				☐O	☐O	☐O	☐O	☐O	
11				☐O	☐O	☐O	☐O	☐O	
12				☐O	☐O	☐O	☐O	☐O	
13				☐O	☐O	☐O	☐O	☐O	
14				☐O	☐O	☐O	☐O	☐O	

Legend: ☑ = Not treated at PHF ; ⊘ = Treated at PHF

Appendix 3.2 Proposed recording form for severe diarrhoea

Village: .....

List of Cases of Acute Severe Diarrhoea during Month: ..... Year: .....

[any patient with at least 3 watery stool a day and severe dehydration]

No	Name	Age	Sex	Period of the month					Remarks
				1-7	8-14	15-21	22-28	29-31	
1				☐O	☐O	☐O	☐O	☐O	
2				☐O	☐O	☐O	☐O	☐O	
3				☐O	☐O	☐O	☐O	☐O	
4				☐O	☐O	☐O	☐O	☐O	
5				☐O	☐O	☐O	☐O	☐O	
6				☐O	☐O	☐O	☐O	☐O	
7				☐O	☐O	☐O	☐O	☐O	
8				☐O	☐O	☐O	☐O	☐O	
9				☐O	☐O	☐O	☐O	☐O	
10				☐O	☐O	☐O	☐O	☐O	
11				☐O	☐O	☐O	☐O	☐O	
12				☐O	☐O	☐O	☐O	☐O	
13				☐O	☐O	☐O	☐O	☐O	
14				☐O	☐O	☐O	☐O	☐O	
15				☐O	☐O	☐O	☐O	☐O	

Legend: ☑ = Not treated at PHF ; ☑ = Treated at PHF

Appendix 3.3 Proposed recording form for hemorrhagic fever

Village: .....

List of Cases of Hemorrhagic Fever during Month: ..... Year: .....

[any patient with persistent fever of abrupt onset and red rash and ecchymosis/ petechiae/ mouth or rectal bleeding]

No	Name	Age	Sex	Period of the month					Remarks
				1-7	8-14	15-21	22-28	29-31	
1				☐O	☐O	☐O	☐O	☐O	
2				☐O	☐O	☐O	☐O	☐O	
3				☐O	☐O	☐O	☐O	☐O	
4				☐O	☐O	☐O	☐O	☐O	
5				☐O	☐O	☐O	☐O	☐O	
6				☐O	☐O	☐O	☐O	☐O	
7				☐O	☐O	☐O	☐O	☐O	
8				☐O	☐O	☐O	☐O	☐O	
9				☐O	☐O	☐O	☐O	☐O	
10				☐O	☐O	☐O	☐O	☐O	
11				☐O	☐O	☐O	☐O	☐O	
12				☐O	☐O	☐O	☐O	☐O	
13				☐O	☐O	☐O	☐O	☐O	
14				☐O	☐O	☐O	☐O	☐O	
15				☐O	☐O	☐O	☐O	☐O	

Legend: ☑ = Not treated at PHF ; ☑ = Treated at PHF

Appendix 3.4 Proposed recording form for suspected measles

Village: .....

List of Cases of Suspected Measles during Month: ..... Year: .....

[any patient with high fever and non-vesicular red rash and cough/ runny nose/ red eyes]

No	Name	Age	Sex	Period of the month					Remarks
				1-7	8-14	15-21	22-28	29-31	
1				☐O	☐O	☐O	☐O	☐O	
2				☐O	☐O	☐O	☐O	☐O	
3				☐O	☐O	☐O	☐O	☐O	
4				☐O	☐O	☐O	☐O	☐O	
5				☐O	☐O	☐O	☐O	☐O	
6				☐O	☐O	☐O	☐O	☐O	
7				☐O	☐O	☐O	☐O	☐O	
8				☐O	☐O	☐O	☐O	☐O	
9				☐O	☐O	☐O	☐O	☐O	
10				☐O	☐O	☐O	☐O	☐O	
11				☐O	☐O	☐O	☐O	☐O	
12				☐O	☐O	☐O	☐O	☐O	
13				☐O	☐O	☐O	☐O	☐O	
14				☐O	☐O	☐O	☐O	☐O	
15				☐O	☐O	☐O	☐O	☐O	

Legend: ☑ = Not treated at PHF ; ☑ = Treated at PHF

Appendix 3.5 Proposed recording form for chronic cough

Village: ....

List of Monthly Cases of Chronic Cough during Year: ....

[any patient aged 15 or more who coughs more than 3 weeks, asthma excluded]

No.	Name	Age	Sex	Month											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1				☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O
2				☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O
3				☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O
4				☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O
5				☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O
6				☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O
7				☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O
8				☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O	☐O

☑ = Not treated at PHF; Ⓥ = Treated at PHF

Village: ……..

List of PW (by TT status) and Deliveries (by outcome) during Year: ……

No	Name	G	Month																						Delivery outcome		
			Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec				
			<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	<7 mo	7+ mo	LB	SB	PD
1																													
2																													
3																													
4																													
5																													
6																													
7																													
8																													
9																													
10																													

Abbreviations: G=Gestational age; LB=live birth; SB= Still birth; PD=Perinatal death; mo= Months of gestation

Pregnancies: ☑ = No TT immunization, ① = 1 dose of TT; ② = At least 2 doses of TT

Deliveries: ☑ = At home & by TBA; ⓒ = At home & by health staff ✪ = At PHF

Appendix 3.7 Proposed revised recording form for deaths

Village: .....
Village Death Register, Year: .....

No.	Name	Age	Sex	Place of death	Cause/ Major Symptoms	PW	Del	Date of death	Name of Household head
1				☐O					
2				☐O					
3				☐O					
4				☐O					
5				☐O					
6				☐O					
7				☐O					
8				☐O					
9				☐O					
10				☐O					
11				☐O					
12				☐O					
13				☐O					

☑ = Died at home or other place than PHF; ☑ = Died at PHF

Appendix 3.8 Proposed revised monthly VHVs' reporting form

Operational District: .....
Health Centre: .....

VHVs' REPORT, MONTH: ..... YEAR 2002
Village: .....

I. Pregnancies, Deliveries, and Deaths in the Village

1. No. of Pregnant Women and Doses of Tetanus Vaccination Received

Below 7 months gestation			7 -9 months gestation			Total
No TT Vaccination	TT1	TT2+	No TT Vaccination	TT1	TT2+	

2. No. of Deliveries

Live Birth			Died after Birth			Still Birth			Total
☑	☑	☑	☑	☑	☑	☑	☑	☑	

☑= Delivery at Home and by TBA; ☑ =Delivery at Home and by (trained) Midwife; ☑ =Delivery at PHF

3. No. of Deaths

Name	Sex	Age	Place of Death		Cause of Death		
			☑	☑	Major symptoms preceding death	PW	Delivery

☑= Died at home ☑ =Died at PHF PW/Delivery=Maternal Death

II. Diseases/ syndromes

Age (Years)	Chronic Cough		Severe Diarrhoea		Suspected Malaria		Hemorrhagic Fever		Suspected Measles	
	☑	✓	☑	✓	☑	✓	☑	✓	☑	✓
0-4										
5-14										
15+										
Total										

☑= Not treated at PHF; ✓ =Treated at PHF

III. VHVs Social Mobilisation Activities

1. Frequency of Data Collection: .....

2. Immediate Reports

-Severe diarrhoea: No. of cases: .....; Date of Report: .....
-Hemorrhagic fever: No. of cases: .....; Date of report: .....
-Suspected measles: No. of cases: .....; Date of Report: .....
-Suspected malaria: No. of cases: .....; Date of Report: .....
-Other disease (specify): No. of cases: .....; Date of report: .....

3. Referral of Patients

-No. of patients advised/Referred to health facilities: .....
-No. of patients who subsequently went to health facilities: .....
-No. of patients who eventually received treatment at health facilities: .....

4. Other Activities in Disease prevention and Control:

.....
.....

IV. Comments and Suggestions

.....
.....

Date: 2002
VHV's name & signature

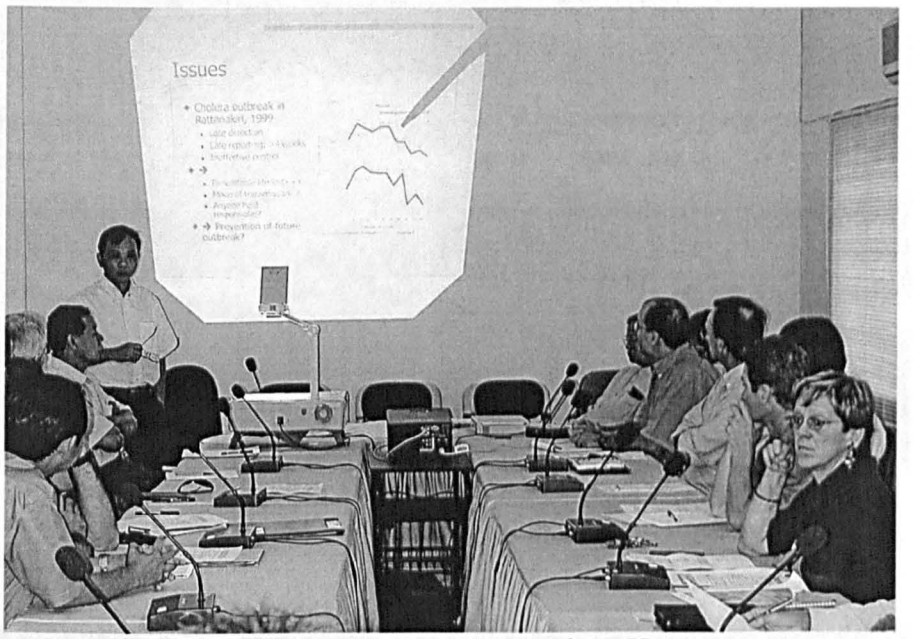
Appendix 3.9 Guideline for outbreak and death investigations

I. Circumstances	II. Time lag	III. Procedures	IV. Responsible
a. **Clustering of cases** of infectious diseases in any village: -Hemorrhagic Fever: 5 cases/ week -S. Diarrhoea: 5 cases/ week -Measles: 2 cases/ week	a. Within 2 days after reception of report or suspicion of outbreak (through the monitoring of diseases trends)	1. Find all cases and deaths (using investigation forms) & determine whether there is an outbreak; 2. Analyse data by time, place and person & identify causes and sources of the outbreak; 3. Treat patients and collect specimen: -DHF: At HC: Paracetamol, Oral Rehydration Salt; refer to RH when necessary. -Measles: paracetamol, Vitamin A, Oral Rehydration Salt & antibiotic -Severe diarrhea: Cholera Kit, stool specimen to be sent to NIPH/Pasteur Institute; report to MoH; 4. Control the outbreak: -Health education -Specific control measures	1. HC 2. OD (PHD/MoH) 3. HC & OD 4. HC & OD (PHD, National Programme)
b. **Any death** due to: -Severe Diarrhoea -Hemorrhagic fever	b. Within 2 days after reception of report or suspicion of outbreak		
c. **Any death** of: infant aged <28 days	c. Within 2 weeks after reception of report	Interview relative of deceased on causes of death (using standardised Verbal Autopsy Form)	-HC (OD/ PHD/ National Programme)

APPENDIX 4

PICTURES OF ACTIVITIES:
Development, Implementation & Evaluation of Cambodia Rural CBSS, 2000-2001

Appendix 4.1 CBSS development: Consultative meetings

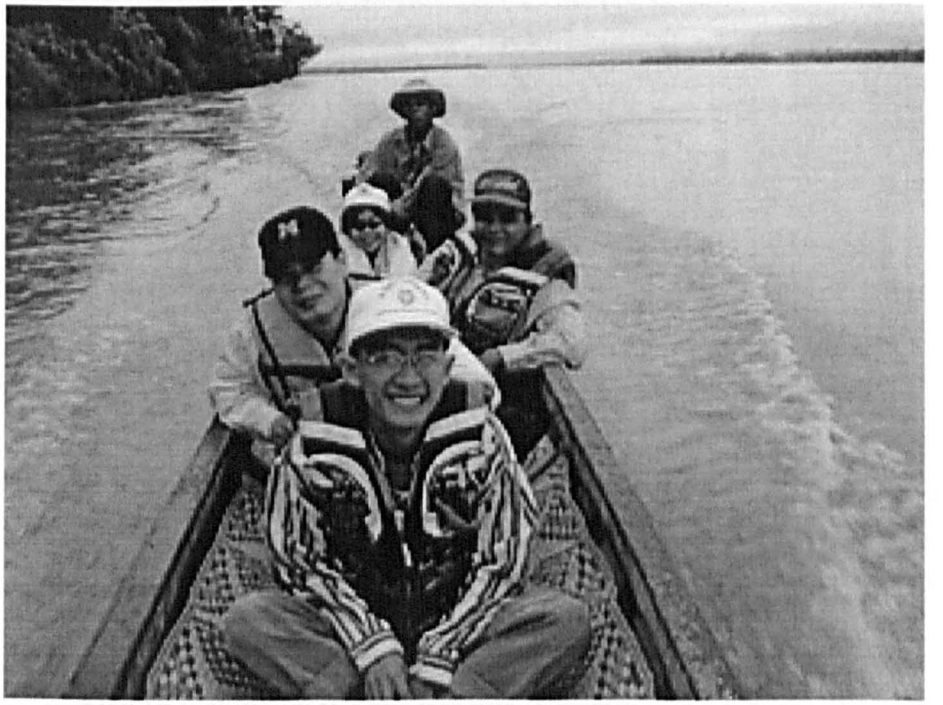


Presentation of CBSS project to IOs, NGOs and MoH programme managers
(NIPH, Phnom Penh)

Discussion of CBSS with NIPH key staff
(NIPH, Phnom Penh)

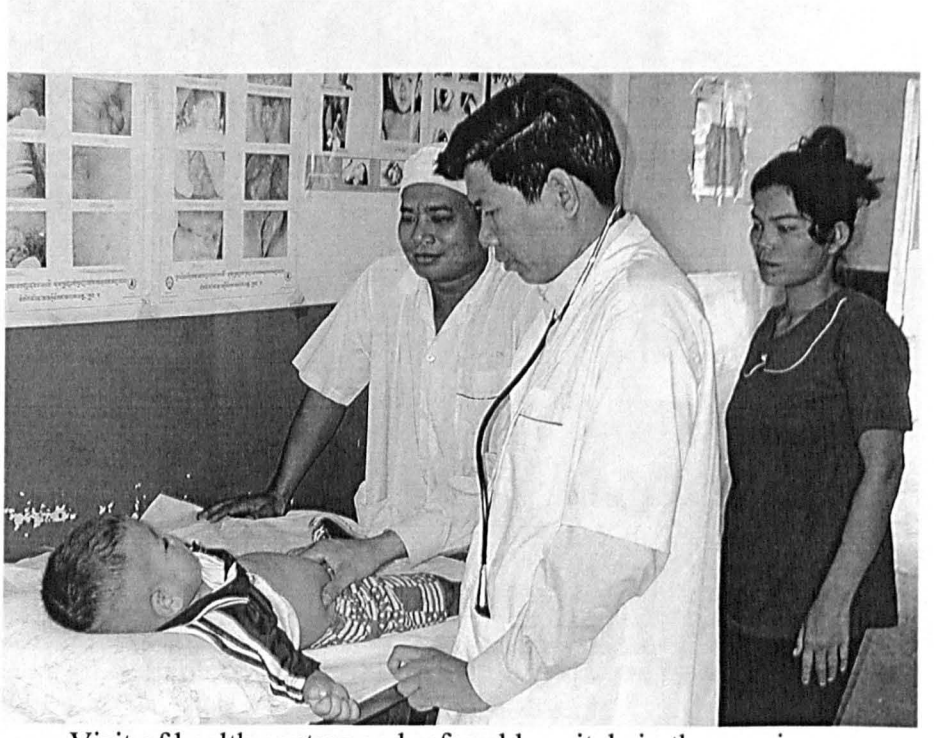
Appendix 4.2 CBSS development: Feasibility study

Many field study sites are accessible by only a four-wheel drive



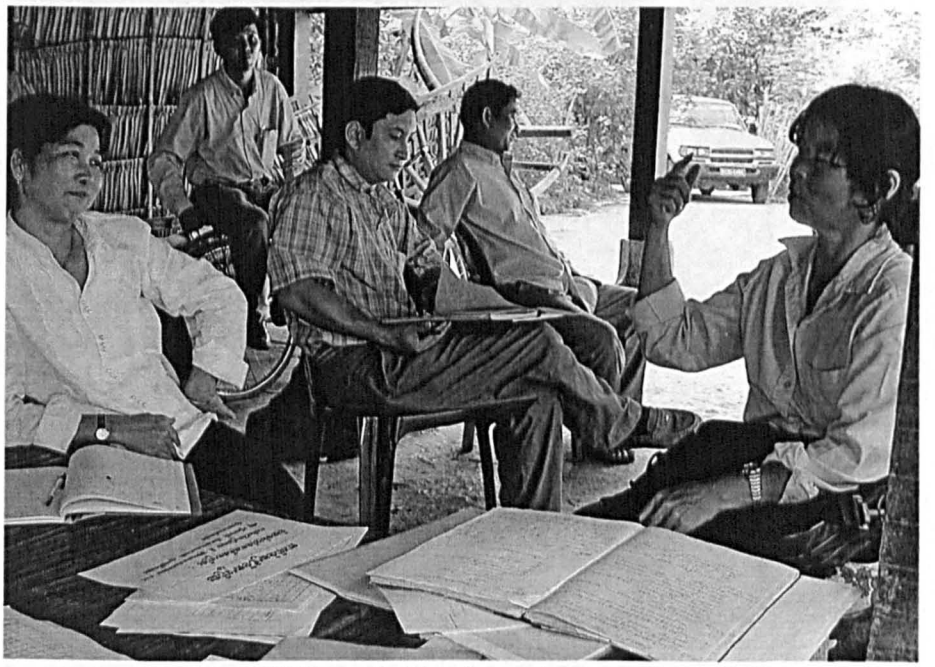
Preah Rumkel commune is only accessible by boat
(4-5 hours from Stung Treng province city)

This (40-year old Russian) plane is practically the only mean to access
Battambang province in the rainy season and
Stung Treng province in the dry season

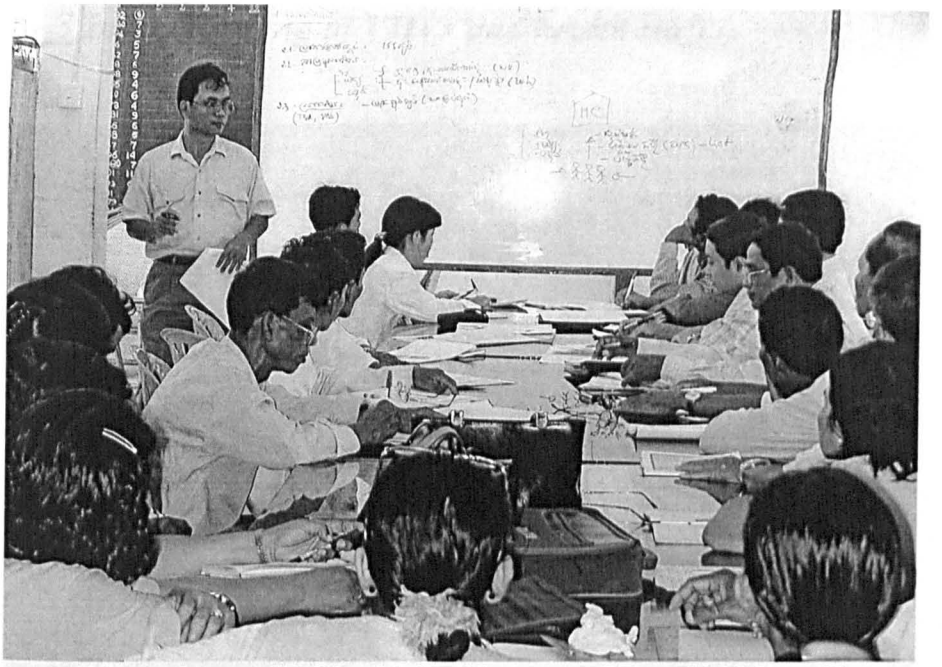


Visit of health centres and referral hospitals in the provinces,
districts and communes
(Stung Treng province)

Visit of study population
(Preah Rumkel commune)



Explore VHVs activities in projects run by NGOs
(Kandal province)



Discussion on CBSS with health centre, OD and NGO staff
(Kandal province)

Discussion on CBSS with health centre, OD and PHD staff
(Kompong Thom province)

Appendix 4.3 Initial training of VHVs and health staff

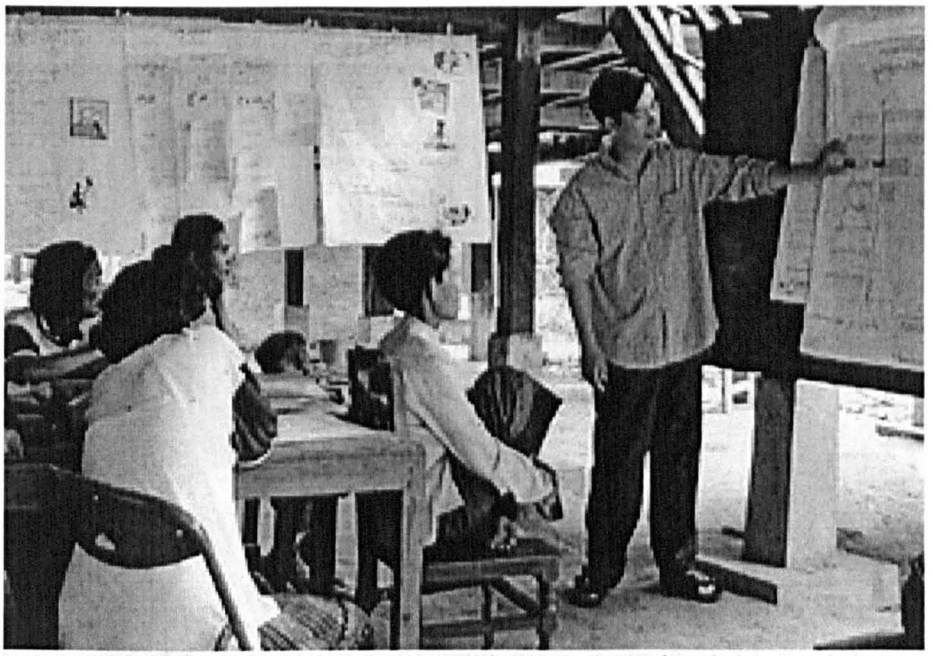
Introduction to disease surveillance and CBSS
(Preah Rumkel commune)

VHVs and health staff group work on community diagnosis
(Preah Rumkel commune)

Community diagnosis: Group presentation by VHVs
(Pir Thnu commune)

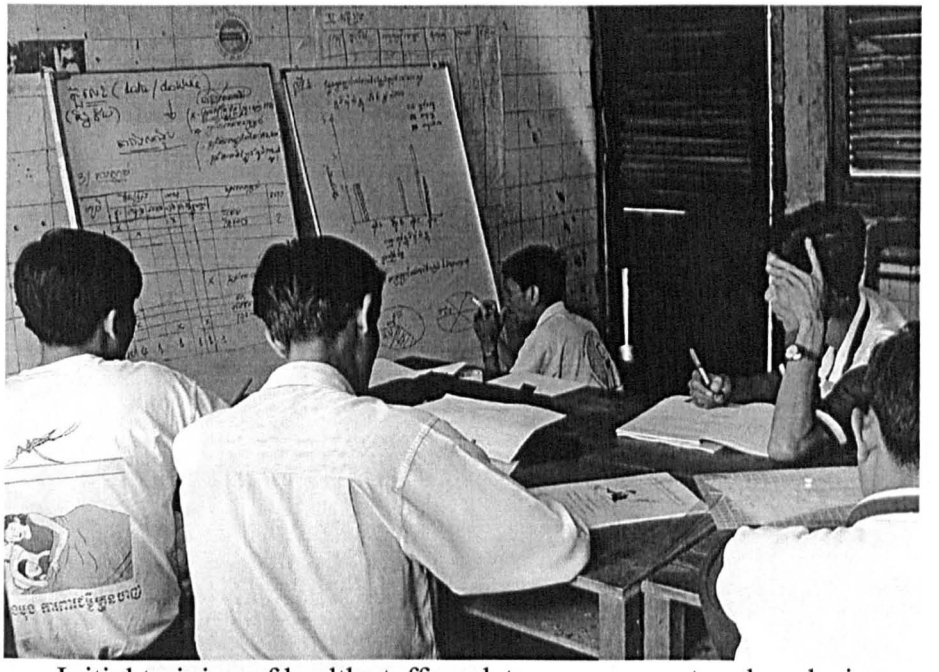
Training of VHVs on how to complete reporting forms
(Preah Rumkel commune)

Training of health staff on data presentation
(Preah Rumkel commune)



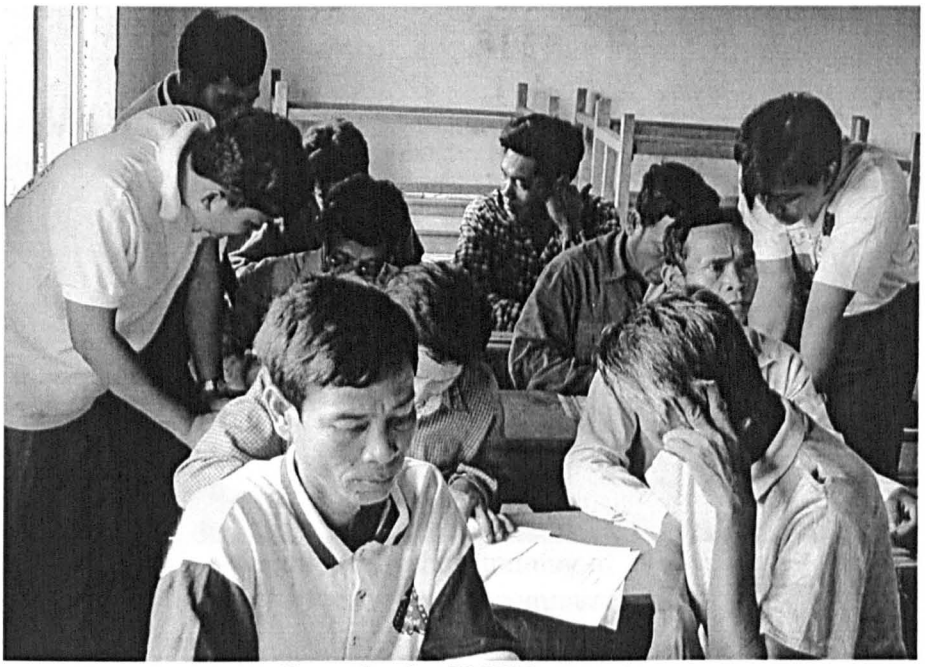
Feedback on information collected by VHVs during initial training
(Preah Rumkel commune)

Initial training of health staff on data management and analysis
(Chan Mul and Choam communes)



Initial training of health staff on data management and analysis
(Pir Thnu commune)

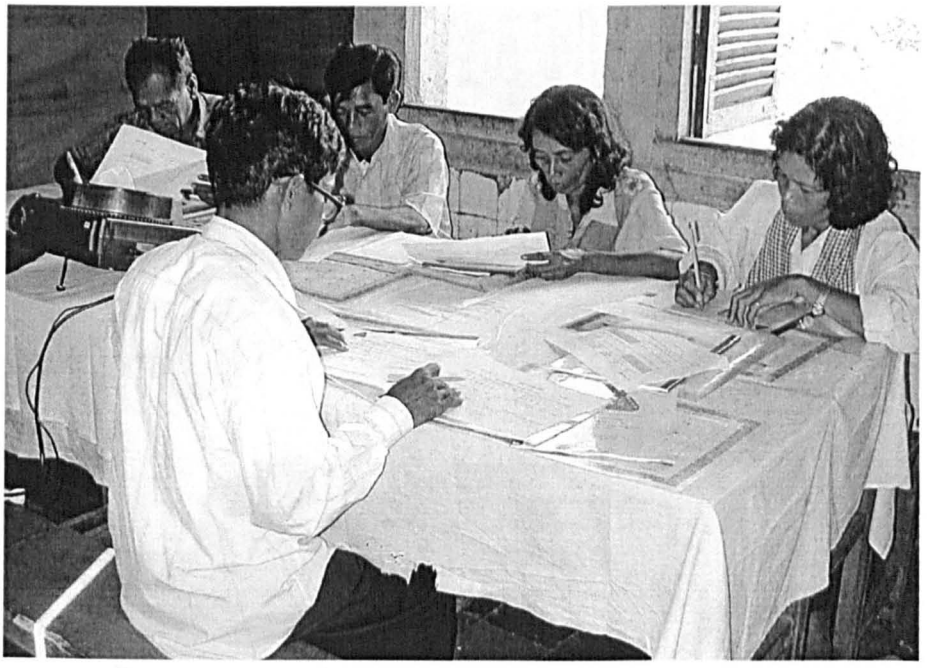
Appendix 4.4 Monthly feedback meetings



Crosscheck of VHVs reports
(Chan Mul and Choam communes)

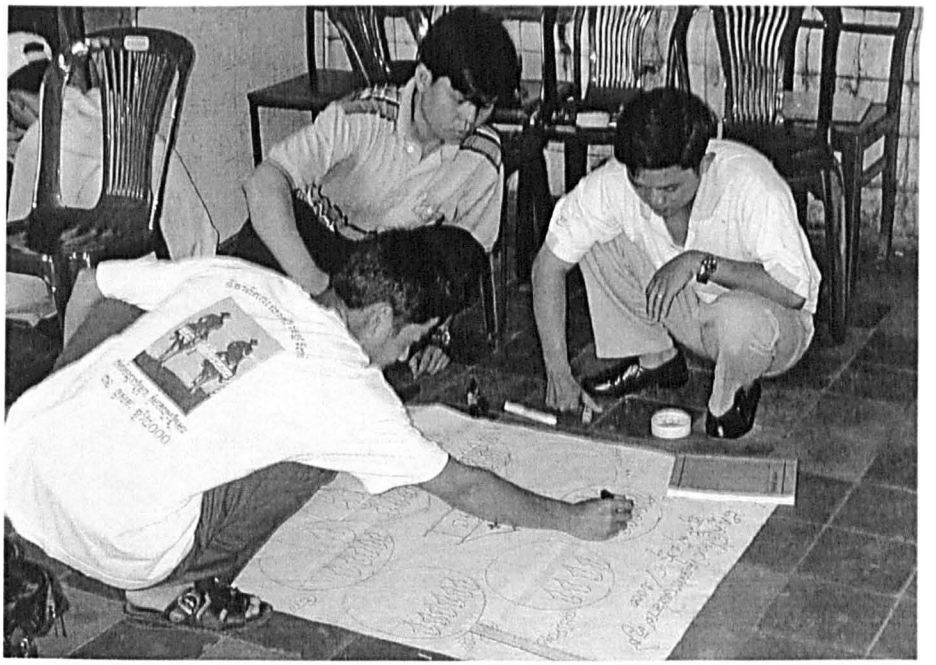
Crosscheck of VHVs reports
(Trang, Tasen and Boeng Raing communes)

Monthly (refresher) training of VHVs
(Preah Rumkel commune)

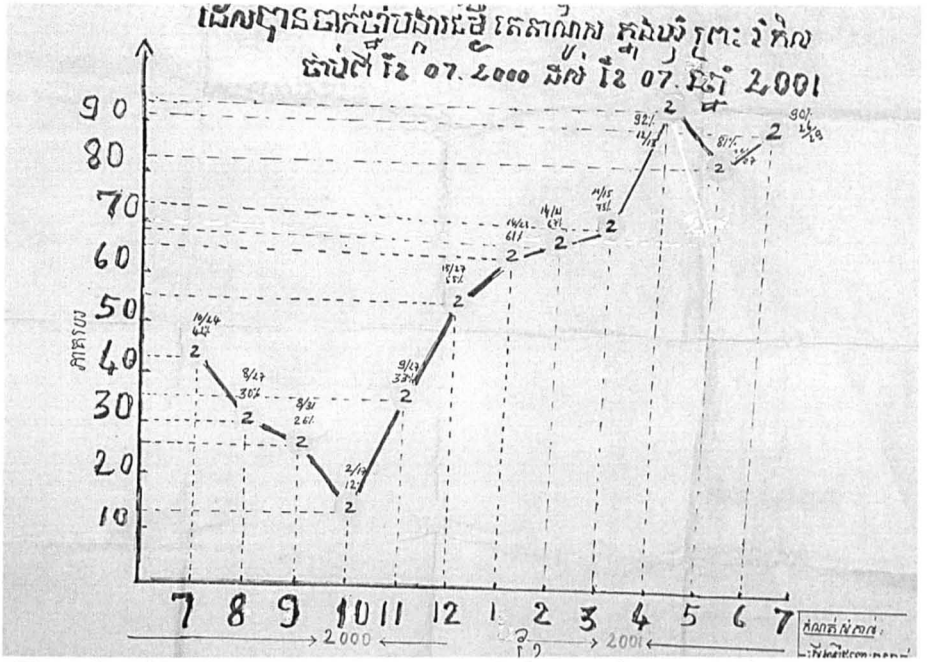


Monthly (refresher) training of VHVs
(Pir Thnu commune)

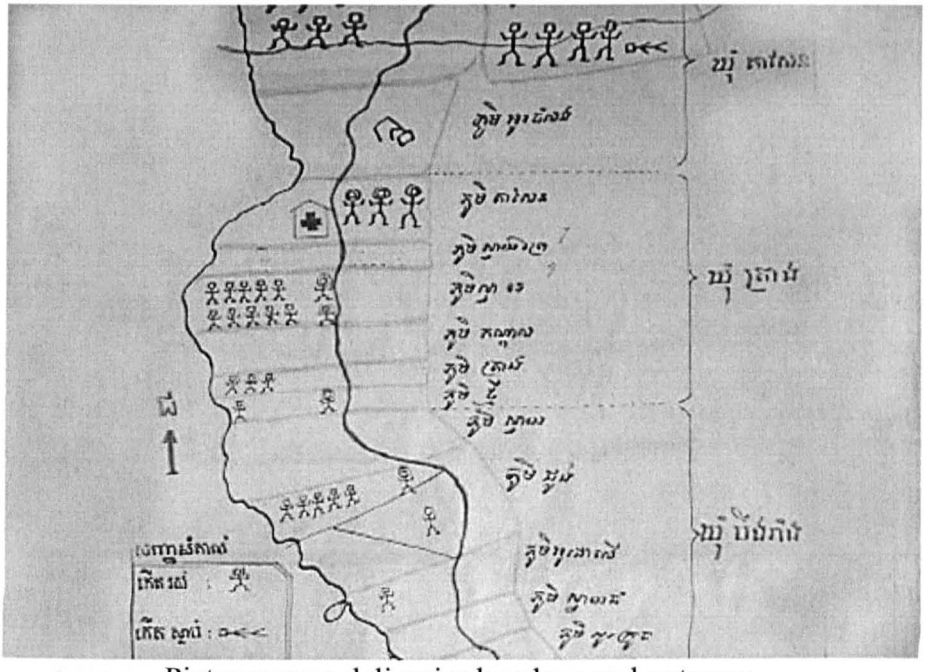
Preparation for data presentation by health centre staff
(Preah Rumkel commune)



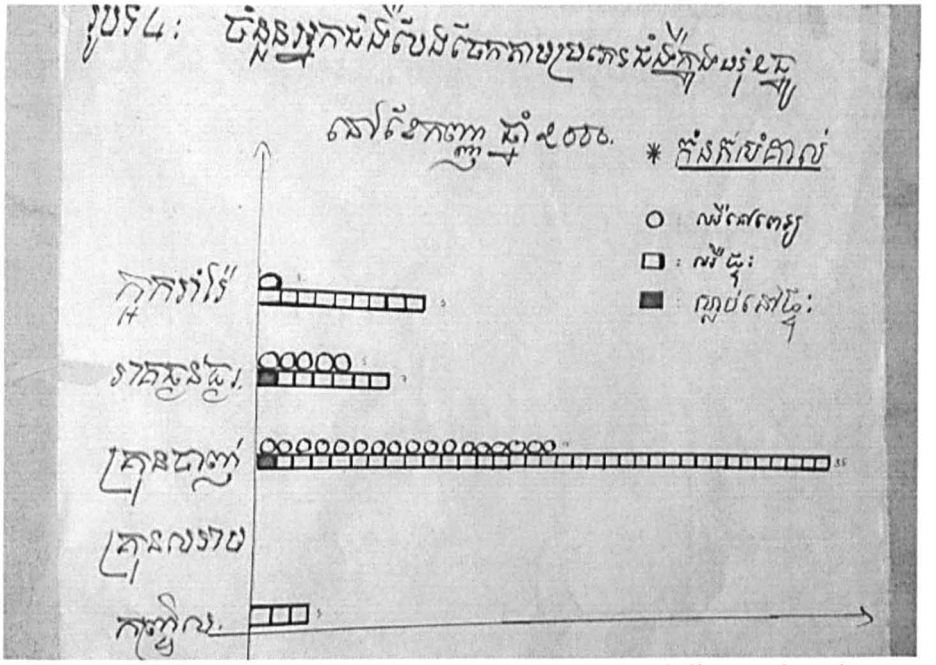
Preparation for data presentation by health centre staff
(Pir Thnu commune)



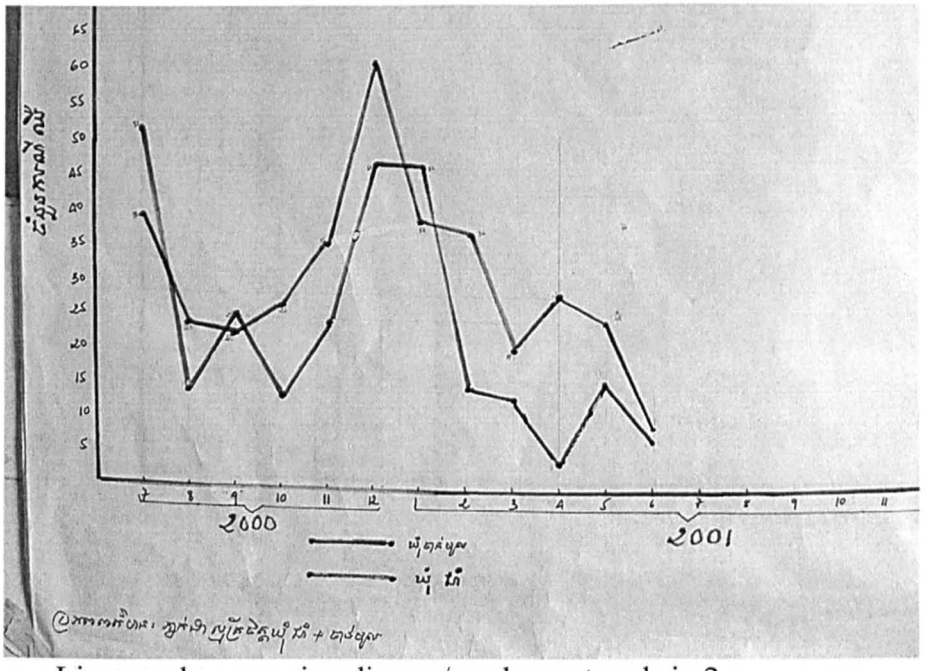
Trends of TT2+ coverage among 7-9 months gestation women
(Preah Rumkel commune)



Pictogram on deliveries by place and outcome
(Trang, Tasen and Boeng Raing communes)



Bar chart showing monthly cases of each reported disease by place
(Pir Thnu commune)



Line graph comparing disease/syndrome trends in 2 communes
(Chan Mul and Choam communes)

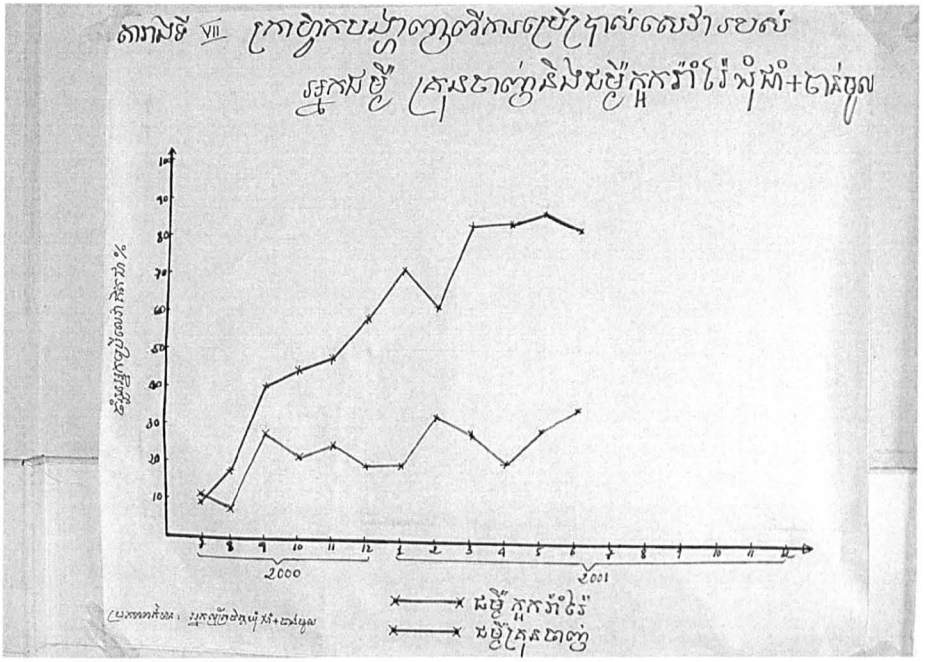
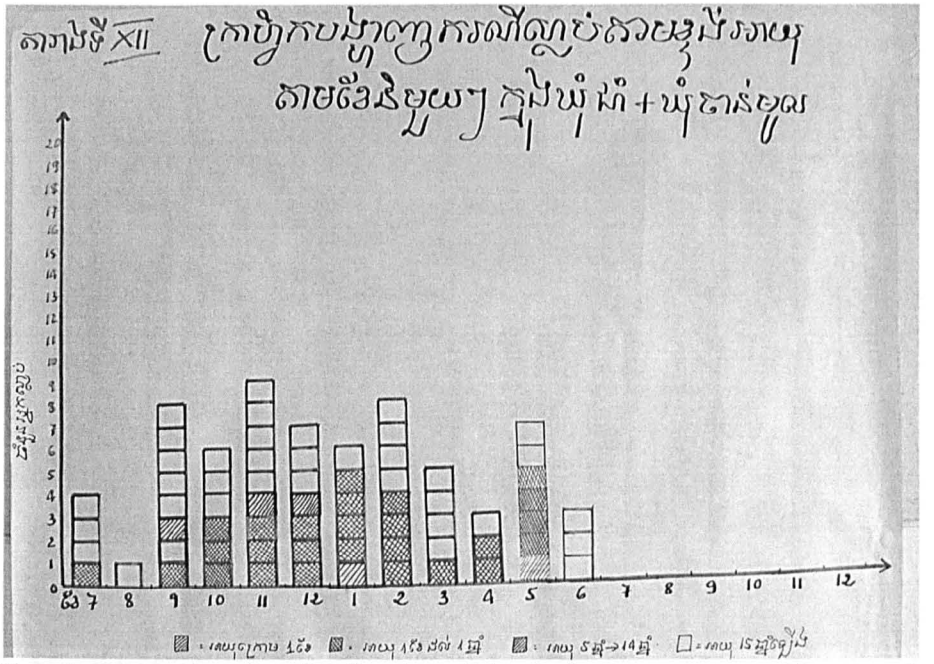
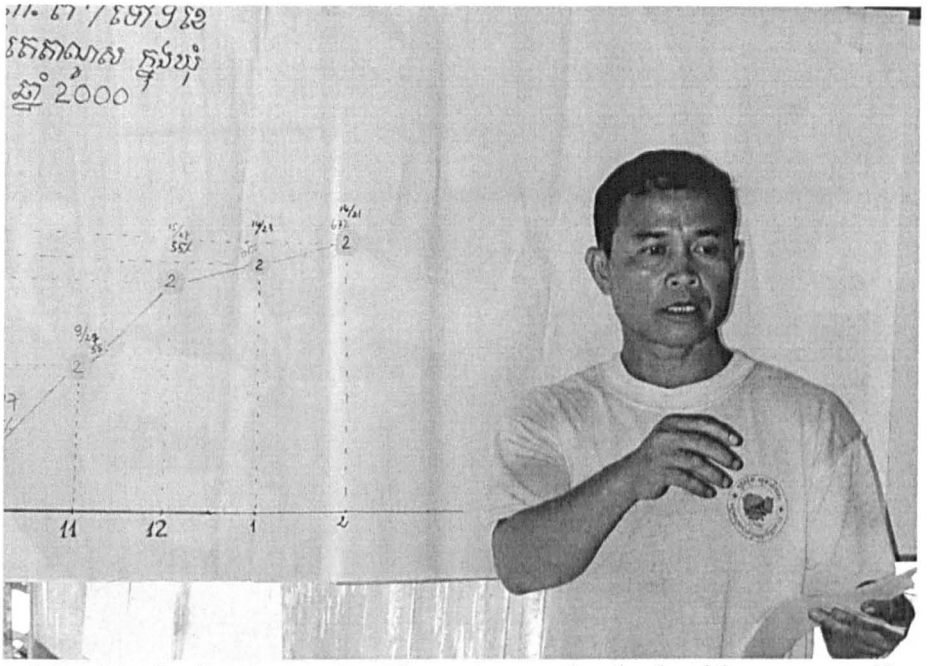


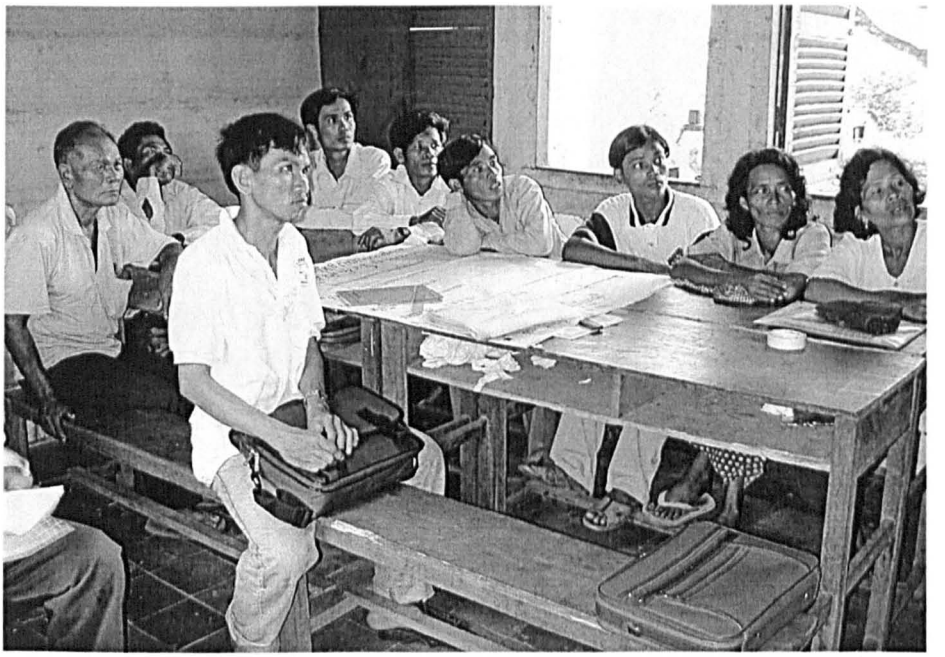
Chart comparing trends of utilisation of health facilities for malaria and chronic cough
(Chan Mul and Choam communes)



Bar chart showing the distribution of deaths by age group and by month
(Chan Mul and Choam communes)



Monthly feedback meeting: data presentation by health centre staff
(Preah Rumkel commune)


Monthly feedback meeting: participants attending data presentation
(Pir Thnu commune)

Monthly feedback meeting: Discussions on follow-up actions
(Trang, Tasen and Boeng Raing communes)

Monthly feedback meeting: Discussion and decision-making
(Preah Rumkel commune)

Lunch taken by participants of the feedback meeting
(Preah Rumkel commune)

Video spot on disease prevention presented during lunch break at a feedback meeting
(Chan Mul and Choam communes)

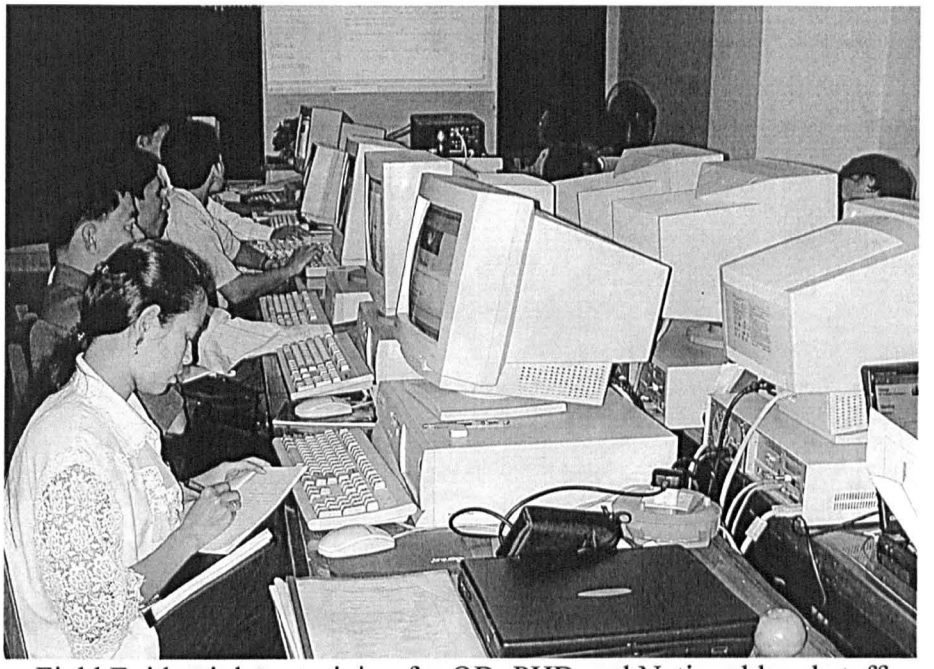
Appendix 4.5 Follow-up activities

Investigation of measles outbreak following VHV's report
(Preah Rumkel commune)

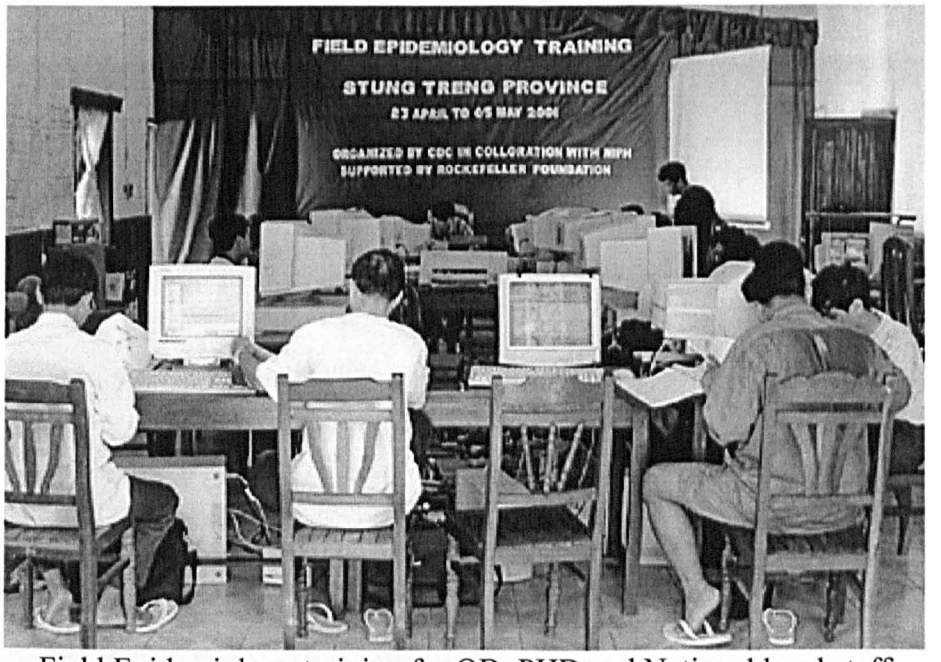
Outreach activities: immunisation and health education
(Preah Rumkel commune)

Appendix 4.6 Capacity building of health staff

Further training of (HC, OD, PHD) health staff on disease surveillance (Battambang province)



Field Epidemiology training for OD, PHD and National level staff
supported by the Rockefeller Foundation
(Kompong Cham province)

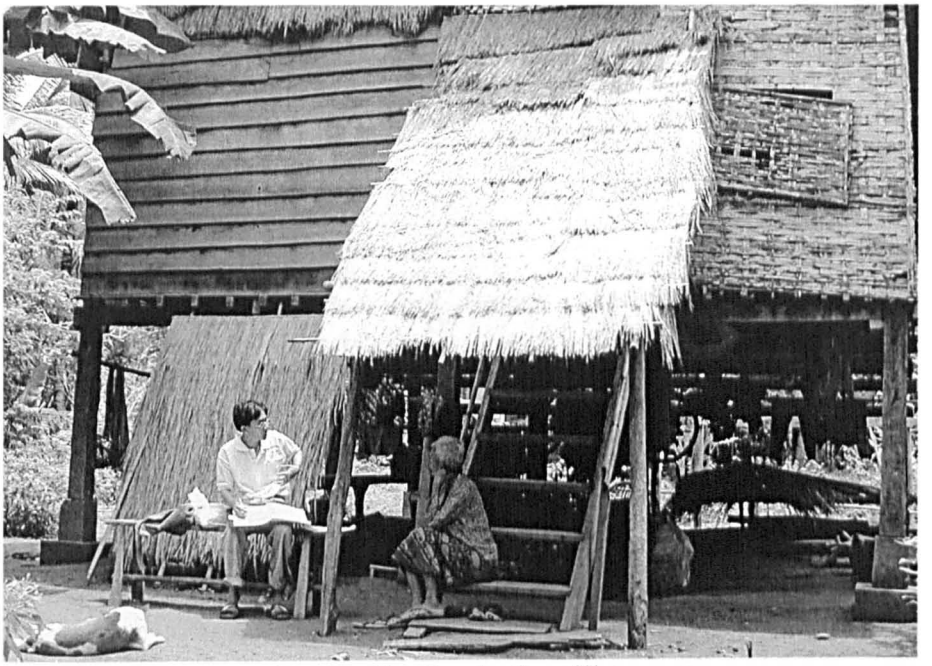


Field Epidemiology training for OD, PHD and National level staff
supported by the Rockefeller Foundation
(Stung Treng province)

Appendix 4.7 Household survey

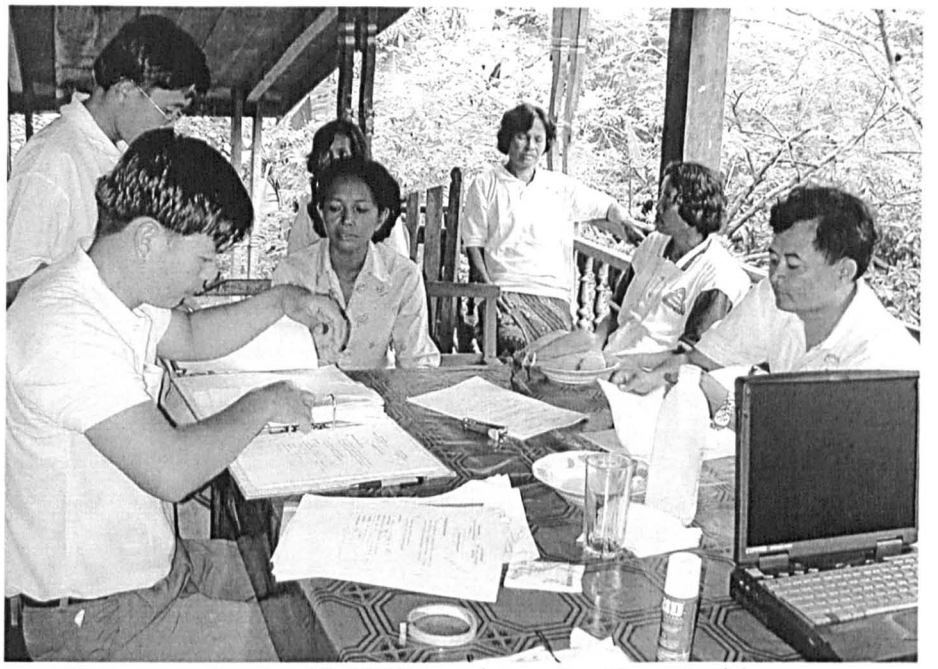
Training of survey team leaders in data collection and management
(NIPH, Phnom Penh)

Pre-testing of questionnaires in a village
(Memot district, Kompong Cham province)



Data collection in the village
(Preah Rumkel commune)

Data collection in the rice field
(Preah Rumkel commune)



Data crosscheck with VHVs to determine True Positive cases
(Preah Rumkel commune)

Data crosscheck with VHVs to determine True Positive cases
(Chan Mul communes)

Data validation and preliminary analysis by survey team leaders
(NIPH, Phnom Penh)

Presentation of survey's preliminary findings to participants from MoH, IOs, NGOs, provinces and districts
(NIPH, phnom Penh, 25 July 2001)

Appendix 4.8 CBSS team members

CBSS team in Stung Treng province

CBSS team in Kompong Cham province

CBSS team in Battambang province

CBSS team in Kratie province