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Ministry of Health
National Center for Tuberculosis
and Leprosy Control

Report

National TB Prevalence Survey, 2002
Cambodia

August 2005

National Tuberculosis Control Program

Ministry of Health

National Center for
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Contents

Page

Annex

List of tables and figures

FOREWORD

The National Tuberculosis Prevalence Survey, 2002, Cambodia, is the first of its kind, ever conducted in the Kingdom of Cambodia. It is the result of excellent collaborative efforts among the major partners and staff of the National Tuberculosis Control Program (NTP).

Since reliable baseline information for the NTP was a long felt need, the findings of the survey will be of great significance for the overall management of the National TB Control Program, particularly in planning, monitoring and evaluation. Moreover, the findings will assist the NTP in gearing its efforts towards reaching the Millennium Development Goals not only, nationally, but also, regionally and globally.

The successful completion of the survey also highlights the tremendous commitment of the Ministry of Health of the Kingdom of Cambodia, the National Centre for Tuberculosis and Leprosy Control (CENAT) and various partners concerned to jointly combat the disease in this high TB burden country.

Phnom Penh, 18 August, 2005

Secretary of State for Health

Dr. Mam Bun Heng

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The National Tuberculosis Prevalence Survey, 2002, Cambodia was conducted by the National Center for Tuberculosis and Leprosy Control (CENAT) of the Ministry of Health, the Royal Government of Cambodia under the supervision of the Executive Committee participated by the representatives from the Ministry of Health and the National TB Control Project by Japan International Cooperation Agency (JICA).

Funding for the survey was provided by the Ministry of Health and World Bank through the Cambodia Disease Control Project, JICA through the National TB Control Project and the World Health Organization (WHO). Research Institute of Tuberculosis (RIT) of Japan Anti-Tuberculosis Association and JICA's National Tuberculosis Control Project Team provided technical support to the survey. WHO was responsible for the conduct of trainings on the Tuberculin survey in collaboration with International Tuberculin Surveillance Center, Netherlands, Korean Institute for Tuberculosis (KIT) and NTP Viet Nam. The Drug Susceptibility Test was carried out by Pasteur Institute, Cambodia.

Experts from IUATLD, KIT, RIT and WHO as well as concerned domestic agencies participated in the review and consensus building activities of the survey. In addition, health workers both at the central and local levels and local communities participated and made great contributions to the survey.

We wish to express our deep thanks and appreciation to all organizations and individuals for their contributions in making this survey successful. We would to particularly thank Dr. Ikushi Onozaki and Dr. Norio Yamada of JICA and RIT for their tremendous contributions from the very beginning of the survey design to the completion of this report. We sincerely hope the survey results will be of great use in bringing a brighter future to those who suffer from Tuberculosis.

Acronyms/Abbreviations

AFB	Acid-Fast Bacilli
AIDS	Acquired Immunodeficiency Syndrome
ARI	Annual Risk of Infection
BCG	Bacillus Calmette-Guérin
C, C(+), C(-)	Culture, Culture positive, Culture negative
CENAT	National Center for Tuberculosis and Leprosy Control, Ministry of Health
CI	Confidence Interval
CIPS	Cambodia Inter-Census Population Survey 2003
CP	Central Panel
DOT	Directly Observed Treatment
DOTS	Directly Observed Treatment, Short Course
EB	Ethambutol
EC	Executive Committee
EPI	Expanded Program on Immunization
HIV	Human Immunodeficiency Virus
HPF	High Power Field
INH	Isoniazid
IOM	International Organization for Migration
ITSC	International Tuberculosis Surveillance Centre
IUATLD	International Union Against Tuberculosis and Lung Disease
JATA	Japan Anti-Tuberculosis Association
JICA	Japan International Cooperation Agency
LLDC	Least Developed Country
MDG	Millennium Development Goal
MDR	Multi-drug Resistant
MOH	Ministry of Health
NDRS	National Drug Resistance Survey
NGO	Non-Governmental Organization
NTP	National Tuberculosis Program
RIT	Research Institute of Tuberculosis, Japan Anti-Tuberculosis Association
RMP	Rifampicin
S, S(+), S(-)	Smear, Smear positive, Smear negative
SM	Streptomycin
STB	Stop Tuberculosis Program
TB	Tuberculosis
TC	Technical Committee
UNAIDS	Joint United Nations Program on HIV/AIDS
WHO	World Health Organization
WPRO	Western Pacific Regional Office, World Health Organization

Executive Summary

The National TB Program of the National Center for Tuberculosis and Leprosy Control (CENAT), Cambodia, successfully conducted the 1st National TB Prevalence Survey in 2002. 97% of the population was covered by the survey except for four remote and population scattered provinces due to logistical difficulties. A high participation rate of 96.7% was achieved: 30,032 out of 31,050 eligible subjects in 42 clusters across the country participated in the study.

An interview by a physician or a medical assistant and an X-ray examination were given to each study subject aged 10 or more to identify TB suspects for sputum examination. Out of 22,160 study participants aged 10 or more, 3,301 were examined for sputum. 81 smear positive and 191 smear negative / culture positive pulmonary TB cases were detected.

Weighed prevalence rates of the population aged 10 or more were 362 (95% C.I.: 284-461) for smear positive and 846 (675-1059) for smear negative/culture positive per 100,000 respectively. If we assume that we can neglect smear positive cases among children aged less than 10, a prevalence rate of smear positive TB becomes 269 per 100,000 populations. Around 34,000 smear positive TB patients, more than 110,000 bacteriologically positive TB patients, lived in Cambodia at the survey time in 2002. While the prevalence rate of smear positive TB was lower than expected, the prevalence rate of smear negative/culture positive TB was much higher than expected. However, no-MDR TB strain was isolated from the survey subjects.

Although 60% of smear positive cases belonged to adults aged between 15 and 54, the older age groups occupied a significant portion of the prevalence. The older the age group is, the higher the prevalence rate is. A smear positive prevalence rate in the age group 65 or more was as high as 1,512 per 100,000. The prevalence rate in male was 2.5 times higher than that in female. Areas with better access to DOTS facilities such as Phnom Penh, provincial capital towns and villages within 5 km from the DOTS centers tended to have lower prevalence rates of smear positive TB.

According to the interview, 6.8% of the study participants aged 10 or more experienced cough for 3 weeks or more in the past one month. The prevalence rate of chronic cough increased as age increased. When we define TB suspects as those who had “cough for 3 weeks or more” and/or “blood contained sputum”, 7.3% fell in the category of TB suspects by symptom screening. However, out of 81 smear positive TB cases, only 50 or 62%, belonged to the category of TB suspects. For bacteriological positive cases including smear negative/culture positive, only 39.1% were screened by the interview. The X-ray examination could detect all bacteriologically positive cases except for a few smear negative culture positive subjects.

Children less than 15 year old received a BCG scar check and a tuberculin test. A BCG scar was observed in 50.2% of children aged between 1 and 14. The BCG scar rate among children aged 1-4 was as low as 64.6% with no sex and geographical differences. This figure was consistent with the government estimation of the vaccination coverage. When we applied the cut-off point of 10 mm as tuberculin reaction, 2.7% of children were infected with TB by age 2.8, 13.7% by age 7.2, and 32.7% by age 12.. The annual risk of TB infection in the age group between 5 and 9 was estimated at 2.06%.

Despite the fact that the numbers of case notifications in male and female have been almost at the same level in Cambodia, the survey saw a considerable difference in the prevalence between male and female. The Prevalence/Notification ratios were relatively constant across all age groups in both sexes. However, male always showed higher ratios than female in every age group. Since there was no difference in delays of diagnosis between male and female, the case detection rate in male might be much lower than that in female.

As the TB prevalence rate increases along the age, it was suggested that, at present, a significant portion of TB diseases in Cambodia are developed from latent infection and reactivation, not from new infections.

Using other available information and some additional studies on TB and HIV in Cambodia, the incidence of TB was estimated. The point estimate of incidence of new smear positive TB was 229/100,000, which was very close to the WHO's recent estimation. The incidence of all forms of TB was estimated approximately at 600/100,000. HIV/AIDS attributed around 13% of incidence of smear positive. However, since the prevalence of smear negative and culture positive TB was much higher than expected, and since we might have more TB cases than expected among children, the total TB burden, or an incidence rate of all TB, could be as high as 700/100,000.

Compared with the past studies from the 1980s and 1990s, the observed prevalence rate of smear positive was much lower in this study, especially in the younger adult population. The better access to DOTS shortened a delay of diagnosis and cut the infection chain. The exerted efforts of expanding DOTS in the past 8 years seemed to have made a significant impact on the TB burden. However, a large pool of latent infection in the middle and elder generations and the impact of HIV/AIDS account for the high TB incidence in Cambodia. As a result, the country still remains a high TB burden country.

Tables of Main Findings

Participation Rate by Age and Sex

	Number		Participation rate		
Age group	Eligible	Participated	Total	Male	Female
0–9	7,966	7,872	98.8%	98.8%	98.8%
10–14	4,598	4,519	98.3%	98.0%	98.6%
15–24	6,439	6,055	94.0%	93.5%	94.6%
25–35	3,808	3,645	95.7%	94.4%	96.8%
35–44	3,323	3,201	96.3%	94.8%	97.5%
45–54	2,276	2,199	96.6%	96.2%	96.9%
55–64	1,359	1,312	96.5%	95.1%	97.6%
65+	1,281	1,229	95.9%	95.7%	96.1%
All age	31,050	30,032	96.7%	96.2%	97.2%
Age ≥10	23,084	22,160	96.0%	95.2%	96.7%

Estimated TB Prevalence, Cambodia, 2002

	Rate (/100,000)		
	Point Estimate	95% C.I.	No. of Cases
(For population aged 10 or more)			
S(+) TB	362	284 – 461	33,998
S(–)C(+) TB	846	675–1,059	79,450
S(–)C(–) X-ray Active TB Suggestive**	1,370	1,117–1,680	128,657
Bacteriologically Postive TB	1,208	997 – 1,463	113,447
Pulmonary Active TB Suggestive**	2,579	2,205–3,013	242,095
(For all age*)			
S(+) TB	269	211 – 343	

*Assuming that there was no smear positive case in children aged less than 10
2002 Population Re-estimate from Cambodia Inter-Census Population Survey '03: 12,630,000
74.34% of eligible population was aged 10 or more in this prevalence survey: 9,389,000
** Including active TB suspected only by a single X-ray examination

Results of BCG Scar Survey

			BCG Scar			
Age group	Evaluated	No Scar	Scar +	Total %	Boy %	Girl %
1–4	2,827	1001	1,826	64.6%	65.0%	64.2%
5–9	4,470	2,273	2,197	49.1%	51.3%	46.9%
10–14	4,469	2,588	1,881	42.1%	44.3%	40.4%
Total	11766	5862	5904	50.2%	51.9%	48.6%

Annual Risk of TB Infection by Different Methods

.	Cut-off 10mm		16 mm Mirror	
Age group	Point estimate	95% CI	Point estimate	95% CI
1–4	0.96%	0.56–1.64	0.42%	0.13–1.38
5–9	2.06%	1.77–2.40	1.00%	0.69–1.43
10–14	3.23%	2.88–3.62	1.64%	1.25–2.15

1. Introduction

1.1 Background

Cambodia, a country with a population of only around 13 million, has been designated by World Health Organization (WHO) as one of the 22 high burden countries of tuberculosis (TB). Its incidence rate of 573/100,000 estimated by WHO in 2001 ranks 8th in the world while the remaining top ten countries are found in Africa. The long lasted conflict and poverty possibly had negative impacts on the situation of TB in Cambodia. Although the studies conducted in the past are limited, the active case finding by the National TB Program (NTP) in the late 1980s recorded a prevalence rate of 455 smear positive per 100,000 population in several provinces. International Organization for Migration (IOM) also found 11 smear positive patients among 2583 examined (426/100,000) in 1995.

To cope with this TB epidemic, the NTP Cambodia was rehabilitated in 1994 with strong support by WHO and introduced Directly Observed Treatment, Short Course (DOTS) through public hospitals. Hospitalization was the principle in the intensive phase. By 1998, DOTS covered all existing 142 TB wards in the provincial and district hospitals, though 20% of Cambodia's districts did not have TB wards. Both treatment and detection have been improving since the introduction of DOTS. In the late 1990s, the treatment success rate exceeded the target of 85%, harboring around 90%, and the case notification rate of smear positive TB steadily increased, reaching the level of 130/100,000 in 1999. However, some pointed out that poor accessibility to DOTS facilities caused long delays in diagnosis and resulted in the low case detection rate of around 50%.

To improve the access to service, the NTP began to pilot a decentralized DOTS program involving community-based primary health care centers, health centers, in collaboration with WHO and JICA in late 1999. In order to analyze the situation of TB and formulate a strategic plan with quality indicators that can appropriately measure the impact of the decentralized DOTS, the NTP planned to implement several national studies, including the National TB Drug Resistance Survey, the National TB Prevalence Survey and the HIV Prevalence Survey among TB Patients. The most challenging among these was the National TB Prevalence Survey, which was carried out by the NTP from April to December 2002. It is probably the first national survey on TB disease prevalence in a least developed country (LLDC) under the strict DOTS program.

The survey was originally scheduled in 2001, prior to the NTP's new initiative of expanding DOTS to health centers to grasp the situation of pre-DOTS expansion as well as to evaluate the impact of the hospital-based DOTS since 1994. However, due to a delay in procurement, the survey had to be postponed. As a result, it was carried out in parallel with the expansion of DOTS in 2002.

With TB prevalence outlined as one of the Millennium Development Goal (MDG) indicators, we are convinced of the importance of this survey. In fact, many countries have begun planning or are now conducting such a survey. Therefore, we tried to describe and record all details of the study process and results rather than to produce a mere routine report. A delay in publication is mostly due to a reassessment of the survey methods and results. As some results of the survey were slightly different from expected, additional examinations and small surveys were carried out to assure the quality of this survey. We sincerely apologize for the delay and any possible inconveniences incurred.

1.2 Objectives

(1) To estimate a prevalence of smear-positive and culture-positive tuberculosis among adults and children aged 10 and above

(2) To estimate a BCG scar rate and a prevalence of tuberculosis infection among children aged 14 and below

(3) To assess an annual risk of tuberculosis infection (ARI)

(4) To investigate and analyze the relationship among the tuberculosis prevalence, the notification rate and the ARI

(5) To estimate a prevalence of tuberculosis suspects from symptoms and patients behaviors

(6) To re-estimate an incidence rate of tuberculosis, using results of the survey and other recent studies

2. Methodologies

2.1 Organizations

2.1.1 Central Committees

The Executive Committee and the Technical Committee were established. The Central Panel was additionally formed with technical experts.

Executive Committee (EC):
The Executive Committee was formed to take overall responsibilities of the survey and perform supervisory tasks. It is composed of 10 persons: Director of NTP as Chairman, Vice-Director of NTP as Vice Chairman, 6 members (Chief and Vice-Chief of Technical Office, Laboratory Chief, X-ray Section Chief, JICA Chief Advisor, MOH/WB Project Coordinator) and 2 secretaries from Technical Committee members.

Technical Committee (TC):
The Technical Committee is responsible for the planning and execution of the survey. It is divided into six sub-committees: Statistic Analysis (4 persons), Census Taking (9 persons), X-ray Examination (10 persons), Tuberculin Test (9 persons), Bacteriological Examination (7 persons) and Administration (4 persons).

Central Panel for Diagnosis:
In addition to the above sub-committees, the Central Panel was formed to determine final diagnostic categorization of study participants. It consists of survey team leaders, a radiologist, a chest physician, and Japanese technical advisors including chest physicians and a laboratory technologist.

2.1.2 Survey Teams

Three survey teams were formed to conduct field surveys in 42 areas. While two teams were active on field operation, the remaining one team stood behind on rotation at the National Center for Tuberculosis and Leprosy Control, Ministry of Health, Cambodia (CENAT). Each team had 4 units: Census Unit, X-ray Unit, Tuberculin Test Unit and Bacteriological Examination Unit. The field operation team was equipped with an X-ray mobile car or an X-ray portable unit and 3 or 4 vehicles. A total number of staff in each team was around 15, excluding a local district TB supervisor, health center staff and community volunteers. The team leader was a medical doctor. A Japanese technical advisor who also served as a senior TB doctor assisted each field team with field operations, especially X-ray screening reading.

2.1.3 Training

All members participating in the survey were trained with the following components:

1-Understanding of the rationale of the survey and study protocols
2-Data collection methods and techniques
3-Training and practice by component to estimate the time required in the field and to identify possible weaknesses
4-Field pilot survey to integrate all above components

These training sessions were conducted 1 to 6 months prior to the survey.

A special training session was arranged for tuberculin testers and readers for standardization. In collaboration with WHO and International Tuberculosis Surveillance Center (ITSC), tuberculin standard nurses were invited from Netherlands, Republic of Korea and Viet Nam as trainers. Out of 12 candidates, only 3 were qualified to serve as principle tuberculin readers and 3 as back up readers.
A mid-term evaluation retreat was organized with all survey technical staff to avoid inter-surveyor/team bias in field operations.

2.1.4 Technical and Financial Support

The survey was carried out by CENAT. The MOH-World Bank Cambodia Disease Control Project provided funds to cover basic field operational costs. The National TB Control Project under the bilateral development aid program of Japan International Cooperation Agency (JICA) and the Research Institute of Tuberculosis (RIT), Japan Anti-Tuberculosis Association (JATA), provided direct technical and financial support at all stages from planning to dissemination of the survey results. Western Pacific Regional Office (WPRO) of WHO provided both technical and financial support in implementing the tuberculin survey in collaboration with ITSC and Korean Institute of Tuberculosis. Pasteur Institute of Cambodia offered a drug sensitivity test. Experts from WHO's Stop TB Department in Geneva and WPRO participated in analytical and consensus meetings to endorse the survey methodology and results.

2.2 Sampling Designs

2.2.1 Study Items

The survey was designed to study the following items:

(1) BCG scar rate and prevalence of TB infection

Identification of BCG scars and tuberculin tests were conducted with children aged 9 and below to estimate BCG coverage, a prevalence of TB infection and ARI.

(2) Prevalence of TB disease

For a screening purpose, chest X-ray examinations accompanied by interview were administered to those aged 10 and above. If identified as TB suspects, sputum examinations were given to obtain a prevalence of smear-positive TB, a prevalence of culture-positive TB and a prevalence of those with active pulmonary TB suggested by X-ray shadows (Active TB by X-ray).

(3) Prevalence of TB related symptoms and behaviors of TB patients

Survey participants were interviewed on their TB history and related symptoms. Detected TB patients were further interviewed on their health seeking behavior including utilization of governmental/private health facilities.

2.2.2 Sample Size

A sample size was determined to estimate a smear positive TB prevalence. Samples were selected by the multistage cluster sampling method. The estimated number of new smear-positive TB cases in 1998 was 25,890 in Cambodia according to WHO. And the expected prevalence rate of new smear-positive pulmonary TB in 1998 was 483.2 per 100,000 (0.4832%).

With the following determinants, a required sample size was calculated to be 15,824.

* The expected prevalence rate of smear-positive pulmonary TB is 0.4832%.
* Relative precision is 25 % of true value (0.001208).
* Confidence level is 95%
* Design effect is 1.25

If we assume that the minimal compliance rate of X-ray examination and sputum collection is 75%, 21,098 subjects will be needed.

15,824/0.75=21,098

Children aged below 10 were excluded from X-ray screening and laboratory examinations due to technical difficulties. We assumed that there would be no smear positive case among children aged below 10. However, we conservatively decided on a sample size of population aged 10 and above to reach 21,098. As the Population Census in 1998 showed 72% of the total population was 10 years and above, finally, the required sample size including children was determined as follows:

21,098/0.72=29,303

2.2.3 Sample Unit and Size

The National Population Census conducted in 1998 found that there were 11,437,656 persons and 13,716 villages (13,339 regular villages and 377 special settlements). On average one village has 834 persons. Considering the capacity of examinations with weekly cycle field operation, a size of cluster was decided to be 720. And this requirement was expected to meet in one village in most of the clusters without visiting an additional village. If 720 subjects were to be selected from each enumeration area (villages and some special settlements), 42 enumeration areas were necessary to obtain the samples of 29,303.

2.2.4 Sample Unit Selection

Sample units were selected by the stratified multistage sampling method. However, four provinces, Mondul Kiri, Rattanak Kiri, Preah Vihea and Stoeung Streng, were excluded from the sampling because of their low population density, small population size (32,407-119,261), and logistical difficulties. Those excluded provinces occupied less than 3% of the total population in the country.

Cambodia consists of two strata of urban and rural districts. In the 1998 Population Census, four central districts in Phnom Penh, all districts in other 3 municipality provinces and all districts with provincial capital towns were categorized as urban districts and the rest as rural.

Table 2-1: Stratification of Sample Units

Stratum	Urban areas	Rural areas	Total
Population (%)	1,725,471 (16%)	9,385,200(84%)	11,110,671(100%)
Sample units	7	35	42

According to the population distribution between urban and rural districts, 7 sample units were selected systematically from urban areas by applying the methodology of probability proportional to size. In the same way, 35 sample units were allocated from rural areas.

Within a selected district, a cluster village was selected with a random number. Most villages selected vary extensively in size, and usually each village has several groups of households (around 10 households per group). The sampling procedure was as follows:

- In a village with a population size of 680 to 760, we considered a whole village as a cluster.
- In a village with a population size of above 760, the survey team randomly selected groups of households until it reached a group with the 720th eligible sample.
- When a village selected does not have a population size of 680, the survey team added another village in the same commune until the required number of 720 was obtained by going north from the selected village, and continued adding a village in a clockwise manner, around the village originally selected until the required number was reached.

2.3 Overall Survey Procedure

2.3.1 Field Survey Preparations

The Executive Committee (EC) selected 42 cluster candidates. The EC representative visited the provinces concerned, examined the feasibility of the survey in the selected areas such as seasonal accessibility with provincial TB supervisors, and finalized enumeration areas for the field survey. It then contacted the provincial health director and local authorities to facilitate cooperation. Survey forms and other needed materials such as the household registry, area map, personal survey cards, posters, and leaflets were sent to the local administrative office in the selected areas through Provincial Health Department 14 days prior to the first day of the survey. One or two weeks before arrival of the survey team, the health centre workers and local authorities in each selected area conducted a campaign with posters, announcements and

so forth. Household lists were filled in by the local authority office and transferred to the Census Unit before taking a census. Two or three weeks before the survey, the team leader visited communes to inform the villages to be involved and to clearly explain the study objectives and procedure**.**

2.3.2 Field Survey Management

The expected amount of time was one week per cluster. For each cluster, provincial, district and commune authorities were briefed on the aims and procedure of the survey. The Provincial and Operational District TB supervisors and commune health workers also participated in this briefing and fieldwork. The Operational District TB supervisors were asked to prepare a list of TB patients from the selected communes, who were diagnosed in the previous and current calendar years.

Typical Weekly Schedule

Sunday: Arrival & Basic Preparation
Monday: Census/ Informed Consent; Arrival of Technical Team
Tuesday/Wednesday: Interview, X-ray, Tu-test, Sputum collection
Thursday: Interview, X-ray, Sputum collection, 1st Sputum transportation to CENAT
Friday: Interview, X-ray, Sputum collection、Tu-reading
Saturday: Sputum collection, Tu-reading (morning only), Departure to next cluster or CENAT

Note: In most of the clusters, interviews and X-rays were completed by Friday morning. Before leaving the village on Saturday, the team completed a summary form with the following information: village name; dates of field work; number of households listed, number of people listed; number of people having X-ray taken; number of abnormal X-ray results; number of people with abnormal X-ray results interviewed; number of people with TB suspected symptoms; number of smears taken; and name of the survey team leader. The information was fed back to the commune chief.

2.4 Examination Procedures

2.4.1 Census Taking

1-On the first survey day in the village, Monday, the census group received a household registry from local field workers or commune health workers.
2-Every household was given a serial number on the list and paste the number label by census group on the door or the gate of households selected by the team leader.
3-The group paid one or more home visits per household to confirm the eligible subjects on the name list of the household registry. In this occasion, local field workers motivated the eligible subjects to cooperate and participate in the survey. Notebooks with photos to facilitate an understanding of the survey procedure were provided to each family as a visual aid to obtain consent to participation.
4- The list of eligible subjects was finalised by adding newcomers who were not registered in the household registry but stayed in the enumerated area for more than a month and deleting those who were registered but had been absent for a month or more.
5-Each subject was allocated with an examination day and time from Tuesday morning to Friday afternoon considering the capacity of X-ray examinations of around 25 films/hour. Children under 15 were allocated either on Tuesday or Wednesday in order to complete tuberculin reading by Saturday.

During the household survey, participants were informed that the survey aimed to identify patients with respiratory diseases, in particular tuberculosis, and to provide treatment as early as possible. They were also informed that risks to participants were expected to be minimal with interviews, X-rays and sputum collection only and that treatment shall be arranged for patients who were identified to be smear and/or culture positive TB patients by the survey.

2.4.2 Interviews (History and Symptoms Inquiry)

On the second survey day, Tuesday, and the 5th day, Friday, census unit members, a physician and a medical assistant from National TB Center Hospital, CENAT, interviewed survey participants or their parents in case of children and collected information on name, sex, age, TB history, TB symptoms and health seeking behaviours. The information was recorded on a personal survey card with a household number and an individual registration number. (Annex)
All participants aged 10 and above with suspected TB symptoms such as coughs lasting for 3 weeks or more and/or blood contained sputum were asked to submit sputum specimens regardless of the results of the X-ray screening. Those who could not appear at the survey site due to sickness, handicaps or old age were home-visited by the census team. Transportation to the examination site was arranged for those who could not afford themselves. When they did not agree to visit the site, at least sputum examinations were carried out if they were identified as TB suspects by symptoms.

2.4.3 BCG Scar Survey and Tuberculin Test (Age below 15)

The Tuberculin Unit inspected BCG scars in the both shoulders of participants aged 14 and below and recorded results on the personal survey card. All subjects aged 14 and below and 4 months and above received a tuberculin test with RT23 with Tween 80, with 2 TU used as one dose. Injections were administered either on Tuesday or Wednesday. Tuberculin readers read skin tests for a transverse diameter of induration approximately 72 hours after the injection (on Friday and Saturday). The results of the BCG scar survey were masked from the tuberculin readers. The tuberculin assistants recorded the diameter of induration on the personal survey card and on the tuberculin survey registry.

2.4.4 Chest X-ray Examinations

The X-ray car or the portable X-ray unit administered chest X-ray examinations with a 35 cm x 35 cm (14 inch x 14 inch) film (Annex Photos). An X-ray technician took X-rays of the participants aged 10 and above. All eligible residents were asked to undergo an X-ray examination. Non-symptomatic pregnant women were exempted from the X-ray examination if they wish. The X-ray assistant technician fixed and developed chest X-Ray films with an automatic film processor on the spot. Soon after the films were developed, a field X-ray reader(s) interpreted the chest films while participants were asked to wait for a result.

The X-ray reader "intentionally over-read" the films to minimize the number of over-looked abnormalities. The result was recorded on the personal survey card and the X-ray examination registry. When the quality of the X-ray film was too poor to serve the screening purpose, the team leader asked participants to have the second film taken. All those deemed to have an abnormal chest radiograph in the lung field or mediastinum more than a single small calcification nodule or pleural adhesion at the cost phrenic angle were asked to proceed to the Bacteriological Examination Unit immediately. Even when abnormal findings consisted of shadows ***Not*** *compatible with* TB such as bronchiolectasis or bronco-pneumonia in the lower lobe, sputum examinations were requested. Local health workers arranged urgent interventions for those who were found to have a serious acute disease(s) such as pneumothorax, massive pneumonia. All X-ray films were sent to CENAT for central reading.

Central Procedures (Procedure at CENAT): At least 2 X-ray readers in the X-ray Examination Committee read all the films to re-evaluate the chest X-rays taken in the field for quality assurance. In case the field reading missed a considerable number of active TB suspected cases, it was planned to dispatch the sputum collection team. In practice, however, such a case did not take place. After the survey was completed, the Central Panel staffed with at least three radiologists and/or chest physicians held reading sessions to arrive at a final consensus and submitted results to the Statistic Analysis Sub-Committee.

X-ray results were categorized as follows by the Central Panel:

No abnormality
Active TB (Active TB is strongly suspected)
TB suspect (Possible TB lesion or stable lesion such as tuberculoma)
Healed TB
Other lung disease
Heart disease
Other disease

For a further analysis in the consensus reading, the Japanese X-ray classification of TB disease was used with some modification. X-rays were categorized as follows: active TB with cavity; active TB without cavity; TB with stable legion such as tuberculoma; and cured TB. At the same time, the extent of TB lesions was evaluated as follows: minimal: TB lesions occupy less than 1/3 of one lung field, moderately advanced: between minimal and further advanced; further advanced: TB lesions spread areas more than one lung field.

2.4.5 Bacteriological Examination

If the field readers find radiological abnormalities in participants and/or if the interviewers identify TB suspected symptoms in participants, they were invited to undergo a bacteriological examination. Two sputum specimens were collected (one spot specimen on day 1, and one early morning specimen on day 2) in a screw-capped container and kept in a cooler box filled with ice. No chemicals were added. Under the supervision of a laboratory assistant, the first specimen was collected soon after the interview and the X-ray exam, and the second morning sputum was collected early morning before starting the survey operation. The examinees were asked to visit the survey site to submit sputum while home visits were also made available if perceived necessary. The laboratory staff filled the number of specimen and necessary information in the sputum smear examination forms. Sputum specimens and sputum smear examination forms were then shipped to the research laboratory of CENAT for smear and culture examinations. The sputum specimens collected on Tuesday, Wednesday and early Thursday morning were transported on Thursday and arrived at CENAT on the same day. Sputum specimens collected later than early morning on Thursday to Saturday morning were transported on Saturday.

Central Lab procedure:
A laboratory technician of the Bacteriological Examination Committee received sputum specimens from the survey teams twice a week to treat the specimens within three days after the collection. The laboratory staff administered sputum smear examinations, culture examinations and identification tests as described below:

Two direct smears per TB suspect, which were collected from separate specimen from the first day and the following early morning, were prepared. Microscopy examinations were administered with a binocular optical microscope using the standard Ziehl-Neelsen stains. AFB positive slides were evaluated with 100HPF while all negative slides and scanty positive slides were examined with 300HPF. All positive slides and approximately 10% of the negative slides were re-examined by another reader. In addition, those with negative smear slides in the initial reading but with positive culture results were re-stained and re-examined. For cultures, the 3% Ogawa and Kudoh mediums were used. Since two sputum specimens were placed in culture, there were four culture tubes per subject. The culture tubes were incubated for 9 weeks with weekly observations.

The identification of *M.tuberculosis* was confirmed by a niacin test and characteristics of the suspected colonies. In case of an unclear niacin reaction, Capilia TB (Nippon Becton Deckinson Co., Ltd.) was used as a second confirmation test. When M.tuberculosis was identified, the specimens were sent to Pasteur Institute, Phnom Penh, for drug susceptibility testing. The test was carried out by the same method as National TB Drug Resistance Survey, which is in line with the WHO-IUTALD guidelines of using the L-J mediums. The laboratory staff recorded all results in the form and submitted it to the Statistic Analysis Sub-Committee.

2.4.6 Identification of TB Cases

The Central Panel reviewed all data of the survey subjects with "any abnormality detected either by field and/or central X-ray reading for quality assurance" and/or with "positive results either by a smear or culture bacteriological examination". The survey used the following definitions in identifying TB prevalent cases:

Smear Positive TB:
i) 2 positive smear results, or
ii) 1 positive smear result with an X-ray result consistent with active tuberculosis, or
iii) 1 positive smear slide with a culture confirmation
Note: Even when a smear result was scanty positive (less than 10 /100HPF), we considered it as positive.

Smear Negative and Culture Positive:
2 smear results were negative with at least 1 culture confirmation of M. tuberculosis excluding the following cases:
Only 1 out of 4 culture tubes was positive with 5 or less colonies without any X-ray finding consistent with tuberculosis (Considering possible contamination in the lab process, the Central Panel excluded those from culture positive cases)

Bacteriologically Negative but X-ray Active TB:
Those with no evidence of bacteriologically positive TB but with strongly suggested active TB disease in the X-ray examination were judged by the Central Panel consisted of at least 4 radiologists and chest physicians.

(Bacteriologically positive TB case: a case of smear positive or smear negative/culture positive)

2.4.7 Post Survey Interview

All bacteriologically positive subjects were contacted by the local TB staff to participate in the DOTS program immediately after the survey for S(+) subjects and after the identification of mycobacterium tuberculosis for S(-)C(+) subjects. Special arrangements of providing DOT were made to cluster villages with compromised access to the routine TB services. Interviews were re-conducted with a questionnaire to collect information on TB history and symptoms.

> *Limitation: Since the post survey interview was not planned in advance, local TB supervisors were not trained in interviews though they often participate in similar activities in routine monitoring and evaluation of the NTP.*

2.5 Statistical Analysis

2.5.1 Data Processing

A dataset was constructed from 4 separate databases: 1) survey questionnaires including the results of the X-ray and symptomatic screening, 2) non-attendance list, 3) laboratory database and 4) results of the consensus reading of chest X-rays. A database of the eligible population was constructed from 1) and 2). When the information was inconsistent, we checked the household registry, which served as a basis for 1) and 2). A database of prevalent cases was constructed from 3) and 4) by the Central Panel. Then the database of the eligible population and that of the patients were merged and then matched using 7-digit individual survey numbers.

To enter the data from the questionnaires, Microsoft Access was used to ensure a double entry. Key indicators (survey number, age, sex, symptoms defining TB symptoms, BCG scar and tuberculin skin test results) in the questionnaire database were compared between the entries while the original questionnaires were reviewed to cross-check the information. TB history was based on the information collected from the both original questionnaire used in the survey and the additional questionnaire used for in-depth interviews with the prevalent cases.

2.5.2 Estimation Method and Hypothetical Test

All statistical analyses were made with an application of Stata version 8.2 (StataCorp PL, Texas) (hereinafter Stata).

2.5.2.1 Point Estimates and Confidence Interval of Prevalence of Tuberculosis Infection and Annual Risk of Tuberculosis Infection (ARI)

A prevalence of infection, used to estimate an annual risk of infection, is derived from the tuberculin reaction among children aged 1 -14 without a BCG scar. The prevalence of infection and ARI were estimated for the following 3 age groups of 1-4 years, 5-9 years and 10-14 years to see the trend of ARI and to compare it with the results of the previous tuberculin surveys. The prevalence of infection is estimated from a proportion of children with tuberculin positive in each age group.

We employed two methods. One is that a prevalence of infection is a proportion of children with tuberculin reaction 10 mm or more among children without a BCG scar. The other, often called the mirror method, is that a prevalence of infection is a twofold proportion of children with tuberculin reaction 16 mm or more. These estimates are based on children without a BCG scar. However, an estimation of a national prevalence of infection is affected by the following two factors: 1) BCG coverage and 2) cluster size. Therefore, we gave each cluster a weight proportional to the product of (1/eligible population in each cluster) and (1/proportion of children who do not have a BCG scar and who have tuberculin results in each cluster). Because of the sampling design, calculation of point estimates of prevalence of infection, the 95% confidence interval and a hypothetical test such as a comparison of prevalence of infection between urban and rural areas were implemented in the same way as mentioned above in the section of "Prevalence of Tuberculosis."

To evaluate a risk of tuberculosis infection and an average annual risk of infection (hereinafter ARI unless we specify another type of estimates) was calculated with the following formula: This is a common and simple estimate and gives an estimated average annual risk of infection during the period between the children's average birth year and the survey year.

ARI = 1 – (1- estimated prevalence of tuberculosis infection) ^(1/ average of age)

The estimated prevalence and the average age are weighted figures as described above. The average age is an average of ages among children with a tuberculin reaction measured in each age group.
The cut-off point was set at 10mm, and ARI for each age group was calculated as follows.
- Point estimate of ARI = 1 – (1- proportion of children with an induration size of 10 mm or more) ^(1/average age)
95%CI was calculated by applying the lower and upper limits of the proportion obtained from the svytab command in Stata version 8.2. We did not take into account variability of the average age. Thus 95% CI of ARI is given as follows.
Upper limit of ARI in 95%CI = 1 – (1 – upper limit of 95% CI of the proportion)^(1/average age)
Lower limit of ARI in 95%CI = 1 – (1 – lower limit of 95% CI of the proportion)^(1/average age)

In the mirror method, point estimates and 95CI of ARI for each age group were calculated as follows.
Point estimate of ARI= 1 – (1 – 2 x proportion of children with induration size of 16mm or more)^(1/average of age)
Upper limit of ARI in 95%CI = 1 – (1 – 2 x upper limit of 95% CI of the proportion)^(1/average age)
Lower limit of ARI in 95%CI = 1 – (1 – 2 x lower limit of 95% CI of the proportion)^(1/average age)

2.5.2.2 Point Estimates and Confidence Interval of Prevalence of Tuberculosis

One of the objectives of the survey is to estimate a prevalence of tuberculosis in Cambodia. Therefore, we adopted a design-based method to carry out a statistical analysis by using svy famity commands of Stata. The Confidence intervals were calculated, taking design effects into account. The point estimates and 95% confidence intervals were calculated by the svytab command. For hypothetical tests of the factors associated with prevalence, the syvlogit command was used. The confidence level was set at 95%. Post-survey weights were given so that contribution of the results from each cluster to the national figure will be the same as planned although this can not overcome a selection bias. In the sample design, cluster sizes should be identical so as to ensure an equal contribution of the samples from each cluster to arrive at a national average. Because there is some variability in size among the eligible population and in the attendance rates as shown in table 3-1,2, we applied weighting to produce a national average. Because TB screening was performed only for those aged over 10, and the prevalence of smear positive TB cases needs to be extrapolated to all age groups, the eligible population and participants were divided into 2 age groups: those aged less than 10 and those aged 10 and above. A weight of participants aged less than 10 in each cluster is a product of (720/egibible population in each cluster) and (1/participation rate among those aged less than 10). A weight for those aged 10 years and above is a product of (720/egibible population in each cluster) and (1/participation rate among those aged 10 years or more).

2.5.2.3 Estimation of Incidence of Smear Positive New Tuberculosis and TB Burden

Incidence of smear positive new TB is estimated by the following calculations using Excel 2000.

Table 2-2 Factors to estimate incidence rate

	Duration of Smear Positivity (year)				
	Before Detection	After Detection	Total	Incidence	Prevalence
1 Patients under DOTS, HIV−	ta1	tb1	T1	I1	P1
2 DOTS HIV +	ta2	tb2	T2	I2	P2
3 Patients under out of NTP treatment, HIV−	ta3	tb3	T3	I3	P3
4 Out of NTP, HIV+	ta4	tb4	T4	I4	P4
5 Undetected Patients (natural history), HIV−	ta5	tb5	T5	I5	P5
6 Undetected, HIV+	ta6	tb6	T6	I6	P6
Total	ta	tb	T	I	P

Prevalence= Incidence x Duration of Disease: P=IT
$P=\Sigma InTn$ Tn=tan+tbn $I=\Sigma In$

P: Estimated by the survey : P= Prevalence of S(+) by the survey x number of new cases / number of cases detected (proportion of new cases) ---(1)

I1+I2=: NTP Notification Rate of S(+)=Case Notification/ Population x 100,000
= 17,258 S(+)New/ 12,630,000 x 100,000 -------(2)
I2/(I1+I2)=0.08: From TB/HIV survey
ta1: from a Delay study: 5 months = 5/12 year
tb1: estimated from NTP treatment results including 2nd month conversion rate = 0.20y
ta2: assumed that it is as same as ta1 ta2=ta1=5/12y
tb2: some early deaths of HIV+ make tb2 shorter than tb1: tb2=0.75, tb1=0.15y
Since **I1** and **I2** are available, **P1** and **P2** can be calculated.

Prevalence of HIV(+): UNAIDS and MOH estimates: Prevalence/Population
= 130,000/ 12,630,000=1.029/100,000

Annual TB incidence among HIV(+) in Cambodia: Experience in Phnom Penh study: 8%
Proportion of S(+) among all TB incidence in HIV(+): 35%

Prevalence of HIV x Annual TB incidence among HIV+ x Proportion of S(+) = I2+I4+I6
=1,029 x 0.08 x 0.35---(3)

Private treatment: I3+I4: X% of patients detected: data from the survey, (private treatment/ patients under treatment) and field experiences:
(I3+I4)/(I1+I2+I3+I4)= 0.X

HIV+ under private treatment: assumpti on: 10% of private treatment: I4/(I3+I4)=0.1
ta3: shorter than ta1 according to a behavior study: ta3=0.4y
ta4: assuming ta4=ta3
tb3: 0.6y due to the rather high defaulter rate but no drug resistance
tb4: 0.3y due to early deaths of some patients
Since (I1+I2) is known, **I3** and **I4** are available, then **P3** and **P4** can be calculated.

Non-detected cases
ta5=T5=2 years according to tradi tional assumption
ta6=T6=1 year due to early death by HIV/AIDS
I6= (3) - I2- I4, then **P6** can be calculated.
Though P5 is unknown, it can be calculated: **P5**= P-P1-P2-P3-P4-P6
Then **I5** is available by P5/T5.

Now all In are available. I can be calculated: $I=\Sigma In=I1+I2+I3+I4+I5+I6$

Incidence of TB All Forms/ TB Burden

STB/WHO utilizes the estimated incidence rate of S(+) to estimate an incidence rate of TB all forms with an assumption that S(+) TB occupied 45% of all TB cases in HIV negative and 35% in HIV positive. For age 10 or more, the WHO formula was applied.

For children, we estimated an incidence rate in two ways. One is from the historical observation in Japan from the 1960s to early 70s where the TB incidence rate among children aged below 10 was estimated to be around 40-50% of the incidence rate among children aged 10 and above. The other is from the ARI available from the survey with the following assumptions: Among age <1 year, 43% of those infected may develop a disease; age 1-4, 24%: age 5 or more, 15%.

3. Findings

3.1 Census and Attendance Rates

Table 3-1

Age Distribution of Survey Participants
Compared with Different Population Models

	Survey		Estimated population	
Age group	Eligible	Attended	CIPS 04	UN 02
0–9	25.7%	26.2%	23.9%	29.1%
10–14	14.8%	15.0%	14.8%	12.9%
15–24	20.7%	20.2%	21.9%	21.5%
25–35	12.3%	12.1%	12.0%	12.3%
35–44	10.7%	10.7%	11.6%	10.3%
45–54	7.3%	7.3%	7.4%	6.9%
55–64	4.4%	4.4%	4.6%	4.2%
65+	4.1%	4.1%	4.2%	2.9%

Table 3-2

Participation Rate by Age and Sex

	Number		Participation rate		
Age group	Eligible	Participated	Total	Male	Female
0–9	7,966	7,872	98.8%	98.8%	98.8%
10–14	4,598	4,519	98.3%	98.0%	98.6%
15–24	6,439	6,055	94.0%	93.5%	94.6%
25–35	3,808	3,645	95.7%	94.4%	96.8%
35–44	3,323	3,201	96.3%	94.8%	97.5%
45–54	2,276	2,199	96.6%	96.2%	96.9%
55–64	1,359	1,312	96.5%	95.1%	97.6%
65+	1,281	1,229	95.9%	95.7%	96.1%
All age	31,050	30,032	96.7%	96.2%	97.2%
Age ≥10	23,084	22,160	96.0%	95.2%	96.7%

Table 3-3

Distribution of the participation rates by cluster villages

	Total	98.0%–	96.0%–	94.0%–	92.0%–	90.0%–	<90.0%
Rural	35	16	17	1	0	1	0
Urban	7	2	3	0	0	0	2
Total	42	18	20	1	0	1	2

31,050 people from 6,019 households were confirmed to be eligible by the census and registered as samples (738 per cluster: range 701-782) on the 1st day of the survey. Although children under 10 years old represented 28% of the total population in the 1998 National Population Census and 29% in the 2002 UN Estimates, which have been used for the WHO TB epidemiology estimates, the survey census found that children under the age of 10 are only 25.7% of the total population (Table3-1). It raised a question whether the survey census accurately detected children. However, CIPS 2003, the recent Cambodia Inter-Census Population Survey, found a significant change in the recent population structure and confirmed the overestimation of the total population in the UN estimates. The population growth has been downwardly re-estimated at 1.81%. Our survey census finding was quite similar to the new population structure estimated by CIPS.

Among the eligible subjects, 30,032, or 96.7%, participated in the study, and out of which, 22,160, or 73.8% were aged 10 and above (Table3-2). Though young adults, specifically, males aged 15-34 and females aged 15-24, showed slightly lower participation rates, the high participation rates of above 90% were achieved in all age categories. When we observed the participation rates by cluster, 38 out of 42 clusters achieved above 96% while 2 clusters in Phnom Penh showed the lowest participation rates of 75.9% and 79.0% (Table3-3). The clusters were sampled by the multi-stage stratified method. The stratification of urban and rural districts by the governmental criteria did not seem to be suitable for our analysis. The survey teams found that some cluster villages in urban districts of the provincial capitals are actually in a very rural setting while some in rural districts are located in rather congestive areas such as Phnom Penh suburb.

It seemed that people's interest in X-ray examinations and active involvement of local community leaders in preparation and field operations led to the participation rate higher than expected. Transportation arrangements and/or home visits, which allowed participation of the sick, handicapped and elderly staying home, also contributed to this success. The analysis on absentees indicated that they were more likely to be healthier, in school, and engaged in field and factory work.

Some of the weaknesses of the survey include the low participation rate in the capital province of Phnom Penh. The routine survey operation hours of weekdays did not fit the lifestyle of the urban population. Although this low participation in the capital area might not affect the overall survey results as majority of people are living in rural areas, we anticipate to see an additional survey/study to clarify the TB situation in the capital city.

3.2 Past and Present TB Treatment

Table 3-4
TB Treatment History

TB Treatment History among 22,160 Survey Attendees Aged 10 or More

	No.	%	(/100,000)
Under treament (new)	39	0.18%	176
Under retreatment	3	0.01%	14
Previoulsy treated	414	1.87%	1868
Total	456	2.06%	2058

TB Treatment History among 7,326 Children Aged between 1 and 10

	No.	%	(/100,000)
Under treatment	11	0.15%	150
Previously treated	82	1.12%	1119
Total	93	1.27%	1269

Table 3-5
Numbers of Clusters and Numbers of Children Aged less than 10 with TB History

Numbers of cases	0	1	2	3	4	5	6	7	8	9	10+ (13)	Total
Previously treated	16	10	3	4	**5**	0	1	1	1	0	1	42
Under treatment	35	4	2	1	**0**	0	0	0	0	0	0	42

ex. 5 clusters had 4 previously treated children while there was no cluster that had 4 children under treatment

Note: The structured questionnaire for participants could not distinguish preventive therapy and disease treatment. However, preventive therapy with INH is rarely practiced in Cambodia.

Out of 22,160 survey participants aged 10 or more, 42 (0.19%) were under treatment at the time of the survey. 417 (1.88%) reported that they received TB treatment previously. Out of these 42 under treatment, 3 were under re-treatment, and 8 (19.0%) were under treatment at non-NTP facilities such as private practitioners'.

As to the children age less than 10, 11(0.15%) reported they were receiving TB treatment at the time of the survey while 82 (1.12%) had received TB treatment previously.

> *The number of TB cases under treatment was 42 (190/100,000) among participants aged 10 and above. This was within the expected range. The NTP was notified of all TB cases of 189/100,000 for all age groups in 2002, and, out of which, the childhood TB cases reported to the NTP were only a few percent. Given that the average duration of treatment is 8 months long and that private TB treatment is not common in Cambodia, the finding did not conflict with the annual NTP notification. After implementing DOTS for 8 years in Cambodia and providing treatment at NTP facilities, it also might be within a reasonable range to have 1.88% of the population age 10 or more with TB treatment history.*

However, considering the facts that the NTP reported a very small number of childhood TB cases every year and that the INH preventive therapy which prevents children from developing disease through close contacts with their smear positive parents had been rarely provided, the number of childhood TB cases under treatment and that of those previously treated were beyond the expectation of the NTP. There was a considerable difference among the clusters in the number of childhood TB cases previously treated: while 16 out of 42 clusters did not have any previously treated childhood TB case, the top 4 clusters occupied more than 40% of the cases. A further study is essential to clarify the TB situation among children. (See further discussion in Childhood TB)

3.3 BCG Coverage and TB Infections

Children more than 3 month and less than 15 year old received a BCG scar survey and a tuberculin test. However, since we may encounter difficulties in interpreting results of young infants, especially those under the age of 1, due to possible variations of the EPI schedule, an analysis of the BCG scar survey and the tuberculin test were made for children age 1 year or more.

Table 3-6
Results of BCG Scar Survey

		BCG Scar			
Age group	Evaluated	No scar	Scar +	Total%	Boy %	Girl%
1-4	2,827	1001	1,826	64.6%	65.0%	64.2%
5-9	4,470	2,273	2,197	49.1%	51.3%	46.9%
10-14	4,469	2,588	1,881	42.1%	44.3%	40.4%
Total	11,766	5,862	5,904	50.2%	51.9%	48.6%

Table 3-7
BCG Scar Rates by Geographical Conditions

	Total	Urban districts		Rural districts		Phnom Penh or provincial town	Other areas
Age group			95% CI		95% CI		
1-4	64.6%	60.7	40.8-77.6	64.9	58.0-71.3	63.4	64.3
5-9	49.1%	44.3	24.2-66.4	49.8	43.2-56.5	61.1	47.1
10-14	42.1%	49.9	29.7-70.1	41.3	34.5-48.6	61.3	38.8

Table 3-8
Association with Presence of BCG Scar among Those Aged >= 1 yr

Variable	Value	Odds ratio	Std. error	P>|t|	95%CI
Age	Linear trend	0.89	0.02	0.000	0.86-0.93
Area	Non town	Reference			
	Phnom Penh or provincial town	2.65	0.58	0.000	1.70-4.14
Access level	Linear trend	1.28	0.15	0.041	1.01-1.62
Sex	Male	Reference			
	Female	0.89	0.03	0.001	0.83-0.95

Out of those children who were evaluated, 50.2% had a BCG scar. The proportion of children with a BCG scar was higher in the younger age groups. It was also higher in boys than girls. Location-wise, Phnom Penh, provincial towns, and cluster villages closer to health facilities recorded higher rates than other areas. However, we did not observe any geographical differences in the BCG scar rates among the youngest age groups. Although the BCG scar rate was lower in girls, the gap between boys and girls became small in the groups of younger children who recently received vaccinations.

The BCG scar rate of 64.6% in younger children was consistent with the government official estimate of the BCG coverage, which was 64% in 2001. Although not all results of the BCG scar observation were verified by interview with mothers or on the vaccination record, it may reflect the actual situation of the BCG coverage in Cambodia.

The total number of children age 1 or more tested and read for tuberculin during the national prevalence survey was 5,835 without BCG scar and 5,886 with BCG scar. The distribution of indurations in children with or without BCG scar was presented in

Figures on the next page. The BCG vaccinated children showed an excess of reactions. However, the difference became smaller in older children, especially those aged between 10 and 14 where a difference is almost non-existent.

There was no obvious anti-mode between infected and non-infected children in any age groups. It seemed that there was no rounding error since no peak was observed in 5, 10, 15 and 20 mm.

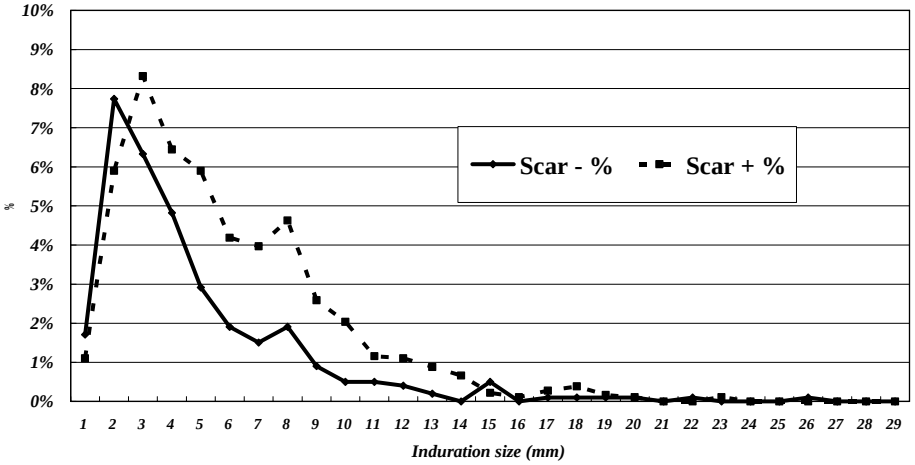
Table 3-9
Prevalence of TB Infection by Different Methods

		10mm cut off		16mm mirror	
Age group	Mean age	Point estimate	95% CI	Point estimate	95% CI
1-4	2.78	2.66%	1.56-4.49	1.16%	0.35-3.78
5-9	7.20	13.65%	12.07-16.07	6.96%	4.89-9.85
10-14	12.04	32.67%	29.67-35.81	18.07%	14.10-23.02

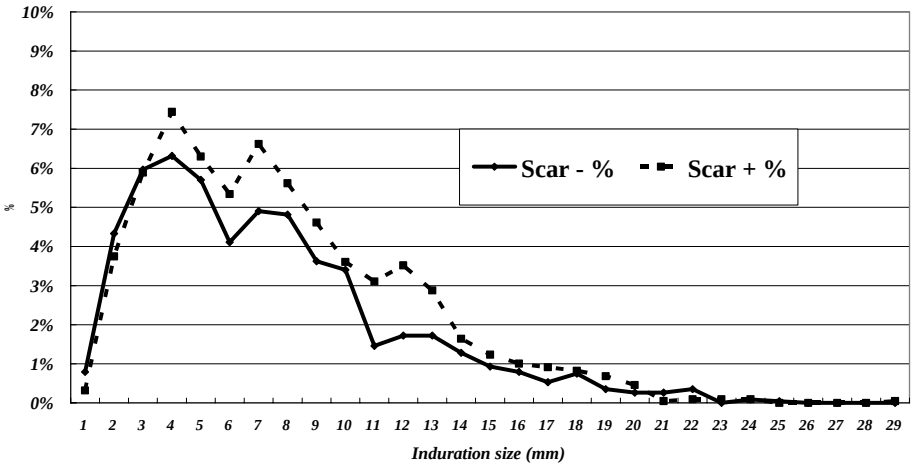
When we used the conventional cut off point of 10 mm, 20.3% of children without BCG scar and 21.9% of children with BCG scar showed positive reactions. 30% of children might contract TB by age 12.

Figure 3-1 Results of tuberculin test among children with and without BCG scar

Tuberculin reaction among children, Age 1-4



Tuberculin reaction among children, Age 5-9



Tuberculin reaction among children, Age 10-14

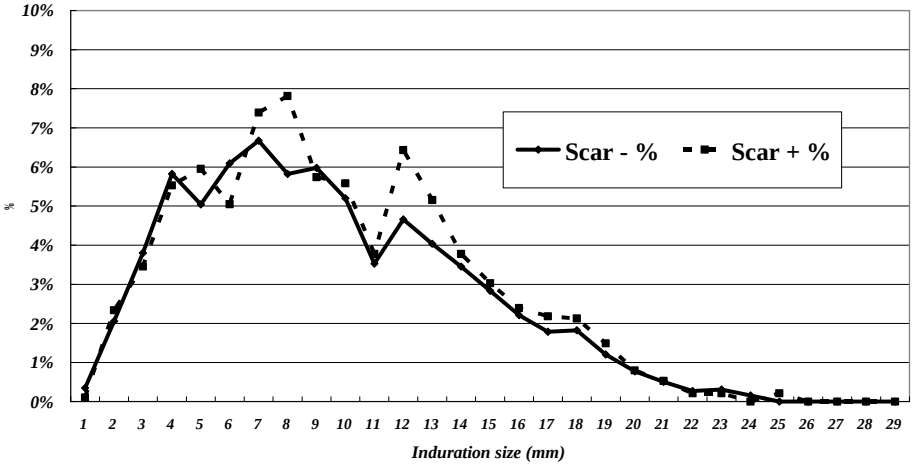


Table 3-10
Annual Risk of TB Infection by Different Methods

	Cut-off 10mm		16 mm Mirror	
Age group	Point estimate	95% CI	Point estimate	95% CI
1-4	0.96%	0.56-1.64	0.42%	0.13-1.38
5-9	2.06%	1.77-2.40	1.00%	0.69-1.43
10-14	3.23%	2.88-3.62	1.64%	1.25-2.15

(Adjusted)

Assuming that children in the same cluster village with BCG and without BCG have an equal chance of TB infection, ARI was calculated with 2 different methods: One is the conventional cut off point of 10mm. The other is the mirror image with 16mm obtained from an additional survey of tuberculin reactions among 332 TB patients in rural districts where the prevalence of HIV infection among TB patients was low (Fig.2). There were significant differences in results between the two methods: age 1-4, 0.96% by 10 mm cut off point and 0.42% by 16 mm mirror image; age 5-9, 2.06% and 1.00%; age 10-14, 3.23% and 1.64% respectively. Although the risk of TB infection might not be constant across the age groups, the recent reduction in ARI might be resulted from the relatively low prevalence of infection among infants.

Figure 3-2 Tuberculin Reactions among TB patients

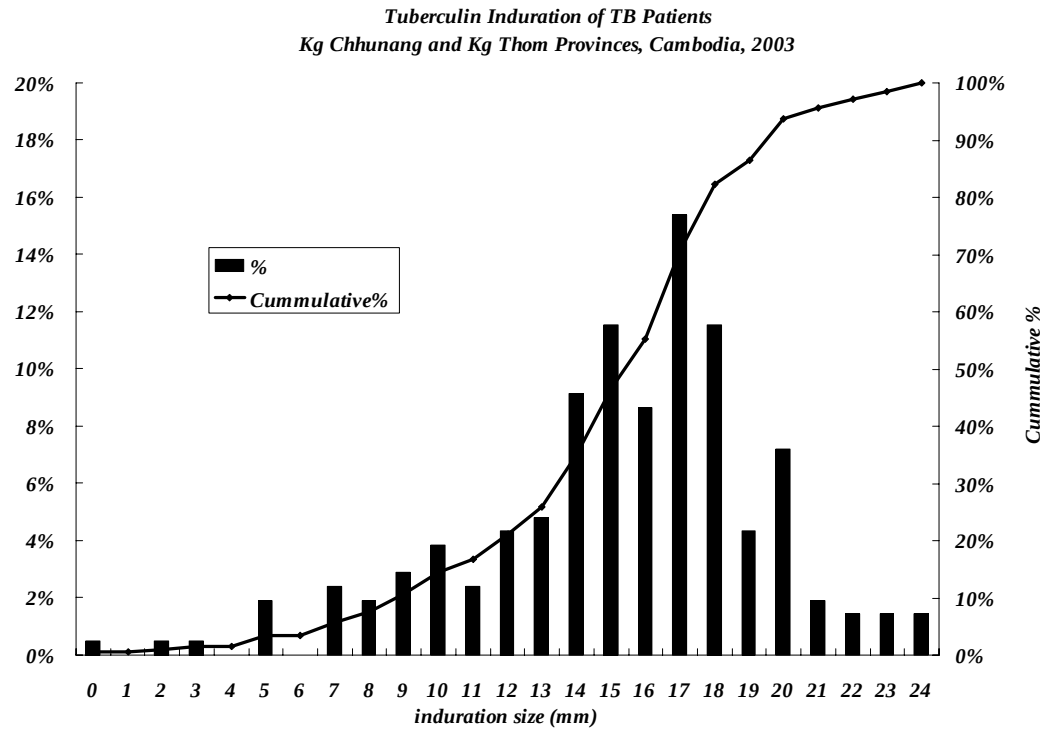


Table 3-11
ARI in Urban and Rural Clusters (10mm Cut-off)

	Urban (7 clusters)		Rural (35 clusters)		
Age group	Point estimate	95% CI	Point estimate	95% CI	p
1-4	0.48%	0.22-1.01	1.05%	0.56-1.64	0.0714
5-9	1.50%	1.17-1.90	2.17%	1.77-2.40	0.0112
10-14	1.99%	1.53-2.58	3.43%	2.88-3.62	0.0002

Although the higher vaccination coverage and the recent reduction in the number of infant population do not indicate a statistically significant difference, a risk of TB infection in urban districts seemed to be lower than that in rural districts in all age groups of children.

Table 3-12 shows a comparison of results from the large tuberculin surveys conducted in Cambodia. The ARI estimated by the 2002 survey has some discrepancies with the previous studies, especially with the 1995 survey. Despite the DOTS expansion in Cambodia, the TB situation seemed to be worsening from 1995 to 2002 if the results are directly interpreted. Since the previous studies were school-based, comparable age groups were limited to those aged between 5 and 9 only.

Table 3-12
Tuberculin Surveys in Cambodia (10mm cut-off)

	Year	PPD RT23	BCG coverage	Age	ARI(%)
School Surveys					
PhononPenh WHO	1955	5TU		8-12	4.3
WHO/UNICEF	1968	1TU	16.7%	5-9	2.7
CENAT	1981	2TU		5-9	1.7
WHO	1995	1TU	73.6%	5-9	1.0
Provinces					
4 provinces	1955	5TU	9.8%	8-12	3.8
3 provinces	1968	1TU		5-9	2.1
19 provinces	1995	1TU	49.3%	5-9	0.7
Community Survey					
National	2002	2TU	64.9%	1-4	1.0
			49.1%	5-9	2.1
			42.1%	10-14	3.2

Major discrepancies observed were as follows: First, the ARI available from the 2002 survey seems to be higher than the one in 1995; Secondly, the ARI in Phnom Penh was higher than provinces in the previous studies while the clusters in rural areas recorded a higher ARI in the 2002 survey; Thirdly, the BCG coverage looks higher in 5-9 year-old children in 1995 than 10-14 year-old children in 2002; Fourthly, the tuberculin reactions observed in TB patients were significantly different between the 1995 survey and the 2002 national survey.

The discrepancies in results between the 1995 and 2002 tuberculin surveys might be caused by the following factors:

Tuberculin potential: 1TU in 1995 survey vs. 2TU in 2002 survey;

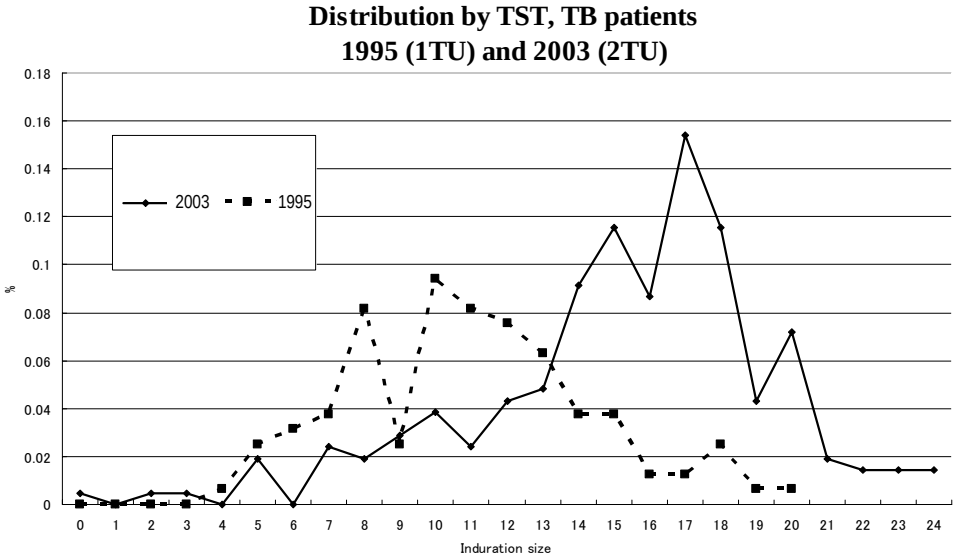
Survey population: School children in 1995 vs. children in communities in 2002;

Access issues: Security issues limited accessibility in rural communities in 1995 vs. peace recovery allowed clusters randomly sampled even in very rural areas in 2002;

Immune status; Poorer nutrition status and higher stress level due to the long lasting conflict in 1995 vs. improved health status in 2002;

DOTS in Phnom Penh: Provided at limited hospitals in 1995 vs. integrated TB services through hospitals and health centers networks, NGOs and home care delivery in 2002.

Figure 3-3 Comparison of Tuberculin Tests among TB Patients in 1995 and 2003



Technically, the tuberculin survey of the 2002 national TB survey was supervised by ITSC-WHO-JICA team composed of international tuberculin standard nurses. The team trained tuberculin injectors and readers and ensured their qualifications to conduct the survey. A mid term evaluation was also conducted. Therefore, the tuberculin reactions among TB patients in early 2003 seemed to be more reasonable. It might not be appropriate to apply the 10mm cut-off point used in the 1995 survey, which probably causes an underestimation of ARI. Considering the prevalence of S(+) TB in young adults aged 15-34, 132-302/100,000, the ARI from the national survey 2002 seems to be more reasonable.

3.4 TB Related Symptoms and the Survey Screenings for Sputum Examinations

Table 3-13
TB Related Symptoms within 1 Month before the Survey (22,160 subjects aged 10 or more)

Symptom	No.	(%)
Cough any period	9,382	42.3%
Cough for 3weeks or more	1,501	6.8%
Blood in sputum	302	1.4%
Sputum	6,813	30.7%
Chest pain	4,912	22.2%
Loss of weight	1,140	5.1%
Tiredness	3,325	15.0%
Fever	7,830	35.3%
Night sweat	1,589	7.2%
Other	22	0.1%
Cough 3w or Blood sputum	**1,614**	**7.3%**
Any symptom	12,902	58.2%

Table 3-14
Prevalence of Cough for 3weeks or more

Age	Partcipants	Symptomatics	(%)
10-14	4,519	52	1.2%
15-24	6,055	170	2.8%
25-35	3,645	213	5.8%
35-44	3,201	327	10.2%
45-54	2,199	248	11.3%
55-64	1,312	230	17.5%
65+	1,229	261	21.2%
Total	22,160	1,501	6.8%

At the survey site, the census team, physicians and medical assistants from the National TB Center Hospital interviewed all participants aged 10 or more on their health status, especially TB related symptoms. 1,614 subjects (7.3%) had cough for 3 weeks or more and/or blood stained sputum in the past month (Table3-13). Therefore, they were eligible for sputum examinations. A proportion of people with chronic cough increased with age. It was only a few percent in young adults but 21.2% in age 65 or more (Table3-14). Experience of cough for any duration in the past month was so prevalent; as high as 42.3% of the participants reported having cough. As a result, it was not feasible to use "cough for any duration" as a screening method.

Out of 22,160 survey participants aged 10 or more, 22,012 received X-rays. Following the X-ray examination, an initial screening reading was performed on the spot without consulting the information collected from interviews on TB history and symptoms. The X-ray results of 2,104 participants fell under the category of having "TB related shadows" from active to healed, while 302 were "other lung disease"; 72 were "heart disease"; 54 were "extra-lung other abnormality" such as serious Goiter. Those 2,406 subjects with "TB related shadows (active, suspected and healed TB)" or "other lung disease" were principally asked to submit 2 sputum specimens except for those with a single calcification nodule only or a minor pleural adhesion at the cost-phrenic angle.

Table 3-15
X-ray Findings by the Initial Screening (intentional over-reading)

	No.	%
X-ray taken	22,012	
Active TB	338	1.5%
TB suspect	1,556	7.1%
Healed TB	210	1.0%
Other lung disease	302	1.4%
Heart disease	72	0.3%
Extra lung abnormality	54	0.2%

149 (9.2%) of 1,614 participants, who were determined eligible for sputum examinations by interview, did not submit sputum specimens. Although the principle was that all participants with TB symptoms submit sputum samples regardless of their initial results of the X-ray reading, the team leader, a physician, exempted from the sputum examination those who did not afford to produce sputum and their X-ray showed no abnormality. Among 149 who missed a sputum examination, 144 had no abnormality found by X-rays. Other 5 had abnormal findings, but no active TB compatible shadow was found.

> *Sputum samples were requested regardless of the X-ray findings. Among the subjects who met the NTP criteria of TB suspects by symptoms, more than 90% submitted sputum samples. Although 149 with TB suspected symptoms did not submit sputum samples, their chances of being bacteriologically positive, especially smear positive, would be very small.*

134 (5.6%) out of 2,406 eligible participants with X-ray abnormalities were not asked to submit sputum or could not produce sputum. All except 5 did not meet the criteria of TB suspects by symptoms. However, it included 2 subjects with X-ray results compatible with active TB: one was 21 year-old female with a minimal shadow without cavity, the other was 23 year-old male with bronchoectasis with consolidation without cavity.

The Central Panel identified another active TB compatible subject by X-rays, 14 year-old female, with a minimal non-cavity lesion, which could not be detected by the spot screening reading. In total, 3 subjects with active TB compatible/possible shadows by X-ray missed sputum examinations. However, they were not TB symptomatic.

> *Typical TB lesions with cavity(ies) tend to be classified as active TB, and most lesions with more than simple calcification were classified as TB suspects. Spot reading within a few minutes after the X-ray examination facilitated a high sputum collection rate among subjects with X-ray abnormalities. Since intentional over-reading on the spot was strongly encouraged, the central readers could find only a few cases with active TB compatible shadows that were overlooked by the initial screening.*

3.5 Laboratory Results

Two sputum samples were collected from 3301 subjects: 1465 with symptoms suspected of TB by interview and 2267 by the X-ray screening reading, where 431 were duplicated. Early morning home visits were carried out in order to prevent suspects from missing the second day morning sputum collection. All collected sputum samples were sealed and kept in a cooler box with ice and sent to the National TB Reference Lab at CENAT, in principle, within 3 days but, in practice, within 60 hours. No examination was performed at the survey spot.

Table 3-16
Smear Results

	Day1	Day2
Positive	50	75
	1.51%	2.27%
Negative	3251	3226
Total	3301	3301

One slide +	9	34
Two slides +	41	

Table 3-17
Smear Grades of S (+) 125 slides

	3+	2+	1+	>3/100	1-3/100	Total
S+ Case	10	16	54	27	18	125
(%)	8.0%	12.8%	43.2%	21.6%	14.4%	100.0%
Cumulative	8.0%	20.8%	64.0%	85.6%	100.0%	

The National TB Reference/Research Laboratory, CENAT, performed smear, culture, and identification tests. Out of 6,602 sputum smear slides from 3301 subjects, 125 smear slides from 84 subjects were determined positive by the direct Z-N stain microscopy examination. 9 were from the day 1 spot sample collection, 34 from day 2 morning, and 41 from the both occasions. Out of 84 positive subjects, 3 were, in fact, judged as negative by the initial reading but captured through the re-assessment after positive culture examination results were obtained. Mycobacterium Tuberculosis was isolated in 276 subjects. Out of 84 smear positive subjects, 74 (88.1%) were tuberculosis culture positive, 1 was Mycobacterium other than tuberculosis positive, 7 were culture negative and 2 were contaminated. Out of 3,224 smear negative subjects, Mycobacterium Tuberculosis was isolated from the specimens of 202 subjects (6.27%).

Isolated tuberculosis colonies were sent to Pasteur Institute in Phnom Penh for drug susceptibility testing. Since we lost some in subculture and examination processes, drug susceptibility results were available for 245 strains (from 245 subjects). 226 (92.2%) were susceptible for all drugs tested. Specifically, they were INH, SM, EB and RMP. While 13 (5.3%) showed resistance to INH and 8 (3.3%) to SM, neither RMP nor EB resistant strains were found. This reconfirms a low prevalence of RMP resistance tuberculosis as well as MDR tuberculosis obtained by the 2000-2001 National Drug Resistance Surveillance Round 1.

> *We found the number of smear positive subjects to be smaller than that of smear negative/culture positive subjects. This led to the following 2 discussions: 1) we might have had biases or experienced systematic errors in detecting smear positive subjects, and 2) our culture examination had a systematic contamination problem, which resulted in over-diagnosis.*
>
> *<Biases and Systematic Errors in Smear Positive Detection>*

We shall discuss the possibility of underestimating smear positives. First, non-participants might have an increased chance of having tuberculosis. However, intensive tracing was carried out to obtain at least sputum samples from those who did not show up at the survey site, especially if they were sick. We made efforts so as not to miss bacteriologically positive TB cases. Secondly, due to the definition of the eligible population, there was no chance to include those who were hospitalized for more than a month in the survey. The active search over the TB registry and observation in TB wards indicated that the number of patients who stayed in TB wards for more than a month was only a few to 10 per 100,000 population. Besides, some were possibly converted to negative. Thirdly, some of those who were overlooked in the smear examination might be, in fact, positive cases. However, we assume that there was only a slight chance to miss cases from this group, since only a few tuberculosis suspects, who had active tuberculosis with X-ray compatible shadows, did not receive sputum examinations. Fourthly, the quality of smear examinations was questioned. However, all the smear examination was processed at the Central TB Lab, and negative slides were re-assessed to capture even scarce positive bacilli if the culture became positive. Fifthly, only 2 sputum samples were collected instead of 3 in the routine practice which might have resulted in the underestimated prevalence of smear positive cases. It is likely that if we increased the number of examinations, we detect more cases. In the 1997 National Survey in Philippines, 13 out of 42 smear positives were diagnosed with 1 positive out of 3. It suggested that the third slide might contribute to 10% of the smear positive diagnoses. However, the recent studies question the added value of the third test, and the contribution of the third sputum, a spot, in the routine program in Cambodia to diagnose smear positives is also smaller compared with the morning sputum, the 2nd specimen. In conclusion, even considering all the factors discussed above, there was only a little chance to have a significantly increased number of smear positive subjects. Moreover, it should be mentioned that the survey counted in scarce positive slides, even 1-3bacclili/100HPF, as "positive", and that might have caused over-diagnosis of "smear" positive tuberculosis cases.

Table 3-18
Why They were Requested Sputum Exams and the Culture Results -smear positive subjects were excluded-

TB suspected symptom	X-ray abnormality	No. Requested	C (+)	%
Yes	No or n/a	1032	8	0.8%
Yes	Yes	381	55	14.4%
No	Yes	1804	139	7.7%
Total		3217	202	6.3%

<Systematic Contamination of Culture Examination>
Contamination of the culture examination can be caused even in a sophisticated laboratory environment. As smear negative/culture positive subjects occupied 70% of bacteriologically positive tuberculosis cases in this survey, a question was raised whether it was caused by the systematic contamination in the laboratory. If it happened to the statistically significant extent, we would have had much more culture positives from the subjects whose X-ray results were normal. It is so since one third of the sputum requests was made only from the subjects with symptoms (Table3-18). However, Mycobacterium tuberculosis was isolated only in 8 out of 1,032 subjects whose X-ray results were normal or not available.

In this survey, 2 sputum specimens were placed in culture while, in other surveys, only 1 sample is cultured. This difference might have led to the increased chance of detecting subjects discharging even a small number of tuberculosis bacilli through sputum.

Drug Resistance

Table 3-19 Results of Drug Susceptibility Tests

Patterns of Combined Drug Resistance

	Prevalence Survey 2002		NDRS 2000-2001	
Total number of strains teste	**245**	**100.0%**	**734**	**100.0%**
Susceptible to All 4 Drugs	**226**	**92.2%**	**651**	**88.7%**
Any Resistance	**19**	**7.8%**	**83**	**11.3%**
Isoniazid(INH)	13	5.3%	57	7.8%
Rifampicin(RMP)	0	0.0%	7	1.0%
Ethambutol(EMB)	0	0.0%	1	0.1%
Streptomycin(SM)	8	3.3%	39	5.3%
Monoresistance	**17**	**6.9%**	**64**	**8.7%**
Isoniazid(INH)	11	4.5%	39	5.3%
Rifampicin(RMP)	0	0.0%	3	0.4%
Ethambutol(EMB)	0	0.0%	0	0.0%
Streptomycin(SM)	6	2.4%	22	3.0%
Multidrug Resistance	**0**	**0.0%**	**3**	**0.4%**
INH+RMP	0	0.0%	1	0.1%
INH+RMP+EMB	0	0.0%	0	0.0%
INH+RMP+SM	0	0.0%	2	0.3%
INH+RMP+EMB+SM	0	0.0%	0	0.0%
Other Patterns	**2**	**0.8%**	**16**	**2.2%**
INH+EMB	0	0.0%	1	0.1%
INH+SM	2	0.8%	14	1.9%
INH+EMB+SM	0	0.0%	0	0.0%
RMP+EMB	0	0.0%	0	0.0%
RMP+SM	0	0.0%	1	0.1%
RMP+EMB+SM	0	0.0%	0	0.0%
EMB+SM	0	0.0%	0	0.0%

It was encouraging to find no MDR-TB isolated from this community-based survey subjects and reconfirm the low MDR prevalence estimated by the 1st National Tuberculosis Drug Resistance Survey. The prevalence of isoniazide resistance was at a modest level. As the NTP has been expanding DOTS, it would be essential to keep monitoring on drug resistance while replacing 6HE with 4HR at a continuation phase of treatment.

3.6 Prevalence of Tuberculosis

3.6.1 Prevalent Tuberculosis Cases in the Survey

Table 3-20

Number of TB Cases Detected, National TB survey		
Participants aged 10 or more	22,160	
Smear(+) TB	81	0.366%
Smear(-) Culture(+) TB	190	0.857%
Bacteriologically (-), X-ray active TB suggestive	309	1.394%
Bacteriologically (+) TB	271	1.223%
X-ray active TB suggestive	580	2.617%
Other TB possible by X-ray (tuberculoma, etc)	57	0.257%
Healed TB by X-ray	854	3.854%

<Smear Positive Cases>

The Central Panel reviewed 84 subjects with at least 1 positive smear slide and decided to exclude 3 subjects since they did not meet the criteria set for smear positive tuberculosis cases. Therefore, the number of smear positive cases detected by the survey was 81.

Table 3-21

Excluded Cases from a list of S(+) TB cases

		Smear Results		Culture Results			
Sex	Age	Day1	Day2	Day1	Day2	X-ray	History
M	49	Neg	12/300HPF	Non-TB	Non-TB	Normal	N
M	34	18/300HPF	Neg	Neg	Neg	Healed TB	Y
M	55	Neg	12/300HPF	Neg	Neg	Normal	Y

We need at least 2 evidences to categorize a subject as a S(+) TB case. The 3 subjects above did not have any evidence other than the single positive slide: Mycobacterium tuberculosis was not identified, and X-ray did not show shadows compatible with active tuberculosis.

Table 3-22

Smear Grades of S(+) Cases

	3+	2+	1+	>3/100	1-3/100	Total
S+ Case	10	11	36	12	12	81
(%)	12.3%	13.6%	44.4%	14.8%	14.8%	100.0%
Cumulative	12.3%	25.9%	70.4%	85.2%	100.0%	

Out of 81 smear positive tuberculosis cases, culture confirmation was not available in 7 cases: 5 cultures were negative and 2 were contaminated. Out of this, 2 were under tuberculosis treatment at the time of the survey, and the X-ray films of all 7 subjects showed definite shadows indicating active tuberculosis. By the international definition of smear positive, 1+ or more, the number of S(+) case became only 57.

It seemed that the distribution of smear grades of the detected cases shifted to the right (non-serious), compared with the daily observation at the TB laboratory. Most of the cases detected by the routine passive case finding showed higher grades of 3+ or 2+. As the higher grades of positivity may have a strong association with seriousness of the disease, patients are more likely to be detected by routine passive case finding activities while patients with lower grade positivity are more likely to remain in community because of their less serious symptoms.

Table 3-23

TB History of 81 Smear Postive Cases		
Newly detected*		62
Previously detected		19
on treatment (new)*	5	
on treatment (retreatment)	2	
only previously treated	7	
never treated*	5	
New*		72
Old		9

Based on the interviews and a review of the local TB registry, 72 were categorized as new S(+) cases and 9 as previously treated old cases. A total of 5 new cases and 2 old cases were under treatment at the time of the survey. 5 cases were identified to have been previously diagnosed with tuberculosis but have never received TB treatment.

<Smear (-) Culture (+) TB Cases>

Among 202 S(-)C(+) subjects, the Central Panel employed its agreed criteria and judged 190 as S(-)C(+) TB cases and 12 possibly contaminated in the examination process: Only 1 tube of culture was positive with 5 or less colonies, and no X-ray finding was consistent with active tuberculosis.

Out of 190 smear negative/ culture positive cases, 177 were categorized as new cases and 13 as previously treated TB cases.

> *It should be discussed if it was necessary to exclude the 12 subjects (6% of S(-)C(+)) from the list of S(-)C(+) cases). Given possible cross contaminations in the lab process, we set up a set of rules of excluding positive subjects in the laboratory from the S(-)C(+) case list: "*Only 1 tube of culture was positive with 5 or less colonies and no X-ray finding was consistent with tuberculosis"*. By applying the rule of excluding positive subjects, no X-ray normal subject remained as S(-)C(+) case. However, in clinic, we sometimes observe bacteriologically positive TB cases with no abnormality in chest X-rays especially in bronchial TB cases or in HIV positive patients. Therefore it might not be necessary to exclude those subjects from the list.*

Table 3-24

12 Excluded Cases from C (+) TB list

		Smear Results		Culture Results		
Sex	Age	Day1	Day2	Day1	Day2	X-ray
M	49	Neg	Neg	Neg	1colony	Normal
M	49	Neg	Neg	1colony	Neg	Artifact?
M	13	Neg	Neg	Neg	1colony	Artifact?
M	41	Neg	Neg	Neg	2colonies	Normal
M	35	Neg	Neg	4colonies	Neg	Normal
M	74	Neg	Neg	Neg	4colonies	Normal
F	54	Neg	Neg	Neg	1colony	Healed(minimal)
F	35	Neg	Neg	Neg	4colonies	Normal
M	41	Neg	Neg	1colony	Neg	Ectasis
M	44	Neg	Neg	Neg	4colonies	Healed?(minimal)
F	80	Neg	Neg	Neg	2colonies	Normal
F	57	Neg	Neg	Neg	5colonies	Normal

Table 3-25

TB Histroy of 190 Smear(-)Culture(+) Cases		
Newly detected*		163
Previously detected		27
on treatment (new)*	3	
on treatment (retreatment)	1	
only previously treated	12	
never treated*	11	
New*		177
Old		13

Table 3-26

X-ray Findings of S(+) Subjects

	S(+) TB cases	Excluded cases	Total
Active(with cavity)	60	0	60
Active(non-cavity)	17	0	17
Healed TB	4	1	5
No abnormality	0	2	2
Total	81	3	84

X-ray Findings of S(-)C(+) Subjects

	C(+) TB cases	Excluded cases	Total
Active(cavity)	56	0	56
Active(non-cavity)	118	0	118
Healed TB	14	2	16
Ectasis	0	1	1
Heart failure	1	0	1
Artifact?	0	2	2
No abnormality	0	7	7
No-Xray	1	0	1
Total	190	12	202

<Bacteriologically Positive Cases>

271 subjects consisting of 81 S(+) and 190 S(-)C(+) cases were categorized as bacteriologically positive cases by the Central Panel. Since culture confirmation was not available in 7 out of 81 S(+) cases, the number of bacteriologically confirmed cases was 264.

<Bacteriologically Negative and X-ray Active Tuberculosis Cases (Active TB suspected cases by X-ray)>

The Central Panel reviewed the X-ray films, which were screened as "abnormal" by the field reader and/or central readers. Except for those bacteriologically positive cases, 309 subjects were categorized as X-ray active TB cases, 57 as TB suspects, 854 as TB healed, and 226 subjects as other lung disease such as pneumonia and bronchial-ectasis. Out of 309 "bacteriologically negative active TB cases by X-ray", 17 (5.5%) were under treatment and 72 (23.3%) were previously treated cases. The Central Panel made very conservative assessments so as to avoid over-diagnosis. However, since the judgments were made without any challenge of anti-biotic treatment, the Central Panel admitted a tendency of over-diagnosis. The previously treated cases, in particular, tended to be diagnosed with active TB, because many of them still have cavity lesions remained.

Table 3-27

X-ray Features of TB Cases

Smear Positive Cases

Areas	Non-cav	Cavity+	Total
Minimal	3	3	6
Moderate	14	31	45
Far advanced	4	26	30
Total	21	60	81

Smear Negative/Culture Positive TB

Areas	Non-cav	Cavity+	Total
Minimal	53	5	58
Moderate	65	35	100
Far advanced	14	16	30
Total	132	56	188

(One patient was categorized as congestive heart failure)

(One patient did not receive X-ray exam due to illness)

Bacteriologically Negative but Active TB Suggestive by X-ray

Areas	Non-cav	Cavity+	Total
Minimal	143	11	154
Moderate	66	54	120
Far advanced	11	24	35
Total	220	89	309
Previously Tx	29	43	72
Non-history	191	46	237

Expanse of TB pathological areas in X-ray was classified according to Japanese Classification system

1:Minimal:TB lesions occupy less than 1/3 of a lung field

2:Moderate:Moderately advanced:between 1 and 3

3:Far Advanced:Total areas of TB lesions occupy more than one lung field

Limitations of Symptomatic Screening in Detecting TB Cases

Table 3-28

TB Related Symptoms and TB Diagnosis

(22,160 subjects aged 10 or more participated in National TB Survey)

	Symptomatics		No. of TB Patients diagnosed				Sensitivity	
Symptom	No.	%)	S(+)	%)	Bac(+)	%)	S(+)	Bac(+)
Cough any duration*	9,382	42.3%	74	0.8%	206	2.2%	91.4%	76.0%
Cough for 3weeks or more	1,501	6.8%	49	3.3%	105	7.0%	60.5%	38.7%
Blood in sputum	302	1.4%	10	3.3%	17	5.6%	12.3%	6.3%
Sputum*	6,813	30.7%	63	0.9%	161	2.4%	77.8%	59.4%
Chest pain*	4,912	22.2%	48	1.0%	142	2.9%	59.3%	52.4%
Loss of weight*	1,140	5.1%	33	2.9%	68	6.0%	40.7%	25.1%
Tiredness*	3,325	15.0%	42	1.3%	115	3.5%	51.9%	42.4%
Fever*	7,830	35.3%	50	0.6%	149	1.9%	61.7%	55.0%
Night sweat*	1,589	7.2%	30	1.9%	65	4.1%	37.0%	24.0%
Other*	22	0.1%	1	4.5%	1	4.5%	1.2%	0.4%
Cough 3w or Blood sputum	**1,614**	**7.3%**	**50**	**3.1%**	**106**	**6.6%**	61.7%	39.1%
Any symptom*	12,902	58.2%	76	0.6%	229	1.8%	93.8%	84.5%
No symptom**	9,258	41.8%	5	0.1%	42	0.5%	-	-

*Sputum examinations were not requested if they didn't have cough for 3 weeks or blood sputum and X-ray were normal

** Sputum examinations were requested only when they had any X-ray abnormalities

Out of 1,614 TB suspects, who were with cough for 3 weeks or more and/or with blood stained sputum, 50 S(+) (3.1% of suspects) and 56 (3.5%) S(-)C(+) TB cases were identified. Sensitivity of detecting smear positive TB cases through interviews was only 61.7%, and sensitivity of detecting bacteriologically positive TB was 39.1%. The rest was suspected TB cases in the X-ray examinations.

> *If TB patients were detected by the routine TB service shortly after developing a disease, for instance, within 1 month, we should find a large proportion of TB cases without cough more than 3 weeks. However, it is not the case in Cambodia. Although the TB related symptom screening is popular prior to sputum examinations in developing countries, interview-based symptomatic screenings can detect only limited cases even in smear positives in a prevalence survey. When the routine TB service, DOTS, removes S(+) cases efficiently from community, the remaining cases are more likely to be S(-). There must be considerable differences in characteristics between those who seek medical assistance from health facilities and those who just stay in community when they have access to DOTS. We need further studies to find out how people recognize chronic coughs.*

The post survey interview with the detected cases revealed that at least 16 cases had visited health facilities suspecting TB but never been diagnosed with TB (TB unit: 5; Health center:6; Others: 5). This indicates a limitation of diagnosis without an X-ray equipment.

3.6.2 TB Disease Prevalence Rates

To estimate a disease prevalence, we used the population data from the 2003 Cambodia Inter-Census Population Survey 2003 with an annual population growth rate of 1.81% and assumed that the number of smear positive cases in children age less than 10 be neglected.

Table 3-29
Estimated TB Prevalence, Cambodia, 2002

	Rate (/100,000)		
	Point Estimate	95% C.I.	No. of Cases
(For population aged 10 or more)			
S(+) TB	362	284 - 461	33,998
S(-)C(+) TB	846	675-1,059	79,450
S(-)C(-) X-ray Active TB Suggestive**	1,370	1,117-1,680	128,657
Bacteriologically Postive TB	1,208	997 - 1,463	113,447
Pulmonary Active TB Suggestive**	2,579	2,205-3,013	242,095
(For all age*)			
S(+) TB	269	211 - 343	

*Assuming that there was no smear positive case in children aged less than 10
2002 Population Re-estimate from Cambodia Inter-Census Population Survey '03: 12,630,000
74.34% of eligible population was aged 10 or more in this prevalence survey: 9,389,000
** Including active TB suspected only by a single X-ray examination

For those aged 10 or more, the S(+) prevalence rate was 362/100,000 (95% C.I. 284-461). The prevalence rate of bacteriologically positive cases, a sum of S(+) TB and S(-)C(+) TB, was 1,208/100,000 (997-1,463), 1506 in male and 983 in female. Assuming that the number of S(+) TB among children aged less than 10 be neglected, a S(+) prevalence rate became 269 (211-343). There could be around 34,000 S(+) cases in Cambodia at the time the survey was conducted in 2002, and more than 110,000 people were living with bacteriologically positive TB. However, only 30% of bacteriologically positive cases were S(+).

Table 3-30 Prevalence rate of TB by sex

	Prevalence per 100,000				
	Smear+	S-C+	S-C-	Bac+	Active Pul
Male	551	955	1575	1506	3082
Female	208	775	1241	983	2224
M/F Ratio	2.6	1.2	1.3	1.5	1.4

(aged 10 or more)

Figure 3-4 Age Distribution of Prevalent S(+) Cases and Prevalence rate (/100,000)

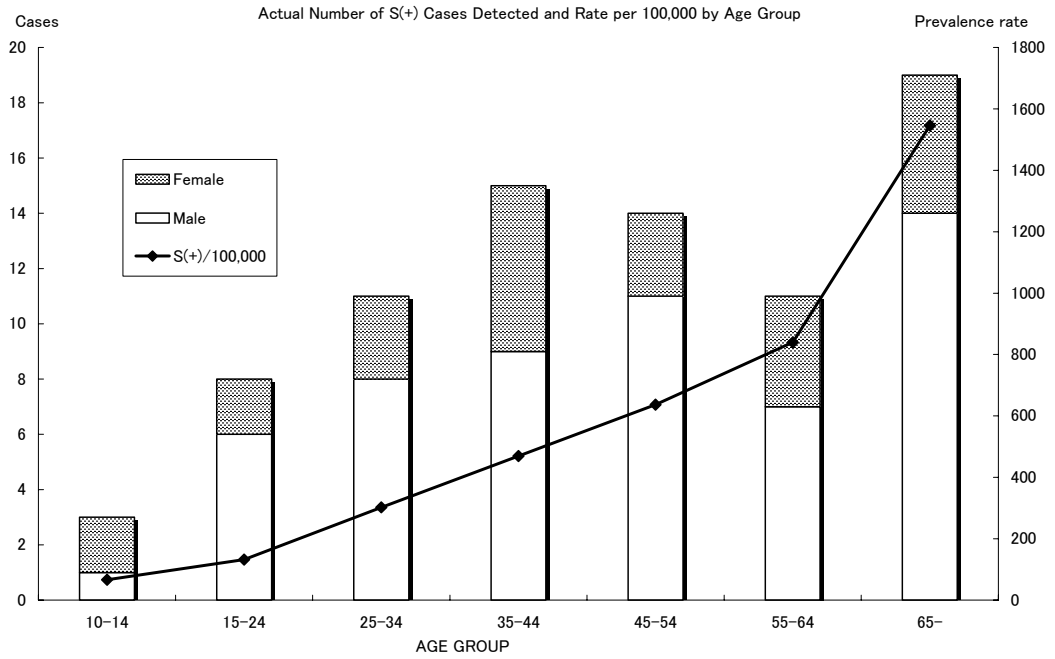
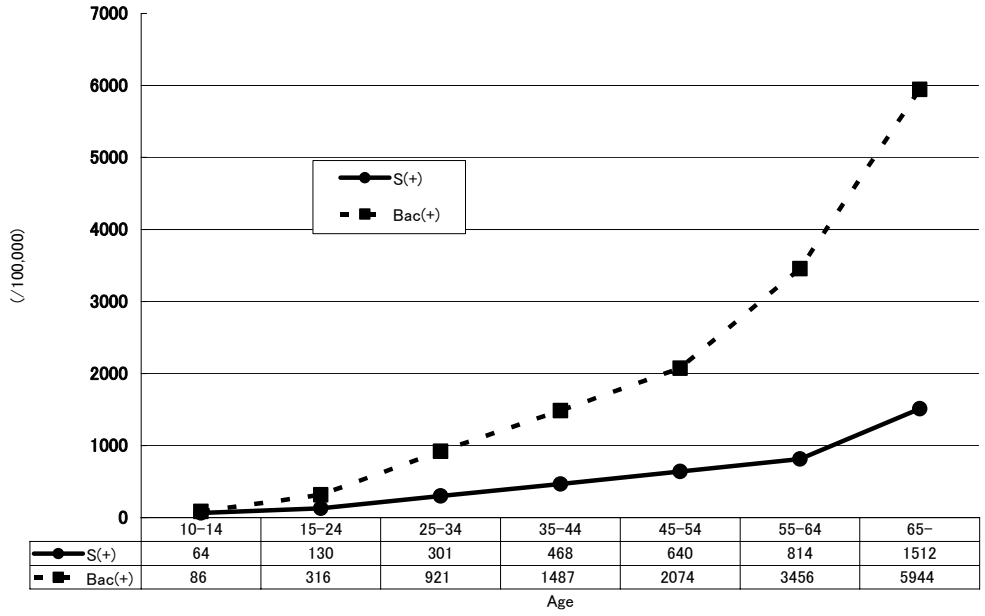


Figure 3-5 Prevalence of TB by Age Category



	10–14	15–24	25–34	35–44	45–54	55–64	65–
S(+)	64	130	301	468	640	814	1512
Bac(+)	86	316	921	1487	2074	3456	5944

The prevalence rates of male were 2.6 times as high as those of female in S(+) and 1.5 times in bacteriologically positives. Though 60% of S(+) cases belonged to the age group between 15 to 54, the older age groups also occupied a significant portion of the prevalent cases. Higher prevalence rates were observed as the age increased.

The NTP has been targeting TB case finding efforts on the reproductive age group since it was believed that majority of smear positive patients belonged to that age group. The high prevalence rates among the elder population groups were beyond the expectations.

Disease Prevalence rate and Access to DOTS

Table 3-31

Prevalence Rates by Service Access (age=>10)	S(+)	S(-)C(+)
Urban districts	315	613
Rural districts	373	898
Phnom Penh or Provincial Capital Town areas	191	392
Other	401	949
	p=0.034	p=0.003
Distance to DOTS Centers in rural districts		
<5km	245	884
5-10km	373	627
>10km	459	1095

Though urban districts showed a slightly lower disease prevalence rate than rural districts, there was no statistically significant difference. However, the clusters in Capital Province in Phnom Penh and provincial town areas showed statistically significant lower prevalence rates both in S(+) and S(-)C(+) TB while the number of clusters was limited. Though not statistically significant, we found the prevalence rate of S(+) was lower in the cluster villages of the rural districts located within 5 km from the DOTS facilities. However, no such tendency was observed in S(-)C(+) positive TB cases. The better access to DOTS might be lowering the S(+) prevalence rate.

High Disease Prevalence Rate in Previously Treated Subjects

Table 3-32 TB Status at the Survey Time among the Subjects with TB Treatment History

Status of 42 Subjects Aged 10 or More on TB Treatment		
Current TB status	No.	%
S(+)C(+)	5	11.9%
S(+)C(-)	2	4.8%
S(-)C(+)	4	9.5%
S(-)C(-)Xray(active)	13	31.0%
Healed TB	11	26.2%
Others	2	4.8%
No significant findings	5	11.9%

Status of 417 Subjects with Past Treatment History of TB		
Current TB status	No.	%
S(+)C(+)	9	2.2%
S(+)C(-)	2	0.5%
S(-)C(+)	13	3.1%
S(-)C(-)Active by Xray	72	17.3%
On treatment	3	0.7%
	(aged 10 or more)	

A high disease prevalence rate was observed in the previously treated subjects. 456 participants aged 10 or more (2,058/100,000 aged 10 or more) were identified to have a TB treatment history at least once including 42 under treatment. Out of these 42 subjects under treatment, 5 still remained smear positive/culture positive, 2 remained smear positive but culture negative and 4 were smear negative but culture positive.

Out of 417 with a previous TB treatment history, 9 were S(+) and 13 were S(-)C(+), making up for 5.3% of the bacteriologically confirmed TB. Having a TB treatment history seems to be a risk factor for the current TB disease.
There were 93 children under the age of 10 with a past history of TB, including 11 under TB treatment at the time of the survey. We made no further investigation into this in the survey.

We should note that 5.3% of the subjects with a past history of TB treatment were confirmed bacteriologically positive TB status at the time of the survey. There was no MDR-TB identified among them. The NTP Cambodia has been using 2HRZE+6HE as a standard regimen for category I since 1994. However, internationally, it has been argued that 6HE might not be strong enough to prevent a relapse of the disease, although it can prevent an appearance of MDR-TB. The survey results may support the international findings of high relapse rate. As the NTP is to change the standard regimen from 8 month to 6 month from 2005, both changes in relapse and drug sensitivity pattern should be monitored carefully.

3.7 Incidence of Tuberculosis

The incidence rate of new smear positive tuberculosis was calculated based on the following findings, assumptions and formulas discussed in 2.5.2.3:
For all population (age 10 or more)
Prevalence of S(+): 269 (362)
Proportion of New S(+)/ All S(+): 72/81 from the survey
Proportion of HIV(+) in S(+) in NTP: 8%
Proportion of HIV(+) among S(+) out of NTP: 10%
Population in 2002: 12,630,000 (9,289,000) from 2004 estimated population with 1.81% annual growth rate by the Cambodia Inter Census Study in 2003; since there was no age-wise population table for 2002, we used our survey population for age-wise distribution.
NTP Notification in 2002: 17,258 (17,200)
Private Treatment/All Detected in S(+): 8/42 from the survey= 20%
HIV prevalence: 140,000 (134,000)
TB incidence among HIV(+): 8%/year
Proportion of S(+) among HIV(+) TB: 35%
Proportion of S(+) among HIV(-) TB: 45%
Average delay to Treatment in DOTS program: 7 months= 7/12 year
Average duration by smear conversion in DOTS program (HIV-): 0.2year
Average duration by smear conversion in DOTS program (HIV+): 0.15year
Average delay to Treatment out of NTP: 0.4year
Average duration by smear conversion out of NTP (HIV-): 0.6year
Average duration by smear conversion out of NTP (HIV+): 0.3year
Average duration of smear positive status of undetected cases (HIV-): 2years
Average duration of smear positive status of undetected cases (HIV+):1year

Incidence rate of new S(+) cases for all population: 229, 203-262 /100,000
Incidence rate of new S(+) cases among age 10 or more: 309
Incidence rate of TB all forms among age 10 or more: 706
Incidence rate of TB all forms among age less than 10:

a) 45% of the incidence rate of age more than 10 (historical observation): 318
b) Based on ARI (1% in age less than 5, 1.7% in age 5-9): 263

The Incidence rate of TB all forms for all age:
706(Age 10 or more) x 0.745 + 318 or 263 (Age less than 10) x 0.255

a) 607
b) 593

The 2 different estimation methods gave us quite close results. The newly estimated incidence rates of 229 for new S(+) and 593 or 607 for all cases were similar to the 2002 WHO estimates of 242 for new S(+) and 549 for all cases. Since we made many assumptions, though evidence-based, the differences might be within a margin of errors. We used the Asian model from Japan, and its incidence rate among children is almost double of that of the European model (Chris Dye). However, the number of cases differed by only around 4000, or 6-7% of the estimated incidence.
As the number of S(+) cases in children is almost negligible, the incidence of TB in Cambodia in 2002 is roughly estimated as follows:

Table 3-33 Estimated TB Incidence in Cambodia, 2002

Estimated TB Incidence, Cambodia	Rate (/100,000)	No.
All TB	600	76,000
S(+)	230	29,000
TB in children aged less than 10	290	9,000

Rounding figures

If we assume that 25% of the TB incident cases are S(-)C(+) as shown above, a disease duration, or an average duration of culture positivity, would be nearly 5 years (incidence in age 10 or more: 706 x 0.25, prevalence: 846). Since S(-)C(+) occupied 70% of the bacteriologically positive TB

prevalence, the duration of the disease could be very long if we apply the traditional theory that S(+) occupies more than a half of the pulmonary TB incident cases. The limitations of the diagnostic facilities, especially concerning X-rays, poor accessibility, and unavailability of TB treatment during the long lasting conflict might have created such a unique situation in Cambodia. Many of the S(-)C(+) cases detected by the survey might be harboring from C(-) status to S(+) status. The results of the post survey interview with S(-)C(+) cases also suggested a presence of chronic cases with very long-term illness

The prevalence of S(+) TB might be lowering sharply as a result of the DOTS expansion efforts which has facilitated detection of TB cases and prevented delays in receiving treatment. However, it would be still difficult for the NTP to decrease the incidence rate as a large pool of latent infection and these chronic pulmonary TB cases could be contributing to the high incidence of S(+)TB.

The calculated disease duration of 5 years for S(-)C(+) TB seems to be too long. While the significant proportion, 10-20%, are HIV(+) with a rather short history of the disease due to early deaths by AIDS, the rest should have a longer duration of the disease.
If an average duration of C(+) disease is 3 years, then the incidence rate of S(-)C(+) TB in age 10 or more becomes 282, which is only 10% lower than that of S(+) TB. This would make all TB incidence around 700/100,000.

Table 3-34
Duration of TB Related Symptoms
(post survey interview to deteced cases)

	Days	
	Median	Mean
S(+)	233	288
S(-)C(+)	229	536

3.8 Coverage of NTP Service

3.8.1 Public versus Private Health Services

Out of 42 subjects aged 10 or more who reported being under TB treatment at the time of the survey, 8 (19%) were receiving treatment at non-NTP facilities. The interview results and the delay analysis indicated that many of the already detected cases had visited private facilities for consultation, mostly at the early stage of their sickness. However, most of them were referred or self-referred to NTP facilities to receive free DOTS treatment. Unfortunately, information on TB types and categories at the initial diagnosis was not available for these cases.
Post survey interviews with bacteriologically positive patients identified 21 subjects had a treatment history prior to the survey (11 received treatment at TB Unit, 8 at health centers and 2 at private facilities).
Although the first contact after developing a disease was often a private facility, the NTP coverage in terms of TB treatment seemed to be as high as 80% or more in Cambodia at least when adult patients are concerned.
However, the poor access and infrastructure of the public hospitals/health centers might show a totally different picture in childhood TB diagnosis and treatment. Since the survey did not target childhood TB except for the infection rate, information made available on this subject was very limited. It was, however, clear that the number of children who received TB treatment at non-NTP facilities far exceeded that of children who received treatment at NTP facilities. A further study is essential to investigate and analyze the situation of childhood TB and the pattern of their service utilization in Cambodia.

3.8.2 Case Detection

The survey was carried out in parallel with the DOTS expansion to health centers. The DOTS expansion had been piloted since late 1999 and became an official policy in June 2001. The expansion process began in late 2001. Though most of the health centers were equipped with DOTS by late 2004, the coverage of DOTS at the health center level was only 25-30% in mid 2002 when the survey was conducted.

The NTP registered 17,258 new smear positive cases out of a population of 12,630,000 in 2002. As the incidence of new S(+) cases was estimated at 229/100,000, the DOTS-case detection rate would be 59.6%. However, as the number of cases of all forms of TB detected in 2002 was 24,610, 195/100,000, we can estimate that only one third of the incident cases were placed under treatment by the NTP.

3.9. Impact of HIV

Although blood was not collected in the survey, an additional survey on "National HIV Sero-prevalence among TB Patients" was carried out in January 2003 and targeted all TB patients across the country who were newly registered in that month (Annex). 8.2% of the new smear positive cases and 20.7% of the new smear negative or extra-pulmonary cases were HIV positive. Considerable differences were observed across different geographical areas; Phnom Penh, Coast provinces and the Thai border recorded higher HIV sero-prevalence. However, due to the nature of TB/HIV disease and unavailability of anti-retroviral therapy in 2002 and early 2003, the impact of HIV on the nation-wide smear positive TB prevalence would have been limited.

We estimated that HIV attributes to approximately 13% of the smear positive tuberculosis cases in Cambodia. It clearly poses a negative impact on the TB control. Vulnerability and rapid progress of the disease in some patients may compromise their access to DOTS.

4. Discussions

4.1 Trend of S(+) TB Prevalence: *Smear positive TB prevalence rate might be declining sharply*

Table 4-1
TB Prevalence Studies in Cambodia

Provinces	Year	Studied population	Screening method	No. of S(+) cases	Prevalence rate/100,000
Phnom Penh	1981-84	12,641	Symptoms	26	206
Kandal	1981-86	13,569	Symptoms	35	258
Prey Veng	1982-89	8,109	Symptoms	42	518
Takeo	1983-89	23,624	Symptoms	140	593
Konpong Chhunang	1984-89	6,628	Symptoms	38	573
Svay Rieng	1985	4,578	Symptoms	34	743
Kompong Speu	1989	5,324	Symptoms	16	301
Kompong Thom	1989	5,500	Symptoms	20	364
Siem Reap	1989	6,404	Symptoms	42	656
Total	**1981-89**	**86,377**	Symptoms	**393**	455
IOM (migration applicants)	1995	2,583	X-ray?	11	426
IOM (migration applicants)	1998-2000	910	X-ray	4	440
National Survey	**2002**	**30,032**	X-ray and symptoms	**81**	**269** (adjusted)

Though Cambodia still has a very high TB prevalence, it should be highlighted that the national survey confirmed a recent decline in the smear positive prevalence rate despite of the appearance of HIV/AIDS epidemic from the 1990's. The point estimate of smear positive was 269/100,000 (95% CI. 211-343), nearly half of the previous WHO estimate in the 1990s and 60% level of the previous experiences in the 1980s. Some were concerned that the survey might have underestimated the current situation. However, since we used the both X-rays and symptoms as screening method prior to the bacteriological examinations, it should have detected even "symptom silent" smear positive cases which would have been overlooked if only the symptomatic screening was employed for active case detection like in the 1980s. As the national survey found that only 50 out of 81 smear positive cases were identified as "TB suspects by symptoms", the prevalence rate of TB symptomatic smear positive cases was even less than that in Phnom Penh in the early 80s. It seems that the efforts of expanding DOTS in the past 8 years have been contributing to an efficient removal of smear positive TB cases from community and reduced the burden on the smear positive prevalence rate to already a half of the 1980's level .

Because the national survey counted scanty positive slides (<10AFB/100HPF) as "positive" and smear negative slides were re-examined when the cultures were identified as TB positive, a chance of underestimating the smear positive prevalence rate as a result of the lab process should be minimal even if only 2 sputum samples were collected from each suspect.

It should be discussed if this lower prevalence rate was due to the lowering incidence or earlier case detection and treatment achieved by the DOTS expansion. The significantly high prevalence of S(-)C(+) discussed below indicates a high incidence of TB, especially, a high level of latent infection in older age groups.

Table 4-2 Results of Recent National TB Surveys in Asia

	Year	X-ray Active	Bac(+)	Smear(+)	S(+)/B(+)	B(+)/Xray	S(+)/Xray
Cambodia	2002	1917	898	269	30%	47%	14%
China	1990	523	177	134	76%	34%	26%
	2000	367	160	122	76%	44%	33%
Philippines	1983	2900	860	660	77%	30%	23%
	1997	4200	810	310	38%	19%	7%
Republic of Korea	1965	5100	940	690	73%	18%	14%
	1975	3300	760	480	63%	23%	15%
	1985	2200	480	240	50%	22%	11%
	1995	1000	220	90	41%	22%	9%

4.2 High Prevalence Rate of S(-)C(+)TB

A high prevalence rate of S(-)C(+) TB might be another most interesting finding of the survey. The prevalence of bacteriologically positive TB, a sum of S(+) and S(-)C(+) cases, was the highest among the recently conducted national surveys in Asia. It should be noted that the TB burden in Cambodia was heavier than anticipated in terms of the prevalence of the bacteriologically positive TB disease.

S(+) cases occupied only 30% of the bacteriologically positive cases. A reduction in the proportion of S(+) was observed in a series of national surveys such as in the Philippines and Korea. Though the national survey in Cambodia recorded a proportion of smear positive cases lower than it was not the lowest: the national surveys of Japan conducted in the 1950s and 60s recorded less than 30%; and S(+) cases occupied only 29% of the bacteriologically confirmed new cases in the famous Kolin study by Styblo. As TB control services improve, a proportion of S(+) in community may decrease. Serious/symptomatic cases are more likely to be removed from communities by routine health services if it is functional and of good quality. In Cambodia, the routine medical practice rarely gave chest X-ray examinations in rural areas. Until recently, smear positive TB cases made up for nearly 90% of the pulmonary cases registered in the NTP. For many years, the NTP has been detecting more than 100/100,000, especially focusing on smear positive cases. If detected, they were involved in the strict DOT program. A large-scale TB prevalence survey had never been carried out in such a unique situation with DOTS, and it may explain why the proportion of smear positives to the bacteriologically positive cases is so low. A small-scale study by IOM also found that, from 1998 to 2000, the number of S(-)C(+) was more than that of S(+) among migration applicants in Cambodia.

It is almost impossible to estimate an average duration of disease among S(-)C(+) in the current situation of Cambodia because many people do not even recognize their illness. If we assume that S(-)C(+) occupy 25% of the incident TB cases, the disease duration would be around 5 years. If shorter, we can assume that this high prevalence is not a result of poor treatment because majority of patients have not been treated and there was no MDR-TB case. However, this pool of S(-)C(+) TB cases could be a continuous source of S(+) cases because treatment interventions provided to non-smear positive cases are still limited especially in rural areas where most people live. Moreover, in Cambodia, people live close together not only by large family but also by house group. Therefore, even S(-)C(+) cases might also serve as a potential source of infection. Further studies are necessary to clarify this unique situation of Cambodia.

4.3 Implication of X-ray Active Cases

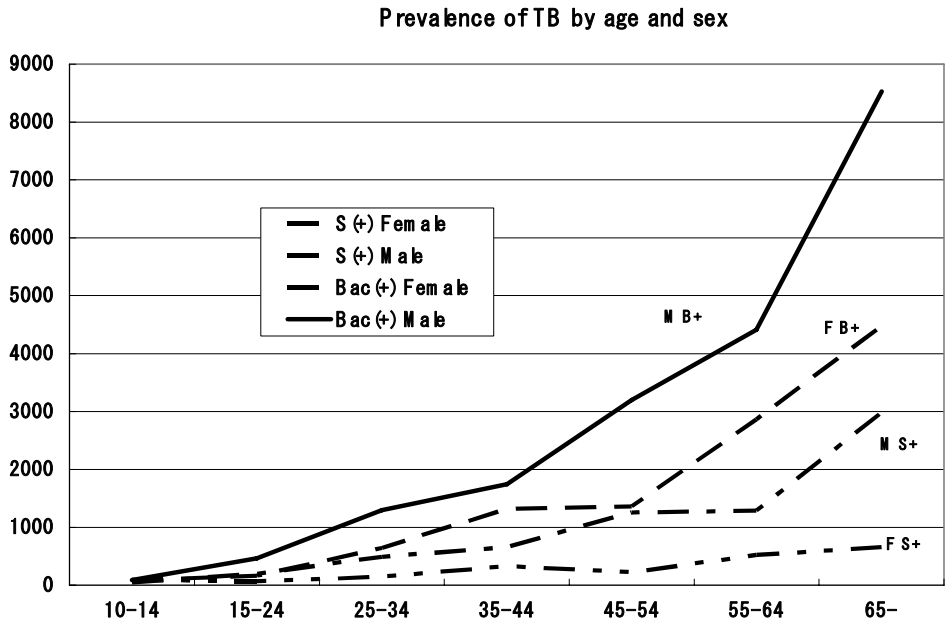
An interpretation of the **high prevalence of bacteriologically negative "X-ray active" cases** is not clear enough. The number of subjects who were categorized as bacteriologically negative but X-ray active was slightly higher than that of the bacteriologically positive cases in this study. Though a series of challenges with anti-biotic agents was encountered prior to the diagnosis of smear negative pulmonary TB in the NTP's routine program, X-ray active TB was diagnosed only with spot X-rays and sputum examinations in this survey. Therefore, there could be over-diagnosis; previously treated cases with remained cavity and/or naturally healed cases without treatment may tend to fall under this category. It might be more appropriate to state with a rather moderate expression such as "active TB suggested by X-rays" in stead of "X-ray active". However, the proportion of bactriologically positive cases to "X-ray suggestive actives," was 47%, recording the highest among the surveys recently conducted in Asia. It indicates that the Central Panel read the X-ray results rather strictly. Just like the surveys in other countries, the reasons for the high prevalence of "bacteriologically negatives but X-ray suggestive actives" are unknown.

4.4 Low Proportion of "Known Cases"

The low proportion of "known cases" was also one of the characteristics in Cambodia. Out of 81 smear positive cases detected, 14 were under treatment or previously treated (22%). The fact that only 7 out of these 81 were under treatment should be well taken note of.

This low ratio of "known cases" might be a result of the following facts: 1) since the DOTS expansion to health centers was still underway (and treatment services were not fully available) at the time of the survey, access to treatment was delayed, and as a result, a duration of illness was rather long; and 2) because of the intensive application of DOT and the extremely low prevalence rate of MDR-TB even in retreatment cases, the average time required for smear conversion after initiating treatment is much shorter than other countries. Out of 42 cases under treatment, only 5 S(+)C(+) and 2 S(+)C(-) were S(+) and the rest were S(-).

Figure 4-1



4.5 Prevalence Rate and Age

One way trend in the prevalence rate, which increases with age, may indicate a result of the effective TB control intervention in Cambodia.

60% of the smear positive cases were from the age groups of 15 to 54, though the elder age groups accounted for a significant portion of the TB cases. In terms of the prevalence rate, the elder age groups have significantly higher rates. During the long lasted conflict including the "Khmer Rouge Era" and especially the late 1970s, many people were killed. This made small the population size of the elder groups, especially males aged between 55 and 64. A reduction in the TB prevalence in Cambodia will be accelerated because of the smaller population size of these heavily war-affected age groups.

It was encouraging to find no second mode in the prevalence rate among young adult populations despite the HIV/AIDS epidemic which has become increasingly serious in the 1990s. Though 10-20% of the TB incidence could be attributed to HIV/AIDS in Cambodia, we can assume that it does not have a considerable impact on the prevalence because of the nature of early progression of the disease. Availability of quality DOTS in urban areas and provinces with high HIV prevalence rates might contribute to non-appearance of a mode in young adults as well.

Although TB is still highly transmitted in Cambodia, a large part of TB cases in adult population seems to be from a pool of latent infections including a reserve of S(-) chronic cases rather than newly acquired ones.

4.6 Gender Issue

Gender issue is also an interesting factor in the survey. Gaps were observed in male-female ratios of the prevalence: 2.6 in smear positives and 1.2 in smear negative/culture positives. It is common to observe more TB cases in males in most of the countries. However, one of the unique characteristics of Cambodia's TB-related statistical data is a high TB detection rate among females, which always accounts for nearly 50% of the registered cases. Given S(+) TB develops with the same ratio of smear negative/culture positive TB in males and females, the smear positive case detection rate among females could be higher than males, and it pushed the M/F ratio of the smear positive TB prevalence to as high as 2.6. Females may have more opportunities to be diagnosed, probably because of their more frequent contacts with and utilization of public health facilities with children.

The gap between the TB notification rate and the prevalence was constantly larger in males across all age groups. However, the delay study by Saint Saly showed no gender difference in delays among notified cases in the NTP (Annex). Males might receive TB treatment at non-NTP facilities more than females, or many are not involved in treatment at all. This unique gender difference should receive careful consideration and be further studied.

Figure 4-2

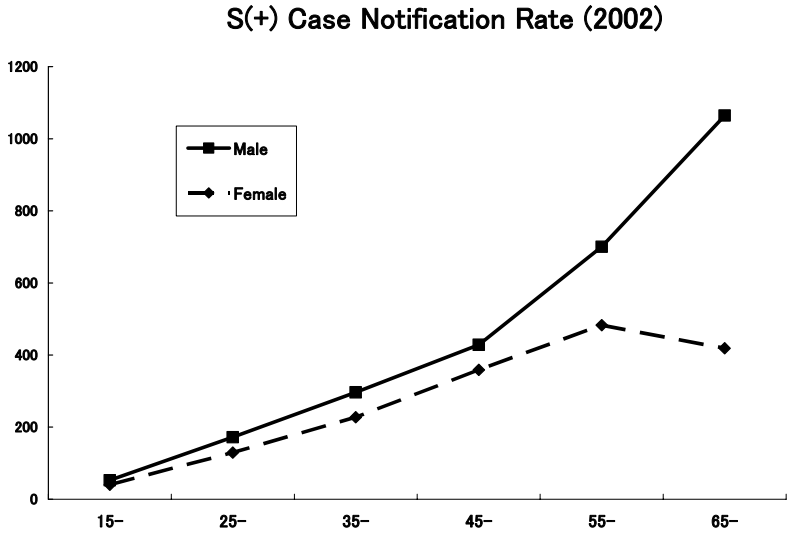
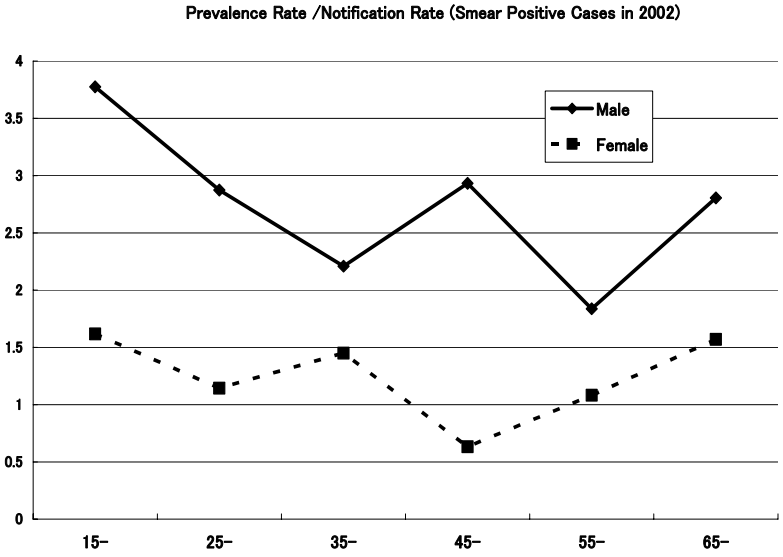


Figure 4-3



4.7 Childhood TB

Childhood TB should draw much more attention. Due to technical limitations, the survey did not study TB in children except for the items related to the tuberculin test. The survey found that the number of children receiving TB treatment at non-NTP facilities is much higher than expected. More than 1% of children aged 1 to 9 had TB treatment experiences. However, 16 out of 42 clusters did not have any child with TB treatment history, while children in some other clusters seemed to have received very intensive treatment. 3 Khuntha Bopha Children Hospitals claim that they are treating more than 12,000 childhood TB cases a year while the NTP notifies only hundreds of cases a year. It is recommended that some specific studies focusing on TB and TB treatment for children be conducted in collaboration with pediatricians in Cambodia.

It is alarming that the BCG coverage is not high enough. Less than two thirds of children age between 1 and 4 had BCG scars. Though it seems to be gradually improving, proper inoculation of BCG should be promoted in order to prevent children from serious forms of tuberculosis.

4.8 High TB Incidence

The Incidence/Burden of TB is estimated still very high in Cambodia. We estimated 229 S(+) and approximately 600 TB cases of all forms. Our estimate was quite similar to the 2002 WHO estimate. Our estimate was slightly higher because of the following reasons: 1) we took into consideration the recent change in the population structure where the proportion of adults is increasing with a smaller population growth rate, and 2) we estimated TB in children to be higher than the WHO estimate. Thanks to quality treatment and improved access to DOTS, the prevalence rate of smear positive TB seems to be declining sharply in recent years. However, it might be still a challenge to attain a decline in the incidence rate in Cambodia. The extremely high prevalence rate of S(-)C(+) TB cases, which have been rarely intervened, may be serving as a source of smear positives. A very large pool of latent infections among adult population also challenges the NTP's efforts of lowering the incidence rate with the quality DOTS program. Appearance of HIV/AIDS from the 1990s, though limited to around 10-15% of the smear positive incident cases, must have been posing a negative impact on the current TB control program, partially offsetting the positive products of the DOTS expansion.

Although the ARI might not be constant across the age groups, a relatively low ARI estimate available from the 2002 survey with younger infants is encouraging. DOTS may begin to cut the chain of infection effectively.

4.9 Survey methodology

The survey used both symptomatic screenings and X-rays to identify TB suspects for sputum examinations including cultures. First, if we conducted interviews only, 38% of the smear positive cases could not be detected. Secondly, the X-ray screening and sputum examinations with cultures were also successful in identifying a large pool of S(-)C(+) cases. In order to understand TB epidemiology and to formulate an strategic plan with TB control strategies, it was useful to find the presence and the size of S(-) TB cases. The prevalence rate of S(+) cases would be rather easily decreased by DOTS. Theoretically, a declining trend in incidence or case notification should be observed in such a program. However, a DOTS program with a good case detection rate and a high cure rate is not always able to decrease case notification, or an observed incidence. The large pool of S(-) cases might partially explain this phenomenon. Although X-ray-taking is a challenge in many settings, we strongly encourage the usage of portable X-rays with full-size films and an auto-processor on the spot to secure a high attendance rate and examination rate among suspects, especially in surveys under the DOTS program. It would be helpful to clarify the underlying situation.

5. Conclusion and Recommendations

5.1 Conclusion

NTP, Cambodia, successfully conducted the 1st National TB Prevalence Survey in 2002 with technically sound methods in collaboration with various partners. A high participation rate of 96.7% was achieved: 30,032 out of 31,050 eligible subjects in 42 clusters across the country participated in the study.

Out of 22,160 participants aged 10 or more, 81 smear positive and 191 smear negative/ culture positive pulmonary TB cases were detected. Weighed prevalence rates of the population aged 10 or more were 362 (95% C.I.: 284-461) for smear positive and 846 (675-1059) for smear negative/culture positive per 100,000 respectively. If we assume that we can neglect smear positive cases among children aged less than 10, a prevalence rate of smear positive TB becomes 269 per 100,000 populations. While the prevalence rate of smear positive TB was lower than expected, the prevalence rate of smear negative/culture positive TB was much higher than expected. However, no-MDR TB strain was isolated from the survey subjects.
Although 60% of smear positive cases belonged to adults aged between 15 and 54, the older age groups occupied a significant portion of the prevalence. The older the age group is, the higher the prevalence rate is. A smear positive prevalence rate in the age group 65 or more was as high as 1,512 per 100,000. The prevalence rate in male was 2.5 times higher than that in female. Areas with better access to DOTS facilities such as Phnom Penh, provincial capital towns and villages within 5km from the DOTS centers tended to have lower prevalence rates of smear positive TB.

A BCG scar was observed in 50.2% of children aged between 1 and 14. The BCG scar rate among children aged 1-4 was as low as 64.6% with no sex and geographical differences. This figure was consistent with the governmental estimation of the vaccination coverage. When we applied the cut-off point of 10 mm as tuberculin reaction, 2.7% of children were infected with TB by age 2.8, 13.7% by age 7.2, and 32.7% by age 12.0. The annual risk of TB infection in the age group between 5 and 9 was estimated at 2.06%.

Despite the fact that the numbers of case notifications in male and female have been almost at the same level in Cambodia, the survey saw a considerable difference in the prevalence between male and female. The Prevalence/Notification ratios were relatively constant across all age groups in both sexes. However, male always showed higher ratios than female in every age group. Since there was no difference in delays of diagnosis between male and female, the case detection rate in male might be much lower than that in female.
As the TB prevalence rate increases along the age, it was suggested that, at present, a significant portion of TB diseases in Cambodia are developed from latent infection and reactivation, not from new infections. Therefore, it is very difficult to interpret the relation between the annual risk of TB infection (ARI) among children and the disease prevalence rate in adult population.

According to the interview, 6.8% of the study participants aged 10 or more experienced cough for 3 weeks or more in a recent month. The prevalence rate of chronic cough increased as age increased. When we define TB suspects as those who had “cough for 3 weeks or more” and/or “blood contained sputum”, 7.3% fell in the category of TB suspects by symptom screening. However, out of 81 smear positive TB cases, only 50 or 62%, belonged to the category of TB suspects. For bacteriological positive cases including smear negative/culture positive, only 39.1% were screened by the interview. The X-ray examination could detect all bacteriologically positive cases except for a few smear negative culture positive subjects.

Using other available information and some additional studies on TB and HIV in Cambodia, the incidence of TB was estimated. The calculated incidence of new smear positive TB was approximately 230, which was very close to the WHO's recent estimation. HIV/AIDS attributed approximately 13% of the incidence of smear positive. The incidence of all TB was estimated approximately at 600/100,000. However, since the prevalence of smear negative and culture positive TB was much higher than expected, and since we might have more TB cases than expected among children, the total TB burden, or an incidence rate of all TB, could be as high as 700/100,000. In short, Cambodia still has an extremely high burden of TB.

Compared with the past studies from the 1980s and 90s, the observed prevalence rate of smear positive was much lower in this study, especially in the younger adult population. The better access to DOTS shortened a delay of diagnosis and cut the infection chain. The exerted efforts of expanding DOTS in the past 8 years seemed to have made a significant impact on the TB burden. However, a large pool of latent infection in the middle and elder generations and the impact of HIV/AIDS account for the high TB incidence in Cambodia. As a result, the country still remains a high TB burden country.

5.2 Recommendations

1. Continuous efforts to expand DOTS should be made to ensure improved access.
2. Adequate attention should be paid to elder populations who exhibit an extremely high TB prevalence.
3. The very low prevalence of MDR TB should be maintained through proper case management, which shall be made available not only by DOTS of the public sector but also in collaboration with the private sector.
4. In addition to the current strategy of DOTS, other approaches such as active case detection, which are suitable for high risk groups, including people living with HIV/AIDS (PWH), should be applied.
5. The impact made by the high prevalence of smear negative / culture positive TB should be carefully studied. Interventions including an operational research on proper utilization of X-rays and culture examinations should be made where necessary.
6. The situation of TB in children should be studied to develop an adequate strategy.
7. Both international and national communities should provide continuous support to TB control activities in Cambodia.
8. As this prevalence survey provided a clear picture of TB in Cambodia, the second round should be conducted 5 or 10 years later. Ideally, the 2nd round results shall be made available before 2010 to allow a final action plan to be developed toward the Millennium Development Goal by 2015.
9. With knowledge and experiences accumulated through the process, NTP Cambodia should support other countries planning to implement a TB prevalence survey.

6. References

World Health Organization
Global Tuberculosis Control, WHO Report 2000. Geneva, WHO, and its series

C. Dye, S. Scheele, P Dolin, et al
Global Burden of Tuberculosis, Estimated Incidence, Prevalence, and Mortality by Country
JAMA, 1999; 282:677-686

National TB Program, Cambodia
Annual TB Report 2002
Phnom Penh, 2003

P.Y. Norval, Kong Kim San, Team Bakhim, Dy Narong Rith, D.I. Ahn, L.Blank
DOTS in Camboda
INT J TUBERC LUNG DIS 2(1): 44-51, 1998

P.Y. Norval. C. Roustit, K.K. San
From tuberculin to prevalence survey in Cambodia
INT J TUBERC LUNG DIS 8(3): 299-305, 2004

L.J. Nelson, C.D.Wells
Global epidemiology of childhood tuberculosis
INT J TUBERC LUNG DIS 8(5): 636-647, 2004

Y.P.Hong, S.J. Kim, W.J. Lew, Y.C. Han
The seventh nationwide tuberculosis prevalence survey in Korea, 1995
INT J TUBERC LUNG DIS 3(1): 27-36, 1998

Tropical Disease Foundation INC. Phillipines
Final Report, 1997 National Tuberculosis Prevalence Survey
5 December 1997

T.E. Tupasi, S.Radhakrishna, A.B.Rivera. et al
The 1997 Nationwide Tuberculosis Survey in the Philippines
INT J TUBERC LUNG DIS 3(6):471-477, 1999

The Ministry of Health of The People's Republic of China
Report on Nationwide Random Survey for the Epidemiology of Tuberculosis in 2000

China Tuberculosis Control Collaboration
The effect of tuberculosis control in China
Lancet 2004; 364:417-422

The Ministry of Health, Japan, Japan Anti-Tuberculosis Association
Reports on the tuberculosis prevalence survey in Japan I-VIII (for 1955-1973 surveys, in Japanese), 1957-1975, Japan Anti-TB Association, Tokyo

Masayoshi Yamaguchi, Harumiti Oka, Hideo Kumabe, Hikaru Yosano
Survey of Tuberculosis Prevalence in Japan, 1954
Bull. Wlth. Org. 1959.21, 145-159

"Kekkaku no Tokei 2003" (TB Statistics in Japan) in Japanese
Japan Anti-TB Association

K. Styblo, D. Dankova, J. Drapela, et al
Epidemiological and Clinical Study of Tuberculosis in the District of Kolin, Czechoslovakia, Report for the First 4 Years of the Study (1961-64)
Bull. Wld Hlth Org. 1967, 37, 819-874

AJ Plant, RE Watkins, N Motus et al
Result of tuberculosis screening in applicants for migration in Vietnam and Cambodia
Int J Tuberc Lung Dis. 2005 9 (2): 157-163

S.Saly, I.Onozaki, N.Ishikawa
Decentralized DOTS Shortens Patients' Delay Significantly in Cambodia
(To be published)

National Institute of Statistics, Ministry of Planning, Cambodia
Cambodia Inter-Census Population Survey 2004, General Report

UNAIDS
2004 report on the global HIV/AIDS epidemic: 4th global report

K. E. Khun, M.Tamura, B.H. Yuos, I. Onozaki, T.E. Mao
New TB screening service for people living with HIV/AIDS (PLWHA) in Phnom Penh, Presented at the 33rd World Conference on Lung Health
Int J Tuberc Lung Dis. 6(10): S174, 2002

M. Tamura, K.E.Khun, I.Onozaki, et al
More than one third of TB patients in Phnom Penh were HIV positive –result of national HIV/TB survey in Cambodia
XV International AIDS Conference, MoPeC3580, abstracts book vol1 136
(to be published as a national TB/HIV survey report)

M.E. Kimerling, J. Schuchter, E.Chanthol, T.Kunthy, F.Stuer, P.Glaziou, O.Ee
Prevalence of pulmonary tuberculosis among HIV-infected persons in a home care program in Phnom Penh, Cambodia
Int J Tuberc Lung Dis. 6(11): 988-994, 2002

The WHO/IUATLD Global Project on Anti-Tuberculosis Drug Resistance Surveillance
Anti-Tuberculosis Drug Resistance in the World, Report No.3
WHO/HTM/TB/2004.343

Table A-1: Survey result by cluster

Result of National TB Survey -Participation and Disease Prevalence-

			All age			Aged >= 10 yrs			TB prevalent cases aged >= 10 yrs					Crude Prevalance among attendance aged >= 10 (per 100,000)				
	District		Eligible pop	Attended		Eligible	Attended		S+ TB	S-/C+	Bac-**	Bac+	X-ray	S+	S-/C+	Bac-**	Bac+	X-ray
Cluster	Urban Rural	Access	No.	No	%	No	No	%	No	No	No	No	No					active TB
			(a)	(b)		(c)	(d)		(e)	(f)	(g)	(i)	(j)	(e)/(d)	(f)/(d)	(g)/(d)	((e)+(f))/(d)	((e)+(f)+(g))/(d)
01	U	n	739	729	98.6%	494	484	98.0%	2	4	6	6	12	413	826	1240	1240	2479
02	R	a	729	710	97.4%	510	494	96.9%	0	4	15	4	19	0	810	3036	810	3846
03	R	n	750	721	96.1%	560	538	96.1%	2	3	4	5	9	372	558	743	929	1673
04	R	n	782	775	99.1%	547	540	98.7%	6	15	13	21	34	1111	2778	2407	3889	6296
05	R	n	720	712	98.9%	505	497	98.4%	3	10	6	13	19	604	2012	1207	2616	3823
06	R	b	749	716	95.6%	516	484	93.8%	4	0	3	4	7	826	0	620	826	1446
07	R	a	732	714	97.5%	578	560	96.9%	0	3	6	3	9	0	536	1071	536	1607
08	R	n	765	762	99.6%	539	537	99.6%	4	7	8	11	19	745	1304	1490	2048	3538
09	R	n	722	705	97.6%	534	520	97.4%	3	11	11	14	25	577	2115	2115	2692	4808
10	R	a	709	695	98.0%	492	481	97.8%	1	5	10	6	16	208	1040	2079	1247	3326
11	U	a	737	720	97.7%	593	577	97.3%	2	6	12	8	20	347	1040	2080	1386	3466
12	R	b	738	721	97.7%	546	529	96.9%	4	8	5	12	17	756	1512	945	2268	3214
13	U	a	742	718	96.8%	591	569	96.3%	0	5	11	5	16	0	879	1933	879	2812
14	R	a	757	727	96.0%	604	578	95.7%	2	5	4	7	11	346	865	692	1211	1903
15	R	a	802	777	96.9%	574	552	96.2%	2	4	2	6	8	362	725	362	1087	1449
16	U	n	726	719	99.0%	523	517	98.9%	1	0	2	1	3	193	0	387	193	580
17	R	n	721	700	97.1%	559	539	96.4%	2	8	7	10	17	371	1484	1299	1855	3154
18	R	n	713	700	98.2%	573	561	97.9%	3	4	12	7	19	535	713	2139	1248	3387
19	R	n	701	688	98.1%	509	498	97.8%	0	6	4	6	10	0	1205	803	1205	2008
20	R	b	731	718	98.2%	507	496	97.8%	0	1	1	1	2	0	202	202	202	403
21	R	a	719	710	98.7%	534	525	98.3%	2	4	8	6	14	381	762	1524	1143	2667
22	R	n	716	686	95.8%	490	469	95.7%	0	2	4	2	6	0	426	853	426	1279
23	R	n	718	676	94.2%	517	478	92.5%	2	3	4	5	9	418	628	837	1046	1883
24	R	b	720	704	97.8%	544	530	97.4%	1	3	9	4	13	189	566	1698	755	2453
25	R	a	734	724	98.6%	521	513	98.5%	1	12	3	13	16	195	2339	585	2534	3119
26	R	n	728	719	98.8%	524	515	98.3%	0	6	4	6	10	0	1165	777	1165	1942
27	R	n	738	726	98.4%	540	528	97.8%	2	3	10	5	15	379	568	1894	947	2841
28	R	b	727	713	98.1%	579	565	97.6%	1	4	10	5	15	177	708	1770	885	2655
29	R	n	740	719	97.2%	534	519	97.2%	3	0	4	3	7	578	0	771	578	1349
30	R	n	740	735	99.3%	564	559	99.1%	4	7	19	11	30	716	1252	3399	1968	5367
31	R	b	750	743	99.1%	565	558	98.8%	0	4	9	4	13	0	717	1613	717	2330
32	R	n	758	744	98.2%	498	488	98.0%	2	1	0	3	3	410	205	0	615	615
33	R	b	754	742	98.4%	557	547	98.2%	3	3	11	6	17	548	548	2011	1097	3108
34	R	b	720	703	97.6%	537	523	97.4%	4	3	7	7	14	765	574	1338	1338	2677
35	R	a	743	729	98.1%	558	546	97.8%	2	8	10	10	20	366	1465	1832	1832	3663
36	U	a	749	731	97.6%	561	546	97.3%	5	3	6	8	14	916	549	1099	1465	2564
37	R	b	782	773	98.8%	587	578	98.5%	2	6	9	8	17	346	1038	1557	1384	2941
38	R	a	739	728	98.5%	533	522	97.9%	1	2	3	3	6	192	383	575	575	1149
39	U	a	747	595	79.7%	650	509	78.3%	0	3	3	3	6	0	589	589	589	1179
40	U	a	750	569	75.9%	651	481	73.9%	2	2	1	4	5	416	416	208	832	1040
41	R	a	740	730	98.6%	554	544	98.2%	2	0	24	2	26	368	0	4412	368	4779
42	R	b	773	706	91.3%	632	566	89.6%	1	2	9	3	12	177	353	1590	530	2120
Total			31050	30032	96.7%	23084	22160	96.0%	81	190	309	271	580	366	857	1394	1223	2617
Avg			739.3	715.0	96.7%	549.6	527.6	96.2%	1.9	4.5	7.4	6.5	13.8	364	854	1376	1218	2594

*Access to DOTS facility: a:<5km ; b 5-10km ; n:>10km

**active TB suspeced by X-ray

Table A-2: TB prevalence by age and sex

Crude Prevalence of TB by age and sex

Total	No. Participants	Number of TB Cases					Prevalence per 100,000				
Age group		Smear +	S-C+	S-C-X+	Bac +	Active Pul	Smear +	S-C+	S-C-	Bac +	Active Pul
10-14	4,519	3	1	22	4	26	66	22	487	89	575
15-24	6,055	8	11	19	19	38	132	182	314	314	628
25-34	3,645	11	23	29	34	63	302	631	796	933	1728
35-44	3,201	15	33	55	48	103	469	1031	1718	1500	3218
45-54	2,199	14	32	54	46	100	637	1455	2456	2092	4548
55-64	1,312	11	35	77	46	123	838	2668	5869	3506	9375
65+	1,229	19	55	53	74	127	1546	4475	4312	6021	10334
Total	22,160	81	190	309	271	580	366	857	1394	1223	2617

Male		Number of TB Cases					Prevalence per 100,000				
Age group		Smear +	S-C+	S-C-X+	Bac +	Active Pul	Smear +	S-C+	S-C-	Bac +	Active Pul
10-14	2,274	1	1	11	2	13	44	44	484	88	572
15-24	2,998	6	8	11	14	25	200	267	367	467	834
25-34	1,619	8	13	12	21	33	494	803	741	1297	2038
35-44	1,377	9	15	28	24	52	654	1089	2033	1743	3776
45-54	876	11	17	28	28	56	1256	1941	3196	3196	6393
55-64	544	7	17	41	24	65	1287	3125	7537	4412	11949
65+	469	14	26	29	40	69	2985	5544	6183	8529	14712
Total	10,157	56	97	160	153	313	551	955	1575	1506	3082

Female		Number of TB Cases					Prevalence per 100,000				
Age group		Smear +	S-C+	S-C-X+	Bac +	Active Pul	Smear +	S-C+	S-C-	Bac +	Active Pul
10-14	2,245	2	0	11	2	13	89	0	490	89	579
15-24	3,057	2	3	8	5	13	65	98	262	164	425
25-34	2,026	3	10	17	13	30	148	494	839	642	1481
35-44	1,824	6	18	27	24	51	329	987	1480	1316	2796
45-54	1,323	3	15	26	18	44	227	1134	1965	1361	3326
55-64	768	4	18	36	22	58	521	2344	4688	2865	7552
65+	760	5	29	24	34	58	658	3816	3158	4474	7632
Total	12,003	25	93	149	118	267	208	775	1241	983	2224

Table A-3: Tuberculin skin test results by age group and BCG scar status

Tuberculins Skin Test Results by Age Group and BCG Scar Status

	Aged 1-4 years BCG Scar Status					Aged 5-9 years BCG Scar Status					Aged 10-14 BCG Scar Status			
Size (mm)	Yes	No	Unknown	Total	Size (mm)	Yes	No	Unknown	Total	Size (mm)	Yes	No	Unknown	Total
0	903	672	0	1,575	0	742	1,029	1	1,772	0	352	660	3	1,015
1	20	17	0	37	1	7	18	0	25	1	2	9	0	11
2	107	77	0	184	2	82	98	0	180	2	44	53	0	97
3	151	63	0	214	3	129	135	0	264	3	65	98	0	163
4	117	48	0	165	4	163	143	0	306	4	104	150	0	254
5	107	29	0	136	5	138	129	0	267	5	112	130	2	244
6	76	19	0	95	6	117	93	0	210	6	95	157	0	252
7	72	15	0	87	7	145	111	0	256	7	139	172	0	311
8	84	19	0	103	8	123	109	0	232	8	147	150	0	297
9	47	9	0	56	9	101	82	0	183	9	108	154	1	263
10	37	5	0	42	10	79	77	1	157	10	105	134	1	240
11	21	5	0	26	11	68	33	0	101	11	71	91	0	162
12	20	4	0	24	12	77	39	0	116	12	121	120	0	241
13	16	2	0	18	13	63	39	0	102	13	97	104	0	201
14	12	0	0	12	14	36	29	0	65	14	71	89	0	160
15	4	5	0	9	15	27	21	0	48	15	57	73	0	130
16	2	0	0	2	16	22	18	0	40	16	45	57	0	102
17	5	1	0	6	17	20	12	0	32	17	41	46	0	87
18	7	1	0	8	18	18	17	0	35	18	40	47	0	87
19	3	1	0	4	19	15	8	0	23	19	28	31	0	59
20	2	1	0	3	20	10	6	0	16	20	15	20	0	35
21	0	0	0	0	21	1	6	0	7	21	10	13	0	23
22	0	1	0	1	22	2	8	0	10	22	4	7	0	11
23	2	0	0	2	23	2	0	0	2	23	4	8	0	12
24	0	0	0	0	24	2	2	0	4	24	0	4	0	4
25	0	0	0	0	25	0	1	0	1	25	4	0	0	4
26	0	1	0	1	26	0	0	0	0	26	0	0	0	0
27	0	0	0	0	27	0	0	0	0	27	0	0	0	0
28	0	0	0	0	28	0	0	0	0	28	0	0	0	0
29	0	0	0	0	29	1	0	0	1	29	0	0	0	0
Total	1,815	995	0	2,810	Total	2,190	2,263	2	4,455	Total	1,881	2,577	7	4,465
No Results	11	6	17	34	.	7	10	10	27	.	20	11	23	54
TOTAL	1,826	1,001	17	2,844		2,197	2,273	12	4,482		1,901	2,588	30	4,519

Prportion of Size >= 10 among Children without BCG scar (excluding Unknown)

	Age 1-4yr	5-9 yr	10-14 yr
No. tested	995	2,263	2,577
>= 10mm	27	316	844
Proportion	2.71%	13.96%	32.75%

Figure A-1: Map of the survey sites

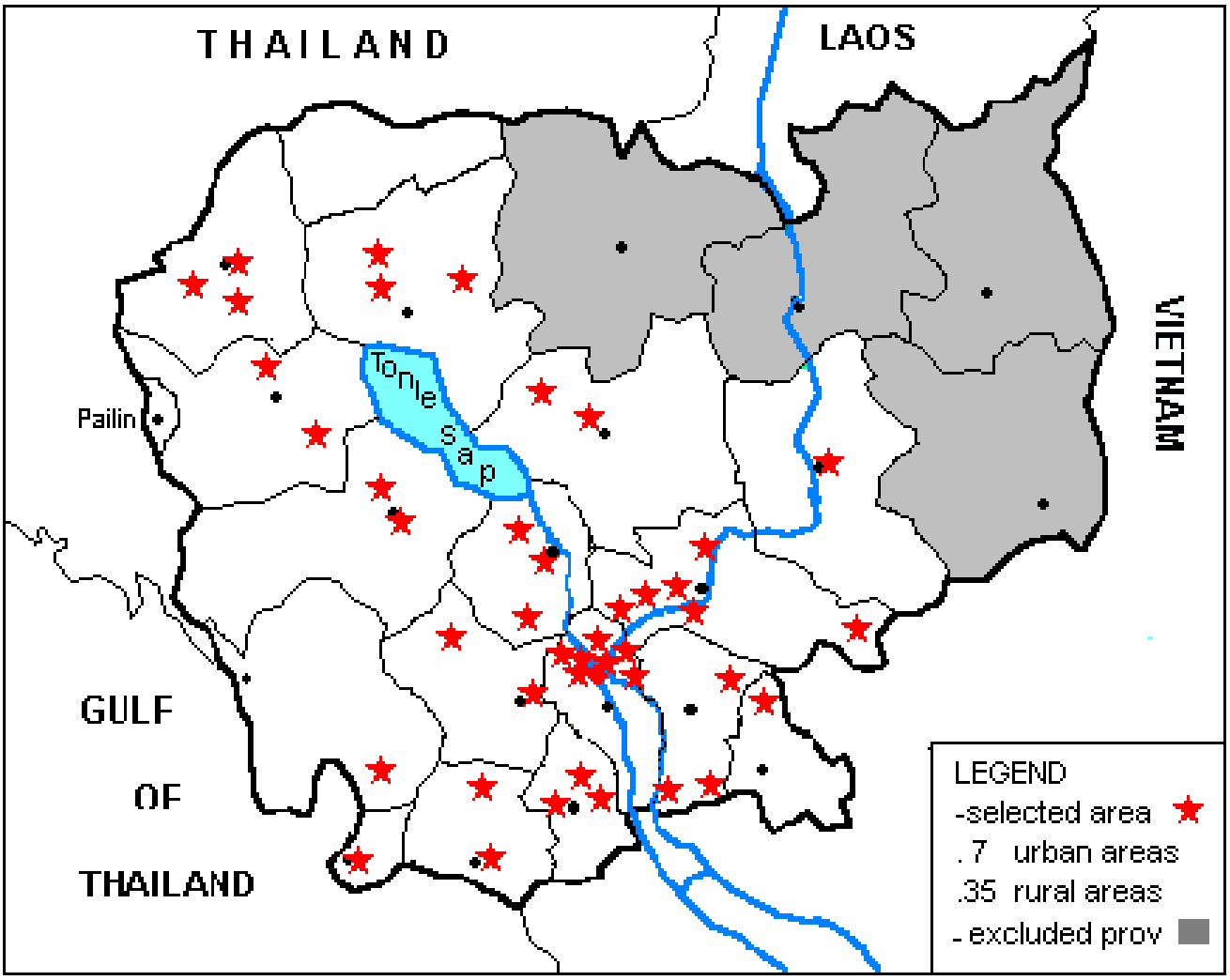


Figure A-2: Result of HIV sero-prevalence survey among TB patients, 2003

HIV prevalence among TB patients by sex, age group, TB site, treatment category, and nationality

		Total	HIV(+)	%	95% CI
By sex	Male	1189	161	13.5	11.7 - 15.6
	Female	1155	104	9.9	8.2 - 11.9
	Total	**2244**	**265**	**11.8**	**10.5 - 13.2**
Age Group	0-14	60	9	15.0	7.1 - 26.6
	15-24	216	21	9.7	6.1 - 14.5
	25-34	346	94	27.2	22.6 - 32.2
	35-44	503	85	16.9	13.8 - 20.5
	45-54	438	25	5.7	3.8 - 8.4
	55-64	402	19	4.7	2.9 - 7.4
	>=65	279	12	4.3	2.2 - 7.4
	TOTAL	**2244**	**265**	**11.8**	**10.5 - 13.2**
TB Site	Sm(+)PTB	1644	140	8.5	7.2 - 10.0
	Sm(-)PTB	306	67	21.9	17.5 - 27.0
	EPTB	294	58	19.7	15.3 - 24.7
	TOTAL	**2244**	**265**	**11.8**	**10.5- 13.2**
Treatment Category	Sm(+)PTB	1644	140	8.5	7.2 - 10.0
	Sm(-)PTB	306	67	21.9	17.5 - 27.0
	EPTB	294	58	19.7	15.3 - 24.7
	TOTAL	**2244**	**265**	**11.8**	**10.5- 13.2**
Nationality	Cambodian	2221	255	11.5	10.2 - 12.9
	non Cambodian	23	10	43.5	23.2 - 65.5
	TOTAL	**2244**	**265**	**11.8**	**10.5- 13.2**

HIV prevalence among TB patients by provinces and registration site

	Province	TOTAL	HIV(+)	%	95%CI
Province	Kandal	154	15	9.7	5.6 - 15.6
	Svay Rieng	164	6	3.7	1.4 - 7.8
	Phnom Penh	289	99	34.3	28.8 - 40.0
	Pursat	72	4	5.6	1.5 - 13.6
	Battam Bang	106	14	13.2	7.4 - 21.2
	Pailin	6	2	33.3	4.3 - 77.7
	B. Meanchey	86	10	11.6	5.7 -20.3
	Siem Reap	216	27	12.5	8.4 - 17.7
	Oudor Meanche	31	4	12.9	3.6 - 29.8
	Kg Thom	115	2	1.7	0.2- 6.1
	Takeo	137	9	6.6	3.0 - 12.1
	Kg Speu	105	4	3.8	1.0 - 9.5
	Kampot	77	6	7.8	2.9 - 16.2
	Krong Kep	4	1	25.0	0.6 - 80.6
	Kg Som	33	11	33.3	18.0 - 51.8
	Koh Kong	20	4	20.0	5.7 - 43.7
	Prey Veng	211	22	10.4	6.7- 15.4
	Kg Chnnang	109	6	5.5	2.0 - 11.6
	Kratie	46	5	10.9	3.6 - 23.6
	Kg Cham	205	11	5.4	2.7- 9.4
	Stung Treng	15	1	6.7	0.2 - 31.9
	Preah Vihear	27	1	3.7	0.1- 19.0
	Mondul Kiri	6	0	0.0	0
	Rattanakiri	10	1	10.0	0.3- 44.5
	TOTAL	**2244**	**265**	**11.8**	**10.5- 13.2**
Registration site	Provincial Capital	930	100	10.8	8.9 - 13.0
	Non-provincial Capital	1025	66	6.4	5.0 - 8.2
	Phnom Penh	289	99	34.3	28.8 - 40.0
	TOTAL	**2244**	**265**	**11.8**	**10.5- 13.2**

Table A-4: NTP case detection

Number of TB Cases Registered under NTP from 1994 to 2004

Year	Smear (+)			Smear (-)	Extra PTB	Total
	New	Relapse	Sub-total			
1994	11,058	540	11,598	2,195	1,319	15,112
1995	11,150	605	11,755	1,575	1,501	14,831
1996	12,065	607	12,672	708	1,477	14,857
1997	12,686	634	13,320	721	1,588	15,629
1998	13,865	705	14,570	705	1,671	16,946
1999	15,744	792	16,536	725	2,005	19,266
2000	14,826	814	15,640	1,108	2,144	18,892
2001	14,361	721	15,082	1,658	2,430	19,170
2002	17,258	789	18,047	2,852	3,711	24,610
2003	18,923	754	19,677	4,307	4,232	28,216
2004	18,978	645	19,623	5,800	5,415	30,838

Case Registration Rate under NTP from 1994 to 2004

Year	Population x 1,000	New Smear (+) and Relapse Cases	New Smear (+) and Relapse/10^5 Population	All New Cases	All New Cases/10^5 Population
1994	9,700	11,598	119.6	15,112	155.8
1995	9,950	11,755	118.1	14,831	149.1
1996	10,200	12,672	124.2	14,857	145.7
1997	10,700	13,320	124.5	15,629	146.1
1998	11,437	14,570	127	16,946	148
1999	11,722	16,536	141	19,266	164
2000	12,014	15,640	130	18,892	157
2001	12,313	15,082	122	19,170	156
2002	12,620	18,047	143	24,610	195
2003	13,287	19,677	148	28,216	212
2004	13,500	19,623	145	30,838	228

(Source: CENAT)

Table A-5: NTP treatment result

Cohort Analysis of Smear (+) Cases Treated with CAT1, CAT2 and Smear (-) / EP Cases Treated with CAT3 Registered from 1994 to 2003.

Year /Cat	Evaluated	Cured (%)	Completed (%)	Failure (%)	Died (%)	Default (%)	Tr. Out (%)
1994 Cat.1 Cat.2 Cat3	 New Relapse Others	 85% 75% 33%	 6% 13% 48% 88%	 1% 3% 3% 0%	 2% 5% 6% 4%	 4% 2% 3% 5%	 1% 2% 3% 3%
1995 Cat.1 Cat.2 Cat.3	 New Relapse Others	 89% 75% 46%	 4% 13% 37% 92%	 1% 3% 2% 0%	 2% 5% 8% 4%	 3% 2% 3% 2%	 1% 2% 4% 2%
1996 Cat.1 Cat.2 Cat.3	 New: 9,111 Relapse: 625 Others: 338 798	 8,139 (89%) 548 (88%) 168 (50%)	 403 (5%) 26 (4%) 110 (33%) 741 (93%)	 63 (1%) 4 (1%) 7 (2%) 0 (0%)	 217 (3%) 23 (4%) 24 (7%) 31 (4%)	 227 (3%) 21 (3%) 18 (5%) 12 (2%)	 63 (1%) 3 (0%) 13 (4%) 14 (2%)
1997 Cat.1 Cat.2 Cat3	 New: 11,329 Relapse: 589 Others: 147 917	 10,088(89%) 520 (88%) 98 (67%)	 534 (4.7%) 28 (5%))) 18 (12%) 864 (94%)	 48 (0.4%) 8 (1%) 10 (7%) 0 (0%)	 258 (2.3%) 19 (1%) 10 (7%) 31 (3%)	 292 (2.6%) 12 (2%) 6 (4%) 14 (2%)	 87 (0.8%) 2 (0%) 6 (4%) 8 (1%)
1998 Cat.1 Cat.2 Cat.3	 New: 13,287 Relapse: 689 Others: 133 893	 12,166 (92%) 613 (89%) 111 (83%)	 402 (3%)) 19 (3%) 11 (8%) 853 (96%)	 49 (0%) 8 (1%) 6 (5%) 0 (0%)	 311(2%) 27 (4%) 11 (8%) 19 (2%)	 290 (2%) 24 (3%) 6 (5%) 8 (1%)	 72 (1%) 0 (0%) 1 (1%) 13 (1%)
1999 Cat.1 Cat.2 Cat.3	 New: 15,700 Relapse: 778 Other: 85 768	 14,236(90.70%) 685 (88%) 66 (78%)	 433 (2.76%) 25 (3%) 3 (4%) 739 (96.2%)	 64 (0.40%) 9 (1%) 0 (0%) 1 (0.13%)	 411 (2.6%) 29 (4%) 8 (9%) 17 (2.2%)	 469 (3%) 22 (3%) 7 (8%) 9 (1.17%)	 83 (0.52%) 8 (1%) 1 (1%) 2 (0.26%)
2000 Cat.1 Cat.2 Cat.3	 New:14,775 Relapse:827 Other:: 104 1497	 12,974 (88%) 706 (85%) 77 (74%)	 523 (3.5%) 37 (4%) 5 (5%) 1372 (92%)	 45 (0%) 6 (1%) 6 (6%) 1 (0%)	 528 (3.5%) 46 (6%) 11 (11%) 56 (4%)	 582 (4%) 30 (4%) 4 (4%) 41 (3%)	 123 (1%) 2 (0) 1 (1%) 27 (2%)
2001 Cat.1 Cat.2 Cat.3	 New:14,277 Relapse:707 Other:: 90 1,276	 12,746 (89%) 618 (87%) 61 (68%)	 364 (3%) 30 (4%) 4 (4%) 1,173 (92%)	 58 (0%) 9 (1%) 6 (7%) 1 (0%)	 578 (4%) 32 (5%) 11 (12%) 46 (4%)	 408 (3%) 12 (2%) 8 (9%) 39 (3%)	 123 (1%) 6 (1) 1 (1%) 17 (1%)
2002 Cat.1 Cat.2 Cat.3	 New: 17,396 Relapse:807 Other: 68 1,445	 15,551 (89%) 710 (88%) 42 (62%)	 519 (3%) 22 (3%) 3 (4%) 1,332 (92%)	 59 (0%) 9 (1%) 4 (6%) 0 (0%)	 661 (4%) 42 (5%) 9 (13%) 52 (4%)	 419 (2%) 18 (2%) 6 (9%) 35 (2%)	 187 (1%) 6 (1) 4 (6%) 26 (2%)
2003 Cat.1 Cat.2 Cat.3	 New: 19,098 Relapse:732 Other: 89 1,317	 17,226 (90%) 630 (86%) 36 (40%)	 495 (3%) 22 (3%) 30 (34%) 1,227 (93%)	 45 (0%) 16 (2%) 8 (9%) 1 (0%)	 665 (3%) 38 (5%) 10 (11%) 35 (3 %)	 404 (2%) 16 (2%) 4 (4 %) 34 (3 %)	 263 (1%) 10 (1%) 1 (1%) 20 (2%)

Table A-6: Result of Delay Study

Delays in treatment among tuberculosis patients in the districts, where DOTS is decentralized through the Health Centers (HC-DOTS), and the districts, where DOTS is provided through hospitals (Hospital DOTS)

	HC-DOTS (n=112)		Hospital DOTS (n=196)	
	Median days	Mean days	Median days	Mean days
Patients' delay	33	76	218	318
First contact delay	5	18	5	57
Subsequent contact delay	24	65	185	291
Doctors' delay	10	19	6	11
Total delay	58	95	232	330

*P<0.001 (Mann Whitney U)

- Source: Saly Saint et Al. (2002, Cambodia): Decentralized DOTS Shortens Delay to TB Treatment Significantly in CAMBODIA

Kingdom of Cambodia

Nation Religion King

Ministry of Health

National Center for Tuberculosis and Leprosy Control

National Tuberculosis Prevalence Survey

Household Register (Form-1)

Cluster # : [ ] [ ] Village: .....Group .....

Commune .....District .....Province ….....

Filled by .....

Serial No	Code *	Name	Present **	Age		Date of Birth	Occupation	Other
				M	F			
1	_ _ _ _ _ _							
2	_ _ _ _ _ _							
3	_ _ _ _ _ _							
4	_ _ _ _ _ _							
5	_ _ _ _ _ _							
6	_ _ _ _ _ _							
7	_ _ _ _ _ _							
8	_ _ _ _ _ _							
9	_ _ _ _ _ _							
10	_ _ _ _ _ _							
11	_ _ _ _ _ _							
12	_ _ _ _ _ _							
13	_ _ _ _ _ _							
14	_ _ _ _ _ _							
15	_ _ _ _ _ _							

* Code number consist of 7 digits

The first 2 digits : stand for cluster number, which range from 01 to 42

The next 3 digits : stand for the house number where participants live in

The last 2 digits : stand for number of individual participant

** Tick (?) on the proper row to indicate the people who participated

Kingdom of Cambodia

Ministry of Heath
Nation Religion King

National Center for Tuberculosis and Leprosy Control
The National TB Prevalence Survey

INDIVIDIAL SURVEY CARD (FORM-2)

Cluster No: [ ] [ ] Village: Group:
Commune: District: Province:

Filled by: .....

(1)House Number	(2) Code	(3)Name	(4)Sex	(5)Age	(6) Occupation
_ _ _	_ _ _ _ _ _ _				

(7) TB Treatment History

1.No ☐
2.Yes
- In the past…….. ☐
- Present ……. ☐

Treatment Facility

1 Public Hospital ☐
2.Health Center ☐
3.Private Clinic ☐
4.Phamacy ☐
5. Traditional Healer ☐
6. Other..... ☐

(8) Symptom and Duration (Last 1 Month)

	Yes	No
1. Cough	……days	☐
2. Sputum	……days	☐
3. Sputum with blood	……days	☐
4. Chest pain	……days	☐
5. Lost weight	……days	☐
6. Fatigue	……days	☐
7. Fever	……days	☐
8. Sweat at night	……days	☐
9.Other	……days	☐

Recommendation: TB Suspect ☐

(9) Behavior toward Symptom

1. Ignore ☐
2. Treat by themselves ☐
3. Consultation ☐
   3.1. Public Hospital ☐
   3.2. Health Center ☐
   3.3. Private Clinic ☐
   3.4. Pharmacy ☐
   3.5. Traditional Healer ☐
   3.6. By Relative ☐

(10) TST ☐

1.Yes ☐ No ☐

2.Test Date
...../...../.....

3.Measurement Date
...../...../.....

4. Induration
…….....mm

(11)BCG

1.BCG Scar
Yes ☐ No ☐

2. Number of Scar…....
3. Scar Aspect
   3.1. small ☐
   3.2. medium ☐
   3.3. big ☐
   3.4. keloid ☐

(12) X-ray

1. Film No….....
2. Result*
   2.1. Normal ☐
   2.2. TB active ☐
   2.3. TB suspect ☐
   2.4. TB cured ☐
   2.5. Lung Disease ☐
   2.6. Heart Disease ☐
   2.7. Other..... ☐
3.Ask for sputum collection
(Group leader) ☐

(13) Laboratory

1.Smear Collection Date:
D1:...../...../.....
D2:...../...../.....
2.Result
2.1. By microscope:
D1: Positive ☐ Negative ☐
D2: Positive ☐ Negative ☐
2.2. By culture

	Positive	Negative	Conta	Niacine
D1:	[ ]	[ ]	[ ]	[ ]
D2:	[ ]	[ ]	[ ]	[ ]

*2.2, 2.3, 2.4, 2.5 must be identified more by smear checking

Kingdom of Cambodia
Nation Region King

Ministry of Health
National Tuberculosis and Leprosy Control Program
Tuberculosis Prevalence Survey

Summary Report

Village Name: ……..... Cluster Number: [ ] [ ]
Commune: …….. District: ……. Province: ……...
Date of Research: From……../……./…….. To ……./……./…….

Census Activities:
- Number of houses ……
- Number of People registered in the Detection Book: ……
  - Number of people cough more 21 days ……...

Tuberculin Skin Test Activities:
- Number of children registered in Tuberculin test book: ……...
- Number of tested children ……..
- Number of measured children ……..

Radiology Activities:
- # of people to take CXR ……...
- # of Taken-CXR people ……
- # of No chest X-ray people ……...
- # of Abnormal chest X-ray and TB suspect ……

Laboratory Activities:
- # of people asked for sputum ……
- # of people collected sputum ……...
- # of people collected sputum in D2 ……

TB patients:
- TB patients in last year and present ……

Other:……
……
……

Date: ……../……./2002
leader of research team
(Name and Signature)

List of members, participants including partner agencies

Members of committees

A-Executive Committee:

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2-Dr. Touch	Sareth	Vice-chairman
3-Dr. Team	Bak Khim	Member
4-Dr. Keo	Sokonth	Member
5-Dr. Khun	SaoRith	Member
6-Dr. Kae	Sinet	Member
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3-Mrs. Phang	Mom	Member
4-Mr. Phan	Phum	Member

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6-Mrs. Prak	Sokunthea	Member
7-Mr. Yang	SamOl	Member

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Survey Photos

1. Work plan was carefully made in each cluster village: Collaboration of local community was essential

2. Census activity of Day 1 to confirm eligible subjects and to ask participation.

3 & 4. Each eligible household was labeled; even it didn't have a real house.

5. Typical survey site setting borrowing a village chief house

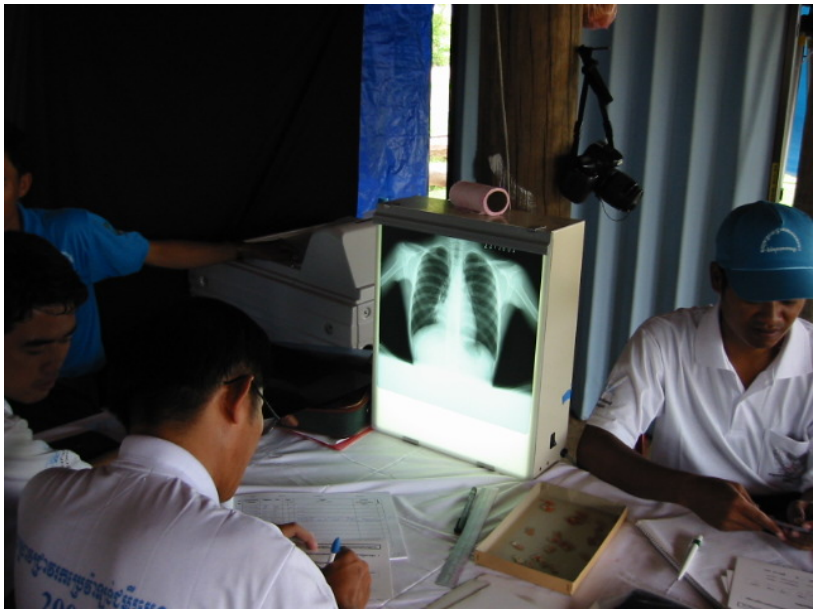
6. Family by family interview to identify individual TB treatment history and current health status was carried out by an experienced physician or medical assistant.

7. X-ray car donated by Japan Anti-TB Association was used in urban and semi-urban cluster villages.

8. Portable X-ray kit was easily installed and transported by a common pick up car

9. Films were developed with the auto-processor on the spot

10. Quality films were available and they were read on the spot to identify TB suspects.



11. Children were given tuberculin test

12. Sputum samples were collected from TB suspects and stored in a cooler box with ice to transport to National TB Lab within 3 days

13. Several experts meetings were held to discuss the survey findings

14. Group photo in time of launching ceremony

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