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Tuberculosis and its Control in Indonesia

by

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Abstract

Based on a tuberculosis prevalence survey with the assistance of WHO in 1962 - 1965 in the areas Jogjakarta and Malang where were found a prevalence of tuberculin sensitivity of 40,6% at the age 10 - 14 years, a prevalence of bacteriologically confirmed cases of 0,6% and those with pulmonary shadows 3,6%, a workshop in Ciloto was hold (january 1969), with the following results :

- a. BCG vaccination without prior tuberculin test to children of 0-14 years of age.
- b. Case finding and treatment to those with sputum "afb" positive.
- c. Health education to the people.

In Pelita I priority was given to BCG vaccination with a target of 55 million of which a 75% coverage will be expected particularly in Java and Bali.

For Pelita II BCG vaccination policy will be changed. To achieve a more realistic target and to have the most susceptible (high risk) ages vaccinated, every child should have a recent BCG vaccination before entering puberty and to vaccinate children early in life, 0-1 year. Only primary vaccination will be done during Pelita II while revaccination will be performed in Pelita III. As performers will be the smallpox vaccinators in a simultaneous vaccination programme with other vaccines.

Case finding and treatment, and Health education will be improved in Pelita II because the health infra structure (organization) and community participation was below expectation in Pelita I; it will be integrated into the existig health activities. Treatment will only be given to patients with bacteriologically confirmed sputum, and free of charge.

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1. History of Tuberculosis

Tuberculosis is not a disease of recent data. The first discovery was made in Egypt as tuberculosis of the spinal column of an ancient Egyptian mummy who lived thousands of years B.C. It turned out that this disease was not only limited to Egypt, but was also found in other continents, e.g. in remaining skeletons of prehistoric men (Indians) in America, Europe and Asia, as well as in Indonesia. At the Borobudur temple built in the beginning of the 8th century, a relief was found showing a man with specific signs of tuberculosis.

With the increasing and improved conditions of the communication system in Indonesia, it is understandable that the disease is consequently spread throughout the country; even the natives living in the highlands of Irian Jaya (Jaya Wijaya Mountains), who were considered free from tuberculosis for many years, now show several cases of this disease among them.

2. Pathogenesis of Tuberculosis

In the beginning tuberculosis was not considered as a contagious disease, and even Hippocrates himself thought it to be a hereditary disease: "A phthisis patient is born as a phthisicus" he said. But his observation was precisely when he found that most people of the 18 - 35 years age group, now known as the pro-

ductive age group, suffered from this disease.

It was just later on that Aristoteles came to the conclusion that phthisis was caused through getting into contact with a tuberculosis patient. Galenus in particular stated that tuberculosis was a contagious disease. And years thereafter several famous names such as Girolamo Fracastoro (1546), Pierre Desault (1650) and Pierre Zacchias (1733) supported this theory of contagiousness; Desault even considered that transmission took place by means of sputum. But there was also the famous Laennec (1819) in France, who said that tuberculosis was a hereditary disease. And fate has ordained otherwise, that while performing an autopsy on a tuberculosis patient in 1809, he became contaminated and got a tubercle on his left forefinger, so that twenty years later he died from lung tuberculosis.

After Robert Koch (1882) had found the tubercle bacilli and his well-known postulates, tuberculosis proved to be a contagious disease.

The mycobacterium tuberculosis is a rodlike bacillus, sometimes a little crooked, 2 - 4 micron in length and 0.3 - 1.5 micron in diameter. These are the sizes of the human type, whereas the bovine type is rather short and bigger in diameter. One of the characteristics of mycobacterium is the difficulty of sta-

ining, but once stained it does not lose its staining easily even in an acid solution; hence the name of "acid fast bacilli".

How does the Tb bacillus enter the human body, especially the lungs? There are several ways, for instance through skin lesions or intestines, but usually through the airways into the lungs.

The transmission takes place by inhaling bacilli-containing-air, so it is called an "air-born" disease. Patients with open tuberculosis may spread the bacilli by coughing, sneezing and also by speaking. Sputum droplets containing the bacilli can float in the air for some period; the smallest ones with the bacillus can be inhaled directly by another human being. A large number will drop on the ground, bed-cover, clothes, etc. where they become dry. The bacilli can withstand this desiccation and with dust they can be blown and circulated by the wind and can be inhaled by people in the surrounding area. A large number of the tubercle bacilli that enter the human body will stick to the mucous membrane of the respiratory tract and by means of the ciliae of the mucous membrane they will be thrown out again. The more bacilli enter the human body the greater the chance they pass through the respiratory tract and finally get into the alveoli to stay there.

The structure of the alveoli is different from that of the respiratory tract, its cells are very thin and not covered by mucus, thus simplifying the entrance of oxygen into the capillaries lining the walls of the alveoli. After the bacillus has arrived in the alveoli, it can be considered as having entered the human body. They multiply in the tissue and destroy it. The reaction of the human body to this local destruction is called inflammation, and consequently it is considered that the human body has been infected by the bacilli. Another mode of infection is through the intestinal tract (enteral), but this is quite rare. It is usually very hard to penetrate the intestinal mucous membrane, except at the end of the small intestine (ileum), where penetration may occur. So it is important to give special attention to the patients working in kitchens or in restaurants. Infection is also possible through non-intact skin, as we know from the case of Laennec mentioned above. It has happened that a newborn was infected, but this is very rare. Apparently the bacilli were able to penetrate the placenta and entered the body of the infant. The most common way of infection with tuberculosis is the aerogenic way through the respiratory tract.

Healthy persons could be present in an area full of the bacilli, never-

theless only a few of them might get infected. Even if the bacilli could make their way into the alveoli, the human body is capable of eliminating the bacilli with its own defense system. So not all persons, who are infected, will become the patients.

Let us follow what will happen if a tbc bacillus settles in the alveole. The bacilli will multiply every 20 hours; in the beginning there will be no reaction of the human body. After 2 weeks the human body will start reacting, meanwhile the tbc bacillus has multiplied itself from one into less than 100.000 bacilli. Though it is a critical number, the bacilli can still be easily destroyed.

The question now arises why some people become ill and others do not? This is possible if multiplication takes place at a higher rate, for instance in less than 20 hours, or if the human body reacts slowly (longer than 2 weeks), so that the number of bacilli could exceed 100.000 and results in further destruction, then the person becomes ill.

The break-down of an infected person depends on:

- multiplication time of the tbc bacillus;
- reaction time of the human body;
- the number of invading tbc bacilli that reach the alveoli.

This situation occurs in a person who has never been infected by tbc

bacilli. On the other hand, the human body that has ever been infected earlier, might not become ill, or, an already sensitized body (by BCG vaccination) will show a faster reaction.

What will happen if the tbc bacillus wins? It will multiply further and an infection takes place, followed by caseous changes of the infected area. These caseous changes are specific for tuberculosis infection. It is seen at the place of the first invasion and is called the primary affect. This is followed by an infection of the regional lymphglands. Primary affect with enlargement of its regional lymphglands is called the primary complex, and it is usually seen in children. This primary complex may heal by itself with calcification of the caseous tissue. This type of disease is called primary tuberculosis. There is also a secondary lung tuberculosis as an endogenous reactivation after the primary tuberculosis is healed. An exogenous reinfection is also known, but rare.

If no healing of the primary or the secondary tuberculosis occurs, the disease will become worse. The caseous tissue will soften and liquefy, and as a corpus alienum it will be excreted by the body leaving a cavity in its place. The caseous material is full of bacilli, and therefore very dangerous for the surroundings. These patients with cavities are the main sources of infection.

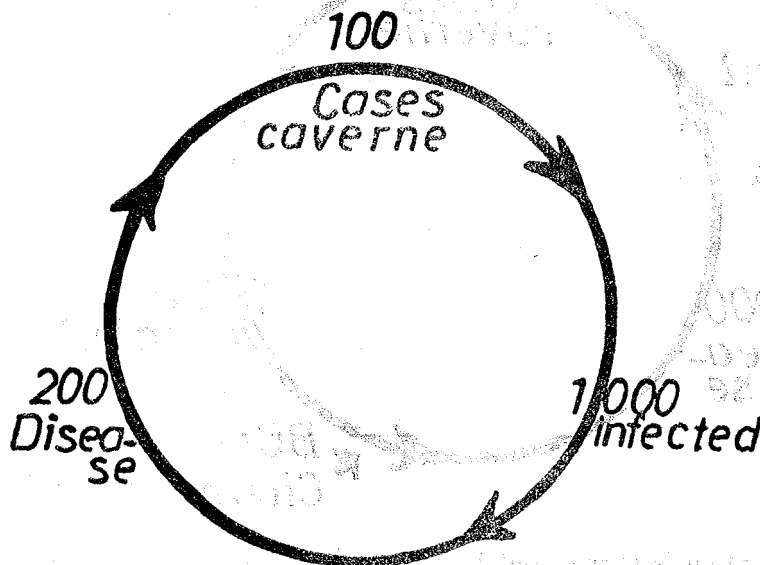
Within an infiltrate with a diameter of 1 cm there are about 6000 - 7000 tbc bacilli, but in cavities of the same diameter we can find hundreds of millions; the maximum amount of bacilli found in a cavity is 800 million. Patients with such an extensive process of the disease will look for help. They come with complaints of chronic cough, sometimes with blood in their sputum; dyspnea, pain in the chest, slight fever, weight loss, loss

of appetite, night perspiration and loss of energy.

3. The epidemiology of tuberculosis in Indonesia

The epidemiology of tuberculosis is the study of all events that arise after contact of the tbc bacillus with the community in natural conditions, as well as after application of control measures.

Fig. 1.



Model of the epidemiology of tuberculosis with or without therapeutic intervention:

If at a specific moment there are 100 patients with cavities (infectious cases), they will infect 1000 healthy persons within 2 years time; if without intervention, of these infected

persons only 200 became ill and one half of them (i.e 100 persons) become new sources of infection (Fig. 1).

On the average a patient is assumed to be infectious for a period of 2 years, so that without intervention every two years an old patient will be replaced by a new person. That's

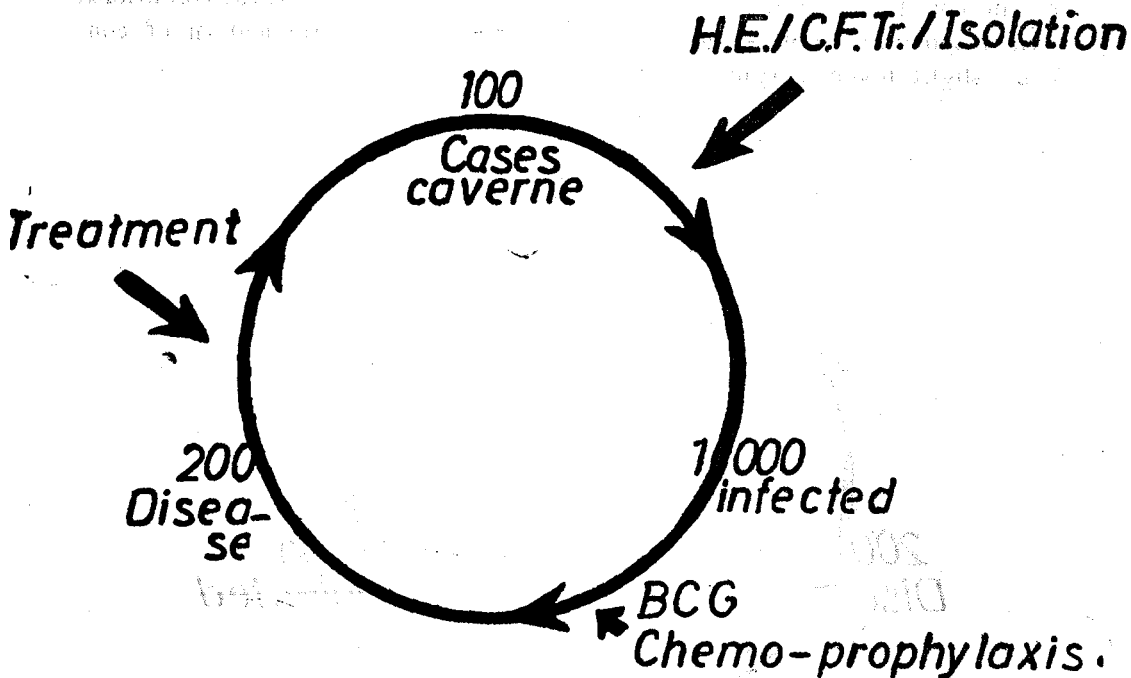
why tuberculosis can be considered as "a stable disease" or "a self-limiting disease".

Possible changes may occur if :

- a. the number of infected persons within a certain period of time

increases, so that we can get an increase of incidence, e.g. 100 patients infect 1100 healthy persons, of whom 220 become ill and 110 new patients will become new sources of infection.

Fig. 2.



- b. intervention is carried out by applying control measures (Fig. 2):
 - through Health Education, Case Finding and Treatment, and also Isolation, the sources of infection can be eliminated and the possibility of transmission decreased;
 - BCG vaccination and Chemo-prophylaxis will prevent heal-

thy persons from becoming ill even if they get infected;

- by giving treatment to patients, who are not yet infectious.

These control measures have the objective to reduce the number of new infectious cases or to prevent them from becoming infectious.

The situation of the epidemiology of tuberculosis in Indonesia.

Between the years 1962 and 1964 with the assistance of WHO a survey was done on the prevalence rate in the urban and rural areas in Yogyakarta and in the rural areas in the surrounding of Malang.

The survey included:

- Prevalence rates of naturally acquired Tuberculin sensitivity.
- Prevalence rate of bacteriologically confirmed cases of Tuberculosis.
- Prevalence rates of pulmonary shadows classified as "Tuberculosis Requiring Treatment".
- Prevalence rate of symptoms suggestive of Tuberculosis.
- Prevalence rate of INH resistance.

In short the results can be seen as follows (see Figure 3).

The results are more clearly seen in Figure 4 and Table 1.

These data are used as a standard for the Control Programme in Indonesia, especially for those of Malang where PPD with the strength of 2 TU was used by WHO, for comparison with other surveys.

As a standard for bacteriologically confirmed the cases in Indonesia is: 0,6%.

c. Pulmonary Shadows and Bacteriologically Confirmed Cases by Age and Sex (see Figure 5).

As standard for the prevalence rate of pulmonary shadows is: 3,6%.

d. Pulmonary Shadows and Symptoms Suggestive of Tuberculosis by Age (see Figure 6).

Prevalence of symptoms suggestive of tuberculosis is: 5,0%.

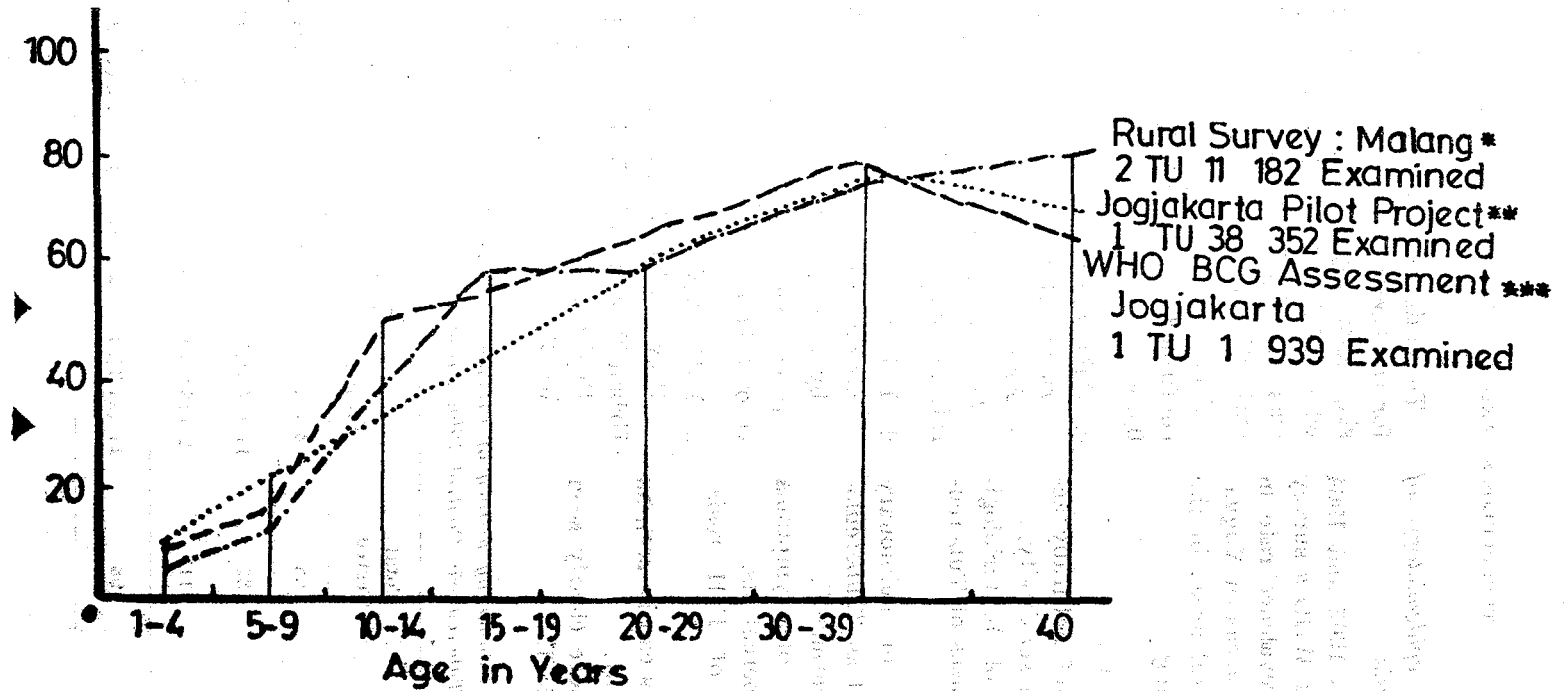
e. INH Resistance by History of Previous Treatment.

Urban Tuberculosis Control Pilot Project: Yogyakarta. (see Table 2).

TABLE 2: INH Resistance by history of Previous Treatment
Urban Tuberculosis Control Pilot Project, Yogyakarta.

History of Previous INH Treatment	Total Tested	INH Resistance		
		Positive	Doubtful	Negative
Not Treated	55	4 (7.3%)	2 (3.6%)	49 (89.1%)
Treatment	32	11 (34.4%)	7 (21.8%)	14 (43.8%)
Unknown	11	2 (18.2%)	1 (9.1%)	8 (72.7%)
T o t a l	98	17 (17.3%)	10 (10.2%)	71 (72.4%)

FIG. 3 : Naturally acquired tuberculin sensitivity for urban and rural areas, by age



- Rural Sample Survey, Malang Regency, East Java ; 2 TU RT 23
- ** Tuberculosis Control Urban Pilot Project, Jogjakarta City, 1 TU RT 23
- *** WHO BCG Assessment Team, Jogjakarta City and Province
1 TU RT 23

FIG. 4 : Bacteriologically confirmed tuberculosis cases by age and sex. Urban tuberculosis control pilot proyek: Jokjakarta.

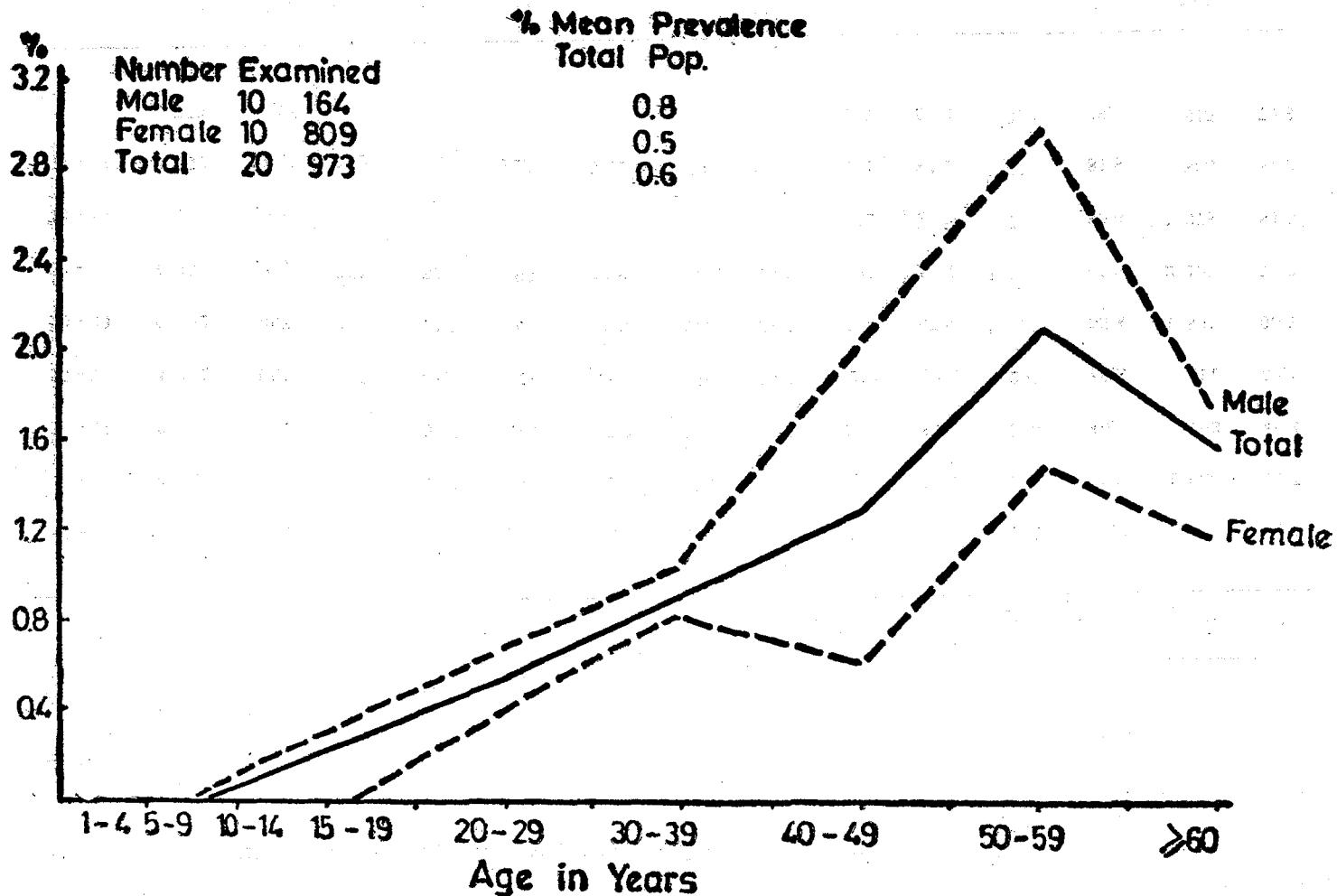
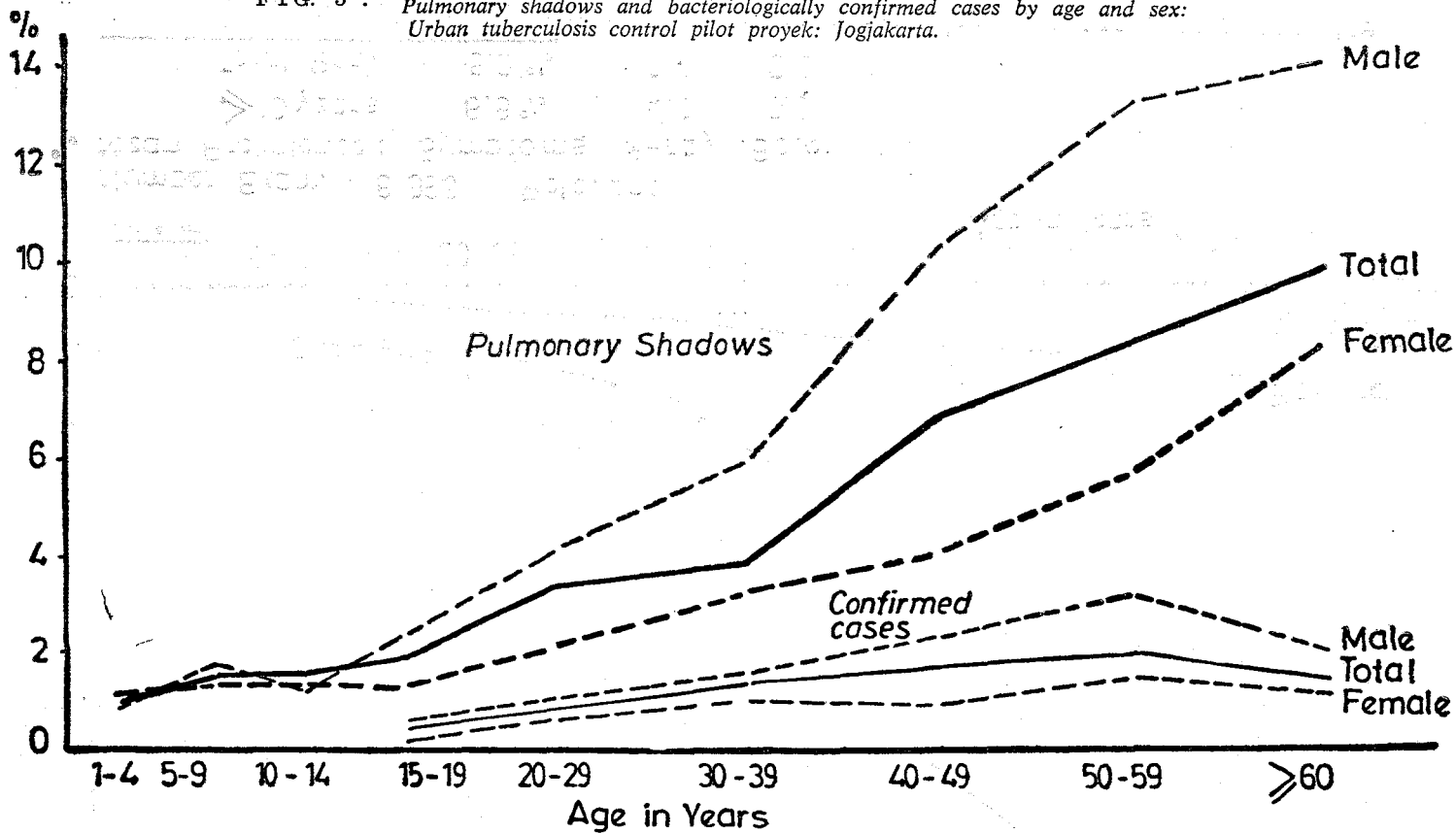


TABLE 1 : Age-Specific Naturally Acquired Tuberculin Sensitivity
 Percentage of Tuberculin Reactors ≥ 10 mm (Persons with old BCG
 Scars Excluded).

Age in Years	Jogjakarta Pilot Project (1 TU)		WHO BCG Assessment: Jogjakarta (1 TU)						Rural Sample Survey: East Java (2 TU)					
			Male		Female		Total		Male		Female		Total	
	No. Read	% ≥ 10 mm	No. Read	% ≥ 10 mm	No. Read	% ≥ 10 mm	No. Read	% ≥ 10 mm	No. Read	% ≥ 10 mm	No. Read	% ≥ 10 mm	No. Read	% ≥ 10 mm
1-4	4 991	5.1	50	2.0	53	7.5	103	4.8	759	3.0	761	3.8	1 520	3.4
5-9	4 820	21.4	233	15.4	288	12.5	521	13.8	849	13.9	784	9.3	1 633	11.7
10-14	3 847	33.2	309	50.8	290	47.9	599	49.4	351	41.3	355	40.0	706	40.6
15-19	4 331	46.1	95	64.2	74	44.6	169	55.6	210	68.1	201	49.8	411	59.1
20-29	6 862	59.8	104	76.9	60	43.3	164	64.7	751	67.6	1 110	55.8	1 861	60.5
30-39	4 930	74.3	121	86.8	63	55.6	184	76.1	1 091	81.7	1 104	67.0	2 195	74.3
40-49	3 633	75.4							672	89.3	706	80.0	1 378	84.5
50-59	2 660	74.2	112	83.9	127	51.2	239	66.5	382	87.2	451	81.8	833	84.2
> 60	2 579	69.7							285	84.6	360	76.1	645	79.8
Total	38 352	48.7	1 024	52.1	955	35.4	1 979	44.1	5 370	56.1	5 832	49.9	11 182	52.9

FIG. 5 : Pulmonary shadows and bacteriologically confirmed cases by age and sex:
Urban tuberculosis control pilot proyek: Jogjakarta.

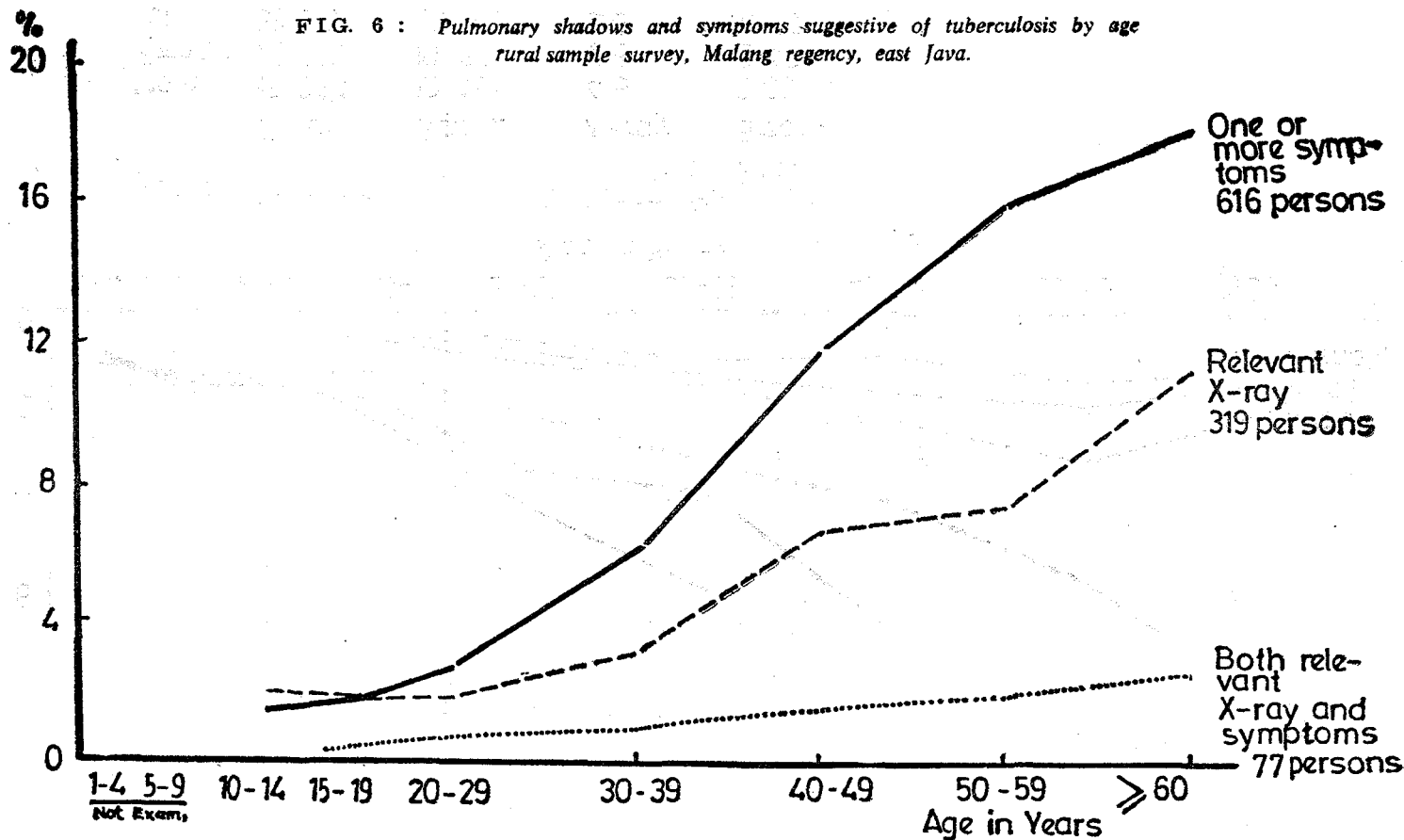


Number Examined

% Mean Prevalence
Total Pop.

	X-ray	Bacty.	X-ray	Bacty
Male	18 234	10.164	4.6	0.80
Female	20 085	10 809	2.8	0.47
Total	38 319	20 973	3.6	0.63

FIG. 6 : Pulmonary shadows and symptoms suggestive of tuberculosis by age rural sample survey, Malang regency, east Java.



Number Exam.	8 996	Relevant
% Mean Prevalence:	Symptoms	X-ray Both
≥10 years	6.8%	4.3 0.9
Total Pop.	5.0%	2.0 0.6

* Only 61%, i.e., 245 of the 400 lesions were classified as "active tuberculosis" and the confirmation rate for "active lesion" would be about 12%.

4. Control Program

a. Objective :

to reduce the incidence and prevalence of the Sources of Infection.

b. Methodology :

- BCG Vaccination;
- Case Finding and Treatment;
- Health Education.

Epidemiologic Model for TBC Control Program (see Figure 7).

— BCG Vaccination

Considering the high annual infection rate, more than 1% (see prevalence rates of naturally acquired tuberculin sensitivity at all ages and those less than 50% infected are children under 15 years of age), so that at the Workshop in Ciloto held in February 1969 it was decided that BCG vaccination will be given to all children at the age of 0 - 14 years without a prior tuberculin test to simplify administration and increase work efficiency. BCG vaccination performed with a good technique using BCG vaccine with a high efficacy which has been stored in ideal conditions, will give a reduction of the incidence although after a long time. Its impact is expected after 25 years (a remarkable reduction of the incidence will show up), even after as short as 10 years,

the incidence of pulmonary tuberculosis will start to decline.

Work Outlines

Java and Bali :

integrated and done by the (pre-trained) health personnel in the Health Centers, Clinics and MCH Centers. Since the 4th year of the Five Year Development Plan (Pelita I), smallpox vaccinators were used instead of this health personnel, who started performing the simultaneous smallpox-BCG program.

Other Islands : (outside Java and Bali) 2 systems were used.

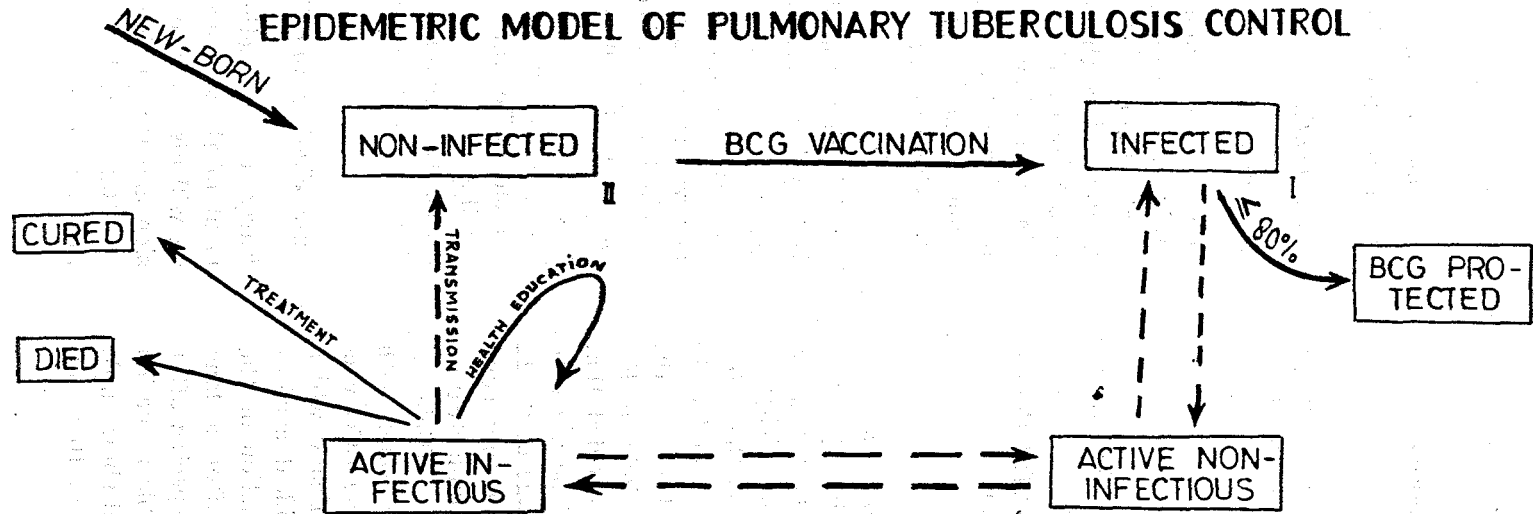
The integrated system as in Java and Bali in the beginning, and afterwards replaced by smallpox vaccinators in a combined program in the 5th year of the PELITA I.

Sweeping teams consist of 4 - 6 persons, afterwards replaced by smallpox vaccinators for remote areas. The number of the teams depends on the areas to be covered.

— Case Finding and Treatment

Early case detection and treatment of those sources of infection will also reduce the transmission and thus reduce the incidence. But a well-performed BCG vaccination program might reduce

FIG. 7 :



Interference with BCG → < 80% BCG protected to reduce the incidence.
 Interference with treatment → (case finding) reduce the prevalence incidence.
 with Health Education → reduce the transmission.
 Without interference → died or self-curred or remain infectious.

ce the impact of this treatment program, also this treatment program is more difficult to perform and rather expensive. It is then important to reduce the prevalence of the disease, and thereby also the the problem.

Work Outlines

Passive case finding of those who come to the Health Centers with symptoms seeking for help and relief and are integrated in the existing health activities. This will be done by spot examination of early morning sputum microscopically, after staining the smear with the solution of Kenyon and Gabbet.

Those who showed acid fast bacilli in their sputum will be treated for 1 - 2 years free of charge. Treatment is given in 3 phases, 2 of which are supervised.

- initial intensive daily phase for a period of 1 month with streptomycin 1 gm and INH 400 mg + vit. B6 10 mg in a single dose.
- continuation twice weekly intermittent phase up to 1 year with streptomycin 1 gm and INH 700 mg + vit. B6 10 mg in a single dose.
- maintenance daily phase for another year with INH 400 mg + vit. B6 10 mg in a single dose, especially for the prevention of relapse.

The above mentioned treatment procedure is for adults, whereas for children it should be adjusted to their age or weight. The implementation of this program should be stressed for densely populated areas and for well staffed and adequately equipped Health Centers.

— Health Education for the Community

With health education and information services we hope to increase the knowledge and awareness of the community about the danger of this disease in order to have them participate in the program, to reduce and prevent the transmission infection and so indirectly to help in the reduction of the incidence of the.

For this purpose flashcards and leaflets have been distributed to key-persons in the community with the cooperation of the Indonesian Tuberculosis Association (PPTI).

c. Assessment

Operational assessment :
by determining the scar index, i.e. the percentage of eligibles having a scar, and compare it with their reports.

For this purpose a sampling of 5% of the eligibles will be examined, based on a random allocation.

Epidemiological and Technical Assessment :

- The Mean Induration of tuberculin positives is determined in individuals with no scar.
- by means of repeated tuberculin test survey (tuberculosis surveillance), the annual infection rate and then the incidence can be estimated. From repeated surveys we can know the trend of the disease, the infection rate and the incidence, and so assess the ongoing program.
- Total BCG Effectiveness (percentage of total protection) :
Coverage x Estimated Vaccine Efficacy x Estimated Susceptibility.
Coverage : real coverage by determining a scar survey.
Estim. Vacc. Efficacy: through viability of BCG vaccine and post vaccination allergy of those with a scar.
Estim. Suscept.: number of not yet infected eligibles, tuberculin negatives.
- Mean Scar : measurement of scar as a measure of technical assessment.

The number of cases detected in the Health Centers is unfortunately not a measure for the incidence or prevalence, because of the inadequate per-

formance of the Health Centers and the lack of knowledge and awareness of the population.

The Case Finding and Treatment Program should also be assessed when it goes on in the Second Five Year Development Plan (PELITA (II)).

5. Achievement during PELITA I

a. BCG vaccination :

a coverage of 60-80% of the target is estimated, particularly for Java and Bali a coverage of more than 80% has been hopefully achieved.

It should be noted that on the Other Islands not all places were covered by the BCG vaccination program, because of communication difficulties.

When this paper was made, the real figures were not yet available.

Manpower : At the end of PELITA I a sweeping team of 3.973 smallpox vaccinators have been trained who were able to perform the simultaneous smallpox - BCG Program.

b. Case Finding and Treatment :

Estimated 35.000 tbc cases were found and got treatment during the PELITA I, while the target cumulatively was 35.500 cases.

6. The Control Program in PELITA II

The Objectives and Methodology of the TBC Control Program in PELITA II do not differ from those in PELITA I.

— BCG Vaccination: it will be done more selectively, and it will not be the total of the 0 - 14 years age group anymore but:

- a. the 12 - 13 years age group or the school-leaving age group; they should not enter puberty without a recent BCG scar.

This age group was chosen, because TBC cases were found more in the productive age group, over 15 years old, to prevent the younger age group breaking down after puberty. Moreover TBC in the older age group may develop into an infectious state. Hereby we hope to prevent the development of infectious TBC, and also to break off the chain of transmission.

- b. 0 - 1 year age group (infants) to prevent TBC in infants.

During PELITA II no revaccination will be done; this will be performed in PELITA III. Only the primary vaccination is performed, as the height of BCG vaccination activity has been done

in the last 2 years of PELITA I. The already well-trained smallpox vaccinators and sweeping team members will be kept working in PELITA II in the Combined Program, next to helping some provinces in other vaccination programs.

— Case Finding and Treatment of Source of Infection and Health Education :

By Presidential Instruction to develop more and better Health Centers in the country during the PELITA II, it is to be expected that this part of the TBC Control Program will be more successful. Giving free treatment to patients whose sputum is found to contain TBC bacilli microscopically, will help a lot in case holding. More attention will be paid to case holding and defaulter action, in order to achieve better results, better treatment efficacy and higher cure rate.

The methodology will be improved into a "Promoted Passive Case Finding" by means of regular and continuous education, information, propaganda and promotion. So the case finding will be intensified and will be more concentrated in Java, Bali and several other provinces in other Islands (Bali is the central Pilot Project). To obtain more

epidemiological impact, the program will be more emphasized on the intensification rather than the extension. The total amount of the operating health centers

will be the same. It is therefore expected that the prevalence of TBC will decline in the areas of those health centers at the end of the PELITA II.