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PREVALENCE AND INCIDENCE OF TUBERCULOSIS INFECTION AND DISEASE IN INDIA:
A Comprehensive Review

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CONTENTS

SUMMARY

The data available on tuberculosis morbidity and mortality from various surveys in India are summarised in this review, with a consideration of their socio-economic aspects. A brief interpretation of the epidemiological situation in India, along with the use of the information on epedemiology in designing the tuberculosis programme in India (NTP) is given in Appendix (vi).

1.1. Tuberculosis problem is more or less spread all over the country. Differences in prevalence rates of disease as observed between area to area did not appear to be statistically significant (barring a few exceptions e.g., Tamil Nadu, Raichur and urban slums as in Calcutta).

Prevalence rate of disease was observed to be the same for the rural and urban areas (Fig.5).

1.2. Of persons in all ages both sexes about 38% were infected. In males, almost 70% of persons above 40 years of age were infected. About 2% had pulmonary tuberculosis, but only 0.4% could be the average prevalence rate of bacillary cases (In 5+ age group). Mortality rate was observed for the last time in a population survey way back in 1966. It was reported to be about 90 per 100,000 (could be half of that, as hypothesised in recent times).

1.3. Prevalence rates of infection, disease and mortality were more in males than in females: a third of the cases in all ages could be females. However, of cases in females, about half could be in the child-bearing age.

1.4. In a rural area in Bangalore, there was a marginally decreasing trend in the infection rate: about 2% per year over a long period of observation ranging from 5 to 25 years, among children (Fig 3). But the same was not seen in the adjoining areas of Tumkur, Doddaballapur and in the neighbouring state of Tamil Nadu (the last, over a 15 year period).

1.5. Pulmonary tuberculosis is an adult disease. Population in 0-19 years (comprising about 50% of total population) could be estimated to contain only 7% of total prevalence cases. Remaining 93% of cases could be distributed in population aged 20 years over (Fig.6). Relatively higher and higher concentration of cases in higher age groups was observed in later surveys as compared to earlier surveys in Bangalore rural area. In later surveys conducted in 1984 in Bangalore rural areas, about 80% of cases were detected among those in 40+ age group as compared to about 50% in earlier surveys (Fig.8).

1.6. Prevalence rates of cases had shown almost no change over a period of over 20 years from different surveys in different areas (Table 9 & 10).

1.7. The incidence of cases was observed to be a third of the prevalence, on the average, which could be interpreted to be due to failure of intervention and pooling up of previous cases. The incidence of smear-positive cases was estimated to have dwindled in 23 years in Bangalore rural area from around 0.65 to 0.23 per 1000 (Table 15). No such observation was made elsewhere.

1.8. Nearly 10% of all causes crude mortality in the community was contributed by death due to tuberculosis (tuberculosis mortality rate: about 90 per 100,000). The highest proportional mortality in women in the reproductive age could be attributed to be due to tuberculosis, higher than even that due to peri-natal causes. Nearly 40% of female population being in the age group of 20-44 years, this could amount to be the highest single cause of death in women in this vulnerable population group.

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1.9. Mortality rate due to tuberculosis was observed to be considerably lower than case rate, and was decreasing with time from survey to survey. The case rates were considerably lower than the infection rates (mortality rate: case rate: infection rate ::90:400:38,000 per 100,000). The observed wide gap between the rates has significance with respect to the age of the epidemic (Fig.15). The survival rate of cases diagnosed in later surveys were better, compared to that in earlier rounds of longitudinal surveys.

1.10. Paediatricians were generally seeing less of miliary, meningeal and fulminant forms of tuberculosis. Occurrence of pulmonary tuberculosis in paediatric age-group was minimal (Table 17). However, children in 0-4 year age group was found to be highly vulnerable in a Madras slum, having conspiculously high mortality to tuberculosis.

1.11. There was a higher prevalence in 'Kutcha' houses than 'Pucca' houses, the former inhabitated by the poor. There was an observed association of pulmonary tuberculosis with lack of education, lack of regular source of income as well as per capita income. Of the workers with tuberculosis, it is recently estimated that about 52% are in the 15-44 years age group (Table 18). In this age group, the proportion of women among the urban workers with tuberculosis (40.0%) was estimated to be higher than among the rural (17.9%).

1.12. The rates observed in the various surveys conducted in India, have been used to estimate the approximate average number of cases and deaths etc., in the country, to serve as a guide for planning for the resources for a programme at the National level (Table 19). The numbers presented in brackets in the table are estimates, revised in the light of more recent observations. The likely estimate of disease in India could be on average; Bacteriologically (culture) positive cases 4.4 million (0.6%), Radiologically active bacteriologically negative 2.3 million (0.3%), and annual tuberculosis mortality 0.42 million (45/100,000).

I. INTRODUCTION

In line with the current scientific development and WHO policy[1], Govt. of India, had in the recent years, re-examined the strategy hitherto followed under the National Tuberculosis Programme (NTP). A revised NTP is currently being formulated with assistance from the World Bank and the WHO[2]. While re-defining the strategy and deciding on the priorities/emphasis on programme activities as well as their scope, the epidemiological aspects of the disease, peculiar to this country, have to be kept in mind. For instance, because of its recognised predilection for affecting the relatively underprivileged segments of the society[3], a control programme addressed to the needs of the country, requires also to evaluate the relevant data with particular reference to the socio-economic and gender differentials, if any. The current report is prepared in this context, reviewing the tuberculosis situation in India. The data could be made use of not only for planning but also evaluation purposes, generating fresh thinking in respect of epidemiologic dimensions of control programmes, especially keeping the circumspection of some of the noted programme managers in view[4].

Considering the infectiousness of the pulmonary forms of the disease, the present report confines itself to the data on pulmonary tuberculosis and tuberculosis infection only. Available data, both published as well as unpublished to the extent available, are relied upon to present:

1. **Prevalence and incidence** of tuberculosis **infection** as well as of **sputum positive and sputum negative pulmonary tuberculosis,** by age and sex.

2. Prevalence of tuberculosis infection and disease by **socio-economic status** of population.

II. MATERIAL

The review mainly derives its material from the published sources, originating from some of the leading tuberculosis research institutions of the country. However, wherever required, unpublished work from these institutions have also been freely referred to. Apart from the main papers originating from some of these studies, a considerable number of subsidiary papers were published as well. These have been referred to in the text, as and when required.

Other lesser known organisations have, especially in comparatively recent times, carried out some significant research; a few of them still to be published. These have been duly evaluated and referred to, if found authentic enough! The major research efforts in epidemiology of tuberculosis are described briefly in Table 1, giving the name of the study, reference, year of study, population represented, the design and methodology (age group studied, population-screening and diagnostic methods used).

III. CRITERIA FOR DEFINING INFECTION AND DISEASE

(A) PREVALENCE OF INFECTION

The estimate of prevalence of tuberculous infection in the community is based on the interpretation of the results of tuberculin testing of persons without BCG scar. The indurations, measured ideally, between 48 and 96 hours of the tests, are distributed in the form of a histogram (FIGURE-1). From these distributions, it is possible to demarcate the positive reactors from those who are negative to the test dose, since the indurations tend to lie around two discernible modes separated by a dip, called the antimode. The nature of distribution of the indurations however differ to an extent from study to study, depending on the tuberculin (or antigen) used, their dosages, testing and reading variations, as well as on cross-reactions on account of the non-specific sensitisations that may be present in a given area due to environmental factors (including non-tuberculous mycobacterial sensitisations). In fact the dip between the two modes is sometimes less recognisable due to a high prevalence of non-specific reactions in India, especially south India[6),23,32]. Due to these problems, it is not possible to have a uniform size of test reaction identified with tuberculin test positivity in every survey.

Besides the type of tuberculin and their dosages used form survey to survey not being the same, the problem of defining the infected is compounded by the changing levels of demarcation between the infected and uninfected from one survey to the other[10,12]. The problem of changing demarcation levels from survey to survey had no doubt engaged the attention of researchers[12,33]. It is suggested after a field study that the demarcation line between the infected and non-infected persons would require to be shifted from survey to survey to take care of the observer variations or the rising proportions of BCG scars in the population being wrongly classified as unvaccinated from one survey to the next, thereby affecting the classification between the infected and uninfected[33]. It is not intended to go into more detailed analysis here owing to space-constraint.

For this review, persons are considered as infected, if the indurations to tuberculin test are observed to lie to the right of the demarcation line as decided on the basis of the distribution of the indurations, for the given study.

Non-specific sensitivity: Frimodt Moller had recognised that there could be two kinds of infection in south India ('specific' and 'non-specific') and that it could have serious implications in understanding infection risks[6]. The prevalence of the non-specific infections were hypothetically considered to be due to other mycobacterial infection. Chakraborty et al had shown that the non-specific infection increased with age, so much as to leave only a small proportion of the population in the age group 15-24 years without any kind of sensitivity to tuberculin[32]. Figure 2 shows that in the age group 15-24 years, where the proportion infected with Mycobacterium tuberculosis was 33.2%, of the uninfected 93.4% were showing evidence of other Mycobacterial infection. Raj Narain had shown its prevalence to be widespread in some areas[23].

Thus the interpretation of the tuberculin test results in older age groups could be unreliable owing to a high prevalence of non-specific sensitivity.

(B) INCIDENCE OF INFECTION

The results of tuberculin testing surveys are usually presented only in the form of prevalence figures for past tuberculous infection. Prevalence figures do not indicate, when in the past the first infections had occurred[34]. **Incidence of infection, which gives the most recent tuberculosis transmission situation in the community, is defined as the number of fresh infections occurring in the community between two points in time, among those uninfected initially.** It calls for direct measurement of the conversions of uninfected persons to infected status, in the intervening period between two succeeding surveys, say a year or so apart. Information on incidence from some of the surveys in India are reviewed here [6,10,15,35].

Apart from the operational constraints in carrying out the incidence surveys on tuberculous infection again and again, there were inherent problems in interpreting the repeat test results[35]. The latter was proposed to be solved by distributing the differences between the two tests in each individual. In younger age group, where the situation was not likely to be complicated by high non-specific sensitivity etc., the distribution was found to be bimodal, the antimode separating the 'new infected' (occurring to the right of the antimode), from those who were 'not newly infected' (to the left of the antimode). In the BCG TRIAL for instance, the antimode was at 12 and 10mm, between the initial test and at retests at 2½ years and 4 years respectively[15]. Thus persons showing more than 12 and 10 mm increases over the first test induration size, when retested after 2½ and 4 year period respectively, were identified as freshly infected in BCG.Trial. Somewhat similar method was adopted for NTI.LS[10].

Annual Risk of Infection (ARI): The problem of obtaining data on incidence of infection could be obviated by computing these from one or more prevalence figures, if these are obtained by similar testing methods and if the prevalence surveys 'cover a range of ages'[34]. The computed estimates of the incidence, called the 'Annual Risk of Infection'(ARI), give the risk of tuberculous infection in successive calendar years. These estimates may be regarded as an alternative method of presentation of the tuberculin surveys. **ARI could be defined as the proportion of the population which will be primarily infected or re-infected (in those previously infected) with tubercle bacilli in the course of 1 year, and is usually expressed as a percentage or as a rate.** A tuberculin survey carried out in a representative sample or a succession of them could be converted into the estimated risks (ARI). The ARI at a particular time indicates the current magnitude of the incidence and prevalence of infectious cases as well. An observed decline in the ARI would be the earliest indicator of a decline in the epidemic cycle of tuberculosis and would therefore be a suitable indicator for evaluating tuberculosis control programme. A rising risk on the other hand could be the portent for a change to the other direction consequent on adverse epidemiological situation e.g., HIV supervening.

The ARI could generally be worked out on the basis of the method described in TSRU Report[34,22]. By this method, the ARI (R) for a group of average age (A) was derived from the prevalence (P) by $R = 1 - (1-P)^{1/A}$

Incidentally, the corroboration that ARI represents annual incidence of infection is available from the study by Chakraborty et al in the LS-Follow up[13](Figure 3).

(C) TUBERCULOUS DISEASE

(i) **Screening for bacteriological examination:** In the classical epidemiological surveys for estimating the case-load, the population is x-rayed at first, mostly using a mobile mass miniature radiography (MMR) unit. Only the persons with shadows on MMR of chest assessed as abnormal, usually by two readers independently, are subjected to sputum test (x-ray-screening). Alternatively, the persons in the community are questioned for presence of chest symptoms (cardinal chest symptoms being cough, pain chest and fever of one or two weeks duration and haemoptysis); those having symptoms (symptomatics) are subjected to sputum examination (symptoms-screening). In the MS, NSS, TUMKUR STUDIES, NTI-LS, BCG-TRIAL and NEW DELHI STUDY, the x-ray screening procedure was adopted[6,7,8,9,10,15,21](Table 1). On the other hand, in the WARDHA, RAICHUR, TRC-TRIBAL and CARNICOBAR Studies, symptoms-screening procedure was followed[25,26,27,28]. In the NTI.PERI URBAN STUDY and LS-FOLLOW UP, again, the population was screened for their eligibility to undergo sputum examination, using a criteria, different from the above mentioned two, and casting a wider net[14,24].

Varying screening procedures from survey to survey affect the observed prevalence rates and therefore the comparability of results between one survey and the other[36,37].

(ii) **Definition of a bacteriological case: It was shown that cases positive by smear alone, detected in an epidemiological survey, were hardly the real cases of tuberculosis, the reproducibility by a second smear or by way of radiological confirmation as active TB in these cases being very poor[15,38].** In the BCG-TRIAL of the 567 persons positive on smear but negative on culture, 76% had only 1-3 bacilli on both smears examined. The x-ray confirmation in these persons having actively tuberculous pulmonary shadows was a mere 13%[15]. Cases with positivity on culture only, without radiological abnormality at the corresponding survey, were also a group whose tuberculous etiology was not acceptable in the NTI-LS[11]. In most of the epidemiological surveys carried out at the NTI using the classical survey method, **a case of tuberculosis was defined as a culture positive person, with a radiological abnormality at the current survey[11]. Persons not confirmed on culture (i.e., smear alone positive) were not defined as bacteriologically positive cases, even if they had an x-ray-abnormality, (they were however eligible to be defined as x-ray positive cases, if shadows on their chest-radiography were classified as actively tuberculosis).**

Three categories of bacteriologically positive cases were presented in the BCG-TRIAL: (i) positive on two cultures (ii) positive on one culture (iii) smear-positive, excluding those showing 1-3 bacilli. There was, of course, the additional group of radiologically positive bacteriologically negative group[15]. In the NSS, the sputum was collected contingent on an abnormal shadow being present on chest x-ray. It appears that the definition of a bacteriological case, under NSS and NTI classical surveys were, essentially similar. In the Madanapalle study, on the other hand, there was too much stress on radiological examination, bacteriological results being comparatively of less prominence[6].

(iii) **Variation in screening prodecure and diagnostic test influencing prevalence rate:** In some of the more recent prevalence surveys carried out in India, mobile MMR units were not employed to screen the population (MMR-screening). An alternative method of screening the population was followed in order to identify the population eligible for sputum tests, by questioning the persons on the presence of cardinal chest symptoms on a house to house basis, followed by sputum tests, either culture or smear microscopy[24,25,26,28,30].

A recent NTI-study, addressing itself to the problem of comparability of culture positive prevalence rates obtained by employing population-screening by MMR vs. symptoms questioning has shown that the efficiency of the above two screening procedures in diagnosing culture positive cases was different from the best estimate obtained of employing multiple screening (MMR and/or symptom question)[24] The correction factor to obtain the best estimate of culture positive cases

from that obtained on symptoms screening could be between 1.30-1.63 (approximately 1.5). **However, the significant finding from this study, which to an extent seemed to extenuate the problems of estimating cases based on variable screening procedures, was that the prevalence rates of the culture positive cases in the community were the same, irrespective of whether symptoms or MMR screening was the procedure of choice in screening the population for identifying the eligibles for sputum test. The same was found to be good even for the estimates of smear positive cases.** Moreover, it was observed that there were no age-sex wise differences in observed rates between the two procedures. It was immaterial for the estimate on the basis of symptoms screening, whether the interviews of the population for identifying symptomatics was carried out by a qualified social investigator or a field health worker, as long as adequate training on the procedure was given prior to the deployment for the investigation. The above could be utilised in evaluating and drawing inferences from some of the latest studies on prevalence.

(iv) **No.of bacteriological specimens examined and prevalence of cases:** The number of specimens of sputum collected from among the eligibles after screening were variable from survey to survey, which would affect the estimate of the bacteriologically positive cases in the community. The extent of difference in rates could be estimated from the finding, that instead of two sputum specimens, if four were examined in a survey, nearly 25% more number of cases could be added to the prevalence[39]. This was found to go as high as 39%, when eight specimens were examined[37]. **Needless to say that the findings from surveys with variable number of sputum specimens need to be suitably revised, before comparative assessment of the rates are made.**

(v) **Definition of a radiologically positive bacteriologically negative case of tuberculosis:** Apart from its use as a screening tool for the identification of persons eligible for bacteriological examination in a tuberculosis survey in the community, MMR-results are also relied upon to diagnose and label persons as radiologically positive cases of pulmonary tuberculosis ('persons with active and probably active shadows'-NSS). Estimates of the problems of tuberculosis on this basis has some serious limitations, principally owing to the inherent 'reader-variations' in interpretation of the x-ray shadows (as well as their identification) their tuberculous etiology as well as the activity. The procedure, usually followed, was to have two independent interpretations of the chest x-ray shadow on MMR (single picture) and to collect sputum from persons with a shadow ('x-ray-screening'). The disagreements between the two independent interpretations were then subjected to a third reader's assessment (or, an umpire reader's arbitration) regarding the nature and etiology of the shadow. However, despite the panel of readers, used in these surveys, being composed of highly experienced persons in their field, there was considerable disagreement in interpretations[15].

A five-year follow up of the persons, diagnosed to have active tuberculous shadows (as also other MMR abnormalities in their chest), was carried out by repeated x-ray of chest, smear exam for AFB and culture for M.tuberculosis (three examinations at 1½, 1½ and 2 years after the initial one)[40]. Based on an overall consideration of all the follow up investigation results, at one time, a panel of x-ray-readers had jointly re-evaluated the initial MMR-interpretations (Joint Parallel Reading-J.P.R.). Of the initial 385 sputum negative x-ray active persons identified initially, only 22.0% could really be classified to have sputum negative x-ray active tuberculosis at the first survey, when such a re-evaluation of the MMR-shadows was carried out by J.P.R.[40]. Unpublished information from the TRC Madras on the BCG.TRIAL FOLLOW UP studies recently corroborated this; not even a third of the radiologically positive cases were later assessed to be having active tuberculosis needing treatment[41].

It could be suggested that the generally accepted **prevalence rate of radiologically active bacteriologically negative pulmonary tuberculosis in India, largely estimated on the basis of data from the NSS and other similar studies (using a single MMR and the pulmonary shadows evaluated by 2 readers and umpire), could be nearly three times the likely estimate of the problem.**

IV. RESULTS

(A) TUBERCULOSIS INFECTION
(PREVALENCE AND INCIDENCE)

1. PREVALENCE OF INFECTION

1.1. Prevalence in different areas (Tables 2 & 3): That the tuberculosis infection was more or less spread throughout the country was hypothesised on the basis of studies done by Ukil and from information available from the mass BCG - Campaign results[42]. However, differences were observed from area to area, e.g., hilly areas. In later surveys carried out in parts of India, different epidemiological situations could be observed between areas in adjoining states (Tamil Nadu and Karnataka)[10,15], contiguous districts in the same state (Tumkur and Doddaballapur in Bangalore district)[8,22] and between areas within the same district (economically backward northern part of Tumkur compared to the southern part: infected, 46.0% and 30% respectively[8]), as also between two panchayat unions of Tiruvallur district in BCG.Trial: Infected 1-9 year old, Kodambathur 8.7, Thiruvalangadu 12.3 percent in 1979[16] (Not on Table). Prevalence by socio-economic criteria is presented separately under Section IV F (see infra).

1.2. Prevalence by age and sex (Tables 2 & 3): Between 25-38% of population in all ages both sexes were infected, as per data available from Tumkur Study (males 42.8, females 33.9 per cent) (Not on Table)[8], infection rising with age, more in males (Fig.4)[6,8,10]. Prevalence rates were almost similar in males and females upto about 14 years in age, after which males had higher prevalence. Whereas the peak in the males was observed at around the age of 30 years, it was so in females by about 40. Similar phenomenon was observed both in Tumkur, as well as in the BCG Trial area (Not presented)[16]. In the BCG.Trial overall prevalence was found to be 50% (males 54.0, females 46.0%)[16].

1.3. Situation over a period of time: There was a declining trend in prevalence with time in NTI.LS area (Appendix table I), not seen elsewhere.

2. INCIDENCE OF INFECTION

2.1. Incidence by age, sex and over time: The incidence of infection was found to be 1% per year and did not seem to vary age-wise in 0-4, 5-9 and 0-14 year age group in the NTI.LS (Table 4)[10]. In rural areas of Bangalore there was a marginally declining trend observed over a period of 5 years (Fig.3)[10].

2.2. A.R.I.: ARI calculated from different parts of the country was found to be between 1 and 2% (Tables 5 & 6). The decline in Bangalore area at about 2% per year annually for over 23 years, as seen in Figure 3[13], was not seen elsewhere, including in BCG.Trial area over 15 years period of observation[15].

(B) PREVALENCE OF DISEASE

This report confines itself to pulmonary tuberculosis. No significant population-based study on extra-pulmonary TB is available, except study on glandular forms in small population groups of Nicobar island and Sheriff garden in Bangalore [28,54]. Being in specific and selected groups, data from them could not be representative.

1. RADIOLOGICALLY ACTIVE CASES:

1.1. **Area-wise prevalence:** Table 7 presents the prevalence of pulmonary tuberculosis, including bacillary cases, across the country from NSS data. Table 8 presents the bacteriologically negative radiologically active case prevalence, derived from it. Tables 9 and 10 present the rates from limited area surveys conducted after the NSS. Prevalence rates of disease **did not appear to be significantly different from area to area, whether rural, semi-urban or city. There were however pockets of high prevalence, possibly related to economic situation.** For example, the prevalence rate of 58 and 50 per thousand in Block No.39 and 8 Calcutta city (slum-dominated) was higher than 2.48 per thousand in Block No.34. Similar was the case with Delhi city.

1.2. **Age-Sex-wise rate:** The rates were seen to be rising with increasing age in both sexes, irrespective of areas of study (Fig.5).

1.3. **Radiologically active abacillary case-rate:** The bacteriologically negative radiologically active case prevalence rate varied from 10-19 per thousand. These could be over-estimates to the extent of about 75% (See section III C.V.),[40]. The rates, after correcting for possible over-estimates, is presented in the last column of Table 8. The NTI-rural study which had followed the JPR method of interpretation of MMR and the Madanapalle study, also following a similar method, had reported prevalence rate of 5.40 and 4.23 respectively (Table 9)[6,40,43].

2. BACTERIOLOGICALLY ACTIVE CASES:

2.1. The prevalence rates are presented in Table.7 (for NSS), Table.9 (for, limited area studies using MRR-screening) and Table 10 (for, limited area studies with symptom-screening). **There was no difference between the rates, either from area to area or with time, provided the same method and criteria were followed.** It should be appreciated that large sample sizes of population are required to be followed up, so as to be able to discriminate small differences in the already low case-prevalence rate of about 4.0 per thousand[44,47] (Appendix Table ii).

2.2. **Age-sex distribution:** Figure 5 shows age, sex distribution by areas. The rates rose with age in both sexes, more in males. Based on the age-distribution of the cases, it could be estimated that the population in 0-19 years age (comprising 50% of total) could contain only about 7% of total prevalence cases (Fig 6). **Remaining 93% of the cases could be found distributed in the population aged 20 years and over** (i.e., in remaining 50% of population). On the other hand, of the total cases, nearly 50 per cent could be distributed among the population aged 40 years and over, constituting about 20 per cent of the total population.

Prevalence of bacteriological cases in each of the age and sex groups studied, is presented in Table 11, as computed on the basis of BCG.Trial. Prevalence in each of the age groups was much less in females. Of the total bacillary cases 79.0% could be in males and 21% in females in BCG.Trial,[15]. **Whereas males in 20-54 years age group i.e., the wage-earners, had constituted 39% of total male population, nearly 70% of all male cases were in this age-group. For females, on the other hand, the population in the reproductive age group of say 20-44 years, had constituted nearly 40% of the total female population, with about 56% of all the female bacillary cases distributed in this age group.**

2.3. **Prevalence by age-sex and categories of case:** Figure 7 presents the distribution of cases by criteria of diagnosis and by age/sex. The prevalence of cases was lower among females than among males and increased with advancing age in males. Whereas prevalence of of bacillary cases had more or less reached its peak in females by about 40-49 years, it had continued to rise for radiologically positive cases in both sexes in BCG.Trial.

2.4. **Change in distribution with time:** The observed age-sex distribution of cases with time in the NTI.LS area was seen to reflect a change in situation as shown in Figure 8[47]. In the first of the longitudinal surveys in Bangalore rural area, about 50% of cases was found in the population above 40 years in age, constituting about 20% of total population. About 43% of the cases were distributed in 20-39 year age group, constituting about 39% of population. In later surveys in the same area, about 70-80% of cases were found among those in 40+ age group. **Relatively higher and higher concentration of cases was observed to take place in higher ages in later surveys.**

2.5. **Bacteriological case prevalence and socio-economic dimensions:** Table 12 along with Appendix Table (iii) and (iv) present the various socio-economic categories in the population and prevalence rates in them along with the proportion of cases contributed by each to the total prevalence cases in the community[25]. These aspects are dealt with separately under Chapter F (see infra) of this Section.

The Wardha study[25] and the NTI.peri -urban study[24] had shown, that as different from other studies, the rural areas had higher prevalence rates. The respective rates per thousand were:- Wardha study: Urban 1.62, Rural 1.98, NTI.Peri-urban: 3.4 (interval estimate 2.7 to 4.2) as compared to Bangalore rural 5.7 (interval estimate 5.4 to 5.9). Whether the differences were due to urban-peri-urban and rural divide or had represented a favourable trend in favour of the urban group is a matter for discussion.

2.6. **Culture: Smear positivity proportion:** Table 13 shows the data from NTI.LS[14].Inspite of the fact that there was no difference in the age standardised case-prevalence rates from survey to survey in the area for a 23 year period, the smear positivity among the prevalence cases had come down to 16% at the survey in 1984, from the initial proportion of 47.0% observed in 1961. More importantly, notwithstanding a very comprehensive screening method in the 1984 survey, the smear positive case prevalence rate had also come down to 68 from 189 per 100,000, observed in 1961 survey. It is debatable, whether this could be attributed to the National Programme, implemented in the area after the Survey 4, in 1970. The trend may be the result of a low-efficiency programme running over a long term in the area[14]. In other surveys conducted elsewhere in India, **the smear positivity proportions were more or less similar to NTI.LS first to fourth surveys (e.g., Bangalore Peri-urban area 44.9 to 46.7%[24], survey 1 of BCG.Trial 57.4%[16]).**

2.7. **Bacterial drug-resistance:** Table 15 and Figure 9 shows the bacterial drug resistance in the community. **Unpublished information from New Delhi TB centre, Bangalore Peri-urban area and rural area in Raichur (Karnataka) shows high initial resistance to INH in recent times.**

(C) INCIDENCE OF DISEASE

1. INCIDENCE OF RADIOLOGICALLY ACTIVE CASES

1.1. **Definition:** Sputum negative persons with a normal MMR of chest or those with non-tuberculous or inactive tuberculous shadows at the initial survey, who had a radiologically active tuberculous shadow at a later survey, but sputum was negative, were classified as incidence of radiologically active bacteriologically negative cases (also called "suspect cases").

1.2. **Incidence rate:** In the NTI rural area study, of 35,876 persons aged 5 years and over, incidence was found to be 2.24 per thousand between two points of observations in 3 months on JPR[43] (not on table). The incidence rates, as calculated for 3 months, was not different from that estimated for one year[44].

2. INCIDENCE OF BACTERIOLOGICAL CASES:

2.1. Definition: Culture negative persons or those without a radiological opacity in a previous survey, who were detected to have culture positive disease at a later survey, were termed as "bacillary case incidence" between the two surveys[40]. The respective incindence rates expressed as an annual average between two surveys are available from New Delhi, NTI.LS and BCG.Trial areas[20,21,10,18]. On the other hand, new cases detected in the community following continued surveillance are reported from Nicobar and CMC-Vellore studies [28,45] (Direct observation of incidence).

2.2. Incidence of cases and age-sex distribution: Table 16 shows the incidence from various surveys in India. Age-Sex distribution of incidence cases over a 5 year period is shown in Figure 10. The incidence in BCG.Trial area was higher than elsewhere, as it was for prevalence also. On an average, **incidence of cases between two points of observation however, was a third of the prevalence** at the initial point of observation, similar to that in NTI.LS. In the NTI.LS about 50% of total incidence was observed to be in males aged 35 years and over. In females the contribution was 15%[10,11].

2.3. Incidence of cases with time: In the NTI.LS, **among the younger population in the age group 5-4 and 15-34 years, a decrease with time was observed, with corresponding rise in those aged 35+ years**[10,11].

2.4. Proportion of smear positivity in incidence cases: The proportion in incidence cases, positive on culture alone (negative or smear), in relation to culture and smear positive cases in the NTI.LS was **75.0% and 55.8%** for surveys 2 to 3 and 3 to 4 respectively (not on table)[10,11]. The incidence of smear positive cases was estimated to have declined in 23 years in the NTI.LS area from 0.65 to 0.23 per 1000 (not to table)[14]. No such observation was made elsewhere.

2.5. Incidence of infection in relation to that of cases: Table 4 shows, that the relationship of annual **incidence of infection of 1%** as observed in various age groups upto 14 years, **corresponded to smear positive case incidence of 45/100,000 in survey 1 of NTI.LS**[10,11], and in line with observations made elsewhere[49]. However, the relationship was not stable in later surveys of NTI.LS (not presented).

2.6. Conclusion: The considerably higher prevalence of cases as compared to incidence (3:1) could be interpreted to be due to failure of intervention and consequent pooling of previous cases in the community.

3. INCIDENCE OF CASES BY EPIDEMIOLOGICAL GROUPS:

3.1. Case incidence by infection: Figure 11 depicts a higher rate of case incidence among the infected, rising with age, especially in males.

3.2. Case incidence by radiological abnormality: Bacteriologically negative persons having radiologically active tuberculous shadows had the highest incidence rate of bacillary cases (2.6% per year), on a five year observation, more so if they were tuberculin positive[11].

3.3. Incidence of cases by epidemiological groups: Various population groups, classified by some epidemiological attributes, and incidence of cases in them, are presented in Figure 12[50]. **The two highest risk groups had constituted only 5.6% of the population** size, but still **contributed 46% to the total new cases arising in the population in a year.** However, one must also balance it with the observation that 48% of the new cases would arise from amongst those who had no shadow in their chest x-ray, *albeit*, with a much lower rate, and was attributable to the relatively larger

Pg 8

Smear
46% +ve TB
5.6% X-ray +ve
54% -ve TB

group size (89% of population). **It could be concluded that surveillance of the two highest risk groups could be useful, if they were action-taking[50].**

(D) PROGNOSIS OF CASES

1. PROGNOSIS OF PREVALENCE CASES:

1.1. Fate: Fate of cases in a situation without active intervention is presented in Figure 13. Based on 1 1/2 year period observation, 20%, 18% and 62% of the cases were dead, became sputum negative and remained sputum positive respectively, in a year's time, subject to the hypothesis that the dynamics within the 1½ year period, had remained uniform.

1.2. Natural dynamics: Figure 14 is a stylised presentation of the dynamics of tuberculosis in the community without active intervention, utilising the information available from NTI.LS[47]. The proportion excluded annually from the existing pool of cases by reasons of death and cure, was rounded up to be nearly a third of the initial pool (d:20%, c:18% of pool, total: say, 1/3 of pool). The exclusions would get balanced with the estimated addition by way of annual incidence (i: to the extent of about 1/3 of size of initial pool). **Thus, year to year, the size of the pool would remain unaltered, and 2/3 of it would be formed by the continuing cases (the so-called "left overs"[51]).**

2. PROGNOSIS OF INCIDENCE CASES:

Of the incidence cases in the NTI.LS between surveys 1 and 2, the proportion of dead, cured and remained positive were 14%, 52%, 33% respectively, thus having a better prognosis than that in prevalence cases[11] (not on table).

3. TUBERCULOSIS MORTALITY:

3.1. Proportional mortality due to tuberculosis: Nearly 10% of all causes crude mortality in the community was shown to be due to tuberculosis in the NTI. LS area (Table 17)[52].

3.2. Mortality rate due to tuberculosis in the community: Mortality rate in the NTI.LS area was reported to be 95/100,000, not changing with time in 5 years (1961-68)[52] (Table 17). In the New Delhi area, between 1972-76, the rates were about 40 per 100,000, consequent on a well organised programme[20,21]. In the Madanapalle area, the mortality was reported to have declined from 253 (in 1949) to 64 (1952-53) and then to about 21 per 100,000 (in 1954-55), the latter hypothetically attributed to be due to a well-organised programme[6]. Murray C.J.L., in his draft trip report (Geneva WHO CDS 1992) estimated **that women in their reproductive age (15-44 years) had about 70,000 deaths from tuberculosis, every year, higher than that attributed to peri-natal causes related to pregnancy and child-birth (un-published).** Further, unpublished report derived from the Sample Registration System (SRS), and available with the TB section, Government of India, estimates around 400,000 annual deaths from tuberculosis in India. The currently estimated mortality due to tubercuolosis could be in the range of 50-80 per 100,000 i.e., between 0.3 to 0.5 millions annually (say 0.4 millions).The above projection agrees with that by Dholakia [53].

(E) TUBERCULOSIS IN PAEDIATRIC AGE GROUP

1. PREVALENCE:

Pulmonary tuberculosis in children was reported to be less of a problem in the paediatric population as compared to those aged 15 years and over[54,55]. Table 17 presents prevalence and incidence of cases from NTI.LS, upto the age 14 years. Average rate of incidence of bacteriologically positive cases among children was $^1/_5$ of prevalence, whereas it was $^1/_3$ in those

aged 15 years and over. In the Nicobar study the best estimate of all forms of tuberculosis in children was 0.6%, including histo-pathology confirmed glandular tuberculosis (smear positive case prevalence 0.4%)[56].

2. MORTALITY:

In a study by Rajnarain and Diwakara, **considerably higher annual mortality rate was reported from a Madras urban population group aged 1-4** years old (239 per 100,000) as compared to between 52-55 in the rural areas under BCG-Tiral and NTI.LS[57]. Of the total causes deaths in that age group, nearly 50% were estimated due to tuberculosis, as against between 4 and 5% in the rural areas in the same age group. The study had concluded that the special risk pertained only upto 4 year of age and not beyond.

(F) MORBIDITY AND MORTALITY: SOCIO ECONOMIC CONSIDERATIONS

1. STUDIES NOT SPECIFICALLY DESIGNED FOR ECONOMIC INFORMATION ON POPULATION:

1.1. Information prior to NSS: Not much reliable information on infection by socio-economic criteria are available in general. It was however known from BCG vaccination campaign results, upto early 1950s, that the infection rates were higher in industrial towns than elsewhere - 50 per cent of those aged 10 years and more and 75 per cent of those 15 years and more were infected[7].

1.2. NSS: In the NSS the only information collected on the economic strata of the population was place of residence (urban/rural) by type of dwelling houses ("Kutcha"/ "Pucca" houses)[7]. In the cities, there was higher prevalence of disease (x-ray active as well as bacillary) among persons living in the "Kutcha" houses than in the "Pucca" houses. The differential in prevalence rates by type of houses did not exist in rural areas. It was taken to indicate the possible effect of economic and sanitary conditions. The NSS had also shown that there were areas within a city (as in Calcutta), where the prevalence of tuberculosis was as high as 40 or 50 per thousand. These areas were invariably inhabitated by the poorest segment of the population. For example, Block 39 and 8 of Calcutta city had prevalence of 58 and 50 per thousand respectively, against 2.48 per thousand in Block 34 (comparatively affluent) as being the lowest estimate. Delhi city also had several blocks with prevalence between 30 and 50 per thousand, and so had other cities too in every zone.

Even though, generally speaking, the bacillary case prevalence rates in urban and rural areas were similar within each zone, Bangalore city, forming part of the Madanapalle zone, had a lower prevalence (2.40 per thousand; confidence limit 1.64 - 3.16) than the rural areas of the zone (6.11 per thousand; confidence limit 5.02 - 7.20). In all likelihood, Bangalore being one of the economically betterof cities, with considerably less slum problem within its environs, had something to do with it. The information is further substantiated by the observation in recent times that a sample population of Bangalore peri-urban area had a lower case prevalence rate than found in the sample survey conducted in the Bangalore rural areas[24].

1.3. Tumkur Survey: The tuberculosis prevalence study in Tumkur district, which had immediately followed the NSS had, as one of its objectives, to investigate the area-wise difference in tuberculosis case-rates[8]. It had made the significant observation, that the southern half of the district, consisting of six subdivisions (talukas), had "strikingly" large differences in the tuberculosis situation over the southern four talukas. (Tuberculous infection rate all ages: Nothern half 46, Southern half 30%. Prevalence of x-ray active cases: North 2.3, South 1.4% and Prevalence of bacillary cases: North 0.58, South 0.24%). Moreover, there was a preponderance of male bacillary cases in the north than in the south. It is well known that the northern part of Tumkur district is comparatively backward than the sourthern areas studied. There was no difference of course due to coverage by age, sex or due to size of villages between the two zones in the study, to which the differences could be attributed.

1.4. **BCG Trial:** In the Chingleput study of BCG.TRIAL there is the consistent finding, that in terms of prevalence of infection, the problem of tuberculosis was higher in Thiruvalangadu area as compared to Kadambathur area, the annual risk of infection in the 1-9 year old children in the former being 1.6 times higher (prevalence of infection 10.9 and 7.6% respectively)[16].

1.5. **Other Studies:** In the study conducted in the tribal area in Madhya Pradesh [30], the tribal population had a significantly higher prevalence rate of bacteriologically positive cases (15.0 per thousand) compared to the non-tribal residents of the same area (9.7 per thousand). This was the nearest approximation to a study of the bacillary case rates by economic stratification, as one could have, without consciously designing for it, provided the hypothesis is true that the tribals were economically weaker in the area than the non-tribals. In the isolated Andaman Nicobar islands territory, the prevalence of smear positive cases among the primitive tribal population of Nicobar island, was found to be 4.1 per thousand, higher than that seen in CMC Vellore study (Table 10) and NTI.LS (Table 13).

1.6. **Mortality:** Apart from these studies, one could consider Rajnarain's finding[57], that there was a considerably higher annual tuberculosis mortality rate in children aged 1-4 years old in the Choolai area in Madras city, dominated by slums (239 per 100,000), as compared to the rural areas of BCG.TRIAL or in NTI.LS in Bangalore district (between 52-55 per 100,000).

2. SPECIALLY DESIGNED BY SOCIO-ECONOMIC CRITERIA:

2.1. **Wardha Study:** The survey carried out in Wardha district is the only tuberculosis prevalence study, specifically designed to observe the socio-economic aspects of population, as related to tuberculosis prevalence rate[25]. It gives information on various socio-economic strata, re: place of residence (urban/ rural); type of dwelling house (kutcha/ pucca), education, occupation and income strata. (Table 12 and Appendix Tables iii & iv). Of all the socio-economic groups studied, the highest prevalence rate was found to be among the urban female professionals (8.49 per thousand) as shown in Appendix Table iv. The rural women service group (5.20 per thousand) and women cultivators (6.80 per thousand) were also particularly vulnerable.

Other salient features of the study are summarised as under:

2.1.1. **By Age and sex:** The prevalence in males was higher than in females (2.39 vs. 1.32 per thousand population), both in urban and rural areas (Not on Table).

In rural areas, the prevalence was higher than in urban areas. The males had twice the prevalence than among females.

The age group 55-59 and 60+ years had the highest prevalence, rising with age in males. In females the rise was upto 39 years, falling after the age of 50-55 years.

2.1.2. **By Literacy standard:** The tuberculosis prevalence per thousand population was the highest among the illiterates (2.49) and lowest among the graduates (0.74) (Table 12). However in the rural population, the high school group (1.79) had higher prevalence than those educated only upto primary level (1.42). This has been interpreted to be due to the hardship that a rural student has to go through, leaving rural environs in pursuit of higher education.

For calculation of the respective prevalence rates by education levels, the eligible population group in the denominator were considered (Narang P, Personal Communication).

2.1.3. **By employment:** Prevalence per thousand (Table 12) was the highest among the professionals (including the petty shop keepers) (4.08) followed by cultivators (3.12) and agricultural labour (2.45). The housewives had a comparatively low prevalence rate, but had

contributed a high proportion to the total prevalence of cases, owing to the group-size being relatively larger. Of all cases in both sexes, about 70% were among those either classified as non-worker (24.9%), cultivators (24.8%) or agricultural labour (21.4%). All these could be persons without a regular source of income. Of the total cases in females, about 48% was among those unemployed (called "non-worker" which included housewives), followed by agricultural labour 23.9% and cultivators 15.2% (Not on Table).

2.1.4. By income-group: The prevalence of pulmonary tuberculosis showed inverse relationship with increase in per capita income from 2.04 per thousand in <Rs.100 group to 1.09 in), Rs.300 group (Table 12). The inverse relationship had held good both for urban and rural population (Appendix Table iv).

In urban areas, prevalence in), Rs.300 group was fairly high (2.18 per thousand).

The grouping by income, used in the survey was decided after a preliminary socio-economic study in the rural areas of Wardha. The economic scenario, reflected by per capita income, is different from India as a whole and gives a grim picture (Narang P, Personal Communication).

2.1.5. By area and living standard: The prevalence (2.4 per thousand) as found in those living in "Kutcha" houses in urban areas was the highest. In rural areas, there was no difference in rates between "Kutcha" - "Pucca" houses (Appendix Table iii). It was probably due to small number of pucca houses and also to the almost similar quality of life and the level of health consciousness among rural population, affluent or otherwise.

3. TUBERCULOSIS AMONG THE WORK FORCE

Dholakia[53] contends that the proportion of workers among the tuberculosis cases is likely to be more than among total population. This may have more to do with the distribution by age-sex in the population than anything else, i.e., more among males than in females and among adults than in children. Evidence, according to him, is lacking to assume a differential prevalence of tuberculosis among workers and non-workers. His estimate of workers with tuberculosis in the base-year 1993-94, among population aged 15 years and over is presented in Table 18. Of the workers estimated to have tuberculosis in India, about 52% were in the age group 15-44 years. In this age group, about 40% of the workers with tuberculosis were estimated to be women in the urban areas. The proportion, however, was only 17.9% in rural areas. There was much lower proportion of women among workers with tuberculosis in higher ages, especially in urban areas.

V. DISCUSSION

1. SUMMARY OF TUBERCULOSIS PROBLEM:

The average rates of tuberculous morbidity and mortality, hypothetically considered to be relevant to the country as a whole, are utilised to estimate the problem in absolute numbers, so as to serve as a guide for planning for resources at the national level (Table 19). **However, it is recommended that the estimates be considered in the light of the comments made in para 2 (vide infra).**

A brief interpretation of the epidemiological situation in India, along with the use of the epidemiology in designing the tuberculosis programme in India (NTP) is given in Appendix (vi).

2. RELIABILITY OF DATA AND PROBLEM OF EXTRAPOLATION:

2.1. Problem in Sampling and identification of strata: The near continental dimension of India and the variability in the socio-economic situation from area to area and even within as small an area as a district, raises the question of representativeness of the data and the wisdom of extrapolation of the findings obtained from epidemiological studies carried out in limited areas to other areas or groups. While some of the surveys had taken samples for ensuring a degree of representativeness, others had arbitrarily selected the population. Even in the sample surveys, owing to lack of hypothesis, an appropriate stratification by relevant variables could not be carried out, thereby rendering the study population less representative for the area, to that extent. Examples of both NSS and Tumkur surveys could be cited in this respect[8,10]. No doubt suggestions were available from the results of these studies that the prevalence rates could vary by the socio-economic strata in society, yet the information could not be reliable for lack of representativeness of samples. The data from the Wardha study[25] as well as Dholakia's study[53], however, could now be useful in this regard. Hypothesis on socio-economic aspects, gender differentials and areawise distributions of cases besides the pressing problem of tuberculosis among the workforce could now be formulated for designing representative sample surveys in other areas of the country, apart form putting it to use in programme planning. Priorities may have to be redefined, keeping in view the relatively deprived sections of the society. **It appears that tribal or urban slum dwelling population groups, living on the fringes of the society, could need specially monitored programme,** may be on the lines of that followed in the Nicobar or North Arcot tribal population groups[28,29,45]. The higher prevalence in the urban slums, as observed in the NSS, needs to be viewed now in the light of the projection that the proportion of urban slum-dwellers, already high at about 37%, is likely to escalate, to be about 50%, by the turn of the century.

2.2. Reconsideration on average prevalence rates: The review has highlighted the need for re-consideration of the average prevalence rates for the country.

2.2.1. Infection: The question of considering the infection rate in the country to be 60-70%, in both sexes of all ages needs to be reviewed. Given the inappropriateness of tuberculin testing for discriminating the population as infected and uninfected in the age group beyond 10 years (or say 15+ years) in age, makes the estimates on infection rates beyond this age inaccurate. From Figure 2 it could be seen that the proportion of positive reactors to tuberculin could be a phenomenon related to age. In the age group of 15-24 years, 93% of those who were negative reactors to 1 TU, were still positive reactors to a higher dose, i.e., its only a small proportion who would be negative reactors to any dose of tuberculin. Because of this problem, **the estimates of infection could only be made in younger age group, with any degree of accuracy.**

2.2.2. **Radiological cases:** The revised estimates of radiologically positive bacteriologically negative tuberculosis prevalence as per NSS are presented in Table 8 along with their revised estimates, correcting them as suggested on JPR[40] (see section III.C.V.). As per the corrected rates, the **bacteriologically negative but radiologically positive cases prevalence in the community would vary from 2.6 to 4.7 (say, 3.0 per 1000, as average), instead of 10.3 to 18.6 (say, 16 per 1000) without correction (Table 8).**

2.2.3. **Bacteriologically positive cases:** The above information, taken together with the finding, that the estimate of bacteriological case rate (culture positive) should be corrected to be 39% more than the rate obtained from surveys examining only two specimens of sputum[37], would mean that the proportion between bacteriologically positive cases and radiologically active and bacteriologically negative cases should be revised. **The bacteriologically positive case rate in the NSS, taken to be between 2 and 8 per thousand (say, 4.0 on an average)** varying from area to area, **should be corrected to be approximately between 3 and 11 per thousand (say, 6.0). The ratio between bacillary cases and radiologically active bacteriologically negative cases would then no longer be 1:4 (i.e., 4.0 vs 16.0 per 1000) as currently estimated for India, but as 2:1 (i.e, 6.0 vs 3.0 per thousand on an average). The use of the revised rates (given in bracket in Table 19), in preference to the oft-quoted NSS rates hitherto followed in respect of radiologically positive cases in the community, has over-riding implications for the planning process of NTP as well as in respect of resources-management under it.**

2.2.4. **Current estimates on pulmonary tubercusis:**

2.2.4.1. Estimates for Andhra Pradesh, South India: In a recent report, the prevalence rates of bacteriologically as well as total problem of positive tuberculosis in Andhra Pradesh is estimated, based on two studies of comparatively recent vintage, rural area in Medak (1992) and tribal area in Khammam (1982)[60]. The smear positive prevalence among those aged 15 years and over in the former was 1.62 per thousand. It was 5.13 in the latter. The coverage of sputum exam of eligibles in Medhak study was only 70.8% and radiolograpic coverage, a mere 55%. To what extent the rates obtained from low coverage of population could be taken to be representative is questionable[15]. In most studies presented in the current review, the coverages were of the order of 90% or more[7,10,12,14,15].

In the Andhra Pradesh estimate, presented by Ramanna, the above rates were adjusted (Total prevalence in the state 890 per 1000 in 15+ age), using the correction factors for varying methods of screening and sputum tests, based on unpublished data from North Arcot study (TRC, unpublished)[61]. This was to make the estimates comparable to NSS, NTI.LS and BCG Trial data[7,10,15]. However, whether these correction factors were seeking to correct rates, falling within 95% confidence limit, as was done in an earlier study[62,63], could not be ascertained, owing to unpublished and brief nature of the material under reference [61]. Correction factors for prevalence rates based on statistically discriminated rates were provided in a later NTI study, revising the earlier correction factors[24,62]. The adjusted rates provided in Ramanna's report are recalculated, adjusting for age-difference, screening method and bacteriological specimens examined. Accordingly, the prevalence rates for culture positive cases are found to be 300.0 per 100,000 for 5+ age group in Andhra Pradesh (270.0 to 330.0 per 100,000). These are similar to rates found in NSS[7]. The prevalence of smear positive cases could be 130, 370 and 150 for Medak, Khammam and Andhra Pradesh respectively, for the population aged 5+.

2.2.4.2. Estimate on patients on treatment: Based on data from secondary sources, as well as qualitative study in 26 villages spread over 13 selected states in India, the National Council of Applied Economic Research New Delhi has estimated the point prevalence of tuberculosis (all forms) to be 4.23 per thousand, with an estimated total number of 3.8 million tuberculosis patients on treatment in the country[64]. Since information on method, population, coverage and diagnostic criteria are not readily available in the report, (as already discussed in Section IIIC, these have vital

bearing on the results), the above should be viewed more as an estimate of the load on the health services than epidemiological estimate of the problem in the population at large.

2.2.4.3. Estimate on morbidity and mortality from SEARO workshop 1996: In the workshop on country-specific estimates of tuberculosis morbidity and mortality, organised by the WHO SEARO at New Delhi in November '96, all available country-specific data were used to estimate the problem, by using four models, namely Notification Method, ARI Method, Incidence Study Method and Triangulation Method (DISMOD). The current estimate on mortality for India, as arrived at, is shown in bracket in Table 19. The disease rates are being further developed and not presently included herein.

2.2.4.4. Use of estimates: The average rates, as estimated and presented above, could be of great use in the planning for provision and utilisation of resources, as well as for monitoring of programme output in terms of the problem in the population at large. It should be realised, however, that these estimates, owing to the nature of their computation and large range, could be of limited purpose in effect-evaluation of intervention. This is especially so, since in tuberculosis control, one is called upon to discriminate between low initial prevalence rates with small amount of change consequent on intervention (say between 5-7%) (see para 3.1, intra).

3. CHANGES IN TUBERCULOSIS WITH TIME: ITS MEASUREMENT:

3.1 Indices for measurement: Starting from the NSS in 1955-58, several surveys were conducted in different areas in India at different times (Table 1). It was observed that the comparatively low prevalence rate of cases between 2-8 per thousand, (say, 4 per thousand) had more or less, remained unchanged over the years. The reason for this is clear from an understanding of the natural dynamics of tuberculosis (Figure 14). It could be observed that the pool of cases remained unchanged over short period of time, without active intervention. On account of the relatively low initial case prevalence rates (Table 9 and 10) and the expectation of a very small change in it, if at all, the population sample size had to be considerably large to identify a statistically valid change (Appendix Table ii)[46,48]. Even mortality rates in tuberculosis did not present itself to be a sensitive index of actual epidemiological time trend. However, on interpreting the above survey results on infection and disease by areas, especially their distribution by age and sex as well as over time, Indian epidemiologists had taken the viewpoint that the **disease could be in an endemic phase in India, on a slow declining trend,** taking their cue from Grigg's work[58,59] (see Fig.15 for the hypothetical secular epidemic curve).

It is to be noted in this connection, that the wide gap between mortality rate, case rate and infection rate in the community (90:400:38,000 per 100,000 respectively) is also considered significant with respect to the interpretation of the interpretation of the age of the epidemic in India (Fig.15). **While dwelling on the current epidemiological situation in India, one may not miss the rather disturbing recent findings on drug resistance as shown in Table 15,** even though information on this is still meagre.

3.2 A.R.I.: It needs to be recognised that bacteriological case-prevalence, in being the pool of cases leftover and carried over time, is more of an index of a failure of the anti-tuberculosis effort, than a representation of the secular epidemiological trend as such. Incidence of cases, on the other hand, represent the current risk of developing disease among the previously infected, and therefore give a cumulated risk over a long time, as it has to be observed in higher ages. As distinct from these, risk of infection is the index, which represents the direct and a near-immediate consequence of the presence of bacteriological cases in the community. Following extensive work on the epidemiology of tuberculosis in the western countries in the comparatively recent times, ARI has been recognised to reflect the current epidemiological situation in an area, in preference to the disease rates[34]. It is also possible to derive from it an estimate of the current rate of incidence of the infections cases, as suggested by Styblo[49], also shown in Table 4. In the Bangalore

rural area studied by NTI in a 23 year period, ARI was seen to have declined at 2.3% per year (Figure 3). The smear positive case incidence was 23 per 100,000 at the last survey, as estimated from the prevalence rate of cases in 1984. It could thus be interpreted as coming down during the period at a rate nearly corresponding to the fall in ARI. However, there was no other evidence of ARI declining in India, apart from Kashmir valley (Fig 16). Thus, **India could be identified as a country of high transmission and inadequate decline, a situation which it shares with the sub-Saharan countries (ARI 1-2.5%, annual decline 0-3%).**

4. CONTROL PROGRAMME AND EFFECT-EVALUATION:

4.1 Objective of a tuberculosis programme in the Indian context: One may wonder whether the epidemiologists are not over-zealous in expecting a control programme, like it is in India with a current efficiency at 33% or less, to bring in the epidemiological returns in a relatively short time. For countries like India, with the likely current average annual number of smear positive incidence of 750 cases in an average Indian district of 1.5 million population, the task of reducing it is altogether a different proposition, as compared to, say, a country like the Netherlands, with an incidence level of 12-15 smear positive cases in a million population (Table 20)[47,65].

The Indian situation should be viewed in the light of the fact **that already diagnosed cases continue to constitute a major proportion of the prevalence (2/3rd) year after year (Fig.14) i.e., it could be a sort "of an epidemic of the left-overs".**[51] This needs to be transformed through the operation of a highly efficient treatment programme, as experts globally contend, with a well-thought out case-finding network in place.

Some salient features of the epidemiological situation, as used for planning a relevant control programme for the country, together with their interpretation with regard to the trend, is given in Appendix Table vi.

4.2 Continued surveillance through ARI and effect-evaluation: In view of the large population size required (Appendix Table ii) for obtaining information on disease from the repeat surveys to be meaningful towards reviewing of the epidemiological situation from time to time, or effecting a comparison from area to area following a tuberculosis programme, the **alternative of carrying out infection surveys instead, could be considered. For this purpose, sub-district level samples of unvaccinated children could be selected (cluster samples).** Care should be taken to obtain socio-economic stratification, in view of differences in rates as seen even between contiguous areas. Study by Bleiker and unpublished information developed in association with the WHO Geneva and available with the reviewer, shows that the relevant sample sizes required for ARI-study in the population, could, infact, be a manageable activity[66]. The question of an adequate number of unvaccinated children available in the community was not found to be a problem, even if the proportion vaccinated was found to be as high as 80-90%[67]. It was also shown that the exclusion of variable proportions of vaccinated children from infection surveys would not affect the estimate[68]. Moreover, ordinary general health workers with simple training could carry out the field work[19,31]. The finding from the NTI as well as BCG.Trial that the prevalence of various grades of protein energy malnutrition among younger children had not influenced the estimates of the prevalence of tuberculous infection, could be of special significance, in this context, to the developing countries[62,63,64].

It is placed on record here that a study on ARI as related to some well-known health incides in the community (e.g., child mortality, infant mortality and tuberculosis case fatality rates etc.) was completed at the NTI Bangalore in 1993-94. (NTI, peri-urban follow up). When analysed, it could show the way towards developing the ARI as an index for general health as well, besides for tuberculosis.

4.3 **Epidemetric Models:** Over and above the direct measurement of the situation through ARI, it is also suggested that repeat surveys in some areas be carried out in order to provide inputs for construction of epidemiological models, feeding into them the data on operational efficiency of the programme also as a variable, as done by the present reviewer's group[48]. The trend obtained from such a model (Fig.17) had shown a marginal decline, relevant to the current programme efficiency over a period of 50 years or more, the decline almost getting arrested thereafter, corroborating the observation of epidemiologists on a slow decline[50,69]. It is suggested that the exercise of mathematical approximation could be perfected from the data obtained from longitudinal surveys in selected areas, of course with adequate provision for reflecting socio-economic changes with time.

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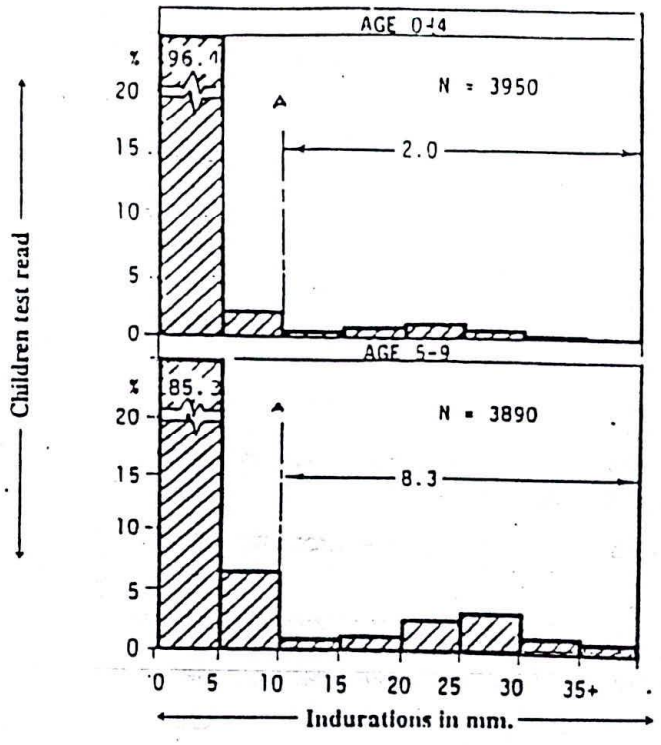
LIST OF FIGURES

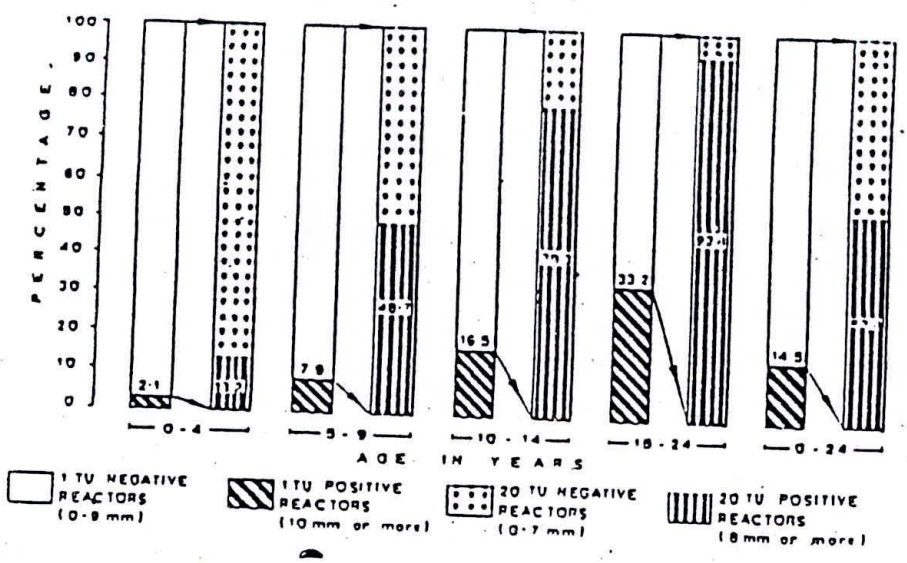
IN A POPULATION AGED 0-9 YRS.



'A' - Antimode of distributions : Arrow to its right infected proportion

SOURCE : OLAKOWSKI[11]

Fig. 2. PROPORTIONS OF PERSONS INFECTED WITH M. TUBERCULOSIS* AND THOSE SHOWING NON - SPECIFIC SENSITIVTY** IN A RURAL POPULATION

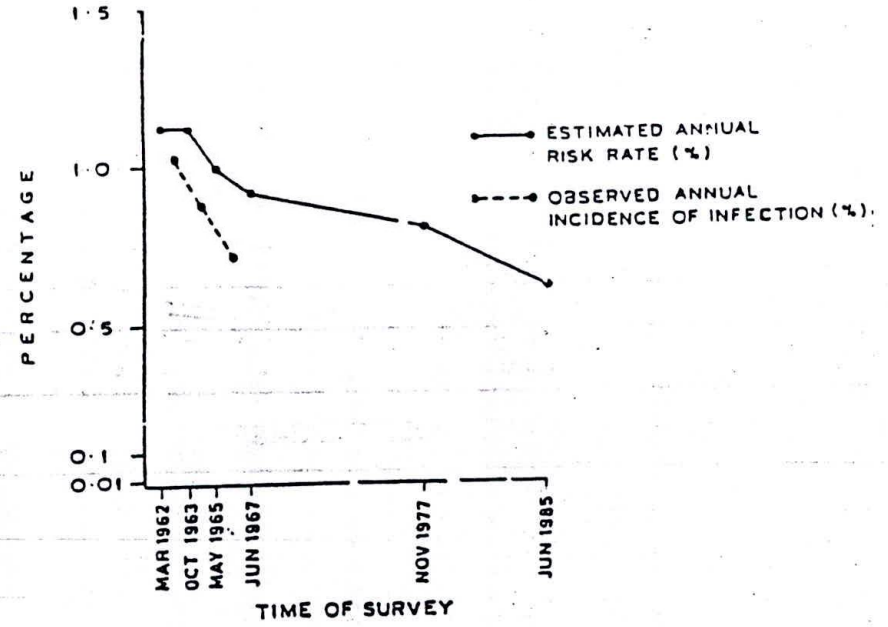


* Infected - Persons who are 1 TU positive reactors

** Non - Specfic sensitvity - Persons 20 TU positive reactors among those with negative reactions to 1 TU.

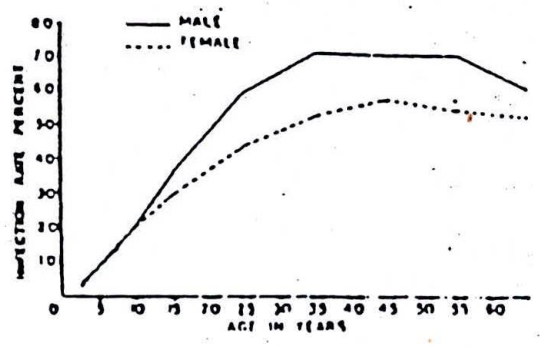
SOURCE : CHAKRABORTY et al[12]

Fig. 3. ANNUAL ESTIMATES OF RISK OF INFECTION (1962 - 1985) AND OBSERVED ANNUA INCIDENCE OF INFECTION (1962 - 1967)



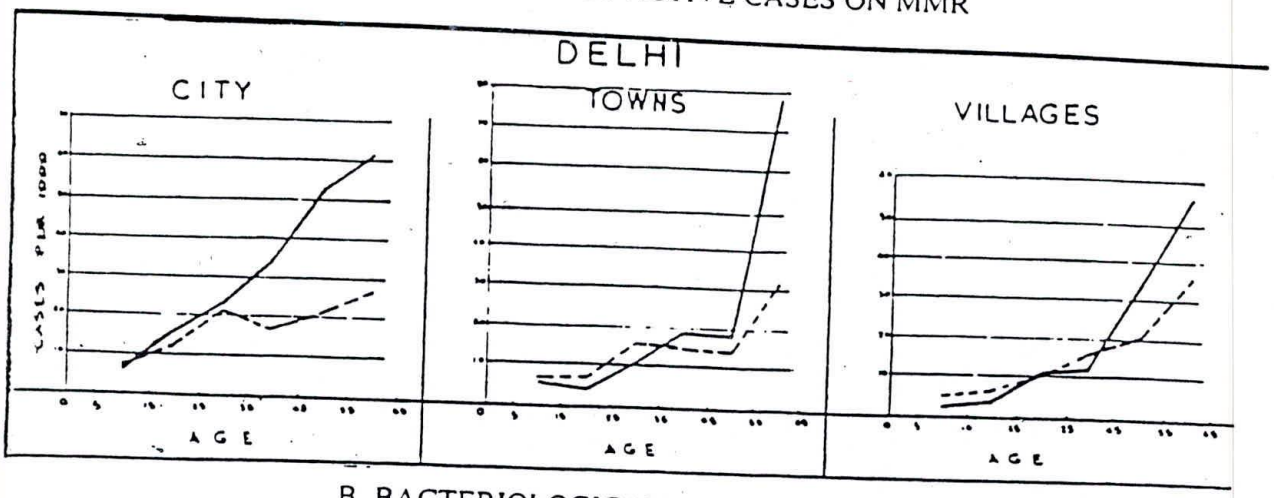
SOURCE : CHAKRABORTY, AK et al[13]

Fig. 4. PERCENTAGE OF REACTORS BY AGE AND SEX (TUMKUR DIST. 1960)

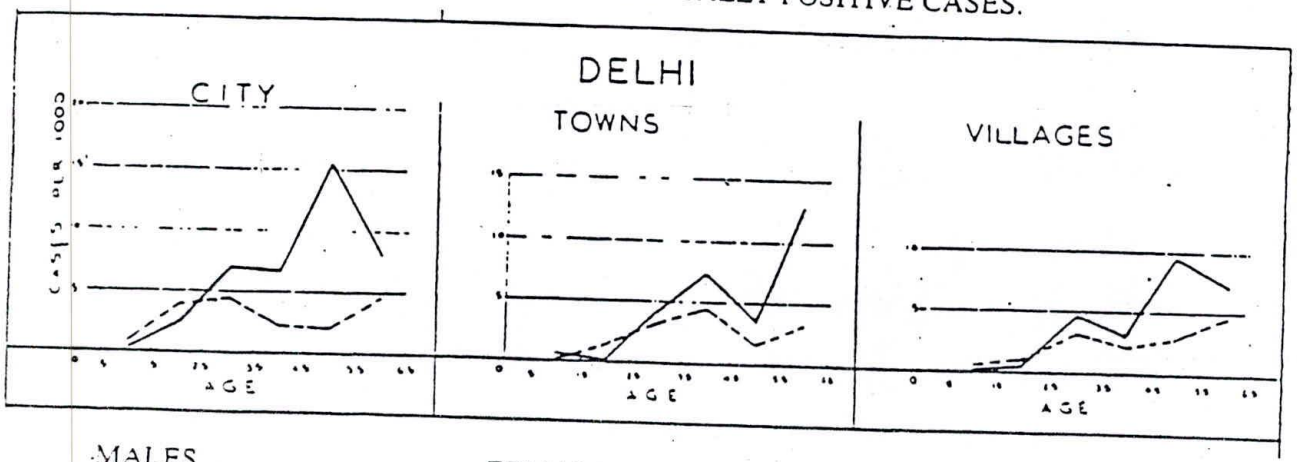


Reactor : 10mm and over SOURCE : RAJNARAIN et al[8]

A . ACTIVE & PROBABLY ACTIVE CASES ON MMR



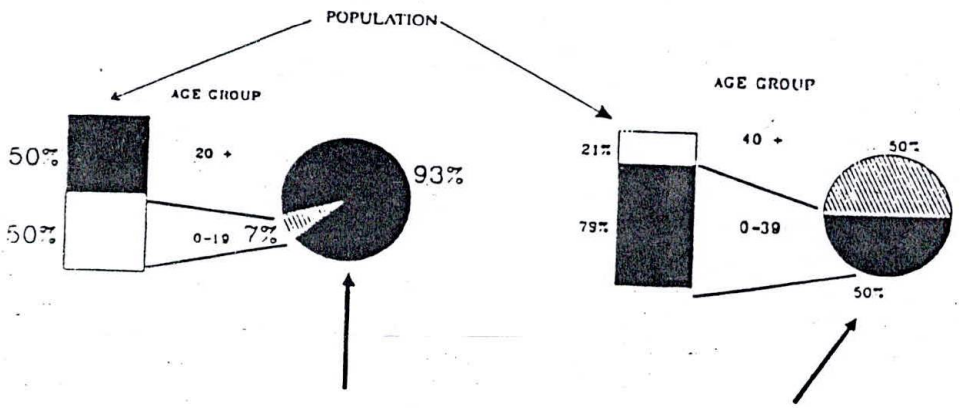
B. BACTERIOLOGICALLY POSITIVE CASES.



MALES _____ FEMALS ---------- SOURCE : NSS (7)

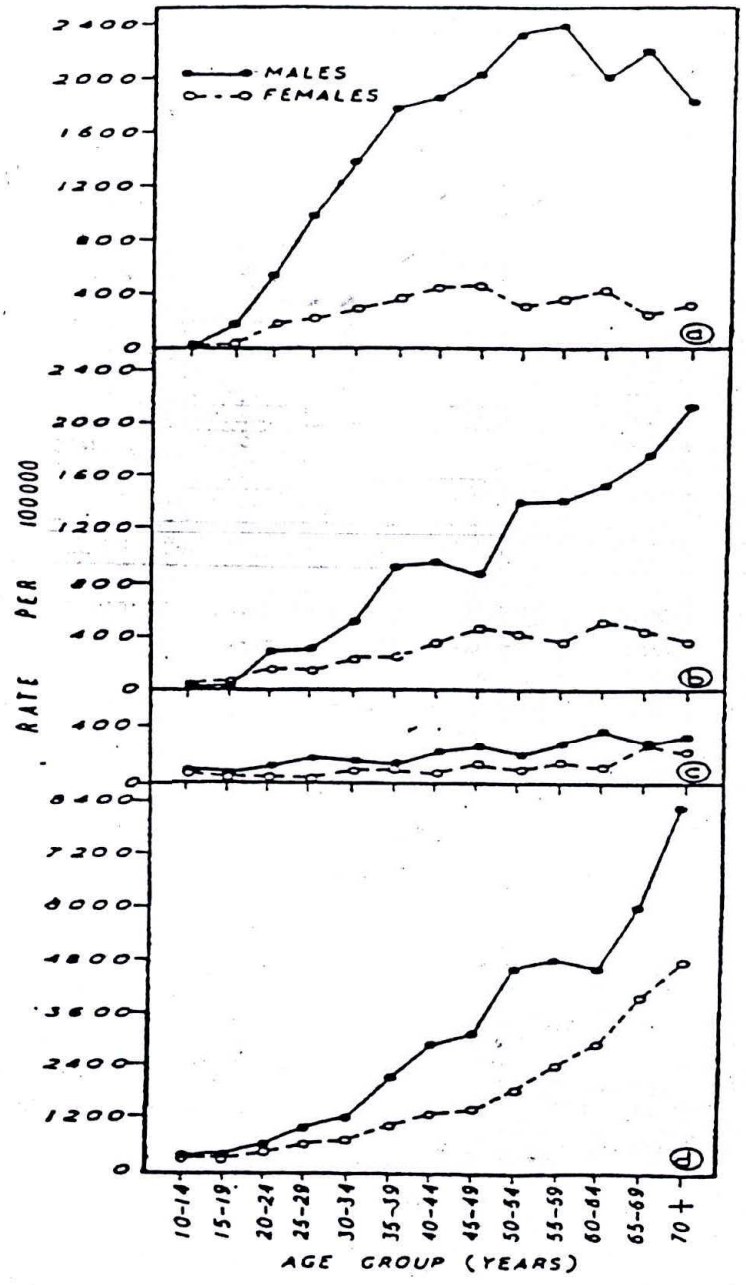
FIG 6

DISTRIBUTION OF AGE WISE PREVALENCE OF BACILLARY CASES IN THE COUMMUNITY



Source: Author (Unpublished)

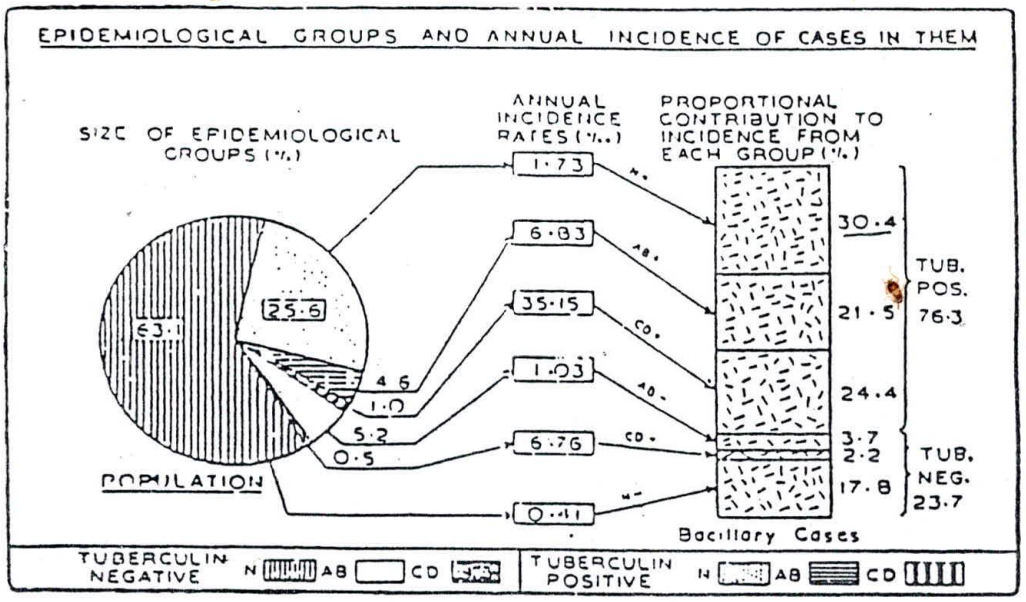
Fig. 7. PREVALENCE OF DISEASE BY AGE SEX AND METHOD OF DIAGNOSIS



Categories of cases :
a) Culture Pos. on 2 specimens
b) Culture Pos. on one specimen only
c) Culture Neg. smear Pos. (3 or more AFB)
d) Abacillary MMR - active (by 2 readers)

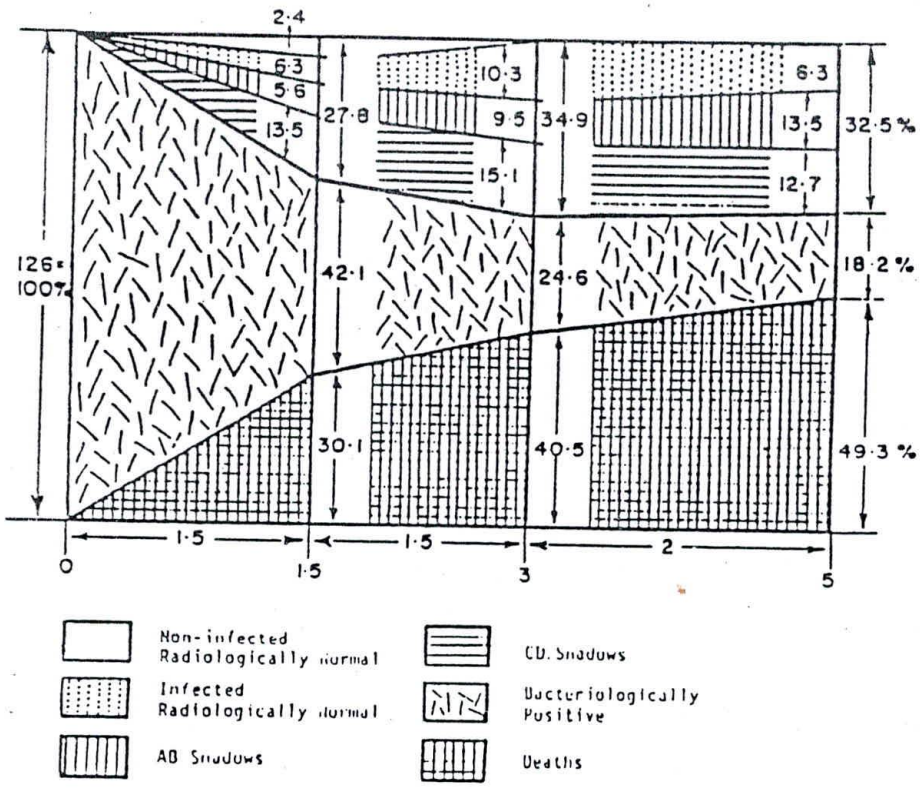
SOURCE : BCG. TRIAL[15]

Fig. 12. INCIDENCE OF SPUTUM POSITIVE TUBERCULOSIS IN DIFFERENT EPIDEMIOLOGICAL GROUPS



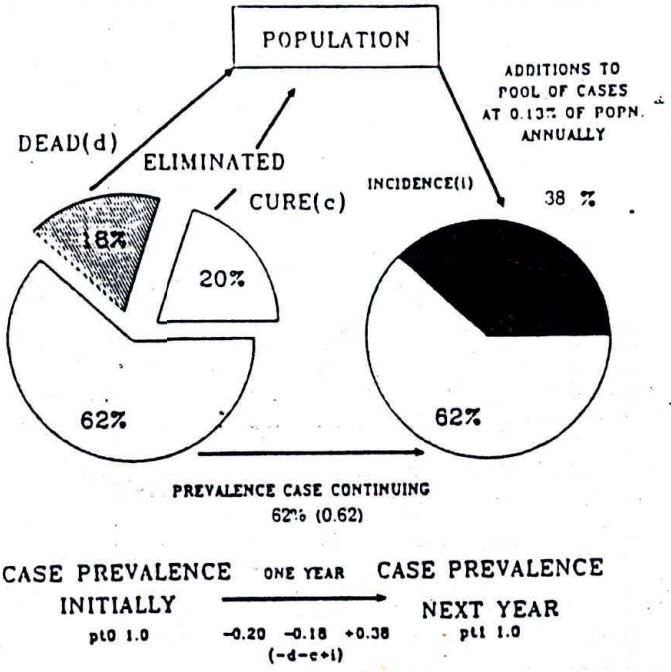
N : X-ray normals, AB : inactive tuberculous lesion and non-tuberculous shadows.
CD : Probably active tuberculous shadows.
SOURCE : Gothi et al[50]

Fig. 13. PROGNOSIS OF TUBERCULOSIS CASES DURING 5 YEARS OF OBSERVATION, ALL AGES AND BOTH SEXES.



SOURCE : OLAKOWSKI T. UNPUBLISHED[11]

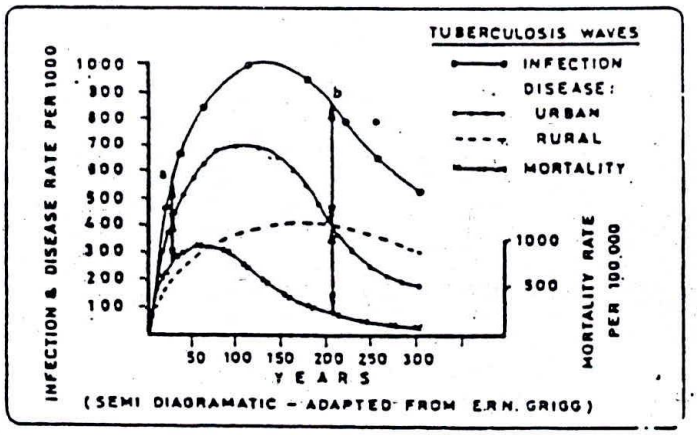
POOL OF TUBERCULOSIS CASES IN THE COMMUNITY
(NATURAL DYNAMICS)



Source Author (Unpublished)

Cure-43%
Died-29%
Failed 28%
Tubercle L D
1993; 74:
180-6

Fig. 15. DEVELOPMENT OF THE WAVE OF TUBERCULOSIS EPIDEMIC THROUGH TIME



SOURCE : CHAKRABORTY AK[47]

The tuberculosis epidemic curve appears similar in form to those of other infectious diseases. However, the former develops through centuries. It has an ascending limb (phase of spread), a peak (phase of transition) and a descending limb (phase of decline), followed by endemicity. The essential proximity of infection, disease and mortality curves characterises the phase of spread (shown with arrow 'a'). Wide gaps between one and the other rate develop at the peak and descending limb (shown with arrow 'b'). In India, gaps similar to the latter, exist now. An inference that could be derived is obviously of an advanced epidemic curve, probably in declining phase. The urban - rural epidemic curves are different entities - but could cross at some point in the descending phase. The urban - rural distribution presently observed in India, may be viewed in this light.

FIG 16. ANNUAL RISK OF INFECTION (ACROSS INDIA)

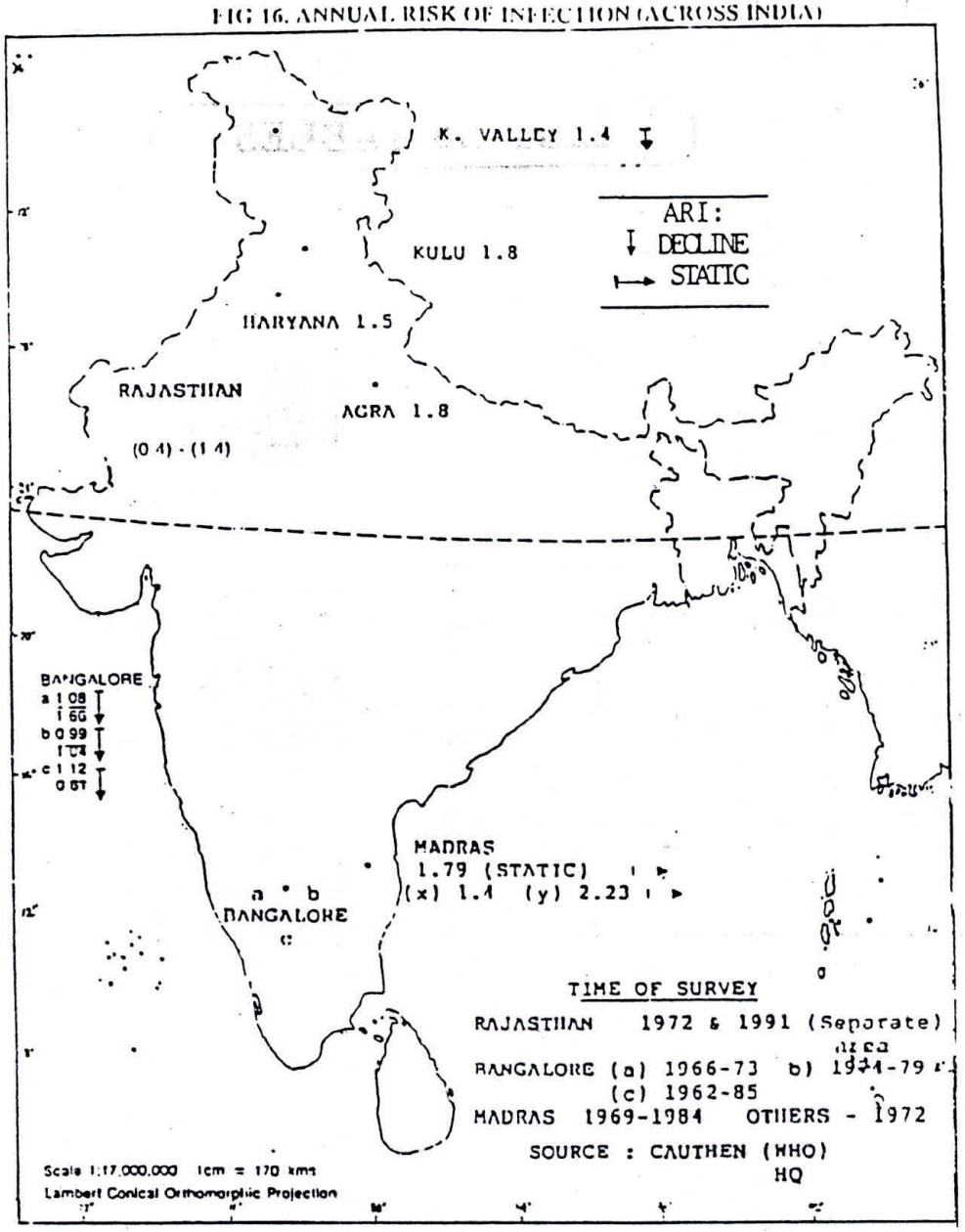
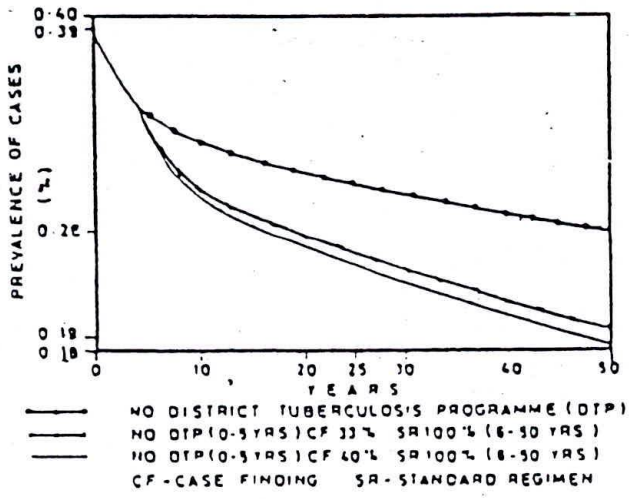


Fig. 17. MODEL DEPICTING HYPOTHETICAL TIME-TREND OF TUBERCULOSIS IN BANGALORE RURAL AREA.



SOURCE : CHAKRABORTY AK

LIST OF TABLES

Table 1: PROMINENT EPIDEMIOLOGICAL STUDIES IN INDIA REPORTED/UNREPORTED

Short Title	Reference	Year	Area	Design	Examined popn & age group	Method & investi- gations	Outcome
•Madanapalle Town study	5	1948 -49	Madanapalle town	Arbitrarily selected	Popn size 14,000	All ages-Tuberculin test PPD-S 1Tu-10 Tu-100 Tu MMR Sputum Culture	i)Infection rate ii)X-ray active case rate iii)Bacillary case rate
•Madanapalle study(M.S.)	6	1950 -55	Madanapalle town & rural area	Sample Survey	60,000 5+ in age	a)House to house census b)All ages-tuberculin test, PPD-S, 1Tu-10 Tu-100 Tu; c)5+ age MMR Sputum Culture	- Do -
•National Sample Survey(N.S.S.)	7	1955 -58	6 Zones: Hyderabad Madanapalle, Patna, Trivandrum, Delhi, Calcutta. Towns, villages & 1 city in each zone	Sample Survey representing 40% of Indian popn	Cities-131,319 Town-59,548 Villages-137,271 5+ in age	a)House to house census b)MMR 5+ in age FROM MMR-abnormals: c)Direct Smear of Sputum -2 Specimens d)Two laryngeal swab culture	i)X-ray active case ii)Culture positve case
•Tumkur Study	8	1960 -61	Tumkur district	Sample Survey	About 30,000 10+ age	a)House to house census; b)MMR 10+ age c)Tuberculin testing all 1Tu RT 23	i)Infection ii)Xray active case iii)Culture+ case
•Tumkur Resurvey	9	1972 -73	- Do -	- Do -	- Do -	- Do -	- Do -
•'Long'Survey (LS.NTI) Su 1 Survey 2 Survey 3 Survey 4 Survey 5	10,11 12	1961 -68 1961 -63 1962 -64 1964 -66 1966 -68 1977	3 sub-districts (taluks) of Bangalore dist	Sample Survey Sub-Sample	Popn 66,000 Age 5+ Popn about 14,500	a)House to house census b)Tuberculin test to all 1Tu RT 23 c)MMR-5+ age	- Do - Fate of infected, suspects, cases & other risk-groups
•LS:Followup	13, 14	1984 -86	Fresh Sample in 2 of the above 3 Taluks	Sample Survey	Popn. about 30,000 age 15+	Tuberculin 0-44 yrs 1Tu RT 23 Chest symptom questioning: 15+ yrs 2 specimens culture & smear exam from chest symptomatics/ tuberculin reactors	Infection & case rates

•BCG Trial (BCG.TL)	15	1968 Followup every 2½ for 7½ yrs	Chingleput district Tamil Nadu	Selected for study of BCG efficacy	All ages(1+) Ap-prox 360,000 in 209 contiguous villages and 1 town	a)House to house census b)All ages tuberculin test PPD-S c)MMR 10+ age, d)2 specimens of sputum from MMR abnormals - direct smear & culture	a)Infection rate b)Xray active cases c)Bacillary cases
•BCG Trial (Infection Trend)	16,17	1978 1983	- Do -	- Do -	Popn:1-9 yr. 10 yr trend: Survey 1, 8703 •15 yr trend: Survey 1, 4808	Tuberculin test PPD-S	Annual infection rate
•BCG Trial 6 resurveys	18	1968 -83	- Do -	- Do -	As in BCG trial with selected group for followup	MMR-5+ in follow up surveys	Incidence of cases
•Infection surveillance feasibility study	19	1983 -84	Anantpur dist AP Dharmapuri dist in TN	Arbitrary selected population	Aged:0-9 yrs Anantpur-4350 in 12 vils Dharmapuri-2077 in 6 vils	Tuberculin testing by general health workers 1Tu RT 23	Infection rate
•New Delhi study 6 surveys	20,21	1962 -75 (resurveys at 2½ yr intervals except Su6: after 4yrs from preceding)	New Delhi area under New Delhi TB centre	Population covered by Centre	Aged-5+ Approx 30,000	a)House to house census b)MMR c)MMR abnormals-culture of sputum & laryngeal swab d)Followup exam by xray, repeated sputum	Xray case, Bacillary case rate Prevalence & incidence of cases
•All India Tuberculin survey	23	1972	Villages in Kashmir, Kulu, Lohaghat Pithoragarh, Agra,Haryana, Rajasthan	Selected for altitude contrast	1-4 yrs Between 76-769 children in each	PPD-S, 5 Tu	a)Infection rate (ARI) b)Non-specific sensitivity
•Kashmir Survey	22	1978	Kashmir valley	Sample Survey	0-4 yrs popn 2448	Tuberculin testing PPD-S, 3Tu	Infection rate (ARI)
•Bangalore dist study on nutrition 2 surveys	22	1974 1979	Dodballapur subdist of Bangalore	Sample survey: repeated in same villages	Aged 0-4 yrs	a)Tubeculin testing 1 Tu RT 23 b)Nutrition assessment	Infection rate by nutrition grades
•Bangalore peri-urban study	24	1986 -89	Bangalore peri-urban area	Random Sample of villages in a 5 km radius 19 km from city centre	Aged 15+ 56,000 persons	a)House to house census b)Chest symptom screening c)MMR d)One specimen of sputum culture from eligibles by (b)/(c)	Symptom screened culture positive case rate
•Bangalore peri urban repeat study (under analysis)			- Do -	- do -	a)Aged 0-14 b)Old cases of previous survey	Tuberculin test 1 Tu RT 23	Infection rate (ARI) Fate of cases

•Wardha study	25	1981	Wardha dist in Maharashtra Central India	Purposive sample (whole dist)	Aged 5+ Popn 773,500	a)House to house census b)Socio-economic stratification c)Chest symptom questioning d)2specimens of sputum from symptomatics - culture & smear	Symptom-screened culture positive case rate
•Raichur study(Analysis not completed) by TRC Madras	26	early eighties	Raichur dist in Karnataka	Sample Survey	Aged 15+ Approx 70,000 in 56 villages and 21 town blocks	a)House to house census b)Chest symptom questioning c)2 specimens of sputum from symptomatic - culture & smear	- Do -
•Tribal study TRC	27	1980	Jawadhu hills of N.Arcot dist in TN	Sample Survey	Aged 15 + Tribal popn of 96,000 in 56 panchayats: 24 selected	a)Tuberculin test:1-9 yr (N-6702) 1TuRT 23 b)MMR 15+ age (N-12745) c)Chest symptom questioning 15+ age (N-15075) d)From symptomatics/MMR abnormals: 2 specimens of sputum-culture & smear	Culture positive case rate
•Nicobar study	28,29	1986	Car Nicobar island in Bay of Bengal	Entire island	Entire popn of 17,277 resident of 15 villages	a)Tuberculin test 0-14 (popn 5907) 1Tu RT 23 b)Chest symptom questioning 15+ age (popn 9514)	Infection rate, smear positive case rate
•Madhya Pradesh Tribal study by Regional Health office	30	1991	Morena dist in MP	Sample Survey	Aged 15+ Tuberculin test 1-9 yr (N-7642) Popn 23,000 in 37 villages	a)Tuberculin test 1Tu RT 23 - 1-9 yr age b)Chest symptom questioning 15+ age c)2 sputum specimens by culture/smear for chest symptomatics	Infection rate, smear positive case rate
•Rajasthan study by URMUL in Lunkaransar	31	1991 -93	Bikaner dist in Rajasthan	Arbitrary selection: 16 of 33 vil in Lunkaransar sub-dist	Popn 0-9 yr (N 2482)	Tuberculin test 1 Tu RT 23	ARI

NOTE: Other studies referred to in the text at respective places.

Table P.No.3

NTI Bulletin 1999, 35/1-4, 39-41

PERFORMANCE OF THE NATIONAL TUBERCULOSIS PROGRAMME – 1998

Vishweswara Sharma*

INTRODUCTION

National Tuberculosis Programme (NTP) of northern regions was monitored by Northern Regional Centre (NRC) at DGHS, New Delhi and southern regions by Southern Regional Centre (SRC) at National Tuberculosis Institute (NTI), Bangalore, till 1978. Since then, NTI has been monitoring the programme for the whole country. Monitoring is a continuous assessment of performance by certain key indicators of the programme through periodic (quarterly and annual) reports. These reports provide information on implementation, case finding and treatment activities and other related aspects. The basic organisational unit of NTP is the District Tuberculosis Programme (DTP), which consists of District Tuberculosis Center (DTC), usually situated at the district headquarters and Peripheral Health Institutions (PHIs), located in rural areas. The salient features on performance of NTP in terms of implementation, reporting, supervision, performance of case finding and treatment activities for the year 1998 are given in this report. Four quarterly reports on the above mentioned activities and one annual report on treatment completion pattern and outcome constitute the material for this report. In all, 1234 quarterly reports, 124 Standard Regimen (SR) annual reports and 154 Short Course Chemotherapy (SCC) annual reports were considered for analysis.

Implementation of DTP

Out of 548 districts in the country, programme is implemented through DTPs in 440 districts. Among the 440 DTPs, 254 (58%) are providing treatment with both SCC and SR and 145(33%) are providing only SR treatment. The remaining 41 (9%) districts are implemented under Revised National Tuberculosis Control Programme (RNTCP). The population coverage under SCC, SR and RNTCP are 61%, 22%, and 17% respectively.

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PHI Implementation

All medical and health institutions other than DTC, in a district are referred to as PHIs. The principal activities of PHIs are case finding, treatment, case holding, recording and reporting. Depending upon the facilities available, implemented PHIs are categorised as X-ray Centres (XCs), Microscopy Centres (MCs), and Referring Centres (RCs). From these PHIs, 70% of the expected reports were received in 1998. Among the reported DTPs, a total of 11202 PHIs are implemented under NTP.

Reporting by DTCs

NTI monitors the programme through the periodic (quarterly and annual) DTP reports received from DTCs. The reporting efficiency in 1998 is 70%. Reporting efficiency of quarterly reports decreased marginally from 71% in 1997 to 70% in 1998. This is because some of the RNTCP districts were submitting the quarterly reports directly to Central TB Division, DGHS, New Delhi. Moreover, most of the RNTCP districts have discontinued to report non- DOTs cases to NTI.

Supervision

The key personnel of the DTC viz., District TB Officer (DTO)/Medical Officer (MO), Lab Technician (LT) and Treatment organiser (TO) are expected to supervise all PHIs, at least once in each quarter. However, the supervision visits were made only in 42% of the PHIs, during 1998.

Case Finding Activity

Performance during the year 1998 with regard to X-ray and sputum examinations, new cases detected, total cases reported per lakh population and quality of case finding is shown in tables 1,2,3 and 4. On an average, 3984 new X-ray examinations and 10750 new sputum examinations have been carried out by DTPs. Of these, 58% of the

X-ray examinations and 59% of the sputum examinations have been contributed by PHIs (Table 1).

Among the total patients subjected for sputum examination, 863 were found positive by smear, 2408 by X-ray, and 211 were having extra pulmonary disease, per DTP (Table 2). Compared to last year 1997, the case finding has declined by 3.8% (Not given in table). This decline may be due to:

* Progressive coverage of the districts under RNTCP, which do not report NTP case finding.
* Decreased diagnosis of smear negative TB cases.
* Non reporting by newly created DTCs.

An overview of the statewise performance in total cases reported per lakh population (excluding under 5 years age group) during 1998 as shown in Table 3 depicts that some states like Arunachal Pradesh, Gujarat, Maharashtra, Pondicherry and Sikkim show better performance in case finding activity. The contribution of the above four states is 42% of the total case finding.

It is observed from Table 4 that the smear confirmation rate i.e., the percentage of sputum positive cases

Table 1 New Examinations done

Type	DTCs	PHIs	Total	Average/ DTP	Contribution of PHI%
X-ray	513569	713475	1227044	3984	58
Sputum	1342969	1967962	3310937	10750	59

Table 2 New Cases detected

Category of Patients	DTCs	PHIs	Total	Average/ DTP
Sputum positive	144046	121801	265847	863
Sputum Negative	390213	351478	741691	2408
Extra Pulmonary	42919	22068	64987	211
Total Cases	577178	495347	1072525	3482

Table 3 Total cases reported statewise per lakh population during 1998

Range	Name of the State
250 and above	Arunachal Pradesh, Gujarat, Pondichery, Sikkim, Maharashtra
250-100	A & N Island, Andhra Pradesh, Chandigarh, Goa, Harayana, Himachal Pradesh, Karnataka, Kerala, Mizoram, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh,
< 100	Assam, D & N Haveli, Bihar, Jammu & Kashmir, Orissa, Tripura, Manipur, Meghalaya, Nagaland, West Bengal

Table 4 Quality of Case Finding

Smear Rates	Observed(%)	Expected(%)
Confirmation Rate	27	32 - 35
Positivity Rate	5	8 - 10

confirmed among pulmonary cases is only 27% at national level, which is far below the expectation of 32% to 35%. This reflects the poor quality of X-ray reading and/or laboratory services. The sputum positivity rate at PHIs i.e., the percentage of sputum positive cases out of total sputum examinations made is 5% compared to the expectation of 8 to 10%. The poor performance of PHIs in achieving the desired sputum positivity rate calls for the need to strengthen the laboratory services. Proper and regular supervision by DTC staff is very much needed in this respect.

Treatment Efficiency

Treatment outcome of the cohort of smear positive cases diagnosed during 1996 from the annual reports received from the DTPs are given in Table 5. The analysis is done separately for the patients put on SR and SCC regimen. Patients making ten or more collections are likely to have favourable outcome in terms of bacteriological conversion.

Table 5 Treatment Result by cohort analysis

Category		Regimen	
		SR	SCC
Total Implemented Districts		440	254
No. of reports analysed		124	154
No. of patients initiated on treatment		79221	47029
Treatment Completed	Number	45221	14061
	%	57	30

The patients making 10+ collections were considered to have completed the treatment successfully. While treatment completion rate is 57% in 1997 for SCC patients, it is 30% for SR patients (Table not given).

It is also observed that the proportion of smear positive cases put on SCC compared to SR has increased during 1998. There is a trend that more number of patients have been put under SCC than SR.

Key Personnel

Out of 440 districts, 231(51%) districts have reported on position of the key personnel which shows that nearly 50% of all the key personnel viz., MOs, Statistical

Assistants (SAs), TOs X-ray Technicians (XTs), LTs have been trained in TB control programme.

Limitation

1. RNTCP patients put on DOTS are not included in the 1998 analysis.
2. In Revised SCC format, PHIwise coverage of the programme and important information on new examinations of sputum and X-ray are not available.

Conclusion

1. The performance needs to be improved, by increasing the trained manpower and supervision by STC and STO.
2. The reporting of cohort analysis of treatment outcome should improve.
3 The "Cure" rate under NTP is not available. It can now be obtained from revised SCC formats of quarterly reports.

STRENGTHENING.....PRIMARY HEALTH CARE

The districtis the frontline unit for planning, organizing and managing primary health care. Programmes have to be devised by governments, the voluntary sector and communities, all planning and working together. While considerable decentralization of authority is called for, overall national guidance and monitoring have to be provided by government. District health systems cannot be strengthened in isolation; the development of the whole system is essential to Unfortunately, there are increasing pressures to organize rersources for health along traditional, vertical lines the functionong of the different parts.

The holistic approach to health care will not work without determinmation and bold enlightened leadership. Unfortunately, there are increasing pressures to organize resources for health along traditional, vertical lines and to pursue goals and programmes in isolation. The organization of health systems based on the comprehensive objectives of primary health care is difficult, and practical experience in this area remains limited,particularly in international organizations. The sceptics who claim that the district approach is woolly and unmanageable should become more closely acquainted with what is going on in the field and should help to encourage joint action. Those working at government level in developing countries should be aware that the giving of special attention to primary health care in the district is a logical step towards health for all.

Source: *Tarimo E & Fowkes FGR : Strengthening the backbone of primary health care: Wld Hlth Forum 1989, 10, 79.*

NTI Bulletin 1999, 35/1-4, 14-17

QUALITY ASSURANCE OF SPUTUM SMEAR MICROSCOPY IN REVISED NATIONAL TUBERCULOSIS CONTROL PROGRAMME

M Jayasheela*

SUMMARY

The paper describes the broad framework of the steps in Quality Assurance of sputum microscopy and how these have been built in under the Revised National Tuberculosis Control Programme (RNTCP).

KEY WORDS : QUALITY CONTROL, PROFICIENCY TESTING, QUALITY IMPROVEMENT, SUPERVISION.

INTRODUCTION

The success of RNTCP depends upon proper categorization of Tuberculosis (TB) patients and their treatment under Directly Observed Treatment Short course (DOTS). Sputum smear microscopy is essential for proper diagnosis & categorization of the patients and is thus invaluable for assessing the treatment outcome.

Quality Assurance Programme (QAP) has been given due priority in the programme. The programme has identified some national institutions as central laboratories for this purpose[1]. National Tuberculosis Institute (NTI), Bangalore is one such Institute to which eight State Tuberculosis Centres (STCs) have been attached; they are: Agra, Ajmer, Ahmedabad, Bangalore, Calcutta, Kangra, Patiala, Srinagar, irrespective of their status of functioning under National Tuberculosis Programme (NTP) or RNTCP.

MERITS AND DEMERITS OF SPUTUM MICROSCOPY

The merits of sputum microscopy are (i) it is simple and inexpensive and can be established in any part of the country easily (ii) results are available quickly and are easy to interpret (iii) can identify an infectious patient and (iv) helps in assessing the effectiveness of the treatment. The main demerit of sputum microscopy is low sensitivity. Neither serological tests nor radiology can act as gold standard because of their own inherent weaknesses. Though histopathology and cultural techniques can be definitive in diagnosing TB, these are not widely available and are difficult to establish. Hence, the only practical way available as a Quality Control measure for sputum microscopy is to ensure that a set of given slides are read by two readers and slides with discordant results are read by an umpire reader whose findings will be treated as final. It is not that the umpire is always right. He may also make mistakes. But that is to be accepted as a shortcoming of the system for want of a better procedure.

QUALITY ASSURANCE PROGRAMME

International Union Against Tuberculosis and Lung Diseases (IUATLD) has described Quality Assurance in sputum microscopy[2] under three heads viz., (a) Quality Control (b) Performance Testing and (c) Quality Improvement.

Quality Control: This essentially refers to the internal monitoring of a laboratory that allows the frequency of errors to be estimated against established limits of acceptable test performance and helps in determining the competence of their sputum microscopy services. Quality Control of sputum microscopy envisages the following as important inputs viz.,

i) Infrastructure: For a well equipped laboratory, it is a must that it should have a good binocular microscope, staining facilities, continued supply of quality stains/reagents, slides, slide boxes, forms / registers and such other necessities, besides running water supply and power supply,. Care must be taken to ensure that there are no shortcomings in this component.

ii) Sputum: Sputum brought out properly by the patient as described in the programme manual[3] is essential if sputum microscopy has to be of any use to the programme. Every effort has to be made to obtain proper sputum sample and not merely saliva from a patient.

iii) Procedure : All the laboratories participating in the programme should follow a single Standard Operating

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Procedure (SOP) as described in the guidelines for preparation of sputum smear, staining, reporting and recording so that the results of different laboratories are comparable.

iv) Performance (human factor) : Sputum smear microscopy for AFB is not difficult to learn; but its challenge lies in the perseverance of continued high quality reading. How well a technician performs and continues to perform under routine conditions is of vital importance.

Performance Testing : It is a method available for a laboratory to assess its diagnostic services by comparing its results with those obtained from other laboratories i.e., performance monitoring with inputs from an external agency.

Performance testing can be carried out in three different ways i.e.,

1. **Centre to Periphery:** The simplest way of assessing the performance of a peripheral laboratory is to send a panel of slides from a central laboratory which has requisite expertise for reading/reporting and then compare the results. As ready made slides are sent, this procedure does not evaluate smear making/staining abilities of the peripheral unit. Similarly, as the technician has unlimited time for the examination of slides sent and is aware of being tested; this method does not allow the assessment of his work under routine conditions. It can only measure the ability of the technician to read the slides correctly. This method can be used after training the new technicians or conducting refresher courses to assess the performance.

2. **Periphery to Centre** : This is a method of proficiency testing wherein a sample of routine smears from a peripheral laboratory are re-read at a designated centre. Re-examination is done using the same technique as used in the peripheral laboratory, specially the same number of fields as specified in the guidelines and not more to ensure proper comparison. Findings of the umpire reader will be taken, as final wherever there is discordance. This method is the most suitable method of proficiency testing as it allows routine work of technician in all its entirety i.e., smear, staining and reporting quality to be assessed but not just the ability of the technician under test conditions, without any extra work load on the peripheral laboratory. As his routine work is going to be assessed at a designated level on a regular basis, a technician is bound to be extra cautious in carrying out sputum microscopy.

3. **Supervision** : Visits by staff from a designated laboratory to a peripheral laboratory would be of great use in getting a realistic picture about (a) Personnel, infrastructure, safety and equipment (b) stocks of supplies/consumables (c) Registration, recording and reporting and (d) performance, so that deficiencies can be identified and remedies found. However, it is difficult to organize visits to all the laboratories by a national laboratory and such visits are necessarily to be carried out by intermediate (State or District) authorities.

Quality Improvement : It is a process of removing obstacles for conducting quality sputum smear microscopy successfully and ensuring non-recurrence of the problems..

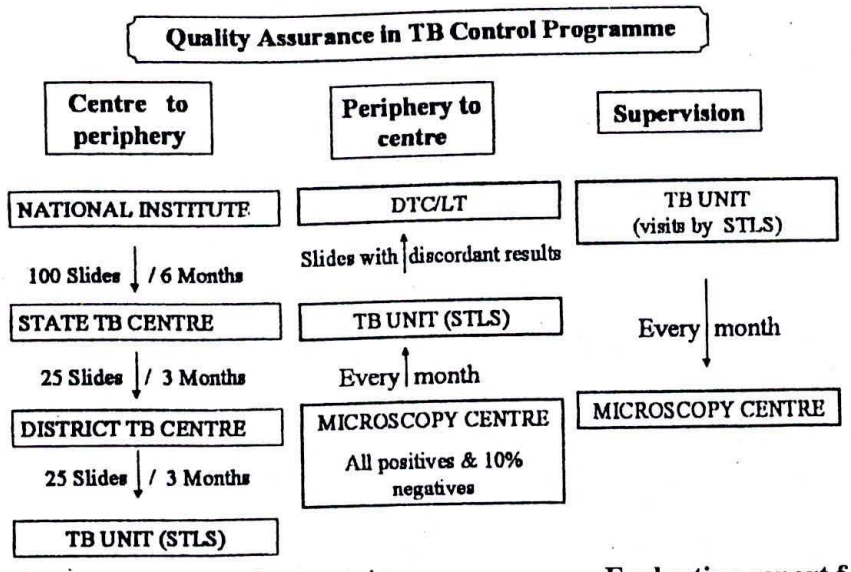
RNTCP encompasses all the above three components viz., Quality Control, Performance Testing and Quality Improvement. to ensure quality sputum microscopy to be carried out under the programme conditions[3].

Quality assurance in TB control programme carried out by NTI (centre to periphery) & from microscopy centre to the TB unit & DTC (periphery to centre) and supervisory visits to the TB unit and microscopy centre is shown in the flow chart.

a) **Centre to periphery:** NTI sends a panel of 100 stained sputum smear slides (made as per guidelines given for the purpose) once in six months to these STCs for reading/reporting. The panel consists of negative slides as well as positive slides of various grades, all arranged in a random fashion. Each technician in the STC reads the slides independently and the results are conveyed to NTI within a month, which compares the results of each technician with its own findings. Discordant results (false negatives or false positives) when it is less than 5% are considered satisfactory. The evaluation results with remarks will be conveyed to the STC concerned. STCs in turn would repeat such an exercise by sending a panel of 25 slides (with predetermined percentages of negative and positive slides of various grades) to different District Tuberculosis Centres (DTCs), once in a quarter, under their jurisdiction. The DTCs should ensure that each technician reads them independently and send the results to STCs within a month.

b) **Periphery to Centre:** The Senior Tuberculosis Laboratory Supervisor (STLS) after his monthly supervisory visit to the microscopy unit, sends all the slides with discordant results to a designated laboratory (DTC) for verification. The results of re-examination with comments should be sent back to the STLS/microscopy unit within a month.

Flow chart



c) **Supervision**: Each microscopy centre is expected to preserve all its slides till a sample from the lot has been subjected to quality control. All the positive slides and 10% negative slides will be re-examined by STLS during his monthly visit to the unit. He will use this opportunity to understand the plus and minus points of that unit including sputum collection/smear making/staining procedures, condition of the laboratory, stocks of consumables etc., and to guide/encourage the technician concerned to achieve optimal performance. He should submit his findings in the prescribed format given below to his controlling officer.

Proficiency Testing Periphery to Centre (an example) Frequency . Quarterly	
No. read as Pos. in the microscopy centre	40
No. confirmed by STLS	30
No. read as Neg. in the microscopy centre	398
No. reviewed by STLS	40
No. confirmed out of above	38

CRUCIAL POINTS TO REMEMBER

* Ziehl Neelsen Staining for acid fast bacilli will fade with time specially in hot and humid conditions. Under such circumstances, it is necessary to restain the slides before taking them up for re-examination.
* The purpose of quality control is to identify the laboratories which are under performing for improvement. Labeling a well performing laboratory as under performing is of minor significance compared to labeling an under performing laboratory as good laboratory.

Evaluating report format

Initial reading & No. of slides	Supervisors reading		Percentage Discordance*
	No. positive	No. negative	
No. of positive slides (40)	39 (a)	01 (b)	(b/[a+b]) 1/39+1 = 1/40 x 100 = 2.5% False Positive
No. of negative slides (40)	02 (c)	38 (d)	(c/[c+d]) 2/2+38 = 2/40 x 100 = 5% False Negative

* The permissible limit for both false positive and negative is ≤ 5

* Scanty positive slides are the ones that are most likely to be missed. Every effort should be made to correctly identify such slides. Minor variations in the grading of smears will not affect categorization of patients. However, labeling positive slides as negative will lead to wrong categorization and may deprive the real TB patient from treatment.
* Every negative slide that has been wrongly labeled as high positive needs probing to ascertain the reasons and to take remedial action. Normally, this will be very rare and are mostly due to administrative error.
* Sputum microscopy can neither differentiate pathogenic and non- pathogenic mycobacteria nor live and dead organisms.

CONCLUSION

The procedure adopted for Quality Control of sputum smear microscopy in RNTCP is simple and eminently practicable and if implemented sincerely will ensure

accurate diagnosis and proper categorization of tuberculosis patients, which is a must for the success of the programme.

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3. Central TB Division, New Delhi: Manual for Laboratory Technicians under RNTCP; DGHS, Min of Hlth & FW, New Delhi 110 011; September 1997.

SEEING THE PATIENT "WHOLE "

Our present system of medical education is founded on the belief that the patient's symptom arises from "disease". We are taught which symptoms occur in which disease, we construct differential diagnisis, and these we seek by examination and investigation to identify the disease which has caused the symptom.

The reality, however, is quite the opposite. The vast majority of symptoms complaind about to do not aim from disease, and are much more clearly related to "problems of living", for want of a better phrase.....Disease and emotional problems commonly co-exist. It all feels the same to the patient. The only useful way forward is to see the patient, in the round as an individual, with a family role, a work role and a social role.

Source: Raymond Pietroni, in a Hospital doctor, Vol.3.No.24. 16 June 1983, P.19.& World Health Forum, Vol.4.P.130

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BRIEF ON
NATIONAL TB CONTROL PROGRAMME

Every year 2 million people in India develop tuberculosis (TB) and nearly 500,000 die from it – more than 1000 every day. The Human Immunodeficiency Virus (HIV) is estimated to have infected 3.5 million people in India. HIV associated TB and the emergence of multidrug –resistant TB will increase the magnitude and severity of the TB epidemic. Tuberculosis has devastating social costs as well – data suggests that each year more than 300,000 children are forced to leave school because their parents have TB, and more than 100,000 women with TB are rejected by their families.

This continued burden of disease is particularly tragic because TB is nearly 100% curable. Untreated patients can infect 10-15 persons each year, poorly treated patients develop drug resistant and potentially incurable TB.

Programme review –1992 :

In 1992 programme review by an expert Committee indicated that despite the existence of a National TB Control Programme since 1962, TB patients were not being accurately diagnosed and most patients did not complete treatment. The 1992 review led to the Revised National TB Control Programme (RNTCP), implementing the DOTS strategy.

Revised National Tuberculosis Control Programme (RNTCP)

Based on the findings and recommendations of the Review, the Government of India evolved a revised strategy with the objective of curing at least 85% of new sputum positive patients and detecting at least 70% of such patients. The RNTCP is an application to India of the WHO-recommended the Directly Observed Treatment, Short Course (DOTS) strategy to control TB and hence prevent emergence of multidrug resistance. The components of the strategy are: i) Political and administrative commitment at all levels, ii) Diagnosis through quality sputum microscopy of patients attending peripheral health facilities, iii) Uninterrupted supply of Short-Course Chemotherapy drugs, which are given in patient-wise boxes, iv) direct observation of treatment through involvement of peripheral health functionaries, NGOs and community volunteers, and v) systematic monitoring, evaluation, and supervision at all levels.

The revised strategy was initially pilot tested in 1993 in a population of 2.35 million and it showed remarkable success. The RNTCP was then extended to a population of 13.85 million to assess its operational feasibility. Having proved both its technical and operational feasibility, a soft loan of US $142 million

Contd/...

In past year RNTCP has been expanding rapidly and reached around 313 million by end 2000 as under :

First year of the project i.e. 1998-99 – 89 million
Second year coverage i.e. 1999-2000-136 million.
Third year coverage i.e. 2000-2001 upto December 2000 only – 313 million.

By the end of this year it is expected that population coverage will reach the approved 400 million.

DFID Assistance

Department for International Development (DFID) has reached an agreement with the Government of India to support the TB Control Programme for five years by implementing RNTCP in the entire state of Andhra Pradesh. The estimated cost of the Project is Rs. 109.93 crores. The proposal has been approved by the Government of India. The service delivery in the 1st year Districts of Andhra Pradesh was started from 3rd quarter 2000. DFID is also providing assistance for strengthening Central TB Division.

DANIDA Support

DANIDA has started RNTCP in 14 districts of the state of Orissa at cost of Rs. 31.95 crore over a period of five years. The coverage will be also in a phased manner. Presently, six Districts --Mayurbhanj, Keonjhar and Sundergarh, Sambalpur, Jharsiguda and Deogarh--are implementing the revised strategy. During 2001 other remaining Districts will be covered under the revised strategy. Above phase I will expire by December 2001. Now under phase II the proposal by Govt. of Orissa to cover remaining 16 districts so as to cover whole of State under RNTCP with help of DANTB is in progress.

Involvement of NGO/Private for the profit health providers.

Involvement of NGOs and Private practitioners in the National Tuberculosis Control Programme is of vital importance as a good proportion of patients seek treatment from them. Programme encourages participation of NGOs/PPs in Programme implementation. An NGO policy has been formulated and widely disseminated. Five different schemes for involvement of NGOs have been envisaged. Under the RNTCP, it is proposed to ensure full involvement of NGOs in different activities of TB control, with selection and monitoring of performance being done at District/State levels. Depending on the capacity of the NGOs it is being proposed to involve them at appropriate levels in planning, programming,

Budgetary inputs in IXth Plan

Approved budgetary allocation for 9th five year plan is Rs.450.00 crores(EAC-Rs.312.50 crores and GC-137.50 crores). Year wise budgetary allocation and Expenditure for TB control Programme are as under:

National TB Control Programme

	Centrally sponsored scheme	Amount (Rs. in Crores)
Ninth Plan (1997-2002) Approved outlay	450.00	450.00
1997-98 (Outlay as Budgeted	80.00	80.00
1997-98 (Actual expenditure)	32.00	32.00
1998-99 (Outlay as Budgeted)	72.00	72.00
1998-99 (Actual Expenditure)	68.50	68.50
1999-2000 (Outlay as Budgeted)	95.00	95.00
1999-2000 (Actual Expenditure)	87.50	87.50
2000-01 (Outlay Budgeted)	110.00	110.00
2000-01 (Actual expenditure)	110.00	110.00
2001-02 (Proposed outlay)	160.62	160.62

Budget requirements for X Plan (2002-07)

Total Plan (2002-07) (Proposed outlay)		1000.00	1000.00

During IX plan Rs. 450 crore is likely to be fully utilised for coverage of population around 500 million under RNTCP. Therefore, approximately Rs. 1000 crore will be required for coverage of entire population of the country during 10th plan period.

Status of RNTCP

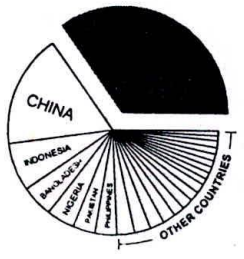
Central TB Division
Ministry of Health and Family Welfare
Nirman Bhavan, New Delhi 110 011

Burden of Tuberculosis

"If the number of victims which a disease claims is the measure of its significance, then all diseases, particularly the most dreaded infectious diseases, such as bubonic plague, Asiatic cholera, etc., must rank far behind tuberculosis."

Robert Koch. *Berliner klinische Wochenschrift*, 24 March 1882; 19:221

India Accounts for Nearly One Third of the Global TB Burden



TB: Burden of Disease

- 14 million TB cases out of which about 3.5 million are highly infectious sputum positive cases
- 2 million new cases out of which 1 million are new smear positive
- 5 lakh deaths/year, >1,000 deaths/day, 1/minute
- Multidrug-resistance and HIV are making the epidemic much worse

Social and Economic Burden

- Indirect costs to society of $3 billion per year
- Direct costs of $300 million
- Loss of 100 million productive work days per year due to illness only
- Every year, due to TB deaths, India is losing more than 130 crore productive work days
- More than 300,000 children leave school as a result of parents' TB
- More than 100,000 women rejected by families on account of TB

TRC. Socio-economic impact of TB on patients and family in India. Int J Tub Lung Dis 1999 3: 869-877

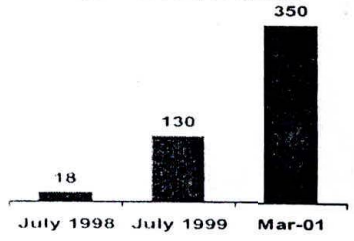
Status of TB Control in India

- **1950s-60s:** Important TB research
- **1962:** National TB Programme
- **1992:** Programme Review- only 30% of patients diagnosed and only 30% of those treated successfully
- **1993:** DOTS pilots
- **1998:** DOTS scale-up begins
- **2000:** > 30% of country covered by DOTS

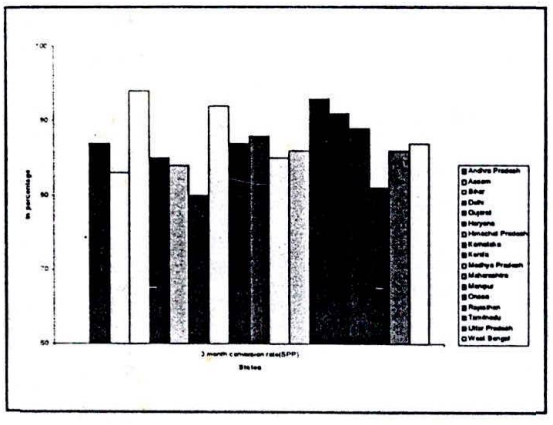
TB Control- coverage plans

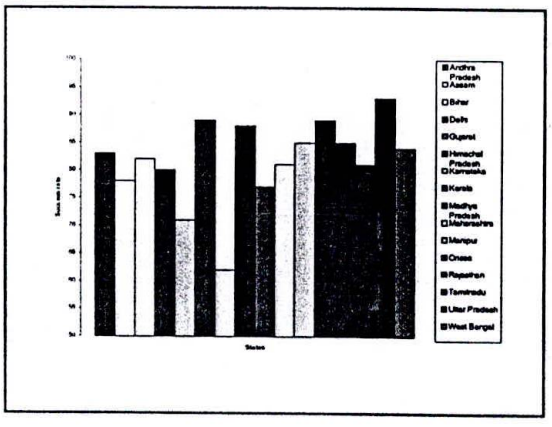
- **2001:** 400 million population by end of this year
- **2004:** 700 million population by March
- **Entire country as soon as technically and operationally feasible**

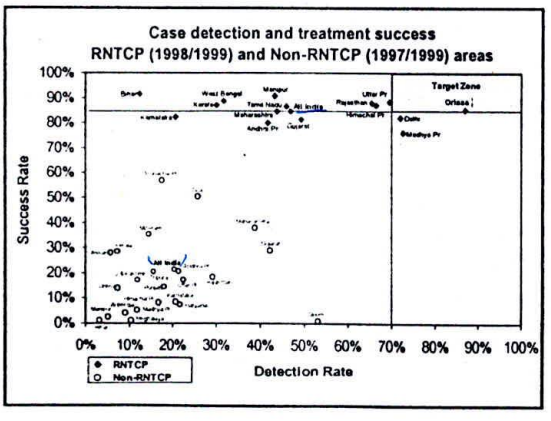
20-Fold Expansion of DOTS in India in just 3 years



More than 1/3rd of the population of India has access to DOTS







RNTCP results in India

- Rapid expansion
  - covering 1/3rd of country
  - 2nd largest DOTS programme in world
- Accurate diagnosis
  - More than 4 lakh microscope exams per month
  - Diagnostic confirmation at globally expected levels
- Reliable cure
  - More than 8 of 10 patients cured (compared with less than 4 of 10 in previous programme and private sector)

RNTCP: impact to date

- Each month, nearly one crore patient visits to health facilities, > 30,000 sputum slides are examined & > 3,000 patients started on treatment
- > 5 lakh patients placed on treatment, saving nearly 1 lakh lives & preventing >10 lakh infections
- To achieve above
  - >1.5 lakh health workers underwent modular training
  - 1,400 supervisors appointed
  - 75 lakh microscopic examinations
  - nearly 2 crore directly observed doses

Systematic monitoring and accountability

- Good record keeping is the cornerstone of success
- The DOTS recording system enables
  - monitoring of patient outcomes
  - evaluation of programme performance
  - analysis of epidemiologic data
  - operational research
- Every level of the health system accountable for diagnosis and cure

Supervision

- Effective supervision at all levels is key to success
- Key areas:
  - ✓laboratory work
  - ✓patient categorization
  - ✓direct observation
  - ✓drug storage and stock
  - ✓record keeping
  - ✓reporting

Operational problems

- Weak primary health care infrastructure
- Low priority given to tuberculosis in most states
- Extensive use of private sector which provides poor quality diagnosis, non-standard treatment regimens, lack of record-keeping, and lack of follow-up resulting in poor treatment outcomes
- Involvement of private sector, non-governmental organizations, civil society

Evaluation: Joint programme review in Feb 2000

Key findings:

Successful implementation

-patients accurately diagnosed

-drug supply regular and uninterrupted

-increase in proportion of patients cured

-sound technical and training policies

-intensive monitoring & supervision

Evaluation: Joint programme review in Feb 2000 (contd.)

Key findings:

Constraints

-not all health care providers are involved

-difficult to coordinate care in areas with weak primary health care system

-treatment observation often not sufficiently convenient to patients

-lack of awareness of the programme

Strategic directions for RNTCP

- Patient as VIP in reality and not name only-treated respectfully
- Involvement of all sectors
- Expansion to cover entire country in phased manner
- Decentralisation of functions to States

Alternative approach to service delivery

- Involvement of corporate sector
- Implementation of NGO policy
- Involvement of PPs
- Other health sectors: Medical colleges, ESI, CGHS, Armed forces
- Community volunteers as DOT providers

Service Delivery by NGOs

- According to RNTCP policy
- Schemes for
  - Health education and community outreach
  - Provision of Directly Observed Therapy
  - In-Hospital care for TB disease
  - Microscopy and treatment centre
  - TB Unit Model

Key roles for NGOs

- Community education -- awareness of availability of and right to services
- Making treatment observation patient-friendly and patient-centred
- Supporting government health services
- Operating health services independently, following policies of, and coordinating with, government authorities
- Watchdog function -- constructive engagement to ensure availability of services as per policy

Mechanism of Decentralization

Societies formed at States and District levels and provided with funds

State specific PIPs for progressive decentralisation of functions

At state level

-Additional financial powers

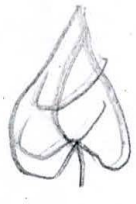
-Planning & budgeting

-Project monitoring

-Logistic management

Decentralization to States

- States to become primary unit of accountability for Central Govt, rather than districts in a phased manner
- Capacity to be built at State level
- Programme, financial, and logistics matters to be decentralized to States



Decentralization:Programme

- Capacity and funds to monitor and supervise (STC, STDC)
- Quarterly meetings at State level
- Feedback from State to district
- Monitoring at TU level not only district level
- Rapid problem-solving by Secretary/others within State

Decentralization:Financial

- Capacity and funds to handle and monitor financial matters
- Tracking of SOEs and correction
- Annual audits from single agency State-wide
- Preparation of budgets

Decentralization:Logistics

- Training of State TB Officers
- Specific to States
- Most states all RNTCP loose drugs
- Most states state-wide distribution
- Printing at State level

Current Assistance

Donor Agency	Period of the Project	Total assistance (Rs. in Crores)	Expenditure up to 1999-2000
World Bank	1997-2002	604.86	133.00
DANIDA	1998-2003	31.90	--
DFID	2000-2005	109.93	--

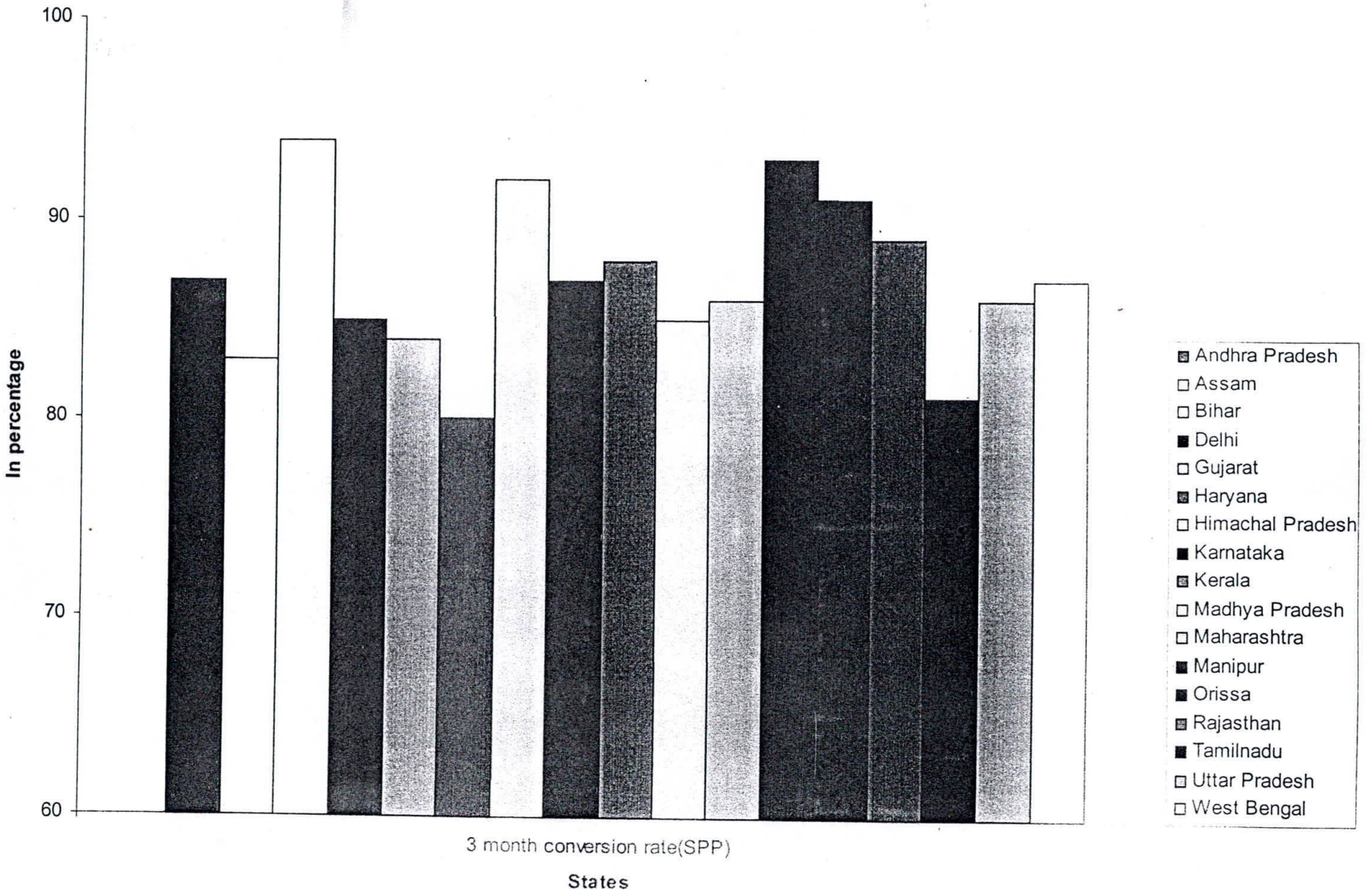
Current Assistance

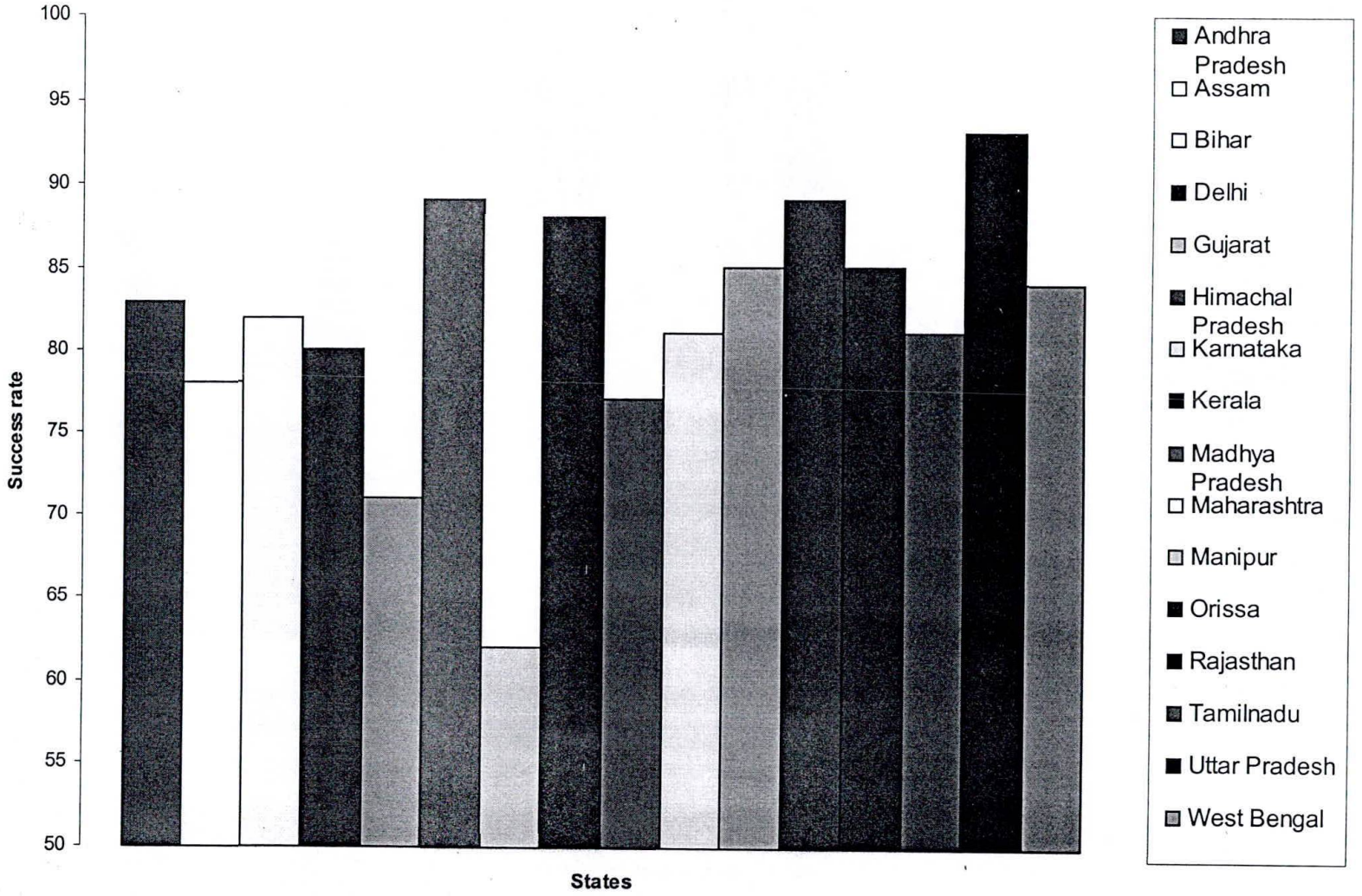
Year	World Bank Assisted Project	* DANIDA Assisted Project	** DFID Assisted Project
1997	20	--	--
1998	20	5	--
1999	135	6	--
2000	250	10	22
2001	360	13	45
2002	400	--	75

* ***DANIDA assistance will cover 14 tribal districts of Orissa with a population of above 13 million***

** ***DFID assisted project will cover the entire population of about 75 million in Andhra Pradesh***

Website is now available


100
90
80
70
60
In percentage
3 month conversion rate(SPP)
States
Andhra Pradesh
Assam
Bihar
Delhi
Gujarat
Haryana
Himachal Pradesh
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Orissa
Rajasthan
Tamilnadu
Uttar Pradesh
West Bengal


100
95
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50
Success rate
States
Andhra Pradesh
Assam
Bihar
Delhi
Gujarat
Himachal Pradesh
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Orissa
Rajasthan
Tamilnadu
Uttar Pradesh
West Bengal

Government of India
Ministry of Health and Family Welfare
(National AIDS Control Organization)

National AIDS Control Programme

1. Estimated burden (1996, 2002-2006)

The National AIDS Control Programme is a 100% Centrally Sponsored Scheme (CSS) implemented as a vertical programme through State AIDS Control Societies (SACS). Keeping in view the complexities of HIV infection, non-random distribution, occurrence of behaviour influencing HIV transmission, it is difficult to make exact estimates of HIV prevalence. It is more so in the Indian context, having its typical and varied cultural characteristics, traditions and values with special reference to sex related risk-behaviours. To estimate the total burden of HIV infection in the country, some efforts had been made in the past by WHO/UNAIDS by using the data generated by NACO and other publications from various research institutes in India. The different estimates of disease burden in the country reported by these organizations are as follows:

Year	Agency	Estimates
1990	GPA/WHO	0.05-0.2 million
1992	GPA/WHO	1 million
1993	GPA/WHO	2 million
1994 (end)	NACP	1.75 million
1996 (mid)	UNAIDS/WHO	2.5 million
1997 (mid)	MAP	2.5 million

1.1 HIV Sentinel Surveillance:

The Sentinel surveillance for HIV infection was initiated in the country in year 1994 by identifying 55 sentinel sites including, both high risk group sub-population, i.e. STD clinic attendees and low population sub

group at antenatal clinics. In year 1998, the network of sentinel sites was expanded to 180 sites all over the country. During August-October, 1998, round of sentinel surveillance, all States/UTs participated. Since then, every year, during the period of August-October, Sentinel surveillance is conducted covering the same sites. A sample size of 250 samples for high risk group, attendees and 400 samples for low risk group of population, i.e., antenatal clinic attendees are collected, maintaining "Unlinked Anonymity" of whole procedure. In year 2000, the number of sites was increased to 232. Based on the Sentinel surveillance, States/UTs can be categorized into: (i) High prevalence States- where HIV prevalence among antenatal mothers is 1% or more. These are Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, Manipur, and Nagaland; (ii) Moderate prevalence States, where HIV prevalence rate in antenatal women is less than 1% but the prevalence among high risk group is 5% or more. The States/UTs like Gujarat, Pondicherry and Goa fall in this category; and (iii) Low prevalence States: where HIV prevalence among high risk group is less than 5% and among antenatal women is less than 1%. All other States belong to this category.

1.2 Accuracy and Reliability:

In order to maintain the accuracy and reliability of data following steps have been taken:-

(i) Consistency in sites: Sentinel Surveillance is conducted at the same sites each year during the same period of the year, i.e. August-October.

(ii) Training of medical and paramedical staff: All functionaries of the sentinel sites as well as the testing laboratories are trained/ retrained each year before commencement of the Sentinel Surveillance.

1.3 Supervision :

Three tier supervision mechanism is adopted to maintain the quality of the data collected through sentinel surveillance system. These are as:

(a) Task Force Members: Govt. has constituted a task force on Surveillance, comprising of experienced biostaticians, epidemiologists and researchers. They conduct field visits and provide feed back to NACO as well as State AIDS Control Societies for any mid course correction.

(b) Regional Co-ordinating Teams: National Institute of Health is the nodal Institutions for coordinating sentinel surveillance activities. They have constituted a team of experts belonging to the disciplines of Microbiology, Epidemiology and Venereology in medical colleges. These teams make field visits twice during the period of sentinel surveillance to provide technical support to the functionaries of sentinel sites or laboratories where samples are tested for HIV.

(c) State AIDS Control Societies: Officers from SACS also visit sentinel sites randomly to ensure the quality of data being collected at the Sentinel sites and laboratory procedures being followed for HIV testing.

For standardization of the procedure, check list and manual are provided to functionaries involved in sentinel surveillance operation.

Based on nationwide Sentinel surveillance results and certain assumption taken into consideration, the estimated number of HIV infections in year 1998, 1999 and 2000 is as follows:

(In Millions)

Year	Point Estimate	20% range	
		Lower	Higher
1998	2.97	2.32	3.51
1999	3.09	2.43	3.72
2000	3.22	2.58	3.86

During the period, 2001-2006, it is estimated that the number of new infections would be 4-6- million.

1.4 Problems in Making Estimates:

It is an institutional based surveillance and therefore, the catchment area may vary from are round to another. The samples collected at sentinel sites may not be the true representatives of the population. Besides, the sentinel sites may not capture all the subpopulation sub groups practicing high risk behaviour. The assumptions made in HIV estimates need to be validated time to time.

1.5 Methods for improvement in 10th Plan Period.

It is envisaged to cover additional sentinel sites in rural areas in order to estimate the disease burden separately for rural and urban areas. The assumptions being used currently in estimation of HIV disease burden would be validated by conducting community based cross sectional studies. Besides, reporting of AIDS cases and deaths should strengthened.

2. Status of National AIDS Control Programme

In order to combat the onslaught of the HIV/AIDS epidemic effectively, the Government of India established National AIDS Control Organisation (NACO) in 1992. A National AIDS Board was constituted under the chairmanship of Secretary (Health), Ministry of Health & Family Welfare in order to review NACO policies, to expedite sanction, approve procurement and to undertake and award contracts to private agencies. A comprehensive programme with World Bank assistance was initiated in 1992 for a period of five years, which was extended till March, 1999. Achievements included much higher levels of awareness creation, the putting in place of State level structures for programme implementation and improvements in "Blood safety". The launch and consolidation of successful individual intervention projects such as the innovative work in Sonagachi amongst commercial sex workers and breakthroughs in reaching out to college youth through University Talks AIDS (UTA) programme were amongst its achievements. The scope of these efforts remained, however, on a limited scale; political acceptance was weak and ownership of the programme by the States proved difficult to establish. Involvement of Non Government Organisations (NGOs) at the peripheral level and of quality needed for sustained interventions proved difficult to obtain. And while the emphasis was on blood safety and strengthening of infrastructure, the approach remained primarily medical, with HIV being seen as largely a health issue. Although the 1st phase of the National AIDS Control Programme was for five years, due to slow implementation in the initial period it was extended to March, 1999.

In order to strengthen the programme management at the state level, the State Governments have established their own managerial organisations, which include State AIDS cells, Technical Advisory Committees and empowered committees as per the guidelines of the strategic plan.

ACHIEVEMENTS:

1. Intensive awareness campaigns through electronic and print media and the field publicity units of the Ministry of Information & Broadcasting in both the urban and rural areas resulted in generation of awareness about the disease both in the high risk groups and the general population. Awareness levels are of the order of 60-65 per cent on an average in urban areas and 35-40 per cent in rural areas. The highest awareness levels are in Tamil Nadu where it is 95% in urban areas and 75% in rural areas.

2. Awareness programs through school and college education has been taken up on a large scale in 18 States.

3. To ensure safe blood to the population, 815 blood banks in the Government and voluntary sector modernised in phases and 40 blood component separation facilities have been established throughout the country. Mandatory testing of blood for HIV, Syphilis, Malaria and Hepatitis B, has been introduced throughout the country. Infection through blood transfusion has been brought down appreciably over the last 2-3 years.

4. For control of Sexually Transmitted Disease which have a direct correlation with HIV/AIDS, 504 STD clinics in district hospitals have been taken up for modernisation. Syndromic management of STD cases has been introduced and doctors are being put on intensive training of Syndromic management techniques for STDs.

5. Over 2200 key trainers for training of doctors have been trained in clinical management of HIV/AIDS diagnosis. The Indian Medical Association (IMA) has so far trained 16,000 general medical practitioners with support from NACO.

6. For the promotion of voluntary counselling and testing, 141 voluntary blood-testing centres have been sanctioned. These centres at presently are mostly located in Medical College Hospitals.

7. For tracking the epidemic in the country, 180 sentinel sites have been established. These sites include both high-risk groups like Sex Workers, Intra-venous Drug Users as well as low risk group pregnant

women attending antenatal clinic. One round of sentinel surveillance is carried out each year during the period of August – October.

8. Targetted Interventions : Several targetted intervention projects have been implemented for groups practicing risky behaviour. These interventions include outreach activities, IEC and interpersonal communication, condom promotion, and general health and STD service provision. Targetted intervention projects such as that for commercial sex workers in Calcutta's Sonagachi area, the Men who have sex with Men project in Chennai, truck drivers in Rajasthan and Injecting Drug Users in Assam, Manipur and Nagaland have increased the use of condoms and reduced STD, yielding lessons in best practice.

9. Role of Non-Government Organisations : NGOs have played a major role in initiating and ensuring effective interventions, defending the human rights of people living with HIV/AIDS and in providing care and support to people living with HIV/AIDS.

The government of India has also made active efforts to involve NGO participation. State AIDS cells have been particularly effective in mobilising community involvement. The Maharashtra State AIDS Cell, for example, works through a nodal NGO to coordinate the work of all other NGOs in the state, while the TNSACS has a nodal NGO officer on its staff. An NGO-AIDS Cell has been established at the All India Institute for Medical Sciences. The States AIDS Cells are empowered to sanction grants to NGOs.

10. Intersectoral Collaboration : NACO has promoted intersectoral collaboration with other ministries such as Human Resource Development, Information and Broadcasting and the Railways. NACO has successfully collaborated with the Steel Authority of India and the Indian Oil Corporation in HIV/AIDS prevention efforts.

11. Private Sector Collaborations : Effective collaborations have also been built with the private sector through the Confederation of Indian Industry and the Bengal Chamber of Commerce. The Tata Iron and Steel Company, for example, has incorporated HIV/AIDS prevention in their ongoing family welfare programmes.

National AIDS Control Project - Phase II (1999 - 2004)

This phase of the programme began w.e.f. April, 1999. Giving a major focus to targeted interventions amongst groups with the highest risk behaviors (sex workers (SWs); injecting drug users (IDUs); truck drivers) and broadening the approach to a multi-sectoral one. The current phase of the national programme has seen the emergence of a strongly de-centralised programme with responsibility for implementation clearly placed with the States. State AIDS cells were created in all the 32 states and UTs of the country for the effective implementation and management of the National AIDS Control Programme. However to remove the bottlenecks faced by the programme implementation at the State level new and more flexible State structures of State AIDS Control Societies have been formed with strong mechanism for programme management at state level, including a strong NGO component of targeted interventions, supported by efforts for mobilising the community around awareness and treatment of sexually transmitted diseases/reproductive tract infections. Innovative approaches to providing technical support to state programmes have been launched through a network of 12 Technical Resource Groups (TRGs) each covering different thematic areas of the epidemic. Surveillance has been both expanded and strengthened. With a new round of resource mobilised from Government of India, the International Development Agency, major bilateral donors and the UN system, the programme is moving into an important new phase of implementation.

The National AIDS Control Project - Phase - II aims :

(i) To shift the focus from raising awareness to changing behaviour through interventions, particularly for groups at high risk of contracting and spreading HIV;

(ii) To support decentralisation of service delivery to the States and Municipalities and a new facilitating role for National AIDS Control Organisation. Program delivery would be flexible, evidence-based, participatory and to rely on local programme implementation plans;

(iii) To protect human rights by encouraging voluntary counselling and testing and discouraging mandatory testing;

(iv) To support structured and evidence-based annual reviews and ongoing operational research ; and

(v) To encourage management reforms, such as better managed State level AIDS Control Societies and improved drug and equipment procurement practices. These reforms are proposed with a view to bring about a sense of 'ownership' of the programme among the States, Municipal Corporations, NGOs and other implementing agencies.

Project Objectives

Phase II of National AIDS Control Programme has two key objectives namely:

(a) To reduce the spread of HIV infection in India; and

(b) Strengthen India's capacity to respond to the HIV/AIDS on a long term basis.

Some special features of program delivery and management in Phase II:

- Delegated financial and administrative authority to NACO
- Ownership of the state and decentralised programme at the state level
- Involvement of the community in social mobilization and awareness at the grass-root level
- Major role of the NGOs in the implementation of intervention programs for marginalised population
- Involvement of democratic institutions (Panchayati Raj) and youth organisation at the district, block and village level

Project Scope

Reflecting the extreme urgency with which HIV prevention and control need to be pursued in India, the AIDS- II project of the National AIDS Control Programme covers across all State and Union Territories as a Centrally Sponsored Scheme with 100% financial assistance from Government of India direct to State AIDS Control Societies and selected Municipal Corporation AIDS Control Societies. The scope of the project would vary with each intervention, taking into account the need and absorptive capacity, feasibility and efficiency. The immediate need is to have a paradigm shift in our response against HIV/AIDS at all levels, with the overall goal to contain the further spread of HIV at a fairly low level of HIV prevalence.

Project Targets

The programme has the following firm targets to be achieved during project period :-

(i) To reduce blood-borne transmission of HIV to less than one percent of the total transmissions.

(ii) To introduce Hepatitis C as the fifth mandatory test for blood screening.

(iii) To set up 10 new modern blood banks in uncovered areas, upgrading of 20 major blood banks, setting up of 80 new district level blood banks in uncovered districts, establishing another 40 blood component separation units, promotion of voluntary blood donation and increase its share in total blood collected to at least 60%. The total blood collection in the county which is now around 3-3.5 million units is sought to be raised to 5-5.5 million units by the end of the project.

(iv) To attain awareness level of not less than 90% among the youth and those in the reproductive age group.

(v) To train up at least 600 NGOs in the country in conducting targeted intervention programmes among high-risk groups and through them promote condom use of not less than 90% among these groups and control of STDs.

(vi) To conduct annual Family Health Awareness Campaigns among the general population and provide service-delivery in terms of medical advice and provision of drugs for control of STDs and Reproductive Tract Infections (RTIs). These campaigns will be conducted jointly by NACO and RCH programme managers at the State level. Through this it is proposed to reduce the prevalence of STDs/RTIs in the general community from the present level of about 15-20%.

(vii) Promotion of voluntary testing facilities across the country at the end of the project. It is visualised that every district in the country would have at least one voluntary testing facility.

(viii) Awareness campaigns will now be more interactive and use of traditional media such as folk arts and street theatre will be given greater priority in the rural areas. It is proposed to cover all the schools in the country targeting students studying in Class IX and Class XI through school education programmes and all the universities through the "Universities Talk AIDS" programme during the project period.

(ix) Promotion of Organisations of people living with HIV/AIDS and giving them financial support to form self-help groups.

COMPONENTS OF PHASE – II

1. Priority targeted interventions for populations at high risk

This component of the project aims to reduce the spread of HIV in groups at high risk by identifying target populations and providing peer counselling, condom promotion, treatment of sexually transmitted infections etc. This component would be delivered largely through Non Government Organisations, Community based Organisations and the Public sector.

2. Preventive interventions for the general population

The main activities would be: (a) IEC and awareness campaigns; (b) provide voluntary testing and counselling; (c) reduction of transmission by blood transfusion; and (d) prevention of occupational exposure.

3. Low Cost care for people living with HIV/AIDS

Under this component activities would provide financial assistance for home based and community based care, including increasing the availability of cost effective interventions for common opportunistic infections.

4. Institutional strengthening

This component aims to strengthen effectiveness and technical managerial and financial sustainability at National, State and Municipal levels, strengthening surveillance activities and building strong Research &

Development component, including operational research etc.

5.Inter-sectoral collaboration

This component would promote collaboration amongst the public, private and voluntary sectors. The activities would be co-ordinated with other programmes within the Ministry of Health & Family Welfare and other central ministries and departments. Collaboration would focussed on; (I) learning from the innovative HIV/AIDS programmes that exist in other sectors; and (II) sharing in the working, generating awareness, advocacy and delivering interventions.

6. Outlay for National AIDS Control Programme - II

There are three funding agencies for Phase II of National AIDS Control Programme. These are :

(a) **International Development Agency (IDA) :** World Bank has provided an account of US $191.00 million as soft loan for the project

and the domestic budgetary support is US $ 38.8 million. The total outlay is US $ 229.8 million (Rs. 11550.00 millon).

(b) **United States Agency for International Development (USAID) :** United States Agency for International Development has extended its assistance to the Govt. of Maharashtra for implementation of 'AVERT' Project based on their earlier experience of working in the State of TamilNadu under the AIDS Prevention and AIDS Control (APAC) project. The outlay for USAID assisted 'AVERT' project is Rs. 1660.00 million.

(c) **Department For International Development (DFID) of U.K. Government :** Department For International Development has extended its assistance for implementation of Sexual Health Projects in the States of Andhra Pradesh, Gujarat, Kerala and Orissa in continuation of their earlier projects in West Bengal. The outlay for this project is Rs. 1040.00 million.

OUTLAY FOR NATIONAL AIDS CONTROL PROJECT PHASE-II	RUPEES IN MILLION
• IDA credit (1999-2004)	11550
• USAID assistance for AVERT Project in Maharashtra.	1660
• DFID assistance for Sexual Health projects for the States of Andhra Pradesh, Gujarat, Kerala and Orissa.	1040
TOTAL	**14250**

Monitoring and Evaluation of the Programme.

For the effective monitoring and evaluation to assess the implementation of the Phase-II of the National AIDS Control Project at National and State level, the following mechanism has been envisaged.

(i) Creating a Comuperised Management Information System (CMIS) at the National and State levels;
(ii) Training NACO Staff and Health specialists in evidence based health programme management.
(iii) Conducting base line, mid term and final evaluation;
(iv) Conducting the Annual Performance and Expenditure Review (APER); and

(v) Conducting the National Performance Review (NPR) under the National AIDS Control Board.

A National level independent outside agency is being identified who would be assigned the responsibility of development of CMIS, conduct of base line, mid-term and end term evaluation.

Financial Management System

It is envisaged to maintain an adequate project financial management system to provide accurate and timely information regarding project resources and expenditure to facilitate efficient project management. For this purpose an consultancy agency is being selected for developing a Project Financial Management System for NACP-II.

The financial management system would be integrated one for the whole project. A common set of policies and procedures would apply to the entire project and a consolidated set of financial reports for the project would be prepared from the FMS.

Utilization of funds:

(Rs. In Rupees)

Year	Budget Estimates	Expenditure
1997-98	100.00	123.01
1998-99	111.97	99.75
1999-2000	140.00	135.25
2000-2001	180.00	168.69
2001-2002	210.00	210 (Expected)

Proposed objectives, Strategies , Initiatives and target for the 10th Plan

Objectives: During the 10th plan period the objectives of the programme would be:

(a) to reduce the spread of HIV infection
(b) to strengthen the capacity of the existing health care system to respond to HIV/AIDS on long term basis
(c) to make accessible and affordable treatment for opportunistic infections to people living with HIV/AIDS up to the level of Primary Health center.

Strategy : to achieve the objectives laid down for 10th five year plan, emphasis would be on decentralization of the programme at the State level, making the States/UTs responsible for implementation of the programme through the existing health care system. The following strategic themes would be pursued:

(i) Expansion of targeted interventions: Based on the experiences gained from the IInd phase of NACP, at least one targeted intervention will be implemented in each district of the country. Similarly, in cities, targeted intervention projects would be initiated for sex workers, intravenous drug users, truckers, migrant workers, men having sex with men etc. A package of services like education, counseling, treatment of sexually transmitted diseases/reproductive tract infection and condom promotion will be delievered under these projects. Efforts would be made to bring other social sector departments like Education, Social Justice & Empowerment, Women and Child development, Police, Urban basic services etc. with the objectives to provide other services not included under the targeted intervention projects to the beneficiaries and their families. This would create an enabling environment which would help these subgroups to seek services provided under the programme and motivate them to change their risk behaviour. It is envisaged to implement 2000 such projects all over the country during plan period.

(ii) Strengthen treatment of Sexually Transmitted Diseases & Condom promotion: As STDs/RTIs have close linkage with that of HIV transmission, facilities for treatment of such infections upto the primary health centers would be promoted. The health care

functionaries would be trained in counseling skill so such services can be provided to the patient without additional financial burden. For the referral services, all 3000 community health services would be strengthened by providing laboratory equipment as well as training of the laboratory staff. A recurring grant of Rs. 25,000/CHC would be given to each CHC to meet out the expenses on procurement of RTI/STI drugs and other consumable needed for this component of the programme.

Condom promotion would be pursued vigorously in co-ordination with the department of Family Welfare. Both, free distribution and social marketing schemes of condoms would be promoted by involving NGOs/CBOs and other possible retail outlets.

(iii) Information, Education and Communication:

In absence of any cure for HIV infection and preventive vaccine to protect the community, awareness is only tool for preventing the spread of HIV infections. Govt. plans to carry out the following activities to empower the people in general and sub groups of population at risk to protect themselves from acquiring HIV infection.

(a) Electronic and Print media : Govt. will use all available electronic media channels centrally as well as locally to disseminate information on HIV/AIDS prevention. Cinema celebrities as well as politicians would be used for advocacy of purposes.

(b) Field Publicity units and Song & Drama Division of Ministry of Information and Broadcasting : There is a nationwide network of these units of Ministry of Information and Broadcasting. They will be extensively used in dissemination of information on Reproductive Health Issues, including Sexually Transmitted Diseases & HIV/AIDS. An integrated programme will be developed in collaboration with the Deptt. of Family Welfare. Ministry of Information and Broadcasting would also be requested to incorporate HIV/AIDS messages in all programmes being telecast or organized through their various field units. State AIDS Control Societies will be asked to use local channels for making the people aware about HIV/AIDS and other common STDs.

(c) AIDS Education in Schools & Colleges : During the IInd Phase of NACP, 90% of the schools and colleges will be covered under AIDS Education Programme. During the 10th plan period, the programme will be pursued in collaboration with Deptt. of Education and NGOs. University Talk AIDS will also be implemented in all colleges and universities in the country in collaboration with the Deptt. of Sports & Youth Affairs.

For the coverage of non-school youth in rural and urban slums, a programme will be chalked out in collaboration with NYK organization of Deptt. of Sports & Youth.

(d) Family Health Awareness Campaign : Govt. has initiated this programme since 1999, with the objective to sensitise the people in age bracket of 15 to 49 years of age about Sexually Transmitted Diseases and HIV and AIDS through house to house contacts, conducted by health and non-health functionaries by organizing health camps at Subcenter/PHC/CHC level for treatment of STDs and follow group education. The strategy is based on the principle of interpersonal communication between the health functionaries and the client for dissemination of facts about STDs and HIV/AIDS : During the 10th plan period, at least one fortnight each year will be dedicated to this campaign.

(e) Multisectoral Involvement : At present, several Ministries and Deptts, NGO, Private Sector are involved in implementation of the prgoramme components in their own settings. Deptt. of Health provides funds to these organizations for carrying out HIV/AIDS related prevention and control activities. NACO would encourage more Ministries/Deptt. to take initiative in making HIV/AIDS prevention and control activities as one of the core activities of their ongoing programmes on training/education and health care services.

(iv) Promotion of Voluntary Counseling and Testing for HIV : Voluntary counseling and testing is one of the key intervention to normalise the epidemic in the community. The objective is to motivate the people with high risk behaviour to get themselves tested for HIV in order to counsel them for a change of their risk behaviour. At the same time,

it also gives them opportunity to know about the facilities available for care and support. During the IInd phase of the NACP, all the districts in the country will have at least one voluntary and counseling and testing center (VTCT). During the 10th plan period it is envisaged to extend this facility up to Community Health Center (CHC). Efforts would be made to cover all 3000 existing CHCs during 10th plan period.

(v) Blood Safety : During the IInd phase of the National AIDS Control Programme, NACO would be able to establish Blood banking facility in all districts of the county and component separation facility in 40 additional institutions. Besides, 10 State of art model blood banks will be established, mostly in backward States of the country. During 10th plan period, 60 blood component separation units will be established in order to cover most of the public sector medical colleges of the country. NACO in collaboration with Deptt. of Family Welfare would establish blood storage facilities at least in 25% of the existing Community Health Centers. Priority would be given to these centers where First Referral centers have been sanctioned by Deptt. of Family Welfare.

(vi) Care & Support of People Living with HIV/AIDS (PLWHA) : It is estimated that the number of HIV/AIDS patients will increase manifolds during the 10th plan period. Hence, facilities for treatment of the patients would have to be created by strengthening existing health care institutions as well as community based health care centers. During the 10th plan period, it is envisaged to :

(a) Increase the number of beds in all district hospitals of high prevalence States by 20% and 10% in about 25% of the district hospitals in other States.
(b) Strengthening of diagnostic facilities for diagnosis of opportunistic infection in all district hospitals of high prevalence States & 25% of the districts in other States.
(c) Strengthening hospital infection control measures.
(d) Availability of anti-retroviral drugs for the post-exposure prophylaxis for the use of Health Workers in Public Sector Hospitals up to district level.

(vii) Prevention of Mother to Child Transmission (PMTCT)

(vii) Training of Medical & Paramedical professionals :

Though during the IInd phase of the NACP, 80-90% of the health Care functionaries would be trained in HIV/AIDS control programme. During the 10th plan period more focused training will be required for the clinical management of HIV/AIDS cases as well as prophylaxis of opportunistic infection. Counseling will be the important aspect of all such training programme. The target for 10 plan period in training will be :-

(a) Refresher training of M.Os and paramedics on HIV/AIDS Control Programme for functionaries working at Primary Health Care Level.
(b) Training of specialists on clinical management of HIV/AIDS cases working at secondary and tertiary level of health care in Public sector hospitals.
(c) Training of private practitioners by involving Indian Medical Association and other professional bodies by linking them with the secondary and tertiary health care institutions.
(d) Training of NGOs involved in community care of PLWHA
(e) Training of incharge of blood banks and technical staff in blood safety programme.

(vi) Mainstreaming HIV/AIDS and other reproductive health problems in the curriculum of Medical and paramedical education:

The research and development efforts in the field of HIV/AIDS have been very limited in the country. Government recognizes the need to encourage and support research and development in the following areas:

(i) The Govt. will look out for collaborative research with scientific groups in developed countries for development of vaccines suitable for the strains of HIV prevalent in India.
(ii) Molecular biology of HIV-1 and HIV-2 in the country and sequencing of sub-types prevalent in various parts of the country.
(iii) Cohort studies to track the natural history of disease
(iv) Development of indigenous diagnostic kits for HIV
(v) Screening of ISM&H drugs having anti-retroviral or immuno-modulator properties and conduction of clinical trials.
(vi) Impact of HIV/AIDS epidemic at Family and Community level

(vii) Socio-cultural determinants of risk behaviour vulnerable to HIV infection
(viii) Impact of targeted interventions on behaviour change of sub-population groups practicing risk behaviour.
(ix) Community based cross sectional studies to validate the surveillance data on HIV/AIDS and STDs.
(x) Cost effectiveness of voluntary counseling testing
(xi) Role of "Substitution Therapy" in reduction of HIV infection among injecting drug users
(xii) Role of Family and community in care and support to PLWHA.

Mechanism of Involvement of NGOs/Private sector/Community/Local self Govt. in implementation and monitoring of the programme :

NGOs are being involved as critical partners in some of the most important thrust areas of NACP. NGOs are being specifically involved in the following activities:

(i) Targeted interventions for the high risk and marginalized populations such as sex workers, intravenous drug users, truckers, migrant labour and street children
(ii) School AIDS Education
(iii) Low cost community care for people living with HIV/AIDS
(iv) Counseling
(v) Family Health Awareness Campaign

The process of selecting NGOs and for funding has been decentralized to the respective State AIDS Control Societies. Detailed guidelines have been formulated to ensure that selection of the NGOs is undertaken in rigorous and only NGOs with a credible track record are selected. There is inbuilt system of monitoring and evaluation with each project proposal. The planned evaluation methodology should be consistent with the objectives of the project. The evaluation will be carried out by an independent agency identified by the State AIDS Control Society.

Private sector is involved in programme implementation through the organizations like CII/FICCI and ASSOCHAM, Transporter's Association of India etc.

(iii) Low cost community care for people living with HIV/AIDS
(iv) Counseling
(v) Family Health Awareness Campaign

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Involvement of Private Sector

Private sector is involved in programme implementation through the organizations like CII/FICCI and ASSOCHAM, Transporter's Association of India etc.

Involvement of the community is being sought at present in awareness generation programme like Family Health Awareness Campaign and Community based care of PLWHA.

During the 10th plan period, there would be more of involvement of NGOs in the thrust areas of the programmes as stated above. Govt. would make efforts to formalize constitution of business coalition to promote the participation of business houses in programme implementation, particularly in workplace intervention projects and care & support component of the programme through their own health care network.

Collaboration with Bilateral agencies

In the past years several Bilateral Agencies have shown their interest and have come up with encouraging support to the national effort for prevention and control of HIV/AIDS in India. Following are some of the major contributions made by such agencies.

USAID (APAC & AVERT Projects)

The USAID funded $ 10 million AIDS Prevention And Control Project (APAC), currently operational in Chennai region, is being implemented through a Tripartite Agreement between the Government of India represented by NACO, United States Agency for International development (USAID), and Voluntary Health Services (VHS), Chennai. The Project has received wider acclaims from the AIDS – watchers, both at National level as well as Internationally.

APAC Project, because of its excellence through technical expertise, has become a model for the ongoing as well as upcoming projects in the country, in the arena of creating awareness about HIV/AIDS, and, taking preventive control measures on the spread of this dreaded epidemic. This success has been achieved through concerted efforts from a number of associated NGOs actively involved in the process.

The AVERT project in Maharashtra is being implemented with the objective to increase the use of effective and sustainable response to reduce transmission of STD/HIV/AIDS and related infectious diseases. An amount of US$ 41.5 million is earmarked for this project. The components are as follows-

(a) Interventions in sex industry;
(b) Improving Comprehensive health services;
(c) Reduce High Risk Behaviour in Priority Population
(d) Developing capacity of CBO/NGOs to respond effectively to STD/HIV/AIDS;
(e) To develop Communications Support Programmes;
(f) Improve Access, Availability and Use of Condoms in the Sex industry;
(g) Establish Pilot/Demonstration Programmes for Out-of-School Youth;
(h) To strengthen State and Municipal Capacity for Planning, Monitoring, and Evaluation of State and Municipal Programme;
(i) To develop longer term HIV/AIDS Programme of Research and Surveillance in Maharashtra.

Department for International Development, UK. (DFID)

The DFID is providing financial support of 1.5 million pound sterling for the "Sexual Health Project" in West Bengal, over a period

of three years. The focus of activity of this project is to control programmes and develop appropriate IEC techniques.

DFID is also supporting a national Healthy Highways Project with the truckers' community. The project is currently in the pilot phase.

In addition DFID has formulated "partnership for sexual health" project for the prevention and control of HIV/AIDS and other sexually transmitted infections in Andhra Pradesh, Gujarat, Kerala and Orissa for a five years at a total cost of Rs. 154 crores (Pound Sterling-28.08 million) of which Rs. 104.01 cores will be routed through GOI as local cost and Rs. 50.29 cores as technical cost to be managed by DFID for this project.

The objectives of the project are

- To ensure better sexual health for people vulnerable to sexually transmitted disease (STDs) and HIV, especially the poor; and
- Lowering incidence of sexually transmitted infections in the four States.

The components of the project are:

- Surveillance;
- Condom programme by ensuring that quality condoms are made available and acceptable to those who are vulnerable to STD/HIV through effective social marketing;
- To strengthen service providers to respond to clients' needs through targeted interventions for vulnerable groups, such as sex workers and their clients, men having sex with men, migrant workers and prison inmates.

The European union is supporting 'the Lawyers' Collective ' for a project that aims at advocacy and law and to protect the human rights of those infected and/or affected by the AIDS epidemic.

Other Agencies

Norwegian Agency for Development (NORAD): In addition to extensive support to NGO activities through out the country, NORAD has contributed financial support for HIV/AIDS intervention programme in the red light areas of Calcutta, West Bengal being coordinated by All India Institute of Hygiene and Public Heath. A contribution of US $ 500,000 has also been received for conducting

National Physicians Training programme, conducted by Christian Medical Association of India in collaboration with NACO and WHO.

AUSAIDS and CIDA are other potential partners in HIV/AIDS prevention and control in India.

Canadian International Developmental Agency

CIDA is providing financial and technical support in the States of Rajasthan and Karnataka for some of the components of the programme. An assistance of Canadian $ 12 million has been offered.

During the 10th plan period these agencies will be persuaded to continue their support.

Improve communicable disease control services through the Primary/Secondary health care information:

National AIDS Control Programme has no infrastructure at district level and below. The programme components are being implemented through the existing primary, secondary and tertiary health care infrastructure. The most important intervention in this context has been the involvement of tertiary care in training and capacity building and their linkage with that of secondary care health institutions. The existing health care infrastructure is also being utilized for management of HIV/AIDS cases.

During the 10th plan period, health care institutions will be strengthened by providing them equipment needed for diagnosis and care and support to people living with HIV/AIDS. The infrastructural supports in terms of their capacity to accommodate more HIV/AIDS patients will also be required, particularly, in States with High HIV prevalence. Budgetary support would be required by institutions at secondary and tertiary care level for this purpose. Health care functionaries would be utilized for dissemination of information.

Current Pattern of Monitoring and Evaluation:

For the effective monitoring evaluation to assess the implementation of phase II of the National AIDS Control Programme, the following mechanism is being adopted:

(i) Conduction of base line, mid term and end valuation of the programme components by an independent agency
(ii) Conducting the Annual Performance and Expenditure Review and
(iii) Conducting the National Performance Review (NPR) under the National AIDS Control Board.

The same mechanism of monitoring and evaluation will continue during the 10th plan period as well.

Current Status of HMIS, disease surveillance, its quality and utilization/proposed:

For the monitoring of the programme, a comprehensive computerized HMIS system is in use, which include a set monthly and quarterly progress reports on different components of the programme. During the 10th plan period, the same computerized HMIS formats for monthly and quarterly progress report would be used.

TUBERCULOSIS

Persistent killer

TB is a social and environmental disease to control which technical packages alone are insufficient, says Thelma Narayan.

TUBERCULOSIS (TB), an ancient infectious disease, was known as the dreaded "white plague," "pthisis" or "consumption" in the English terminology of the last century and as "*Rajyaroga*" (king of diseases) in India.

Fifty years after Independence it is still India's biggest public health problem, claiming an estimated 500,000 lives every year and causing disease in about 17 million. Affecting adults in the prime of their lives, it causes much suffering and economic loss for patients, their families and the nation. It results in 26 per cent of preventable adult deaths and is one of the most important causes of death among women of child-bearing age. What is tragic is that the disease is curable.

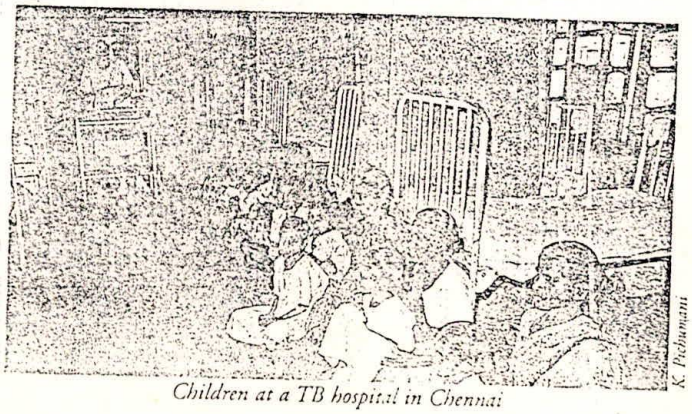
Causative agent

Though its infectious nature was recognised earlier, it was the German scientist Robert Koch, who in 1882 isolated the bacteria *Mycobacterium Tuberculosis* as the causative agent of tuberculosis. The work of several researchers suggests that the tubercle bacillus has co-existed with human beings since early times. Like other organisms in the process of evolution it has developed a complex ecological relationship. This is indicated by the presence of various strains of the organism with differing virulence. The south Indian strain, for instance, is less virulent than the British strain.

Animals harbour different species of mycobacteria. From the human disease point of view, cattle are the most important. In Europe, *Mycobacterium Bovis* was a fairly important source of infection. It spreads from cattle to people through drinking raw, unpasteurised or unboiled milk. A major control programme, involving the detection and slaughter of infected tuberculin positive animals, was successfully conducted.

Studies in Calcutta and Bombay in the Thirties and Forties found that *M. Bovis* was not a cause of human TB in those areas and was relatively uncommon in cattle. Studies in Madras around the same period indicated the presence of TB infection among cattle herds.

More recently in 1995, at a meeting in Madras, veterinary scientists and TB specialists expressed concern about the occurrence of TB in cattle. Cattle primarily suffer from pulmonary TB (affecting the lungs) with infection almost invariably progressing to disease. It spreads through the air borne route. The primary human disease due to *M. Bovis* is usually non-pulmonary.



K. Pachumani

Children at a TB hospital in Chennai

There are a wide range of species of saprophytic atypical environmental mycobacteria. While not usually associated with human disease, more recently, infections caused by *M. Avium Intracellulare* have occurred in patients with AIDS.

Reasons for the spread

Tuberculosis was probably only a disease striking animals many years ago. Two important periods in the epidemic spread of the disease among major human population groups appear to have been:

(a) The period of transition to agriculture and cattle domestication followed by population increases during the sixth and seventh millennia BC in the eastern Mediterranean region and Europe. Some of the earliest written records and ancient Indian medical treatises are said to describe the disease in early India. Tuberculosis probably existed among people at low levels of endemicity. Most often, that is, small proportions of the population suffered from the disease at any time.

(b) The period of industralisation starting in England and Europe in the 16th century. This resulted in a process of urbanisation with overcrowded, unhygienic living conditions for the working class in the new industrial and mining towns. People were paid low wages and had long hours of hard working in appalling conditions. Research indicated that this process was repeated in the U.S. and Africa and that industrial and urban growth were correlated with TB. There has been the observation that TB was "perhaps the first penalty that capitalistic society had to pay for the ruthless exploitation of labour." The environmental conditions during that time were closely associated with the poverty of people though the elites were reaping the benefits of empire and industry.

Observations in different countries, during the past 150 years, have shown these conditions to form the essential substrate in which TB and other infectious diseases thrive.

With improved housing, working conditions and nutrition of large proportions of their populations, disease and death rates from TB started declining substantially in West Europe and the U.S. This was unrelated to medical intervention and before the discovery of anti-TB drugs, which occurred from the late Forties onwards.

It has been suggested that population increase and European migration, colonialism and war initiated "epidemic waves" in different regions of the world in the last century. In India, people faced heavier taxes, landlessness increased and textile and cottage industries were affected. The process of impoverishment set the scene for repeated famine, an increase in TB and other epidemics.

During the First World War (1914-1918), death rates due to TB increased in all countries at war. The decline of TB in the U.K. was halted for 10 years from the start of the Second World War in 1939. Recent studies show higher rates of TB during war, conflict and among refugees.

India had a big problem of TB among the post-Partition refugees in 1947. Disrupted social conditions, undernutrition, poor housing and physical and emotional stress are pre-disposing factors. Tibetan resettlements in India also report a high prevalence of TB.

The disease thus seems closely linked to the social history of humankind mediated through its effect on the environment and on living standards.

> The association of socio-economic factors with TB was forgotten in the "scientific optimism" generated by the discovery of chemotherapeutic drugs.

The association of socio-economic and environmental factors with TB has been highlighted internationally by researchers. It was explicitly recognised in India at policy making levels by the Bhore Committee (1946) and the Mudaliar Committee (1961). It later was forgotten in the "scientific optimism" generated by the discovery of effective chemotherapeutic drugs. These discoveries did accelerate the tailend of the decline of the disease in countries that could afford and organise good nation-wide health services.

Physical environment

a) *Housing*: Tuberculosis primarily affects the lung but can also spread within the body affecting several other organs. It is an air-borne disease, transmitted to others by coughing, spitting and talking.

Poor working conditions cause TB.

Only patients whose phlegm or sputum contain bacteria (termed sputum positive) are sources of infection for other people.

The bacteria disperse in the atmosphere through small droplets which survive for long periods in dark, unventilated conditions. Sunshine, present abundantly in India, effectively kills the bacteria.

Small tenements and houses with insufficient or no ventilation provide the right environment for the survival and spread of the organism. Poor, congested housing, a result and indicator of poverty, is an important element in disease transmission.

The National Sample Survey, a large multi-State cross-sectional Indian study conducted in 1955-58, found that people living in kutcha houses had a higher prevalence of TB. Twenty to twenty five per cent of patients with TB give a history of someone in the family also having had TB. Government and development groups working on housing schemes and activist groups campaigning towards housing rights thus indirectly contribute to TB control.

Smoky *chulhas* or cooking fires are shown by studies and experience in India to increase the risk of respiratory problems. They could aggravate the disease and make the life of a TB patient more difficult and perhaps be a risk factor in the spread of TB. Similarly patients with TB are advised not to smoke to prevent further lung damage. Promotion of smokeless *chulhas* by development agencies, could also be part of the anti-TB package.

b) *Urbanisation*: There were attempts in the Revised National Tuberculosis Control Programme in India in 1993 to give greater importance to urban areas in the programme. The urban population has increased over three decades from 20 per cent to 26 per cent in 1991, with some inter-State variations. Before the Fifties, TB was considered to be largely an urban problem, as it was in Europe. The National Sample Survey findings, however, showed that it was equally prevalent in urban and rural areas. Since 80 per cent of the population was then rural, the problem was understood as being predominantly rural.

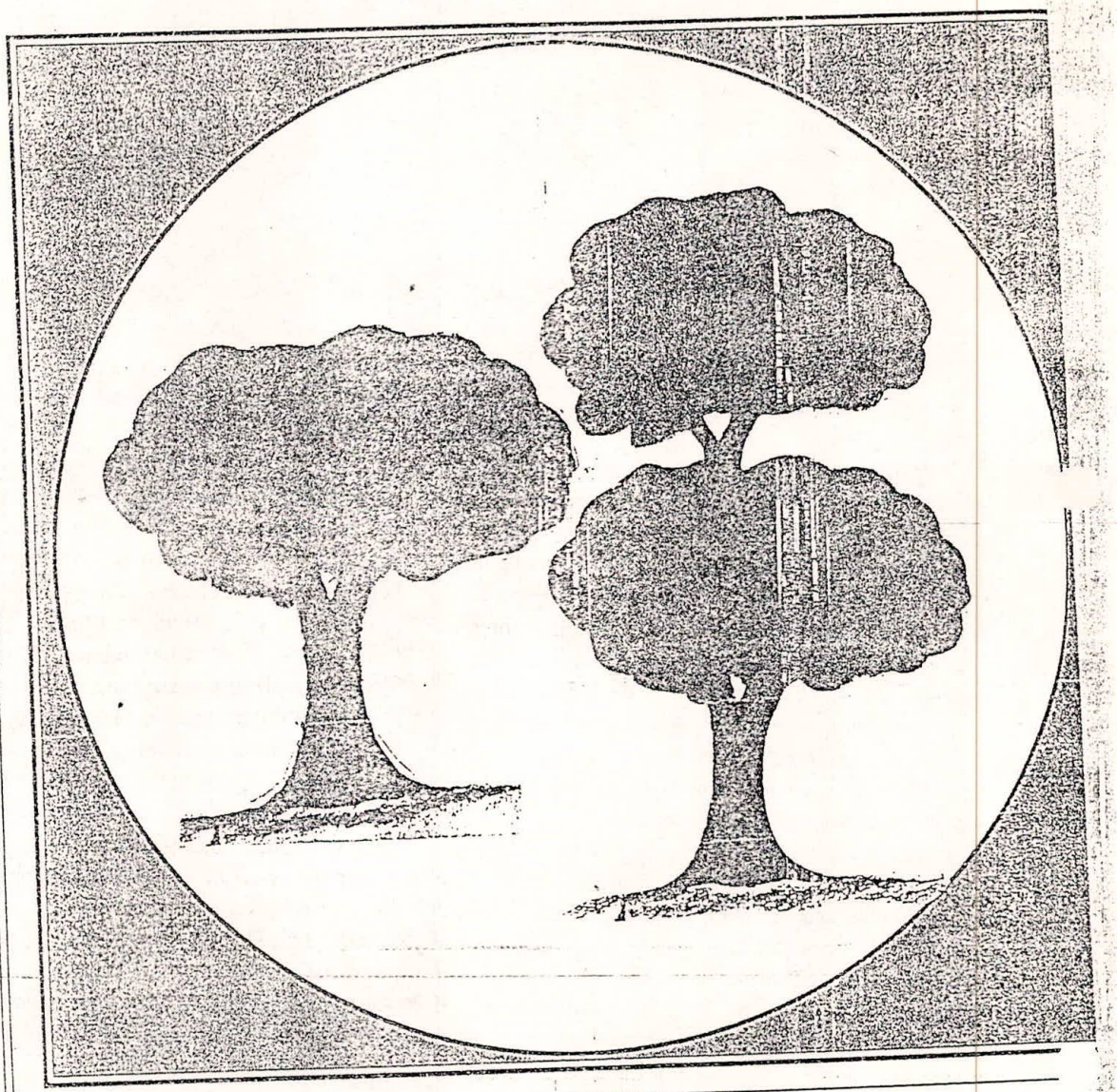
The National Tuberculosis Programme was the first health programme to emphasise the need to develop general health services in rural areas with which TB services were to be integrated. Health services and health personnel were then predominantly urban based. Thirtyfive years later, 74 per cent of the population is still rural. Though some gains have been made, there continue to be urban-rural differentials in health budgets and health care services.

Vulnerable groups

The urban poor living in slums, *jhuggi* colonies and shanty towns comprise about 60 per cent of the urban population. The most deprived are homeless migrants, rag pickers and street children. These vulnerable groups are at greater risk of TB and need specific intervention, protection and social security.

The urban habitat has deteriorated greatly over the years with basic infrastructure unable to cope with the growing demands for housing, water, sanitation, roads and transport. The growing presence of small unregulated factories close to domestic sites or

A TREE IS NOT A RAW FACE OF RUPEE



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the growth of slums next to large factories add to the problem. The all-pervasive corruption prevents and slows the development of basic services.

c) *Industralisation and work environment*: The work place provides an important environment which could predispose to or facilitate the development of TB. Miners and quarry workers exposed to various kinds of dust are likely to develop silicosis, and are at greater risk of developing TB. In crowded industrial sheds and factories, with poor ventilation, inadequate sunshine and fresh air, if one or some workers have untreated sputum positive TB there are definite chances of spread of infection.

Rapid industralisation, driven by the present economic imperative, most often sacrifices safety procedures (dust control) and effluent treatment (air pollutants) which decrease profit margins. This is particularly so when regulatory mechanisms are poorly implemented and the workforce is inadequately informed and poorly organised.

There are several indicators that air pollution levels are growing alarmingly in urban areas. Any additional assault or damage to the respiratory system (like smoking) could aggravate TB. The potential occupational hazards faced by health personnel working in close contact with TB patients has received scant attention.

d) *General causes*: In the early parts of the century there ware anti-spitting drives in several countries such as the U.K. Australia and South Africa among others as a preventive measure against tuberculosis, besides providing for better general environmental hygiene and cleanliness. Given the rampant practice of spitting in India, this would certainly be a challenge.

Impact of political and economic policies

Moving beyond the physical environment to the broader political and economic enviromments, it is important to understand global changes that are occurring and their impact on nations and on people, especially the poor. Studies to understand the immediate and short-term impact of structural adjustment on poverty, unemployment and the environment are important for several reasons.

These programmes also have a direct relationship with TB. Several countries across the world, for instance in Africa and the Phillipines, have documented the ill-effects of these programmes on the health of the poor, including high TB rates.

The impact of explicit pro-privatisation policies in State-run health services also needs careful study. These services are used most often by the poor to whom private care is inaccessible for long-term serious illnesses like TB.

Nationally, an important issue is the low priority given to health in terms of Central and State Government budgets. Equally important is the lack

Congested and unhygienic housing: another cause of TB

of commitment to develop and maintain quality of care and service in public sector institutions. Political interference, mismanagement and rampant corruption have reached unacceptably high levels in a vital area affecting the health and well-being of citizens. This is an area for concern and social action.

Expectations belied

There were great expectations that the National Tuberculosis Programme (NTP), articulated in 1962 after indigenous research, would be able to relieve human suffering caused by TB and later reduce disease transmission so that it no longer was a public health problem.

Evaluation studies in 1975 and 1988 and the monitoring system of the NTP consistently report gaps between expected performance and actual outcome. One study has indicated that only 8 to 16 per cent of expected cases of TB get complete treatment from the public health services.

The past decade has seen a major change in the TB situation globally. In the mid-Eighties there was a reversal of decline in the incidence of TB in the U.S. This was followed between 1986-91 by an increased number of cases up to 33 per cent. Increased TB rates occurred in several West European countries too. Reasons cited for the increase in TB are association or co-infection with HIV/AIDS, neglect of TB control programmes by governments for over two decades and the development of Multi Drug Resistant (MDR) TB (bacteria that are resistant or non-responsive to two to three basic anti-TB drugs). A number of cases occur among the inner city homeless, among drug users, and among migrants and indigenous people. Twentyfive per cent of cases in the U.S. were among the "foreign born," similar to West Europe.

MDR TB arises because of inadequate and incomplete treatment for which the health services and patients have been blamed, out of context to the under-resourced and difficult circumstances in which they function and live respectively. The treatment of MDR TB is extremely expensive and often has a unsuccessful outcome under the best conditions. These events created a panic, raising the spectre of a new epidemic in which available tools of treatment would not be effective. Newer diagnostics and drugs were not available as basic research in TB had stopped three decades ago. The new events brought to mind the long period, from the late 18th to the early 20th centuries when TB was the leading cause of death in Europe and America, decimating about 20 per cent of the population.

With international travel, global trade and international capital being involved and potentially affected, the sense of urgency appeared great. This resulted in a new global policy environment in which TB was once again high on the international public health agenda.

The World Health Organisation (WHO) declared TB a global emergency in 1993. There was increased intervention by the WHO, World Bank and bilateral agencies in the control of TB in "low and middle-income" countries.

> Poor and congested housing, a result and indicator of poverty, is an important environmental element in disease transmission.

Revised programme

A revised National TB Control Programme (RNTCP) has been introduced in India. A $150 million soft loan from the World Bank has been negotiated. This is conditional to using the WHO package prescription. A key element in this is the Direct Observation Treatment, Short Course Chemotherapy (DOTS) in which health workers have to watch patients swallowing their pills three times a week, for at least two months, out of a six month treatment.

There are doubts about the feasibility, sustainability and ethics of such an approach. Being entirely technical it does not consider the social and environment roots of the disease. Hence it ignores social and community dimensions within which any technical package needs to be embedded. This would include personal, social support to affected people and their families. It would also recognise development organisations and activists as partners. Most importantly, it would address the question of social and economic inqeuality and injustice. It also assumes that the health system will "deliver" the RNTCP and does not try to understand the reasons why the NTP did not fulfil expectations.

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Infection And Disease In a Group Of South Indian Families—Part XIII Skin Sensitivity To Six Mycobacterial Antigens[1]

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A skin test survey using six mycobacterial antigens, namely PPD-S, G, A, B, F and Y was conducted on a sample population of Vellore, Tamil Nadu. Each individual was tested with PPD-S, G and two of the remaining four antigens. The frequency distribution of reactions to PPD-S according to the size of induration showed a bimodal pattern with one cluster of small reactions (less than 8 mm) and another of large reactions (8 mm or more). The prevalence of large reactions increased with age from 2% in pre-school children to nearly 90% in adults of 35 years and over. Reactions to the other five antigens were also very common in the population. However, a majority of such reactions meaured only 2-7 mm in diameter. The pattern of sensitivities to the 6 antigens suggests that **M. tuberculosis** infection is common in this community and that reactions to the antigens from mycobacteria other than **M. tuberculosis** are to a large extent cross-reactions arising from tuberculin sensitivity. At the same time there were a few individuals who had large reactions to one or more of these 5 antigens in the absence of tuberculin sensitivity. They indicate that some other mycobacteria are also prevalent in this community.

Introduction

The tuberculin skin test has been widely used in epidemiological studies of infection by **Mycobacterium tuberculosis**. After the discovery of other mycobacteria that infect man and at times cause disease similar to tuberculosis, skin test antigens have been prepared from them and used in epidemiological studies (Edwards **et al** 1968, Smith 1967). We conducted a skin test survey using antigens derived from **M. tuberculosis** and five other species of mycobacteria on a sample population of Vellore, Tamil Nadu, in an attempt to study the prevalence of infection by these organisms. The

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methods of study, the overall results of the rate and range of reactions and an evaluation of the role of cross-reactions are reported in this paper.

Material and Methods

The sample population : A continuing longitudinal study of infection and disease in a group of families from three localities in Vellore town began in September, 1965. The methods of selection and recruitment to the study and a description of the sample population have previously been reported in detail (Feldman **et al** 1969). The sample was representative of the population from which it was drawn in several demographic characteristics. At the time of the skin test survey in January 1967 there were 90 families with 420 members under surveillance. Infants under 3 months of age were not tested.

The antigens : Purified protein derivatives (PPD) from six species of mycobacteria presented in Table I were used for skin tests. They were obtained from the Tuberculosis Research Laboratory, Chamblee, Georgia, U.S.A., stored refrigerated and transported and kept at the work spots in chipped ice. PPD-S, prepared from **M. tuberculosis** was given in doses of 5 tuberculin units (TU), in 0 1 ml fluid. The other antigens had equal protein nitrogen content as PPD-S and were also administered in 0·1 ml volume.

Table I. Six mycobacterial antigens used in the study

Antigen	Prepared from
PPD-S	**Mycobacterium tuberculosis** (prepared originally by Siebert)
PPD-G	Scotochromogen, Gause strain
PPD-A	**Mycobacterium avium**
PPD-B	Non-photochromogen, Battey bacilli
PPD-F	Rapid grower, **Mycobacterium fortuitum**
PPD-Y	Photochromogen (yellow) **Mycobacterium kansasii**

The tests : All tests were performed by a nurse who was unaware of the identity of antigens which were coded along with similarly coded syringes. Each person was given 4 antigens intradermally at proximal and distal sites of volar surface of the forearms. PPD-S and PPD-G were given to everyone along with two of the remaining 4 antigens. Thus, there were six combinations of antigens (Table II). The first six persons tested on any day were given these combinations in a serial order and this cycle repeated thereafter. Thus, the population was equally allocated to the six combinations. The sites of injection were so rotated that each antigen had an equal chance of being given at any of the four sites. Tests were given in morning and afternoon sessions on Monday, Tuesday and Wednesday and the reactions read on Thursday, Friday and

Saturday. The horizontal and vertical diameters of induration were measured by the same nurse and dictated to a recording clerk.

Table II. Six combinations of PPD antigens used

Combination of antigens					
PPD	S,	G,	A	and	B
PPD	S,	G,	A	and	Y
PPD	S,	G,	A	and	F
PPD	S,	G,	B	and	Y
PPD	S,	G,	B	and	F
PPD	S,	G,	Y	and	F

The greater diameter of induration was used for purposes of analysis. The results on each individual were punched on an 80 column punch-card and all data analysed with the help of a sorter and a tabulator.

Results

A total of 350 persons were tested and 347 returned to be read. They consisted of 102 infants and pre-school children, 97 school-age children, 35 adolescents and young adults and 113 adults of over 24 years (Table III). All persons were tested with PPD-S and G, 174 were tested with PPD-A, 176 with PPD-B, 171 with PPD-F and 173 with PPD-Y.

Table III. Age distribution of persons tested and read

Age (years)	No. of persons
0— 4	102
5—14	97
15—24	35
25—34	70
35—44	22
>45	21
All ages	347

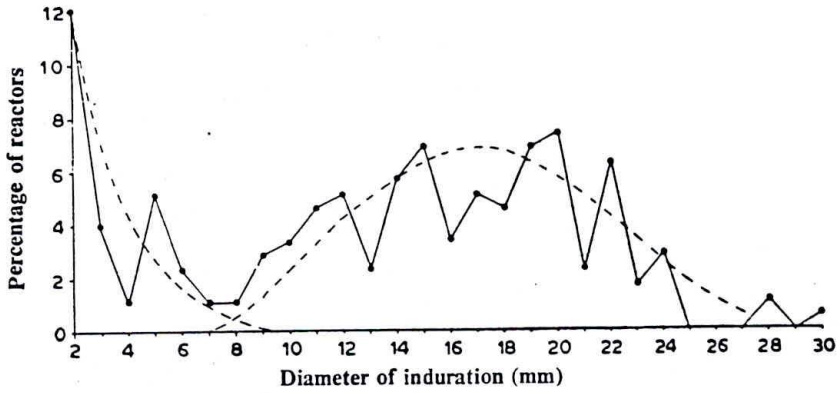
Among the 347 persons tested 172 (50%) had no reaction to PPD-S and 175 (50%) reacted with indurations measuring 2 to 30 mm. The distribution of those who reacted according to the size of induration is shown in Graph 1. The distribution is clearly bimodal and two visual-fit curves have been drawn to separate the clusters one of small reactions and the other of large reactions, the point of separation being at 8 mm. Reactions of 8 mm or more were recorded in 130 persons (38%).

Measurable reactions of 2 mm and over occurred to PPD-G in 68%, to PPD-A in 63%, to PPD-B in 69%, to PPD-F in 28% and to PPD-Y in 53% of those tested (Table IV). The frequency distributions of rections to these five antigens

according to the diameter of induration are shown in Graph 2. Although all distribution curves show a trough at 3-4 mm level, none of them is as clearly bimodal as that of PPD-S.

Graph 1

The frequency distribution of reactors to PPD-S according to the size of induration



Graph 2

The frequency distribution of reactors to PPD-F, A, G, B and Y according to size of induration

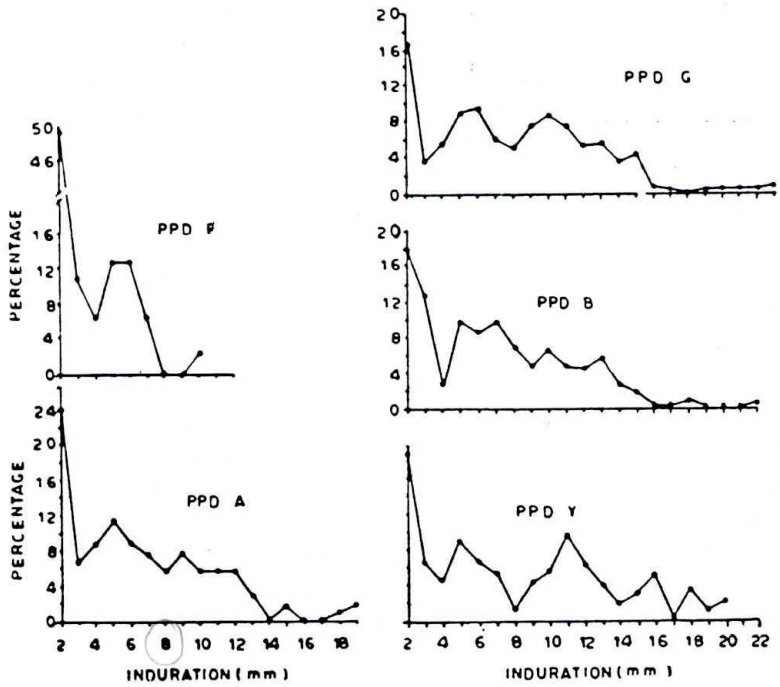


Table IV. A comparison of the frequency of reactions to 5 PPD antigens with PPD-S

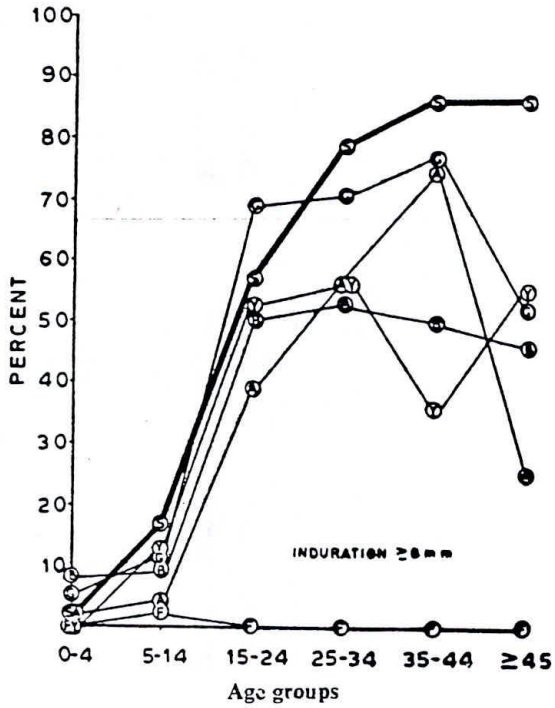
Tested with		PPD-G & PPD-S		PPD-A & PPD-S		PPD-B & PPD-S		PPD-F & PPD-S		PPD-Y & PPD-S	
Reactions to		PPD-G	PPD-S	PPD-A	PPD-S	PPD-B	PPD-S	PPD-F	PPD-S	PPD-Y	PPD-S
Induration size	0 mm	112 (32)*	172 (50)	65 (37)	82 (47)	55 (31)	81 (46)	124 (73)	92 (54)	82 (47)	89 (51)
	2 mm or more	235 (68)	175 (50)	109 (63)	92 (53)	121 (69)	95 (54)	47 (27)	79 (46)	91 (53)	84 (49)
	4 mm or more	188 (54)	147 (42)	78 (45)	74 (43)	85 (48)	82 (47)	19 (11)	66 (39)	68 (39)	72 (42)
	8 mm or more	118 (34)	130 (38)	40 (23)	63 (36)	48 (27)	73 (42)	1 (1)	58 (34)	45 (26)	66 (38)
Number tested		347		174		176		171		173	

*Percentage shown in parentheses

When all reactions, irrespective of their size are considered they occurred more frequently in response to PPD-G, A, B and Y than to PPD-S. However, reactions of 8 mm or more were more frequent to PPD-S than to others in most age groups (Graph 3). Such reactions to PPD-S occurred in 2% of children below 5, 17% of children of 5 to 14 years, 57% of those 15 to 24 years, 79% of those 25 to 34 years and 86% of those 35 to 44 years and 45 and avove.

Graph 3

The percentage of reactors with indurations of 8 mm or more to the 6 PPD antigens in different age groups



Discussion

It is customary in clinical practice to classify tuberculin reactions as **negative** and **positive** according to the size of induration. Usually, an arbitrary value such as 6, 8 or 10 mm is taken as the dividing line. It is assumed that reactions of smaller dimensions are non-specific being caused by infection with mycobacteria other than **M. tuberculosis**. In certain communities the results of skin test surveys may demonstrate a logical level for such division. In the sample studied, approximately 50% had no reaction. Those who reacted fell in two groups, one with small reactions and the other with large reactions. The point of separation was at 8 mm (Graph 1). Therefore, indurations of 8 mm and more were considered **large reactions** or **positive** in this sample. The frequency

of such large reactions was low in pre-school children (2%) but rose steadily with increasing age until nearly 90% were positive after 35 years of age.

Recently, Wijsmuller **et al** (1968) reported on the pattern of tuberculin sensitivity in the villages of Mysore State. A bimodal pattern with the breaking point around 12-14 mm of induration was observed only among females, in response to 5 TU of PPD-S. Reactions of 12-14 mm and over occurred in about 20% of the population studied. They were found in 2% of pre-school children, 30% of those 35 to 40 years and 40% of those over 55 years.

Frimodt-Moller (1966) studied the pattern of tuberculin sensitivity in six villages around Madanapalle, Andhra Pradesh. There was no bimodal pattern. Among 402 persons tested, 100 (25%) had no reactions, 214 (53%) had 1-7 mm of induration and only 88 (22%) had 8 mm or more of induration. Reactions of 8 mm or more were seen in 5 to 10% of children at the age of 10 years, 20% of young adults of 20 and 40-50% of older adults.

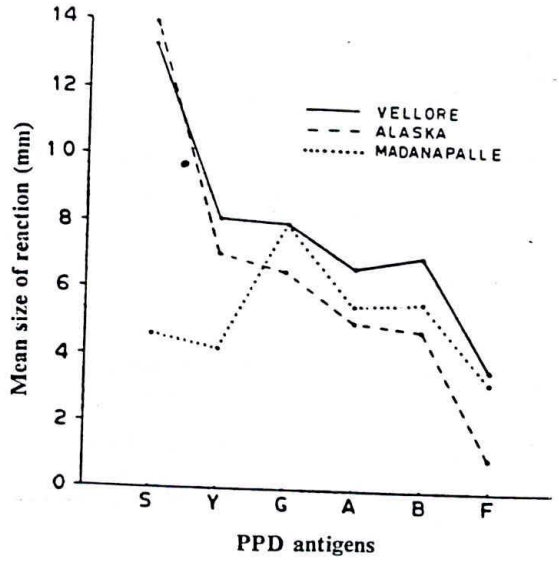
These three areas with different prevalences of tuberculin sensitivity are located within 200 miles from each other. It appears that infection by **M. tuberculosis** is more common in Vellore town than in the rural areas of Mysore and Andhra Pradesh.

Mycobacteria other than **M. tuberculosis** have been classified mainly into four groups namely scotochromogens, photochromogens, non-photochromogens and rapid growers (Runyon 1959). The avian tuberculosis bacillus (**M. avium**) is closely related to the non-photochromogen group (Wayne 1966). All four groups were represented by skin test antigens in this study. Though a majority of individuals reacted to these antigens, it appears that such reactions are, to a large extent, cross-reactions arising from tuberculin sensitivity. There are three main reasons for this conclusion, as discussed below.

Among guinea-pigs infected with **M. tuberculosis** and no other mycobacteria, a significant proportion react to PPD-G, A, B, F and Y with indurations ranging from 5 to 15 mm (Edwards **et al** 1968). The same phenomenon occurs in Eskimos of Alaska who are believed to harbour only **M. tuberculosis** and no other mycobacteria of the kind considered here (Edwards **et al** 1968). Therefore, the demonstration of skin reactions alone does not constitute evidence for the prevalence of mycobacteria other than **M. tuberculosis** in the community.

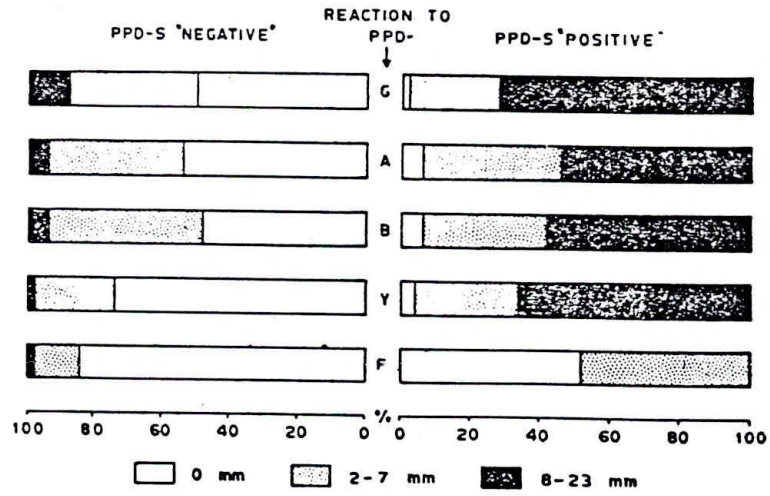
A comparison of the PPD sensitivity **profile** of the Vellore population with that of Eskimos in Alaska and of the village population near Madanapalle is shown in Graph 4 (Edwards **et al** 1968, Frimodt-Moller 1966). The **profile** is a line joining the mean indurations of reactions to PPD-S, Y, G, A, B and F in that order (Edwards **et al** 1965). It is obvious that the vellore **profile** resembles more closely that of Eskimos than that of the villagers near Madanapalle. The Eskimos **profile** is known to resemble that of tuberculous guinea-pigs and of tuberculous patients (Edwards **et al** 1968). The Madanapalle profile resembles that of residents of Georgia (USA) in whom infection by scotochromogens is known to be common and also that of guinea-pigs infected only with scotochromogens (Frimodt-Moller 1966).

Graph 4
The PPD sensitivity profile



The sample population can be divided into two groups, one with no or small reactions to PPD-S (or PPD-S **negative**) and the other with large reactions (or PPD-S **positive**). If the reactions to PPD-G, A, B and Y are studied in these two groups, it will be seen that in the former group are the majority of individuals with no or small reactions to these antigens and in the later group are the majority of individuals with larger reactions (Graph 5). This pattern suggests that the tuberculin sensitivity

Graph
A comparison of reactions to PPD-G, A, B, Y and F between PPD-S negative and PPD-S positive individuals



influences to a large extent the reaction to the other antigens. Reaction to PPD-F alone differs from this pattern.

Though **M. tuberculosis** has thus been shown to be the predominant mycobacterium in Vellore population, the results of our study also show that it is not the only agent causing sensitivity to various PPD antigens in this community. In a population exposed only to **M. tuberculosis** as in the case of Eskimos or that of infected guinea-pigs, the frequency distribution of the size of reactions to PPD-S forms a bell-shaped curve. In them nearly all reactions are large. The frequency distribution in our study shows a bimodal pattern with a cluster of small reactions ranging from 2 to 7 mm. It is now well recognized that this pattern of tuberculin sensitivity indicates the prevalence of some non-tuberculous mycobacteria in the population (Palmer 1953, Edwards **et al** 1968). It is believed that these small reactions are the result of cross-sensitivity to antigens of some other mycobacteria.

In 63 individuals the reaction to at least one other PPD was greater by 4 mm or more than that of PPD-S. The difference was 6 mm or more in 32 individuals and 8 mm or more in 11 individuals. Though in most persons with no reaction to PPD-S there was little or no reaction to the other antigens there were 39 persons with 0 reaction to PPD-S and 4 mm or more reaction to at least one of the other antigens. Among these 39, 20 had reactions of 6 mm or more and 8 had reactions of 8 mm or more. These results also indicate the prevalence of infection by some other mycobacteria in addition to **M. tuberculosis**. Since the numbers and sizes of reaction to PPD-G were greater than to any other PPD in this group it is likely that scotochromogens are present and do contribute to this pattern of PPD sensitivity.

Acknowledgment

We are grateful to Miss Leela Thomas who performed the skin tests and to the Vellore families for their participation in this study.

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Draft

Could Tuberculosis be a Psycho-somatic disease ?

Robert Koch's discovery of M.tuberculosis in 1882 seemed to prove that the disease was infectious in nature. The introduction of skin testing in 1908 however showed that many more persons were infected with the bacillus than acutally had the disease. In India it is generally held that one-third of all people are infected with TB (primary tuberculosis) and that this constitutes disease immunity. However a small proportion of people reactivate the disease in adulthood (secondary tuberculosis) for as yet unknown reasons. How is it then that, urbanisation, poor housing, overcrowding, poverty, exposure to occupational dusts and a variety of other factors, predispose to a reactivation of tuberculosis.

A large amount of TB research today is focusses on the immune response, why it is that only some people develop tuberculosis, why some people respond differently to treatment. An area of research which is ignored in current literature is psycho-somatic research in Tuberculosis. Rene Dubos, and other early TB researchers discussed that the issue of stress was closely related to the concept of resistance to tuberculosis. But with the focus on the germ and therapeutics, this ideas has not been pursued.

Thomas Holmes was a pioneer in psychosomatic research credited for showing the relationship between stressful life events and disease in general, and his work became the cornerstone of modern 'mind-body' research. He started his work on psycho-somatic research as a physician in a United States TB sanatorium in 1949 exploring the relationship between stress and tuberculosis. Although he lacked the sophistication of modern epidemiological techniques, several of his studies showed that persons who had experienced stressful situations such as divorce, death of spouse, a loss of a job were more likely to develop tuberculosis and less likely to recover from it. He devised numeric scales that quantified stressful events and did prospective studies with control groups (some of his work is summarised below). Although Holme's work was rudimentary, and open to scientific criticism, his basic contention may have been correct. Holmes was well regarded among his colleagues and his work received governmental funding. His scientific findings however were not necessarily accepted. This may have been because at that time the focus was on the 'germ' and that TB treatment was believed to be causing a major decline in the disease. He left TB research in 1962 and his subsequent work was all published in psychosomatic journals.

Holmes also emphasized the need to understand each patient holistically. The following is a discussion of a 29 year old black woman at a case presentation:

At this point in her life, the man she later married returned from war service to the small town in Louisiana, and after a month superficial acquaintanceship they were married. The marital adjustment was always poor .... She spoke of herself as "not a

...2

hotblooded woman" who preferred church activities. Her husband preferred sports and parties. She resented the fact that he was not a good provider and stated, "My father built a good home for my mother. Here we are packed in; I need my own home". The husband chose Seattle as a place to live, and in 1946 they moved here.... The patient always resented the separation from her family and stated, "I always keep the far home available".

Holmes then explained why this particular woman had become tuberculous : "It was in the setting of unfulfilled dependency needs, and an increasingly strained marital adjustment in a new and unsympathetic environment, that the patient developed pulmonary tuberculosis " (33). This analysis recalled the holistic approach to psychosomatics that placed disease in the context of a patient's personal history.

The contention of this article is not that Holme s work proved the link between stress and tuberculosis, but that the body of his research has been completedly ignored in contemporary tuberculosis liteature. His research and his presentations sought to challenge the standard model of the disease as a straightforward infection. "Although infection with the bacillus was necessary, tuberculous could not be understood without recognition of the etiologic role played by underlying personalities and stressful situations". However the research agenda that he initiated, has remained unworked on since that time.

While Holmes developed a sophisticated model of tuberculosis as a 'psycho-somatic disease' he had little say about its prevention and treatment. Of course one way to alleviate stress among the poor would have been to provide them with better jobs, housing and nutrition. However like most contemporary medical people he advocated educating people about their fears, anxieties and misperceptions, enabling them to anticipate stressful events and thus adjust to them better.

The fate of Holme's work is not unusual. Although we know that tuberculosis is a disease with social and environment roots, our technical solutions ignore this. Could the various factaors that we are discussing, urbanisation, overcrowding, poverty mediate some of their influences through stress ? Is there a different way of looking at the same problem ?

Summary of Thomas Holmes work of tuberculosis

* In a study of 109 sanatorium residents Holmes found that patients who had localised resolving tuberculosis, were anxious and had normal or high urinary ketosteroid levels, whereas those with advanced and deteriorating TB were depressed and had low urinary ketosteroid level.

...3

* In a study of Seattle residents he found that the disease predominated in areas where those were poorer and non-white people.

* To understand the effect of emotional stress and difficult social relations, he interviewed 100 patients admitted to the Seattle sanatorium. He found that 71 % had experienced financial hardship, 52 % job dissatisfaction, 31 % met criteria for alcoholism and that these factors clustered in the 2 years preceding the admission.

* He did the same study using a control group and a interview schedule which he devised to measure the previous occurence of psychosocial stress (Schedule of Recent Experience). He compared 20 matched sanatorium employees who developed TB and those who did not and found disturbing occurences more frequently in the preceding two years of tuberculous employees alone. He also assessed their "emotional integration" by a different scale and found that the TB employees were more frequently pathologically disturbed".

IHL → you ask Q about problems → That person is likely to recall. than the healthy guy.

* In the next study he used a partially prospective design, comparing patients who redeveloped sputum positivity on treatment after 3 months of sputum negativity (21 patients) to patients who remained sputum negtive (24 patients). He found that those who had "thrown a positive" faced emotional problems during hospitalisation and had long histories of unstable lifes, lack of social, economic and family supports. He then devised a new instrument to measure the of the level of emotional disturbance which predisposed to "throwing a positive", based on his data. He re-analysed 10 controls and assigned them scores on the basis of their baseline psychological difficulties. He predicted that of them, two would 'throw a positive' and his prediction came true.

poor nutr. ↓resistance ↓ infection prevalent areas.

* His final major study titled 'Experimental study of prognosis' used the Berle Index, an instrument that identified psychological and social factors characteristic of recovering patients. A high Berle score predicted recovery. He prospectively studied 41 randomly selected patients. When 26 who had achieved a normal or high Berle Score were located 5 years after the testing, none of them were treatment failures. However 5 of 15 patients who had low Berle scores were treatment failures.

→never causative
→adjuvant / predisposing.
→disease → ~~Setbacks~~ in life: social economic emotionally.

ADULT TUBERCULOUS MENINGITIS : COMPARATIVE STUDY OF DIFFERENT CHEMOTHERAPEUTIC REGIMENS

VN Acharya*, BT Kudva**, VJ Retnam†, PJ Mehta‡

SUMMARY

One hundred and two cases of adult tuberculous meningitis were studied over a period of 5 years. According to treatment regimens, they were divided into four groups. Groups A and B were treated with streptomycin, isoniazid and PAS/ ethambutol initially for 3 months followed by maintenance with INH + PAS/ethambutol for 15 months (total 18 months). Groups C and D were treated with streptomycin, isoniazid + rifampicin or rifampicin + pyrazinamide for 2 months followed INH + rifampicin for 7 months (total 9 months). The response to therapy, which was quantitated by means of a scoring system on a computer, was poor for Group A, fair for Group B and good for groups C and D.

INTRODUCTION

Tuberculous meningitis in adults has witnessed a drop in its mortality with the advent of anti-tuberculous drugs. Classically, long chemotherapeutic regimens have been advocated in its management. The disadvantage of this is frequent patient dropouts due to non-compliance. The advantage, however, is the low cost involved. Grosset[1] elucidated the bacteriological basis of short-term chemotherapy in the treatment of tuberculosis. This regimen involves chemotherapy of 9 months' duration with essentially bactericidal drugs. Many studies have been published using the short-term regimen in pulmonary tuberculosis; such a study has been lacking, however, in adult tuberculous meningitis.

This prospective study was started in January 19 and the data on all cases was analysed in December 1983.

MATERIAL AND METHODS

One hundred and two consecutive cases of adult tuberculous meningitis were studied. Their detailed neurological examination, investigations aimed at diagnosis and prognosis and a follow-up for complications and sequelae was done. The criteria for selection of cases were as follows:

1. CSF pleocytosis;
2. Raised CSF proteins with low/low-normal CSF sugar.
3. Positive CSF smear and culture for acid fast bacilli;
4. Presence of other neural or extra-neural tuberculosis;
5. Therapeutic response to anti-tuberculous drugs in the presence of a high clinical index of suspicion. At least four of these five criteria had to be met with in each case.

The age range of these patients was 18 to 30 years (mean ± SEM 24.7 ± 1.1). The male to female ratio was 3:1. These patients were randomly assigned to one of four chemotherapeutic regimens. In Groups A and B (long-term regimens), the initial therapy was for 3 months and maintenance therapy for 15 months (total 18 months). Groups C and D (short-term regimens) received initial therapy for 2 months followed by maintenance therapy for 7 months (total 9 months). The drug combinations used, their dosages and mechanism of action are listed in Tables 1 and 2.

Prednisolone was used in the dose of 30 mg/day initially and 5 mg/day as maintenance therapy in all the 4 regimens. All cases were studied on indoor basis for one month, and followed up at approximately one, three, six, nine, 12 and 18 months. During follow up, clinical appraisal, CSF examination, blood white cell count and ESR were done to judge response. Both clinical (percentage of amelioration of symptoms and signs) and cytological (percentage of disappearance of lymphocytes in CSF) responses were considered. The responses were quantitated after assigning a point to each symptom and sign with the aid of a computer. The response was

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TABLE 1 : **The dosages of various drugs used and their mechanism of action.**

Drug	Dosage	Mechanism of action
Streptomycin (SM)	25 mg/kg	C
Isoniazid (INH)	10 mg/kg	C
Ethambutol (EMB)	15-25 mg/kg	S
Para-amino salicylic acid (PAS)	150 mg/kg	S
Rifampicin (RFM)	10 mg/kg	C
Pyrazinamide (PYZ)	35 mg/kg	C

C = Bactericidal S = Bacteriostatic

TABLE 2 : **Details of the four chemotherapeutic regimens**

Groups	Initial therapy	Maintenance therapy	Duration
A (40)	SM, INH, PAS (3 months)	INH, PAS (15 months)	18 months
B (24)	SM, INH, EMB (3 months)	INH, EMB (15 months)	18 months
C (18)	SM, INH, RFM (2 months)	INH, RFM (7 months)	9 months
D (20)	SM, INH, RFM, Pyz (2 months)	INH, RFM (7 months)	9 months

SM= Streptomycin; INH= Isoniazid; PAS= Para-amino salicylic acid; RFM= Rifampicin; PYZ= Pyrizinamide.

TABLE 3 : **Response to anti-tuberculous chemotherapy regimens**

Groups	Cytological response (weeks) Mean ± SEM	Clinical response (weeks) Mean ± SEM	Follow-up after completionoftherapy (months0 Mean ± SEM
A (40)	4 ± 0.20	6 ± 0.16	24 ± 2.2
B (24)	4 ± 0.10	5 ± 0.18	24 ± 2.8
C (18)	3 ± 0.05	5 ± 0.14	18 ± 1.5
D (20)	2 ± 0.03	3 ± 0.10	8 ± 1.2

TABLE 4 : **Time profile (in months) of the occurrence of neurological sequelae.**

Groups	HC	OA	BPP	MR	E
A (40)	8 ± 1.0 (n = 10)	9 ± 1.0 (n = 5)	12 ± 2 (n = 6)	18 ± 1.0 (n = 8)	20 ± 0.0 (n = 1)
B (24)	7 ± 1.0 (n = 5)	7 ± 0.5 (n = 3)	11 ± 1 (n = 2)	18 ± 0.0 (n = 1)	22 ± 0.0 (n = 1)
C (18)	6 ± 0.0 (n = 1)	0	0	0	0
D (20)	0	0	0	0	0

HC= Hydrocephalus; OA= Optic atrophy; BPP= Behaviour and personality problems; MR= Mental retardation; E= Epilepsy

said to be good with a score of 90% and above, fair when 89 to 50% and poor when less than 50%. The cut-off point of the response in time was considered when maximum response could be judged from the data collected. After completion of therapy, the patients were followed up for a period of 8 to 24 months (mean 18 ± 1.88) for neurological sequelae.

RESULTS

The response to the four anti-tuberculous regimens is shown in Table 3. The patients on short-term therapy responded earlier and had fewer neurological sequelae (Table 4) than those on long-term regimens. The patients in Group D had the best results. The patient from Group C, one of the 5 from group B, and 3 of 10 from group A who developed hydrocephalus required ventriculoatrial shunts. Hydrocephalous and optic atrophy were early complications whereas behaviour problems, mental retardation and epilepsy came later. Based on computer analysis, the therapeutic response was judged as poor for Group A, fair for Group B, and good for Groups C and D.

DISCUSSION

In this study, short-term chemotherapy was shown to give good results. This regimen has been advocated for several reasons. It is known that *Mycobacterium tuberculosis* is an obligatory aerobe growing optimally at a pH of 7.4[1].

It is hence not surprising that the organisms invade the pia and arachnoid. Its replication time is only 20 hours[1]. For optimum therapy, 3 populations of organisms need to be treated: (a) the rapidly dividing extracellular organisms, (b) the slowly dividing extracellular organisms, and (c) the slowly dividing intracellular organisms. The aim of short-term chemotherapy is to kill a large number of organisms in the rapidly dividing group, therapy achieving rapid sterilization of the CSF and lesions in the pia and arachnoid[2]. Furthermore, bactericidal drugs must be used in combination to prevent survival of mutant strains. Unlike in parenchymatous involvement of the lung and liver, the blood-brain barrier must be overcome. Pharmacological studies indicate that pyrazinamide diffuses into the meninges to about 80% of the serum level. Rifampicin too has been shown to cross the blood — brain barrier and achieve a good CSF level. Both these are superior to levels achieved by isoniazid (about 50%) and ethambutol (about 20%). The use of steroids in all patients was based on earlier results[4,5].

As seen in Table 3 cytological response was seen earlier than clinical response, but it was earliest in Group D, followed by Groups C, B and A in that order. The neurological sequelae were least in Groups C and D. While the four groups were age-matched, but not time, nutritionally or immunologically matched, the patients did better with short-term regimens than with long term-regimens. A longer term study is warranted to determine whether delayed response decides neurological sequelae and the occurrence of relapse if any in the short-term regimen.

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SERUM FERRITIN LEVELS IN APPARENTLY HEALTHY ADULT POPULATION

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SUMMARY

Serum ferritin concentration was estimated in 60 men and 60 women aged between 20 and 60 years. They belonged to the high socio-economic strata and had normal haemoglobin levels. The mean level of serum ferritin was 50.4 ug/l and 24.0 ug/l in men and women respectively. Ferritin concentration was significantly low in women below 10 years of age, while the levels in post menopausal women were comparable to those of men. Thirty percent of them had values below 12 µg/l, indicating latent iron deficiency.

INTRODUCTION

Ferritin is the storage form of iron and only small quantities of it are present in the circulation[1]. The development of a sensitive immunoradiometric assay has stimulated a number of studies on ferritin status in different population groups[2]. These studies suggest that the level of circulating in is related to body stores of iron and, herefore, it is a valuable method for assessment of the status of iron stores[3]. In the present study, serum ferritin concentration was measured to determine the iron stores and assess the extent of latent iron deficiency in apparently healthy adult Indians.

MATERIAL AND METHODS

A total of 120 adults belonging to the high socio-economic group were investigated. There were 60 men and 60 women and their ages ranged from 20-60 years. They were apparently healthy and had normal haemoglobin levels (> 12 g/dl in women and > 13 g/dl in men). The mean haemoglobin levels in men and women were 15.4 g/dl and 13.7 g/dl respectively. Women had no menstrual irregularities.

Venous blood samples were collected from all the subjects for the estimation of haemoglobin and serum ferritin concentration. Haemoglobin was estimated by the cyanmethemoglobin method and ferritin levels by immunoassay[4].

RESULTS

Serum ferritin concentration ranged from 2-115 ug/l. The mean levels were 50.4 ug/l and 24.0 ug/l in men and women respectively (Table) In women aged between 20 and 40 years, the ferritin levels were significantly lower as compared to those in men. Serum ferritin showed a rise with age and in women above 40 years the mean level was similar to that of men (Fig). Thirty percent of the women had ferritin levels below 12 µg/l,

TABLE : **Serum Ferritin Concentration in Men and Women**

	No	Haemoglobin Mean ± SE	Serum Ferritin (ug/l) Mean ± SE	Range
Men	60	15.4 ± 0.19	50.4 ± 3.2	9.2 — 115.0
Women	60	13.7 ± 0.11	24.0 ± 2.2	2.9 — 70.0

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NTI Bulletin 1999, 35/1-4, 27-28

National Sample Survey to Estimate Annual Risk of Tuberculosois Infection in Different Parts of India

A nationwide tuberculin survey with the National Tuberculosis Institute (NTI), Bangalore as the nodal centre is currently under progress. The objective of the survey is to assess the current epidemiological situation of tuberculosis in different parts of the country by computing Annual Risk of tuberculosis Infection (ARI)

The survey has been designed to estimate ARI in each of the four zones of the country i.e., north, south, east and west. In each zone 51,000 children aged 1-9 years are to subjected to tuberculin testing. These children shall be covered in 600 clusters spread over six districts, selected by stratified systematic sampling. Therefore, a total of about 2,04,000 children from 24 districts in the country are to be included for the survey. The selected districts and the number of rural and urban clusters to be covered in each district are given in the Annexure.

A written consent for participation in the survey is obtained from the parent/guardian of every child. Every child is given '1TU of PPD RT23 with tween 80' intradermally on the mid-volar aspect of the left forearm. A suitable disposable tuberculin syringe and needle is used for injection. A trained person reads the test results after three days and the maximum transverse diameter of the induration is recorded. The fieldwork is conducted strictly following the work instructions finalised after the pilot studies.

Teams of Contractual Field Health Workers who have dergone intensive training in tuberculin testing and reading conduct the field work under direct supervision of NTI and other collaborating centres. TRC, Chennai who also have the responsibility of training all but one of the eight survey teams is conducting the fieldwork in the South zone. The fieldwork in rest of the country is being carried out by NTI, which also has the responsibility of conducting supportive studies. New Delhi TB Centre, Delhi and Mahatma Gandhi Institute of Medical Sciences, Wardha are collaborating for joint supervision of the survey in 3 districts each of North and West zones respectively. The support of district health services and state TB cells is solicited for the conducting the fieldwork.

The expected duration of the survey is about 3-4 years. The analysis and reporting of the data shall be done centrally at NTI.

Progress of the survey till 29.02.2000 is as under:

* Consequent to acceptance of the survey protocol by Central Steering Committee on operational research, approval to conduct the survey was received from Central TB division, Directorate General of Health Services in April 1999. Subsequently, the finer technical and operational details were re-examined and the protocol was revised.
* The work instructions were formulated and revised following the experience gained in the pilot studies conducted in Anekal, Bangalore (rural component) and Mysore City (urban component).
* The clearance from an Ethical Committee headed by a retired Chief Justice . has been obtained.
* Recruitment of five teams of Contractual Field Health Workers has been completed. The training of three teams has been completed and another teams training is under progress.
* The field work for the main survey which commenced on 3.1.2000 in Dakshina Kannada and on 1.2.2000 in Junagadh is under progress. About 30 clusters in Dakshina Kannada and 19 clusters in Junagadh have been completed so far.
* The planning work including procurements has been undertaken for initiation of the fieldwork in Rae Bareilly, Medak and Delhi.

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Annexure I
Details of Selected Districts for National ARI Survey

State	District	Population in 1000's (1991 census)			No of selected clu sters	
		Total	Urban	Rural	Urban	Rural
South Zone		197298	59100	138198	180	420
Andhra Pradesh	Medak	2270	329	1941	13	61
	Belgaum	3584	842	2742	33	86
Karnataka	Dakshina Karnataka	2694	762	1932	30	61
Kerala	Malapuram	3096	282	2814	11	89
Tamilnadu	Chingleput-M.G.	4654	2090	2564	82	81
	Kanyakumari	1600	270	1330	11	42
Selected Districts(total)		17898	4576	13322	180	420
East Zone		218346	40291	178055	110	489
Assam	Golaghat	828	49	779	3	27
Bihar	Bhagalpur	3202	387	2815	24	96
	Dumka	1496	91	1405	6	48
	Giridh	2225	345	1880	21	64
Orissa	Cuttack	5523	679	4844	42	166
West Bengal	Bankura	2805	233	2572	14	88
Selected Districts (total)		16079	1785	14294	110	489
North Zone		198804	48632	150172	147	453
Delhi	Delhi	9421	8469	952	129	39
Himachal Pradesh	Kangra	1174	60	1114	1	46
Punjab	Gurdaspur	1757	387	1370	6	57
Uttar Pradesh	Hardoi	2747	321	2426	5	100
	Jaunpur	3215	222	2993	3	124
	Raebareli	2323	209	2114	3	87
Selected Districts(total)		20637	9668	10969	147	453
West Zone		229042	69508	159534	182	418
Gujarat	Junagadh	2395	778	1617	20	80
Maharashtra	Nagpur	3287	2031	1256	52	62
	Ratnagiri	1544	137	1407	3	69
	Thane	5249	3391	1858	86	92
Madhya Pradesh	Jhabus	1130	98	1032	2	51
Rajathan	Kota	2031	739	1292	19	64
Selected Districts(total)		15636	7176	8460	182	418

Total Urban Clusters 619
Total Rural Clusters 1780
Grand Total 2399

Effectiveness of BCG vaccination against tuberculous meningitis: a case–control study in São Paulo, Brazil

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A case–control study was carried out in the Metropolitan Region of São Paulo, Brazil, to determine the protection against tuberculous meningitis conferred by BCG vaccination to children aged less than 5 years. The BCG vaccination coverage in the study area was about 88%. A total of 72 tuberculous meningitis patients were studied as well as 505 neighbourhood and 81 hospital controls. Analysis of the data using a conditional logistic regression for matched case–control studies indicated that the efficacy of BCG was similar for both groups of controls, that for neighbourhood controls (84.5%) being slightly greater than that for hospital controls (80.2%). No significant interactions were found between vaccination status and sex, age, or socioeconomic status.

Introduction

At the beginning of the last decade of the 20th century, tuberculosis still presents a public health challenge, particularly in developing countries. In Brazil the death rate from tuberculosis has dropped systematically since the introduction of specific chemotherapy. However, the current death rate of 5.9 per 100 000 per year from tuberculosis indicates that, apart from intestinal infections and pneumonia, it is still the infectious disease that causes most deaths in the country (*14*). According to official figures, the incidence of tuberculosis has shown a tendency to rise in Brazil (*11*). The annual risk of infection is, however, not precisely known because the policy of mass and indiscriminate vaccination with BCG has not facilitated such estimates.

To reduce the global problem of tuberculosis, international health bodies have designated the identification and treatment of cases and vaccination with BCG as the principal components of control programmes (*25*). Intradermal injection of BCG is considered to be the best method of immunizing against the disease. Nevertheless, the effectiveness of BCG has been placed under doubt since several controlled trials reported contradictory results, with efficacies that ranged from zero to 76% (*2–5, 7–9, 12, 17, 18, 24*). More recently, the case–control approach has been advocated for the evaluation of the effectiveness of BCG vaccination (*21, 22*); however, such studies have also reported a wide range of efficacies (*13, 19, 23*).

Notwithstanding doubts about the effectiveness of BCG on the chain of transmission of tuberculosis, and therefore on the incidence of and death rate from the disease, the vaccine may still be useful if it gives protection against severe infantile forms of tuberculosis, although such forms are not contagious (*1, 15, 16*). The results of a study in the United Kingdom in 1950 already indicated that BCG vaccine offered such protection (*4*); however, the results of a survey conducted in Chingleput, India, were unclear on this matter (*1, 12*).

In Brazil, tuberculous meningitis is a notifiable disease. For all cases of the disease a surveillance form is completed, covering data from clinical and laboratory examinations and an epidemiological history (*6*). Despite the difficulties in diagnosing this type of tuberculosis and the lack of confidence in the data collection in countries with socioeconomic characteristics such as Brazil, the seriousness of the disease probably results in all cases being notified.

The hypothesis that BCG offers greater protection against tuberculous meningitis than against pulmonary tuberculosis (*4*) is consistent with evidence from two Brazilian states with different schedules for BCG vaccination. For example, in Rio Grande do Sul, where children aged 7 years or older are vaccinated with BCG, the incidence of pulmonary tuberculosis in 1982 was about 12.5 times greater than that of tuberculous meningitis. In contrast, in São Paulo, where children receive BCG vaccine during the first year of life, the incidence of pulmonary

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tuberculosis to that of tuberculous meningitis was 52:1; regional differences may, however, confound this apparent relationship.

BCG vaccine coverage varies markedly in different regions of Brazil. Vaccine coverage in São Paulo city is reported to be very high, exceeding 100% according to official estimates; a survey conducted in 1982–3, however, estimated that the coverage was 88% for children less than 18 months of age.[a]

In view of these facts and of the necessity to better define the role of BCG in tuberculosis control programmes, we carried out a case–control study in the Metropolitan Region of São Paulo to evaluate the effectiveness of BCG against tuberculous meningitis. Our findings are reported here.

Materials and methods

Study area

The study was conducted in the Metropolitan Region of São Paulo (MRSP), which comprises 37 municipalities within an area of 8053 km². The population of MRSP recorded in the 1980 census was 12.5 million, which corresponded to 50.3% of that of the State of São Paulo and 10.6% of the entire Brazilian population. A wide range of living standards prevail in the study region, with some areas having only very basic environmental and social amenities. MRSP is very urbanized with only a few rural areas in the outskirts of the city (*20*).[b]

Tuberculous meningitis

Between 1979 and 1983, about 150 cases of tuberculous meningitis per annum were notified in the State of São Paulo, and of these a third were among children under 5 years of age (incidence, approximately 1.7 per 100 000 per annum). The majority of cases of the disease notified in the State of São Paulo are admitted to two hospitals: Emilio Ribas or Mandaqui.

BCG vaccination

Routine BCG vaccination (Moreau–Rio de Janeiro strain)[c] is compulsory in Brazil as part of a programme established by the Ministry of Health. It is recommended that the vaccine be given to children without a previous tuberculin test, between birth and the end of their first year of life. Although BCG is widely used the protection afforded by it has never been assessed in Brazil.

Selection of cases

All notified cases of tuberculous meningitis which were admitted to the Emilio Ribas or Mandaqui Hospital from 1 January 1981 to 31 December 1983 that involved patients who were born after 1978 (coverage with intradermal BCG became high in Brazil only from 1979) were ascertained. Because of the difficulties in diagnosing tuberculous meningitis unequivocally, criteria were defined based on clinical and epidemiological findings, as well as on the results of bacilloscopy, culture of cerebrospinal fluid (CSF) and necropsy. All cases selected were residents of MRSP.

Data on cases were collected in two questionnaires: one based on the hospital records and the other on household interviews to clarify and complement the hospital record data, particularly in relation to the BCG vaccination status of the children. The vaccination status of children was determined from their vaccination cards and, if possible, by the presence of vaccination scars. Cases were classified as BCG-positive only if their date of vaccination preceded that of diagnosis of tuberculous meningitis. In situations where a case died, the child concerned was still included in the study and a household visit was made. The mother was then questioned about the dead child's BCG vaccination status and was asked to produce the vaccination card. If the mother had lost the child's card, health centre archives were searched. The mother's word was accepted only if she affirmed that her child had never been vaccinated, and such children were classified as unvaccinated. Cases were excluded from the analysis if they could not be located or information could not be obtained about their vaccination status.

Selection of controls

Neighbourhood controls. Cases and controls were matched by home area and socioeconomic stratum. In order to obtain a minimum of four suitable controls per case, eight potential controls were

[a] [*Investigation of vaccination coverage in the municipality of São Paulo*]. Centre for Health Information. Government of the State of São Paulo. Unpublished document, 1982 (in Portuguese).

[b] [*Health care in the Metropolitan Region of São Paulo*]. Paper presented at the WHO/PAHO Regional Meeting of the Technical Consultation on Primary Health Care and Development Services in Urban Areas and Large Cities, Washington, DC, 20 November 1981. PAHO unpublished document (in Portuguese).

[c] Fundação Ataulpho de Paiva, Rio de Janeiro, Brazil.

sought from children in the neighbourhood of each case. The mother of the index child was asked to nominate two children of neighbours, each of whose mothers nominated two more. This process was continued until eight controls were identified. The only requisite was that the children nominated should have been born after 1978. Information on controls was collected during home visits, using a very similar questionnaire to that used for cases. To determine the BCG vaccination status of the neighbourhood controls, the same procedure was used as for cases, and only those children whose vaccination status was known with certainty were accepted. Children who had a past or present history of tuberculosis were rejected as controls.

Hospital controls. In order to detect any biases that might have been introduced by the neighbourhood controls, a second series of controls was selected from patients in Emilio Ribas Hospital. In order to ensure that there was one suitable hospital control for each case, attempts were made to identify three potential controls per case.

Hospital controls who were suspected to have had tuberculosis were excluded. Also, children with diseases which could have been prevented by vaccination, e.g., measles or diphtheria, were also excluded, because it was considered likely that those not vaccinated against these diseases would have had less chance of having received BCG vaccine. The hospital controls were selected from patients admitted with meningitis caused by *Streptococcus pneumoniae* or *Haemophilus influenzae* and who also satisfied the matching requirements of sex, home area, date of birth, and date of admission to hospital ±6 months with respect to that of the index case.

Two questionnaires were used for hospital controls, one to obtain hospital records data and the other, which was similar to that for the neighbourhood controls, for the home visit. The BCG vaccination status of the hospital controls was determined in the same way as that of the cases and neighbourhood controls.

Sample size and estimation of vaccine efficacy

With the number of cases that were expected to be found during the study period and the level of BCG coverage, it was concluded that vaccine efficacy above 50% could be detected at the 5% level of significance at a power of 80%.

Vaccine efficacy was estimated from the relationship $1-RR$ (*21*), where RR is the relative risk of tuberculous meningitis among the vaccinated compared to the unvaccinated children, estimated from the odds ratio. The odds ratio was calculated by conditional logistic regression analysis for matched case–control studies, using the EGRET software package (*10*).

Results

Characteristics of the study population

During the study period, a total of 474 cases of tuberculous meningitis were notified in São Paulo State, 196 (41.4%) of which involved 0–4-year-olds. In the two hospitals where the investigation was carried out, 271 diagnosed cases of tuberculous meningitis were admitted, 115 (42.4%) of which were children aged less than 5 years. Any case that transferred between the two hospitals or which was readmitted was counted only once, using the initial admission to the first hospital in the respective year. A total of 94 eligible cases remained, 19 of which were omitted from the study (11 were born outside the study area, while eight could not be located). Of these 75 cases that were located and visited, there was uncertainty about the true vaccination status of two children, who were therefore also eliminated from the study. Also a control could not be obtained for one case, which was therefore removed. Altogether, 72 cases fulfilled the study criteria (25 cases from 1981, 24 from 1982, and 23 from 1983).

For these 72 cases, which formed the basis of the study, the history of contact with tuberculosis patients was traced for 46 of them (63.9%). Chest X-rays were available for only 50 of the 72 cases, and 46 (92%) were positive for tuberculosis. The results of CSF cultures were available for all cases, and *Mycobacterium tuberculosis* was isolated from 10 children (13.9%). The results of CSF smears for acid-fast bacilli were available for all cases and were positive for four children (5.5%). The overall case fatality rate was 50%, but was higher among those aged less than 1 year (60.5%). Of children who survived, many suffered neurological sequelae from which they recuperated with difficulty. Only 11 of the children investigated recovered without exhibiting apparent neurological abnormalities (Table 1).

A total of 520 neighbourhood controls and 83 hospital controls were visited. Of the neighbourhood controls, 15 were omitted (12 were born outside the defined study area, one was being treated for pulmonary tuberculosis during the period in which he was visited, and for two others doubts remained as to their true vaccination status). Neighbourhood controls could not be located for four cases. Of the 83 hospital controls, two were omitted (one was born outside MRSP and there were doubts about the vaccination status of the other), leaving 81. Hospital controls could not be obtained for 12 cases.

Table 1: **Clinical outcome of the 72 cases of tuberculous meningitis that formed the basis of the study, São Paulo, Brazil**

Outcome	No. of cases
Died in hospital	36 (50.0)[a]
Died after discharge from hospital[b]	2 (2.8)
Neurological sequelae	23 (31.9)
No apparent neurological sequelae	11 (15.3)
Total	72 (100.0)

[a] Figures in parentheses are percentages.
[b] Death was verified at a home visit.

Table 2 shows the distribution of cases and controls by age, sex and socioeconomic status (defined in terms of family income, area of residence, degree of domestic crowding, and mother's education level), and vaccination status. For ease of presentation, unmatched data are shown; however, matching was preserved to estimate vaccine efficacy. Two-thirds of subjects came from the municipality of São Paulo, most from the peripheral poorer areas, while the remainder were from the other 36 municipalities of MRSP. Hospital controls were matched by sex and by age (within 6 months) but differed from cases with respect to their socioeconomic status, more frequently coming from higher status groups. Neighbourhood controls, as expected, had the same socioeconomic status as cases, but were older and had a higher proportion of females.

Table 2: **Characteristics of the study cases and controls, São Paulo, Brazil**

Characteristic	No. of cases	No. of neighbourhood controls	No. of hospital controls
Age			
<6 months	14 (19.4)[a]	35 (6.9)	20 (24.7)
6–11 months	30 (41.7)	36 (7.1)	34 (42.0)
12–23 months	21 (29.2)	104 (20.6)	18 (22.2)
≥24 months	7 (9.7)	330 (65.3)	9 (11.1)
Sex			
Male	49 (68.1)	250 (49.5)	51 (63.0)
Female	23 (31.9)	255 (50.5)	30 (37.0)
Socioeconomic status[b]			
1	58 (80.6)	431 (85.3)	55 (67.9)
2	13 (18.1)	74 (14.7)	26 (32.1)
Unknown	1 (1.4)		
Vaccination status			
Vaccinated	42 (58.3)	463 (91.7)	72 (88.9)
Unvaccinated	30 (41.7)	42 (8.3)	9 (11.1)
Total	72	505	81

[a] Figures in parentheses are percentages.
[b] Children were classified as socioeconomic status 1 if they satisfied at least three of the following conditions: per capita household income less than one minimum wage (about US$ 58.26 in May 1986); greater than four persons per bedroom; resident in the peripheral area of São Paulo municipality or other municipalities of the Metropolitan Region of São Paulo; and mother illiterate or only partly literate.

Efficacy of BCG vaccination

Vaccine efficacy was calculated separately for each group of controls using a conditional logistic regression analysis, and the results are shown in Table 3. The efficacies obtained were similar and high, the efficacy for neighbourhood controls (84.5%) being slightly greater than that for hospital controls (80.2%). No significant interactions were found between vaccination status and sex, age, or socioeconomic status.

Discussion

To the best of our knowledge, this is the first large study to quantify the effect of BCG vaccination against tuberculous meningitis. Previously, Miceli et al. in a case–control study in Argentina reported that BCG vaccination had an efficacy of 100% against this form of tuberculosis, although the sample size was small (*13*). Our results indicate that in the study community in São Paulo, BCG vaccination was highly effective against tuberculous meningitis in children below 5 years of age. This finding is very encouraging for the prevention of a disease that has a high fatality rate and serious neurological sequelae among many of those who survive. Tuberculous meningitis predominantly affects children from

Table 3: **Efficacy of BCG vaccination against tuberculous meningitis for matched pairs of cases and controls, São Paulo, Brazil**

	Vaccine efficacy (%)
Cases and neighbourhood controls[a]	84.5 (66.7–92.8%)[b]
Cases and hospital controls[c]	80.2 (40.6–93.4%)

[a] Adjusted for age, sex, and socioeconomic status.
[b] Figures in parentheses are the 95% confidence intervals.
[c] Adjusted for socioeconomic status.

poorer socioeconomic and environmental backgrounds, who may also be less likely to have been vaccinated with BCG. Since the majority of cases occur among children aged 3–11 months, we recommend that BCG vaccine be administered within the first 3 months of life and that efforts are made to achieve a high coverage across all socioeconomic strata.

Use of the case–control approach has been recommended for studies of the effectiveness of BCG vaccination (*15*, *21*, *22*). Compared with controlled trials, the case–control approach is both quicker to carry out and cheaper. In accord with the reports of other workers (*13*, *19*, *23*), our findings indicate that the case–control method is useful for evaluating the effectiveness of BCG vaccination. It is particularly encouraging that similar results were obtained with the two groups of controls. Hospital controls, although easy to locate, differed from cases with respect to socioeconomic status. The neighbourhood controls, although they had the same socioeconomic status as the cases, differed from the latter in their age and sex distributions; they were, however, a more plentiful source of controls. The analysis with each group of controls therefore still required some control of confounding variables, which led to similar estimates of BCG efficacy. The vaccine efficacy was slightly higher for neighbourhood controls, but this may have arisen because of further confounding. No evidence was found for interactions between vaccination status and age, sex, or socioeconomic status, but the sample size was rather small to study these effects.

In most countries where tuberculosis is endemic, its incidence has remained fairly constant. For such countries, BCG vaccination is an attractive policy to protect children against tuberculosis, although it does not significantly decrease transmission of the disease. Our results are encouraging for the prevention of tuberculous meningitis and should hopefully stimulate further case–control studies of BCG vaccination and childhood tuberculosis in other countries.

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Résumé

Efficacité de la vaccination par le BCG contre la méningite tuberculeuse: étude cas-témoins à São Paulo, Brésil

A l'approche de la fin du XXe siècle, la tuberculose pose encore un problème de santé publique, notamment dans les pays en développement. Pour y remédier, les organismes sanitaires internationaux ont décidé d'axer les programmes de lutte sur l'identification et le traitement des cas de maladie et sur la vaccination par le BCG.

Bien que le vaccin BCG soit largement utilisé dans le monde à titre de mesure préventive contre la tuberculose, sa valeur a été remise en question. L'article présente une discussion du rôle du BCG en tant que mesure de lutte contre la tuberculose et étudie la protection qu'il confère contre la méningite tuberculeuse.

Les politiques de vaccination par le BCG dans les Etats brésiliens de Rio Grande do Sul et de São Paulo, qui ont différents calendriers vaccinaux, ont été évaluées; on a pour cela examiné l'incidence de la méningite tuberculeuse dans chacun de ces Etats. Dans l'Etat de Rio Grande do Sul, où les enfants sont vaccinés à l'âge de sept ans, l'incidence de la méningite tuberculeuse est environ quatre fois plus élevée qu'à São Paulo où les enfants sont vaccinés avant l'âge d'un an. La couverture vaccinale du BCG varie sensiblement d'une région à l'autre du Brésil. Par exemple, en ville de São Paulo, elle est très élevée, dépassant même 100% selon les chiffres officiels; toutefois, une enquête réalisée en 1982–1983 conduit à estimer à 88% la couverture vaccinale chez les enfants de moins de 18 mois. L'article rapporte les résultats d'une étude cas-témoins menée dans la zone urbaine de São Paulo (Brésil) afin de déterminer la protection que confère le BCG contre la méningite tuberculeuse chez les enfants de moins de cinq ans.

L'étude a porté sur 72 cas de méningite tuberculeuse, 505 témoins de voisinage et 81 témoins hospitaliers. On a calculé l'efficacité du vaccin selon la formule 1-*RR*, dans laquelle *RR* est le risque relatif de méningite tuberculeuse chez les sujets vaccinés par rapport aux sujets non vaccinés, exprimé par le odds ratio. Avec une analyse de régression logistique conditionnelle, nous avons calculé que l'efficacité du vaccin était analogue dans les deux groupes de témoins, légèrement plus grande toutefois chez les témoins de voisinage (84,5%) que chez les témoins hospitaliers (80,2%). On n'a observé aucune relation

significative entre l'état vaccinal et le sexe, l'âge ou le niveau socio-économique.

Bien que des réserves aient été exprimées quant à l'efficacité du BCG sur la chaîne de transmission de la tuberculose et par conséquent sur l'incidence et la mortalité générale dues à cette maladie, nos observations montrent qu'il peut être utile s'il protège contre les formes infantiles graves de tuberculose. Comme la plupart des cas de méningite tuberculeuse chez l'enfant surviennent chez les nourrissons de 3 à 11 mois, nous recommandons d'administrer le BCG au cours des trois premiers mois de la vie.

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Women and TB

The research team of the FRCH project "Socio-cultural Aspects of Tuberculosis Among Women - Implications for Delivery of Services" comprising of ***Dr. S.N. Morankar, Dr. N.S. Suryavanshi, O.N. Patil, A.M. Kudale & D.C. Deshmukh*** *traces the methodological problems in field-based research on gender differentials in Tuberculosis and offers some practical solutions*

Introduction

Despite decades of research and effective treatment strategies being available, the problem of tuberculosis remains unsolved, taking its toll on society even today. The Government of India is rehauling its National Tuberculosis Programme in an effort to ensure the cure of TB patients by providing the most effective medicines and by direct monitoring of treatment follow-up of patients. However, as with other such projects, successful implementation of this programme would require community involvement for which it is mandatory to study the disease in its socio-cultural aspect.

While much has been written about the influence of socio-economic and cultural factors on compliance with tuberculosis treatment, there is hardly any research done on gender differentials in tuberculosis and its control. Hence, FRCH has undertaken a study on the gender specific problems of help-seeking behaviour of women TB patients, simultaneously providing them with useful information to help improve their access and adherence to treatment.

TB Takes its Toll

* Approximately one third of the world's population is infected with Mycobacterium Tuberculosis.
* Tuberculosis kills over one million women each year.
* About 80% of deaths due to tuberculosis occur in the age group of 5-49 yrs. - the most productive years of life.
* The risk and prevalence of tuberculosis infection are similar in males and females until adolescence, after which, they become higher in males.
* Tuberculosis is as prevalent in the rural areas as it is in the urban concentrations.

Methodology

The study methodology includes conducting interviews of TB patients and non-affected people with the Exploratory Model Interview Catalogue (EMIC)* method, which is the first time such a method is used in data collection in studying TB.

The purpose of using EMIC in the present study is to identify patterns of distress, perceived causes and the preferences as well as past history of help seeking and treatment. A section of the EMIC will be focussing on social stigma attached to the disease, which has an important effect on TB-related illness behaviour, to produce a stigma scale.

Selection of Patients and Interview Strategy

Initially, the following strategy for selection of patients and their interviews was decided upon:

i) Clinic based patients : 80 rural clinic-based patients (40 male and 40 female) who have been registered for treatment 4-6 weeks prior to the date of interview at the District TB Centre, Pune were each to be interviewed by one male and one female investigator.

ii) Community based patients: Mapping of all patients diagnosed as suffering from TB 3-4 months before the start of data collection or currently on treatment in the Parinche Valley, Pune District (FRCH's action-research area consisting of 20,000 population) would be done by contacting all available formal and informal sources. The patients would be interviewed by an FRCH researcher working at Parinche. Information about these patients would be collected by community based women known as "tais" as per specific guidelines provided to them by FRCH staff. Tais would prepare case studies of the patients and do a follow-up of their treatment behaviour for six months. This would also allow us to study the advantages/ disadvantages of involving community based female workers in a research process.

iii) Non-affected persons : Non-affected persons would be selected from 20 villages picked out from a list of villages from where come the patients registered at the DTC. These 20 villages are within a radius of 50-60 kms from Pune city, for the purpose of logistics and convenience of data collection.

iv) Health care providers : All health care providers in the same 20 villages would be identified through discussions with key informants from the villages and interviewed with the help of a semi-structured interview schedule. This would include all providers identified and visited by villagers including traditional and folk healers for health and medical care.

v) It is proposed to conduct a focus group discussion (FGD) in the evening after completing the interviews in each of the 20 villages. In each village emphasis would be laid on participation by a different socio-economic or gender strata in the FGD so that all stratas would be covered. The Sarpanch or members of the Mahila mandal were to be contacted to help gather the kind of people we wanted for the discussion. It has been our experience so far, that besides the target group many others take part in the discussion and it is quite difficult to stop them from interfering in the proceedings.

Village Health Ethnographic Study

To understand the community's perceptions about health it was decided to conduct a detailed study emphasising health and related aspects of the village concentrating on stigma related diseases such as TB, leprosy, HIV/AIDS etc. with a focus on gender differentials. This study was to be conducted by a village based local women researcher. This is an attempt at developing methodology for collecting health information using qualitative research methods with the help of a village based local woman as an investigator by giving her appropriate inputs.

Altering the Methodology

During pretesting we faced certain difficulties regarding our methodology hence, after due discussion with members of our research advisory committee, certain changes have been made in selection criteria of patients as follows:

Clinic based patients: As Directly Observed Therapy (DOTS) has been implemented in the whole of Pune district, we had to take patients who came under DOTS treatment. Not a single rural woman patient who attended the clinic at DTC and who fulfilled our criteria could be interviewed by us. The explanations given by medical staff at the DTC and as understood by the researchers are:

* Even if a woman came to the DTC she is always accompanied by her husband, brother, mother-in-law etc. and hence, is unable to talk on these sensitive issues in their presence.
* She is in a hurry to go back home.
* Most of the patients, female as well as male, are transferred to the nearest PHC for further treatment.

Hence, the criteria for interviewing patients was changed and it was decided to visit rural hospitals and PHCs in rural areas of radius 50-60 kms from Pune to cover the target.

Moreover, it was observed during pretesting that females feel more comfortable with and talk more openly to female researchers. So instead of one male and one female researcher it was decided that female researchers would interview female patients and male researchers, male patients. The same strategy was followed in interviewing non-affected persons. The qualitative information gathered in the interview is immediately coded by the interrater method. The code is mutually decided upon by the researchers.

Initially, we had planned to conduct FGDs in the evening when all the women would be at home and had some time to spare for us but it was suggested by village women and others in the community to conduct FGDs in the morning on a weekly market day. The reasons given were: firstly, it being the market day nobody would go for work and hence, everybody would be available for group discussions and secondly, in the evening most of the men folk in the community came home absolutely drunk making it difficult for women to come for group discussions. Incidentally, the problem of alcoholism was prominent in 2 of the 4 villages where FGDs were conducted.

After due discussion it was decided that as it would be very hectic for the community based patient if s/he was visited by FRCH researchers and again by tais for in-depth study and follow up, instead, only tais would visit the patient and take in-depth information form patients. When it was observed that tais give more information orally than in writing, as writing seems to be a constraint for them, we decided that the one of the FRCH researcher would write whatever relevant information the tais had gathered about the patients. The data collected through this method has been purely qualitative to date and will be analysed by the computer package popularly used for qualitative data `Text Base Beta'.

These were a few methodological problems faced by the researchers in the present study and the necessary modifications made to our strategy. We hope our experience will benefit other researchers carrying out similar work.

Note : * EMIC: The Explanatory Model Interview Catalogue is a highly appropriate method for acquiring information about social and cultural determinants of illness, help seeking, treatment adherance and other aspects of illness behaviour. Though rather lengthy and exacting, it is able to simultaneously collect qualitative as well as quantitative information in depth about any particular illness.

EMIC has been developed in studies of tropical diseases and mental health in India and used in Africa, East Asia, Europe and North America. It has already been used for operational research studies of leprosy, onchoceriasis and childhood diarrhoea. ❑

Contd. from page 4

ensure proper utilisation of the existing public and private health systems through health education, awareness of individual rights, more economic resources to help them buy better services, timely referrals to public/private providers by the village health workers in complicated cases etc.

Empowerment of the People - Bottom-up Approach:

It has been realised that no development initiative including basic health care can succeed unless people's participation in the scheme is ensured. The 73rd amendment to the constitution now offers people an opportunity to initiate and plan schemes for their own development. The 33% reservation provided to women and schedule castes in Panchayats should ensure the participation of the weaker sections of the society in the political process and give them socio-economic empowerment. ❑

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TUBERCULOSIS CONTROL AND ECONOMIC ISSUES

VK Chadha[1], Preetish S Vaidyanathan[2], Sanjay Singh[3]

SUMMARY

The health of its people is reflected in the economy of a nation - healthy people produce healthy economies. It is unfortunate that in our country the effects of ill health on economy have not been fully appreciated. The burden imposed on individuals, families and the community by diseases like tuberculosis (TB) contains an economic dimension. TB extracts costs - invariably in an economic sense - at all levels of the society, either directly through e- nditure incurred in providing health and social c.. and support, or indirectly in terms of lost opportunities such as loss of employment. Other intangible costs include the anguish and anxiety experienced by the patients and their families. The havoc wrought by TB on individuals, families, whole communities and economies is enormous and the ensuing discussion shall focus on the economic issues related to the problem of TB and its control.

KEY WORDS: HEALTH ECONOMICS; CONSTRAINTS, SCC, DOTS, FINANCIAL SUPPORT

THE BURDEN OF TUBERCULOSIS

The magnitude of TB can be appreciated from the fact that it is now the world's foremost cause of death from a single infectious agent killing more people than AIDS, r. ria and other infectious diseases[1]. There are about 3 million deaths from TB annually all over the world with someone dying of TB every 10 seconds[2,3]. In India alone, there is one death due to TB every minute[4]. Though many children die of tubercular meningitis and miliary TB, the brunt of the disease is borne by those in the age group of 15-59 years[5-8]. Approximately 6.7% of all deaths and 18.5% of deaths in the age group 15-59 year age group in the developing world are attributable to TB[2,8]. Though TB deaths are more common amongst males, it is pertinent to mention that TB kills more women than all other infectious diseases and maternal deaths combined[9]. Among more than 900 million people in India today, every second adult is infected with the tubercle bacilli and more than 2 million people develop active TB each year. At any point of time in our country there are an estimated 14-15 million TB patients, which is nearly one third of the global burden of this disease. About 3 million of these patients are highly infectious and spread the disease in the community[10].

There are few studies, if any, on the actual cost or consequences of TB on the family, community and the overall economy of our country. However, the special burden on the society caused by TB is evident from the age and sex distribution of this disease. Although morbidity and mortality in any age group have significant economic and social consequences, no community can afford to lose its citizens in prime years of life which are not only the productive years in terms of wage earning but also a period of shouldering family and social responsibilities. Further, the prevalence of the disease increases with age, and in those over 35 years, the disease is 2 to 3 times more common among males as compared to females[5]. The economic consequences as a result of TB are enormous since the contribution to the economy is generally higher by older adults as compared to young adults and by males as compared to females[11]. In a high proportion of households, the patients suffering from TB are the sole breadwinners. Several gainfully employed persons lose time from work due to their illness and many even stop working[12]. The time off from work prior to diagnosis and during treatment is an economic loss to the families and the nation. Moreover, many of the caregivers have to take time off from work to assist the patients. The magnitude of the economic losses to the nation can be gauged from the fact that TB is the single largest cause of loss of Disability Adjusted Life Years (DALY's) among adults of the developing countries[1]. In our country, TB accounts for 3.7% of total DALY's lost because of disability and premature death[1] (One DALY is equal to one lost year of healthy productive life).

The deaths in prime aged adults who are parents, community leaders and breadwinners have a particularly onerous burden and its consequences on children and

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other dependants can be great. It is commonly observed that when a mother dies, her children are more prone to suffer from malnutrition, disease and death. This assumes great significance in TB as the maximum prevalence of disease in females occur in the age group of 20-35 years[5]. Similar are consequences arising out of paternal deaths.

TB begets poverty and poverty begets TB

Most of the communicable diseases are associated with poverty, under-nourishment, over-crowding and unhygienic living conditions. In the National Sample Survey (1955-58) it was found that the prevalence of TB in urban areas was higher among those living in 'kutcha' houses as compared to those in 'pucca' houses[5]. This indicated a possible association between economic and hygienic conditions and the prevalence of disease. Similar observations have also been made in the only study conducted in the country with the specific objective of comparing the disease prevalence in different socio-economic groups[13]. In the same study, prevalence of pulmonary TB was found to decrease with increase in education level and per-capita family income. Nearly 70% of the cases were accounted in non-workers and agricultural workers[13]. Studies from other countries have also shown that TB is concentrated in lower socio-economic groups as these people are most vulnerable to contract the disease. It has been observed that the poorest households lose more time from work than better off households through chronic diseases like TB. Thus, the effects of the disease on patients can be devastating both financially and emotionally.

Worsening of TB situation has been observed in recent years all over the world. In 1970's and 1980's, TB was ignored by much of the International health community and priority was not accorded to the control or research of this disease. This neglect of TB control programmes and advent of HIV epidemic has already facilitated the return of TB in wealthy nations[4]. In the developing countries where the disease was never controlled the situation is expected to worsen in future as a result of the increasing HIV sero-prevalence rates since HIV infection is the single most important risk factor for developing TB[4]. Due to HIV/TB interface, there has been a resurgence of TB in developed countries and the incidence of TB has been recorded to have increased 3-4 times in some of the African countries[4]. The impact of HIV epidemic on the burden of TB is expected to be equally pronounced in our country since about half of the population in the age group susceptible for HIV infection is already infected with tubercle bacilli. This upsurge in HIV related TB incidence would make the economic burden of TB much greater in addition to the human catastrophe. In addition, the socio-demographic changes and increase in multi drug resistant cases shall further exacerbate the problem. It is estimated that the worldwide incidence of TB would increase by more than 50% by the year 2005 and at least 30 million people would die of TB in the next 10 years[2]. Consequently, TB has been declared as a global emergency by the World Health Organization.

CONSTRAINTS IN TB CONTROL

The National Tuberculosis Programme (NTP) was formulated by NTI after carrying out many path breaking Operational Research studies in the field of TB. It has a strong sociological basis as it was the first felt-need programme based on scientific observations[14]. Though formulated in 1962 and subjected to periodical revisions, the NTP, which is one of the largest disease control programmes in our country, has not achieved the desired results. Nearly half of the patients seek relief due to suffering from the government health facilities[14] and others from private health agencies[15]. Among those approaching general health facilities, only 16% are offered sputum examination[14]. These patients incur sizeable expenditure on general antibiotics, cost of transportation and loss of wages before they are diagnosed as suffering from TB. X- ray, as a case finding tool has limitations of over diagnosing and is about 7-10 times costlier than sputum microscopy which is also a more reliable diagnostic tool[17]. The priority to sputum microscopy has been given in the programme from its inception. Nevertheless, there has been an overemphasis on using X-rays by the physicians for diagnosing TB. This leads to economic losses, which is augmented by overestimation of cases and avoidable operational problems.

Under the NTP, antitubercular drugs are provided free of cost to the patients. However, there is a perpetual shortage of drugs in the government pharmacies while there are adequate supplies of drugs in the market at high prices. This leads to irregular and inadequate intake of anti-TB drugs leading to treatment failure. At the same time, the patients may have to incur the high cost of procuring drugs at the market price. Even in a programme offering free service, there are direct and indirect costs to the patients, which may encourage drug defaulting in the long run. The private health agencies, in addition to high service charges, do not adhere to the standard drug regimens[15]. This leads to financial losses for the patient and increased possibility of drug resistance. In a recent study by NTI, it was found that 50% of the TB patients raised money during their illness by way of debt and mortgage[18]. Economic insecurity also intensifies the existing emotional problems like anxiety and fear about the future.

Effective TB treatment not only cures prevalent cases but also prevents future cases, which are indirect benefits of chemotherapy. When the treatment is not completed, the disease has a greater likelihood of becoming multi drug resistant. The cost of treating such patients is so enormous that it is beyond the scope of any health programme and the patient continues to infect others in the community. Secondly, the efficacy of failure regimen is poor.

One of the alternatives adopted to overcome the problem of drug default has been the gradual replacement of the 12 month long course treatment with a shorter and more effective six month short course chemotherapy (SCC). Though the cost of long course therapy is initially less than the short course, it is ultimately higher when one considers the cost incurred due to treatment failure. Since SCC leads to better compliance resulting in higher cure rates, the cost per death averted is lower when compared to the long course treatment. Even though SCC has been proven to be more cost-effective than long course regimen both from provider perspective and household perspective, it has so far been introduced only in 294 districts. Within these districts only a small proportion of smear positive cases actually receive SCC drugs. Even this situation is because of constraints of resources and not according TB the priority it deserves.

Quality control is another area, which has not received sufficient attention. India is poorly equipped in terms of quality control laboratories. Studies reveal that the bioavailability of Rifampicin varies from one manufacturer to another and even from batch to batch. Monitoring of drug quality is not easy in a country of India's size and more so because of involvement of the large number of small pharmaceutical manufacturers in addition to the major ones. Expensive drugs like Rifampicin and Ethambutol have limited shelf lives in the hot and humid weather conditions prevalent in India. Poor packaging, lack of proper cold storage and transportation facilities compounds the problem.

Globally speaking TB receives the least amount of funding amongst all infectious diseases. In 1990, only 16 million dollars of foreign aid from all donors was available to control the TB epidemic and this amounted to less than one-tenth of all external aid to developing countries making TB the worlds most neglected health crisis[20]. Though it has increased to 40 million dollars in 1996, still the funds are grossly inadequate considering that only a fraction of all health expenditure is directed towards the process of controlling activities in the developing countries.

SUGGESTED ACTIONS

Early diagnosis and treatment of TB is important. Therefore, promoting the awareness of the disease through health education and the importance of prescribing the appropriate antitubercular drug regimens and preventing treatment default cannot be over- emphasized.

One of the major determinants for successful cure of TB cases is the level and intensity of supervision provided by the health care delivery system. The approach that is being gradually adopted by TB programmes all over the world is to ensure that each dose is administered to the patient under the supervision of a health worker or a dedicated health volunteer. This strategy is called the Directly Observed Treatment Short Course (DOTS) and has yielded high cure rates of 85-90% in many countries and in pilot areas of our country[21,22]. In 1993 after Government of India, WHO review the programme has been revised with DOTS as the main theme.

Implementation of RNTCP - Though implementation of RNTCP involves additional expenditure for creating the infrastructure for maintenance of the programme and giving DOTS, it is the only way to ensure high cure rates. The successful implementation of DOTS minimizes deaths due to TB and averts hospitalization of patients releasing many beds in hospitals that require large resources to be maintained. Reduction in the prevalence of TB among workers reduces their absenteeism on account of poor health. There are additional savings due to lower number of relapses and preventing development of resistance to anti-TB drugs and in both of these situations the treatment is much costlier. Reduction in transmission of infection by rendering infectious cases non- infectious also leads to future benefits. It has been estimated that for every 1% of GDP spent on DOTS in India there will be a return of 8% per annum[11]. The government of India has sought World Bank assistance to extend DOTS to about 330 million people in the course of the next five years[11]. However, it has so far been introduced in only a miniscule of the population. DOTS should be implemented as early as possible to rapidly cut down the chain of disease transmission.

Increased financial support - The analysis of TB control programmes in some African countries has shown that treating smear positive TB costs around 20-57 dollars per death averted[23]. The cost per discounted year of life saved is less than US $ 10. There are few interventions that are as cost effective as anti-TB treatment[8]. Thus, the worst infectious killer of adults is also a very cost-effective disease to combat and by curing even one person, the disease can be prevented from spreading to dozens of other people in the community.

Appropriate use of funds - Although few public health expenditures provide so much value for so little money yet many nations are spending more than half of their health budget on expensive hospital services that by comparison save very few lives. The role of Sanatoria and TB hospitals is very limited and needs evaluation as it is expensive to maintain beds for TB patients in developing countries.

Deaths due to TB could only decline if increased financial support is made available each year to TB control programmes in developing countries. Additional resources are also required to cater to the increasing number of patients having HIV and TB as these patients may also require expenses due to hospitalization.

Occupational resettlement - Some of the patients may be physically incapacitated due to destroyed lung even if the patient is cured and ruined financially during the course of treatment. So, occupational resettlement of the individual is of great importance. It is essential that consideration be given to after care and rehabilitation, taking into consideration the person's ability to work. One who was employed prior to his illness should go back to his previous job provided it is not unsuitable for the altered state of his health. Vocational training may be imparted to others so that they can be suitably employed and do not become a burden on the society.

Research - Strengthening the operation research, improving the functioning of the existing health care systems and roping in of NGOs to assist control programmes are other essential ingredients to successfully combat the menace of TB.

CONCLUSION

Considering the enormous burden imposed by TB both in terms of suffering and its socio- economic impact on our country, TB control interventions must be intensified with provision of all necessary support. Even though the health systems in our country is given lower priority and budget, there is sufficient justification for enhancing investments in TB control. Since TB control activities are also one of the most cost-effective interventions, appropriate actions aimed at reducing the enormous burden of TB must be accorded the highest priority. For this a strong political will and advocacy is required to appreciate the enormity of the problems due to TB and to allocate appropriate budgets for TB control programmes. Enhanced finances are needed to enable the TB programmes to undertake training programmes, improve registration systems and monitoring tools, to finance medicines, microscopes and to improve the modest infrastructure so that these programmes work efficiently. The resources will also be needed to fund and coordinate practical research projects to build the basis for effective long-term TB control. Implementation of DOTS strategy under RNTCP is the step in the right direction but rapid expansion of the programme and long term financial support is the need of the hour.

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HEALTH CARE REFORM

..... clear statements of policy objectives in health are often lacking, and governments have an important responsibility in this area. The roles of the principal actors in health care delivery and consumption are in a state of flux. Government responsibilities are being scaled down, but public regulation is essential. Patients, rather than administrative units, are being more commonly regarded as the proper focus for planning resource utilization. New methods of paying providers have to accommodate cost-containment as well as the professional needs of providers and equitable access for patients.

A transfer of responsibility to private financing sources exaccerbates inequities, and on its own will do nothing to improve performance in the public sector. Public sector improvements are being explored through decentralization of fund holding, contracted purchasing,overall budget control mechanisms and in some cases a clearer purchaser-provider separation. In choosing the principal policy instruments, clear policy objectives are necessary. Formulating these is a government task, and cannot be privatized.

Source : **Crease A: Global trends in health care reform:**
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EDITORIAL

Good news from India

ALL THOSE CONCERNED with the grim global problem of tuberculosis will be greatly encouraged to read the report on 'The status and prospects of tuberculosis control in India' by Khatri and Frieden in the present issue of the Journal.[1] India, with its vast population and diversity, has long been regarded as one of the greatest global challenges for tuberculosis control. It is thought to harbour nearly 30% of the world's tuberculosis.[2] A national sample survey in the mid-1950s documented the high prevalence;[3] as a result, a National Tuberculosis Programme was initiated in 1962, but over the years encountered many difficulties in implementation.[4,5] Reviews revealed treatment completion rates of less than 30%,[6] and little effect on incidence.[7]

Following these reviews, a Revised National Tuberculosis Programme (RNTP), based on the WHO 'DOTS' programmes,[8] was launched in late 1993. Starting with pilot projects in five sites in different States covering 2.5 million population, the programme expanded to cover 130 million by mid-1999. Altogether 146 000 patients had been put on treatment.

Results of treatment have been most encouraging. In smear-positive new patients, cure rates rose from 70.7% in 1993 to 83.9% in 1998, with an overall average of 79.4%. The overall failure rate was 3.5%, mortality only 3.7% and default rate 8.7%. Among those who had remained smear-positive after earlier treatment and received retreatment (Category II), 63% were cured and 3% completed treatment; only 8% remained smear-positive at the end of treatment. This suggests that most of the 'failures' of initial treatment were not due to multiple drug resistance (MDR), but to failure to observe treatment meticulously.

This has been an impressive start, but of course many challenges lie ahead. By late 1998 the RNTP covered only 2% of India's population. At that stage large scale expansion was initiated, aiming at covering a quarter of the whole population by early 2000. This must be putting great strain on the organisation of new resources, including training. It had been recognised that the quality of supervision, national, State and local, would be crucial. Supervisors must have the status and training to stimulate, encourage and monitor the work. This has now been initiated.

Two formidable difficulties lie ahead. Most patients with health problems in India first consult private practitioners, many of whom may not even be Western trained. Treatment is often chaotic and ill-sustained.[5,9,10] There must be resultant risks of MDR development, though this has not yet been systematically reviewed. There is obvious need for extensive undergraduate and post-graduate training, and for schemes to develop cooperation between private practitioners and the national programme.[10,11] HIV infection is rapidly expanding in India. Though many patients are still in the incubation phase, there is a real threat of a future explosion of case load of tuberculosis, perhaps with a grim component of MDR. It may be a race against time to prevent, or at least mitigate, MDR TB by widespread good treatment.

The clear global threat of HIV, and the as yet incompletely defined threat of MDR,[12] still fully justifies WHO's 1993 claim of tuberculosis as a global emergency. It becomes even more urgent to increase the number of countries fully implementing the DOTS programme. The addition of a 'DOTS Plus' programme to deal with MDR is at present under discussion.[13]

Have these excellent initial results of the revised Indian national programme any lessons for the rest of the world? One of the problems causing concern is the increasing advocacy of health sector reform, whereby responsibility and budgets are delegated to peripheral areas.[14] In many developing countries peripheral areas are thought to have been neglected by the centre. There are obvious theoretical advantages in the proposed reform, but certain disadvantages. These include loss of the economies of scale in such matters as drug purchase. Not all peripheral areas may give tuberculosis the degree of priority it deserves. Resultant high prevalence in one area can soon spill over into others. There may be loss of central leadership and expertise. In India much responsibility for tuberculosis is being decentralised to local 'coalitions' which have to fulfill certain conditions to receive free drug supplies from the centre. The centre also provides much technical support and leadership. Establishing coalitions is proving more complex in big cities where many diverse bodies tend to be involved. Experience in India may prove of value to other countries.

Indonesia and the Philippines are two other countries with large and diverse populations, and an immense tuberculosis problem. They are only in the earliest stages of establishing a practicable national programme, and could benefit from some of the lessons being learnt in India. Although the DOTS programme, aided by a substantial loan from the World Bank, has been brilliantly successful in about half of China,[15] it is still uncertain whether the costs will be taken over by the Chinese Government when the loan runs out in 2001. There is a danger that the tendency towards health sector reform may lead to exclusively peripheral responsibility and to patients having to pay for their treatment. The USA, the richest country in the world, has demonstrated in New York the sort of

disaster that can occur when a previously successful service is subsequently neglected.[16]

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The status and prospects of tuberculosis control in India

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SUMMARY

SETTING: India, where much of the global strategy for tuberculosis control was established, but where, every year, there are an estimated 2 million cases of tuberculosis.
OBJECTIVE: To describe the policies, initial results, and lessons learned from implementation of a Revised National Tuberculosis Control Programme using the principles of DOTS (Directly Observed Treatment, Short-course).
DESIGN: A Revised National Tuberculosis Control Programme (RNTCP) was designed and implemented starting in 1993. With funding from the Government of India, State Governments, the World Bank and bilateral donors, regular supply of drugs and logistics was ensured. Persons with chest symptoms who attend health facilities are referred to microscopy centres for diagnosis. Diagnosed cases are categorized as per World Health Organization guidelines, and treatment is given by direct observation. Systematic recording and cohort reporting is done.
RESULTS: From October 1993 through mid-1999, 146 012 patients were put on treatment in the programme. The quality of diagnosis was improved, with the ratio of smear-positive to smear-negative patients being maintained at 1:1. Case detection rates varied greatly between project sites and correlated with the percentage of patients who were smear-positive among those examined for diagnosis, suggesting heterogeneous disease rates. Treatment success was achieved in 81% of new smear-positive patients, 82% of new smear-negative patients, 89% of patients with extra-pulmonary tuberculosis, and 70% of re-treatment patients.
CONCLUSION: The RNTCP has successfully treated approximately 80% of patients in 20 districts of 15 states of India. Treatment success rates are more than double and death rates are less than a seventh those of the previous programme. Starting in late 1998, the programme began to scale up and now covers more than 130 million people. Maintaining the quality of implementation during the expansion phase is the next challenge.
KEY WORDS: tuberculosis; India; direct observation of treatment; short-course chemotherapy; microscopy; supervision

MANY OF THE PRINCIPLES of tuberculosis control were established in India, but these principles were not widely applied within the country until recently. In the mid-1950s, India conducted a national survey of tuberculosis prevalence which documented the enormous burden of suffering caused by the disease and indicated the need for political commitment to its control.[1] The Tuberculosis Chemotherapy Centre in Madras (now the Tuberculosis Research Centre, Chennai) first documented the efficacy and safety of domiciliary treatment of tuberculosis,[2] the necessity and feasibility of treatment supervision in the community—now called directly observed treatment,[3] and the efficacy of intermittent chemotherapy for tuberculosis as a means to simplify treatment observation for patients and providers.[4] The National Tuberculosis Institute (NTI), Bangalore, demonstrated in the early 1960s that even with limited health services most tuberculosis patients seek care at health facilities, indicating that active case finding is not necessary.[5] The NTI also demonstrated that technicians in the periphery can perform sputum smear microscopy effectively if they are given minimal training but regular supervision, indicating the feasibility of the use of sputum microscopy as the primary tool for diagnosis of tuberculosis.[6] Hence many of the principles which are now globally recommended as the Directly Observed Treatment, Short-course (DOTS) strategy[7] were documented in India.

India has nearly 30% of the global burden of tuberculosis disease.[8] With an estimated incidence of new smear-positive tuberculosis of 85 per 100 000 population, there are nearly 1 million new smear-positive cases of tuberculosis a year and about 2 million total new cases. A National Tuberculosis Programme has been implemented since 1962 and has established tuberculosis centres in more than 440 of the more than 520 districts in India. In addition, there are 330

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chest clinics, located mostly in urban areas, and more than 47 000 beds exclusively for TB patients. In spite of the fact that the programme had been in operation for three decades, no significant epidemiological impact on disease prevalence was observed.[9] With this background, in 1992, the Government of India, together with the World Health Organization (WHO) and Swedish International Development Agency (SIDA), reviewed the national programme and concluded that it suffered from managerial weakness, inadequate funding, over-reliance on X-ray, non-standard treatment regimens, low rates of treatment completion, and lack of systematic information on treatment outcomes (Government of India/WHO, unpublished). As a result, a Revised National Tuberculosis Control Programme (RNTCP) was designed with input from the Government of India, State governments in India, the World Bank, and bilateral donors. In this article we describe the evolution, experience, and results of this programme, and the prospects and challenges for the future.

METHODS

As of 1999, India had a population of more than 980 million people in 32 States/Union Territories. The country has an infant mortality rate of 72 per 1000 live births, ranging from 78 in rural areas to 46 in urban areas. Between States infant mortality rates range from 13 to 97 per 100 000 live births.[10] There are 19 official languages in the country.

Starting in October 1993, the RNTCP was implemented in a population of 2.35 million in five sites in different states of India (Delhi, Kerala, West Bengal, Maharashtra, and Gujarat). The programme was expanded to a population of 13.85 million in 1995 and 20 million in 1996. Rapid scale-up began in late 1998, when another 100 million population were covered under RNTCP.

The basic principles of the RNTCP are: 1) political commitment to ensure adequate funds, staff, and other key input; 2) diagnosis primarily by microscopy of patients presenting to health facilities; 3) regular and uninterrupted supply of anti-tuberculosis medications including the use of a patient-wise box which contains the entire course of treatment for an individual patient; 4) direct observation of every dose of treatment in the intensive phase and at least the first of three doses each week in the continuation phase of treatment; 5) systematic monitoring, supervision and cohort analysis; one additional paramedical staff for organization of uninterrupted treatment and one for ensuring quality laboratory service for every 500 000 population. Additional staff are provided for difficult mountainous and tribal areas.

The diagnostic algorithm recommended by the WHO[11] is used, except that X-ray is taken if all three acid-fast bacilli (AFB) smears are negative and there is no response to 1–2 weeks of antibiotics, without waiting for three more smears to be done. If only one of three specimens is positive, an X-ray is taken and the patient is evaluated. Treatment regimens are as given in Table 1. Patients treated in Categories I and II whose smears are positive at the end of the intensive phase receive another month of intensive phase treatment. All treatment is given thrice weekly on alternate days. During the intensive phase, every dose is directly observed; medications for the continuation phase are packaged into a weekly blister pack, and at least the first dose each week is directly observed.

Funding is available based on a 5-year 'soft' loan of US$142 million from the World Bank. The loan is structured as a 'time slice' so that an increasing proportion of the costs are to be borne by the State and National governments of India. Policy direction, supervision, drugs and microscopes are provided by the central government. The districts, each of which has an average population of about 2 million, have a Dis-

Table 1 Treatment regimens used in the Revised National Tuberculosis Control Programme, India

Category of treatment	Type of patient	Regimen*
Category I	New sputum smear-positive Seriously ill sputum smear-negative Seriously ill extra-pulmonary †	$2H_3R_3Z_3E_3/4H_3R_3$
Category II	Sputum smear-positive relapse‡ Sputum smear-positive failure‡ Sputum smear-positive treatment after default	$2H_3R_3Z_3E_3S_3/1H_3R_3Z_3E_3/5H_3R_3E_3$
Category III	Sputum smear-negative, not seriously ill Extra-pulmonary, not seriously ill	$2H_3R_3Z_3/4H_3R_3$

* The number before the letters refers to the number of months of treatment. The subscript after the letters refers to the number of doses per week. Patients who weigh more than 60 kg receive additional rifampicin 150 mg. Patients over 50 years old receive streptomycin 500 mg. Patients in Categories I and II who have a positive sputum smear at the end of the initial intensive phase receive an additional month of intensive phase treatment.
† Examples of seriously ill patients are those suffering from meningitis, disseminated TB, tuberculosis pericarditis, peritonitis, bilateral or extensive pleurisy, spinal TB with neurological complications, smear-negative pulmonary TB with extensive parenchymal involvement, intestinal and genitourinary TB.
‡ In rare and exceptional cases, patients who are sputum smear-negative or who have extra-pulmonary disease can have relapse or failure. This diagnosis should be supported by culture or histological evidence of active tuberculosis. In these cases, the patient should be registered as 'Other' and given Category II treatment.
H = isoniazid (600 mg); R = rifampicin (450 mg); Z = pyrazinamide (1500 mg); E = ethambutol (1200 mg); S = streptomycin (750 mg).

trict Tuberculosis Control Society which receives funds directly from the Central Government out of the World Bank assistance and which can hire contractual staff, purchase necessary items, and perform other functions more efficiently than through the usual government procedures. State governments provide the health infrastructure and staff. In rural areas, India has an established health infrastructure, with larger health centres for each 100 000 population and smaller centres for each 30 000 population.

Printed technical and operational guidelines have been provided to all health centres, laboratory guidelines have been provided to all microscopy centres, and illustrated guidelines for health providers giving observed treatment have been provided in local languages. Modular training has been used for all staff, from medical officers to health workers. Smaller centres are assisted by sub-centres each covering a population of 5000 and staffed by a male and a female health worker. These individuals are responsible for treatment observation; where they are not available, treatment observation is done by community volunteers including child survival workers, traditional midwives, and community and religious leaders. Observation by a family member is not acceptable in the programme. In urban areas the institutional arrangements are more variable. In some larger cities with limited health infrastructure, the RNTCP has funded specialised full-time staff for microscopy and for treatment observation. In these urban areas, approximately one laboratory technician and one treatment observer (TB Health Visitor) are funded and hired to provide services for each 100 000 population covered. In some rural areas with large numbers of vacancies, laboratory technicians have been funded by the programme as a temporary measure.

Outcomes are analysed and presented as per standard definitions.[11] Only patients who were started on treatment were registered; outcomes are presented only for evaluated patients. Whereas virtually all (99.4%) new smear-positive patients registered have been evaluated, in the early years of the programme some patients with smear-negative and extra-pulmonary tuberculosis who were placed on treatment were not evaluated. This situation improved in 1996, when more than 90% of all patients' outcomes were evaluated, and improved further in 1997, when more than 99% of all patients' outcomes were evaluated.

RESULTS

From 1993 through mid-1999, more than 146 000 patients were put on treatment in the RNTCP. In terms of case detection activities, detailed information on microscopy activities is available for 1998; of 145 906 patients examined for diagnosis, including both new and previously diagnosed patients, and including some patients living outside the areas covered, 19 698 (13.5%) were found to be sputum smear-positive.

Rates of sputum positivity have been quite consistent within individual project sites, but vary markedly in different project areas. For example, positivity rates ranged from 3–4% (average 3%) over five quarters in Pathanamthitta District of Kerala, which had the lowest proportion, to 15–25% (average 21%) over six quarters in Mehsana District of Gujarat, which had the highest proportion positive of all districts in 1998. Project areas with a higher proportion of patients with chest symptoms who had positive smears also had higher total and smear-positive detection rates (e.g., 33 vs 99 per 100 000 per year in Pathanamthitta and Mehsana, respectively). This relationship is an increase of approximately 20 cases/100 000 population/year in detection of new and retreatment smear-positive cases for every 5% increase in sputum positivity rates, beginning at 30 smear-positive patients per 100 000 population per year at a positivity rate of 5% (Figure 1, $r^2 = 0.8$). There is an analogous, although weaker, inverse correlation between median age and detection rate ($r^2 = 0.4$); areas with a higher median age have lower detection rates, with a relationship of a decrease of about 30 new smear-positive cases per year per 100 000 population for every 5-year increase in median age.

Quality of diagnosis has improved, as indicated by a ratio of smear-positive to smear-negative patients of approximately 1:1 (Table 2). The guidelines to put only seriously ill patients with smear-negative and extra-pulmonary tuberculosis on Category I treatment have generally been followed: in 1998, of 14 477 patients with smear-negative or extra-pulmonary tuberculosis for whom information is available, 2034 (14%) were placed on Category I treatment. Detection rates of new smear-positive patients show substantial variability between sites (range, for example, annualised from the second quarter of 1999, from a low of 60 total and 24 new smear-positive cases per 100 000 population in Kannoor District of Kerala, to 269 total and 104 new smear-positive cases per 100 000 in Jaipur district of Rajasthan). Different rates may reflect varying incidence, but detection rates in virtually all areas have increased over time, particularly after widespread expansion. For all RNTCP areas, rates increased from 87 total and 36 new smear-positive cases per 100 000 to 120 total and 47 new smear-positive cases per 100 000 population, annualised, between the first and second quarters of 1999.

There have been large differences in the rates of smear-positive tuberculosis for males and females. While the ratio of male to female new smear-positive cases is 2:1, the male to female ratio among extra-pulmonary tuberculosis is 1:1.4. Among smear-positive patients, the male:female differences increase markedly with age (Figure 2).

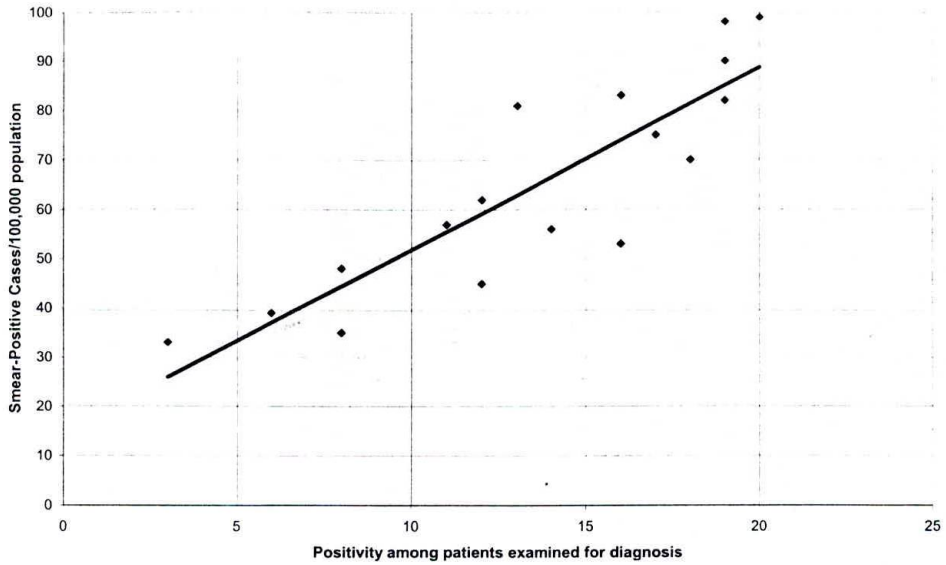

Figure 1 Correlation between per cent of patients with chest symptoms who are AFB smear-positive and smear-positive detection rate per 100 000, Revised National Tuberculosis Control Programme, India, 1993–1998. For every 5% increase in the percentage of patients who are sputum smear-positive, there is an increase of approximately 20 smear-positive patients per 100 000 population, starting at 34/100 000 with a positivity rate of 5%. Two project areas with small total populations and two areas with a large floating population have been excluded.

Treatment outcomes have been consistently good, with about eight out of 10 patients being successfully treated (Table 3). Treatment success has been high among all types of patients and in all but one of the 20 areas implementing the RNTCP (range in 19 areas, 72% to 90%). Treatment success has increased for all types of patients between 1995 and the first two quarters of 1998, the most recent period for which information is available. In the 'other retreatment' category, the proportion of smear-negative patients has increased, resulting in an increased proportion of this type of patient being reported as having completed treatment rather than being cured. Among the 1458 patients who had remained smear-positive after earlier treatment and who were treated with the Category II regimen, 63% were cured, 3% completed treatment, 8% died during treatment, 15% interrupted treatment, 8% remained smear-positive at the end of treatment, and 2% were transferred to other jurisdictions.

DISCUSSION

Since 1993, India has successfully implemented a TB control programme using principles for diagnosis and treatment which were documented in India, and which are now recommended by the WHO as DOTS. Because of India's diversity, inadequate resources, huge population, and problems of implementation, ensuring effective tuberculosis control is not easy.

Effective diagnostic policies have been difficult to implement because of long-standing over-reliance on X-ray as the primary means of diagnosis. This practice has continued in the former programme despite the documentation that 50–70% of smear-negative patients placed on treatment did not have tuberculo-

Table 2 Patients placed on treatment under the Revised National Tuberculosis Control Programme, India, 1993–1999 (first half)

Year	New smear-positive	New smear-negative	Extra-pulmonary	Relapse smear-positive	Other retreatment cases	Total patients
1993	392	603	13	44	2	1 054
1994	1 060	1 179	288	410	311	3 248
1995	2 144	1 945	606	679	669	6 043
1996	6 365	6 198	1 814	868	1 724	16 969
1997	7 747	7 129	2 186	1 035	2 644	20 741
1998	12 354	11 268	4 015	1 937	5 687	35 261
1999 (1st half)	24 959	20 020	7 426	3 487	6 804	62 696
Total	55 021	48 342	16 348	8 460	17 841	146 012

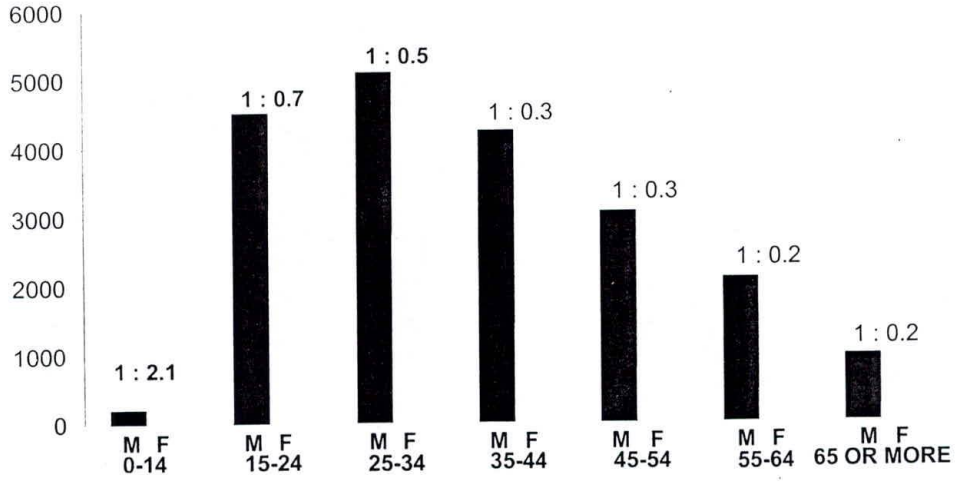

Figure 2 Cases by age and sex, Revised National Tuberculosis Control Programme, India, 1993–1998.

sis at all.[12] Close monitoring of the ratio of positive to negative patients diagnosed, and intensive supervision to ensure that three AFB smears are correctly performed and a trial of antibiotics is given prior to X-ray and treatment of smear-negative tuberculosis, have been essential. In quite a few areas, ensuring accurate history-taking has also required intensive supervision; initially some areas placed previously-treated patients on Category I regimens, which resulted in higher rates of relapse (Ministry of Health and Family Welfare, unpublished data, January, 1999).

Wide variations (5–32%) in the proportion of smear-positive cases among patients examined for diagnosis have been reported earlier.[13] The correlation seen between detection rate and smear positivity rate, if confirmed in other areas, may provide indirect evidence to help evaluate the proportion of all cases that are detected in the programme by providing a rough estimate of the number of total cases. Specifically, if confirmed and if taken in conjunction with other data, this ratio, by providing a rough estimate of total cases, might help provide a denominator to assess whether a programme is meeting the global target of detection of 70% of new smear-positive cases? Similarly, trends in the proportion of patients found to be symptomatic among those examined could provide data on trends of disease, but only if the rate of sputum examination is constant or if changes in this rate are taken into account.

In some areas, there have been concerns that patients are being selected to be placed on the RNTCP. This situation has arisen primarily, although not entirely, because of the partial geographic coverage of the programme, as some of the patients who attend RNTCP facilities for diagnosis may live outside of RNTCP areas of coverage. The goal is that, among diagnosed patients living in RNTCP areas, at least 90% should be treated under the RNTCP. Patients who are unable or unwilling to participate in the programme are to receive conventional treatment with isoniazid, streptomycin, and ethambutol. Until recently, the reporting system did not allow accurate determination of the number of patients living in the covered area who were diagnosed but not started on RNTCP treatment. The reporting formats have recently been changed so that this important indicator can be monitored in the future.

To maintain high rates of sputum conversion and cure has also required frequent supervision. Evaluation of areas with poor treatment outcomes has nearly always revealed that the primary problem has been failure to ensure direct observation of treatment at a time and place convenient to patients.

Although the Category II regimen has been controversial, even among patients who remained smear-positive after 5 months of Category I treatment and who were then placed on Category II treatment, two thirds were successfully treated and only 8% remained smear-positive after 5 months of Category II treatment.

In this initial phase, the results of India's RNTCP have been comparable to those of other countries implementing DOTS. Case detection rates are higher than those reported from Bangladesh[14] and China,[15] while rates of successful treatment are comparable to those from Africa and South-East Asia and lower than those from Peru, China, and Vietnam.[8]

The high rates of treatment success and low rates of death among patients treated are particularly remarkable when compared with the previous programme. A systematic analysis of the outcomes in smear-positive patients treated with short-course, non-observed chemotherapy in a relatively well-functioning district revealed success rates of only 40% (compared with 80% in the current programme) and death rates of 29% (compared with 4% in the current programme).[16,17] The population coverage of the RNTCP until late 1998 was only 2% of the total population

Table 3 Outcomes of treatment under the Revised National Tuberculosis Control Programme, India, 1993–1999 (first half)

Year	Patients	Cured *n* (%)	Completed treatment *n* (%)	Died *n* (%)	Remained smear-positive (failed) *n* (%)	Defaulted *n* (%)	Transferred out *n* (%)
New smear-positive patients evaluated							
1993	392	277 (70.7)	17 (4.3)	32 (8.2)	2 (.5)	43 (11.0)	21 (5.4)
1994	1 058	860 (81.3)	9 (.9)	41 (3.9)	32 (3.0)	68 (6.4)	48 (4.5)
1995	2 138	1 606 (75.1)	68 (3.2)	71 (3.3)	77 (3.6)	167 (7.8)	149 (7.0)
1996	6 345	4 855 (76.5)	170 (2.7)	228 (3.6)	262 (4.1)	649 (10.2)	181 (2.9)
1997	7 672	6 176 (80.5)	108 (1.4)	270 (3.5)	259 (3.4)	668 (8.7)	191 (2.5)
1998 (1st half)	4 660	3 910 (83.9)	47 (1.0)	172 (3.7)	139 (3.0)	336 (7.2)	56 (1.2)
Total	22 265	17 684 (79.4)	419 (1.9)	814 (3.7)	771 (3.5)	1 931 (8.7)	646 (2.9)
New smear-negative patients evaluated							
1993	603		327 (54.2)	28 (4.6)	10 (1.7)	215 (35.7)	23 (3.8)
1994	651		483 (74.2)	15 (2.3)	7 (1.1)	132 (20.3)	14 (2.2)
1995	1 264		947 (74.9)	45 (3.6)	11 (.9)	201 (15.9)	60 (4.7)
1996	5 538		4 379 (79.1)	181 (3.3)	88 (1.6)	725 (13.1)	165 (3.0)
1997	7 099		5 990 (84.4)	207 (2.9)	115 (1.6)	691 (9.7)	96 (1.4)
1998 (1st half)	4 451		3 894 (87.5)	145 (3.3)	66 (1.5)	310 (7.0)	36 (.8)
Total	19 606		16 020 (81.7)	621 (3.2)	297 (1.5)	2 274 (11.6)	394 (2.0)
New extra-pulmonary patients evaluated							
1993	13		8 (61.5)	0 (0)	0 (0)	5 (38.5)	0 (0)
1994	169		156 (92.3)	2 (1.2)	0 (0)	7 (4.1)	4 (2.4)
1995	467		402 (86.1)	11 (2.4)	0 (0)	27 (5.8)	27 (5.8)
1996	1 669		1 438 (86.2)	23 (1.4)	6 (0.4)	163 (9.8)	39 (2.3)
1997	2 181		1 951 (89.5)	47 (2.2)	2 (0.1)	155 (7.1)	26 (1.2)
1998 (1st half)	1 550		1 427 (92.1)	25 (1.6)	5 (0.3)	79 (5.1)	14 (.9)
Total	6049		5 382 (89.0)	108 (1.8)	13 (.2)	436 (7.2)	110 (1.8)
Relapsed smear-positive patients evaluated							
1993	44	23 (52.3)	3 (6.8)	4 (9.1)	1 (2.3)	10 (22.7)	3 (6.8)
1994	376	284 (75.5)	4 (1.1)	17 (4.5)	11 (2.9)	21 (5.6)	39 (10.4)
1995	433	257 (59.4)	32 (7.4)	22 (5.1)	15 (3.5)	72 (16.6)	35 (8.1)
1996	838	521 (62.2)	24 (2.9)	36 (4.3)	92 (11.0)	117 (14.0)	48 (5.7)
1997	1 024	714 (69.7)	30 (2.9)	72 (7.0)	57 (5.6)	118 (11.5)	32 (3.1)
1998 (1st half)	687	499 (72.6)	16 (2.3)	41 (6.0)	40 (5.8)	76 (11.1)	15 (2.2)
Total	3402	2 298 (67.5)	109 (3.2)	192 (5.6)	216 (6.3)	414 (12.2)	172 (5.1)
Other retreatment patients (includes smear-negative cases)							
1993	2	2 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
1994	217	95 (43.8)	45 (20.7)	18 (8.3)	19 (8.8)	32 (14.7)	8 (3.7)
1995	563	337 (59.9)	49 (8.7)	31 (5.5)	28 (5.0)	76 (13.5)	42 (7.5)
1996	1 598	1 023 (64.0)	68 (4.3)	105 (6.6)	114 (7.1)	211 (13.2)	77 (4.8)
1997	2 511	1 585 (63.1)	136 (5.4)	172 (6.8)	135 (5.4)	377 (15.0)	106 (4.2)
1998 (1st half)	1 298	765 (58.9)	167 (12.9)	83 (6.4)	60 (4.6)	200 (15.4)	23 (1.8)
Total	6 189	3 807 (61.5)	465 (7.5)	409 (6.6)	356 (5.8)	896 (14.5)	256 (4.1)

of India. Starting in the third and fourth quarters of 1998, large-scale expansion was undertaken, and as of mid-1999 about 130 million people were covered by the RNTCP. Case detection rates have been high, with more than 60 000 patients placed on RNTCP treatment in the first half of 1999. Treatment outcomes in the expansion areas are not yet available. Expansion to these areas required the finalisation and printing of several hundred thousand copies of technical documents, hiring of more than 500 staff, training of more than 4000 doctors, 1000 laboratory technicians, and 20 000 allied health staff, and procurement of nearly 3000 microscopes as well as drugs for more than 100 000 patients.

The population which will be covered by mid-2000, if it were a single country, would be the fifth largest country in the world, and the DOTS programme is now second only to China's in size globally. In 1999, more than 140 000 patients were placed on DOTS in India. Current plans are for continued expansion to a population of approximately 250 million by the end of 2000, and to the entire country as soon as technically and operationally feasible. This may entail the additional coverage of 100–150 million population or more, per year, in a phased manner so that drug supply, training, supervision, and monitoring can all be ensured. Sustainability of the programme will require creation of new supervisory posts by state governments, which was a condition of the World Bank credit and which has already taken place in some states and is underway in others, and continued financial and technical support from the national level. Costs of key inputs such as drugs and microscopes have decreased in recent years, and

the total incremental recurrent cost of coverage of the entire country may be of the order of $50 million or less, an expense which may not be unrealistic for a population of one billion people. The key challenge in the years ahead will be to balance the urgent need for rapid expansion with the paramount importance of ensuring quality of implementation.

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RÉSUMÉ

CADRE : L'Inde, où une grande partie de la stratégie mondiale de lutte contre la tuberculose a été élaborée, mais où chaque année, on estime à 2 millions le nombre de cas de tuberculose.

OBJECTIF : Décrire les tactiques, les résultats initiaux et les leçons tirées de la mise en œuvre du Programme National Révisé de Lutte contre la Tuberculose appliquant les principes du DOTS (traitement directement observé et de courte durée).

SCHÉMA : Un programme National Révisé de Lutte contre la Tuberculose (RNTCP) a été élaboré et mis en œuvre depuis 1993. La fourniture régulière de médicaments et l'appui logistique ont été assurés par le financement du Gouvernement de l'Inde, des Gouvernements des Etats, de la Banque Mondiale et par des donateurs bilatéraux. Les sujets accusant des symptômes thoraciques et se rendant dans les services de santé sont référés dans les centres de microscopie pour le diagnostic. Les cas diagnostiqués sont classés selon les directives de l'OMS et le traitement est donné sous observation directe. L'on assure un enregistrement systématique et des rapports par cohorte.

RÉSULTATS : D'octobre 1993 à la mi-1999, 146 012 patients ont été mis sous traitement dans le cadre du programme. La qualité du diagnostic était bonne, le ratio des patients à bacilloscopie positive sur les patients à bacilloscopie négative étant maintenu à 1:1. Les taux de détection des cas varient largement selon les sites de projet et sont en corrélation avec le rapport du nombre de patients à bacilloscopie positive sur l'ensemble des consultants, ce qui suggère une hétérogénéité des taux de maladie. Le succès après traitement fut obtenu chez 81% des nouveaux patients à bacilloscopie positive, 82% des patients à bacilloscopie négative, 89% des patients atteints de tuberculose extra-pulmonaire et 70% des cas de retraitement.

CONCLUSION : Le RNTCP a traité avec succès environ 80% des patients dans 20 districts de 15 états de l'Inde. Les taux de succès du traitement ont plus que doublé et les taux de décès sont réduits à moins d'un septième de ceux du programme antérieur. Le nouveau programme démarré à la fin 1998 commence à s'étendre et couvre actuellement plus 130 millions de personnes. Le prochain défi est de maintenir la qualité de sa mise en œuvre au cours de sa phase d'expansion.

RESUMEN

MARCO DE REFERENCIA: India, donde fuera establecido gran parte de la estrategia mundial de control de la tuberculosis, pero donde cada año hay 2 millones de casos de tuberculosis.

OBJETIVO: Describir las políticas, los resultados iniciales y las lecciones aprendidas de la implementación de un Programa de Control Nacional de Tuberculosis basado en el DOTS (tratamiento directamente observado de corta duración).

MÉTODO: Se designó e implementó un Programa de Control Nacional Revisado de Tuberculosis (RNTCP) en 1993. Con fondos del Gobierno de la India, de los Gobiernos Estatales, del Banco Mundial y de donantes privados se aseguraron drogas y logística. Las personas con síntomas respiratorios que concurren a los centros médicos son reteridos a centros para estudio microscópico para diagnóstico. Los casos diagnosticados son clasificados según las normas de la OMS y se les suministra tratamiento con observación directa. Se efectúa un registro sistemático y un informe de cohortes.

RESULTADOS: Desde octubre de 1993 hasta mediados de 1999, se incluyeron 148.012 pacientes en el programa de tratamiento. La calidad del diagnóstico fue buena, con una relación de pacientes esputo positivo a esputo negativo mantenida en 1:1. La tasa de detección de casos varió grandemente entre los lugares seleccionados y está en relación con el porcentaje de pacientes que eran esputo positivos entre los examinados para diagnóstico, sugiriendo tasas de enfermedad heterogéneas. Se alcanzó un éxito terapeútico en el 81% de los pacientes nuevos con esputo positivo, en el 82% de los pacientes nuevos con esputo negativo, en el 89% de los pacientes con tuberculosis extrapulmonar y en el 70% de los pacientes en retratamiento.

CONCLUSIÓN: El RNTCP trató con éxito alrededor del 80% de los pacientes en 20 distritos de 15 estados de la India. Las tasas de éxito terapeútico son más del doble y las tasas de mortalidad son menos de una septima parte de aquellas de los programas previos. El programa se inició en 1998, ha crecido y ahora cubre más de 130 millones de habitantes. El próximo desafío es mantener la calidad de la implementación durante la fase de expansión.

Cure rates prior to 1992

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Modeling the epidemiology and economics of directly observed therapy in Baltimore

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SUMMARY

SETTING: From 1958 to 1978, Baltimore maintained one of the highest pulmonary tuberculosis (TB) rates in the US. But, from 1978 to 1992 its TB rate declined by 64.3% and its ranking for TB fell from second highest among large US cites to twenty-eighth. This TB trend coincided with the implementation of an aggressive directly observed therapy (DOT) program by Baltimore's Health Department.

OBJECTIVES: We used modeling to estimate the range of TB cases prevented in Baltimore under DOT. Case estimates equal the difference between the observed number of TB cases in Baltimore versus the expected number if Baltimore's TB trend was replaced by the TB trend for the US (low estimate) or the TB trend for all US cities with over 250 000 residents (high estimate). Economic savings are estimated.

RESULTS: Without DOT we estimate there would have been between 1577 (53.6%) and 2233 (75.9%) more TB cases in Baltimore, costing $18.8 million to $27.1 million. Cases prevented and expenditures saved increased with increased DOT participation.

CONCLUSION: Our model predicts that Baltimore's TB decline accompanying DOT resulted in health care savings equal to twice the city's total TB control budget for this period. These results are most plausibly due to DOT, since it was the only major change in Baltimore's TB control program, and rising TB risk factors—AIDS, injection drug use, poverty—in a city where TB had been epidemic should have triggered a TB increase as in comparable US cities, rather than the observed decline. As national TB rates continue to decline it will be important to identify ways to capture and reinvest these savings to support effective TB control programs.

KEY WORDS: tuberculosis; directly observed therapy; economics; prevention; public health; health care expenditures; community-based treatment

FROM 1958, when the Centers for Disease Control and Prevention (CDC) began reporting pulmonary tuberculosis (TB) incidence by city as part of its modern TB surveillance program, to 1978, Baltimore maintained one of the highest TB rates in the US, generally ranking among the highest two or three US cities for TB (Figure 1).

However, between 1978 and 1981, the Baltimore City Health Department (BCHD) launched a clinic-based program of directly observed therapy (DOT) for city-defined 'high risk' TB patients, people who were unemployed, homeless, or alcoholic. These patients were recruited with free anti-TB medications and free transportation to attend one of the city's five chest clinics for DOT. Each year during this period, roughly 25% of all TB cases in Baltimore were treated using this case management strategy.

In late 1981, a community-based arm was added to the DOT program whereby any TB patient in Baltimore was eligible to receive city-managed DOT. Community outreach, including home-based TB therapy by public health nurses, provided additional incentives for program participation.

Over time, BCHD expanded its outreach to include workplace and school-based DOT, hospital visits by public health nurses, community and provider education, to recruit a higher proportion of newly diagnosed cases, and city nursing staff assigned to help manage high risk patients such as prisoners, substance abuse treatment facility patients, participants of a clinical study tracking the natural history of human immunodeficiency virus (HIV) infection among injection drug users,[1] and clients of a community-based AIDS service facility.

By 1992, DOT was being used to treat nearly 80% of Baltimore's TB cases. During this same time, TB declined by 64.3% in Baltimore and its ranking for TB fell from second highest among large US cities to twenty-eighth.[2] This trend contrasts sharply with the unexpected rise in TB in the US between 1985 and

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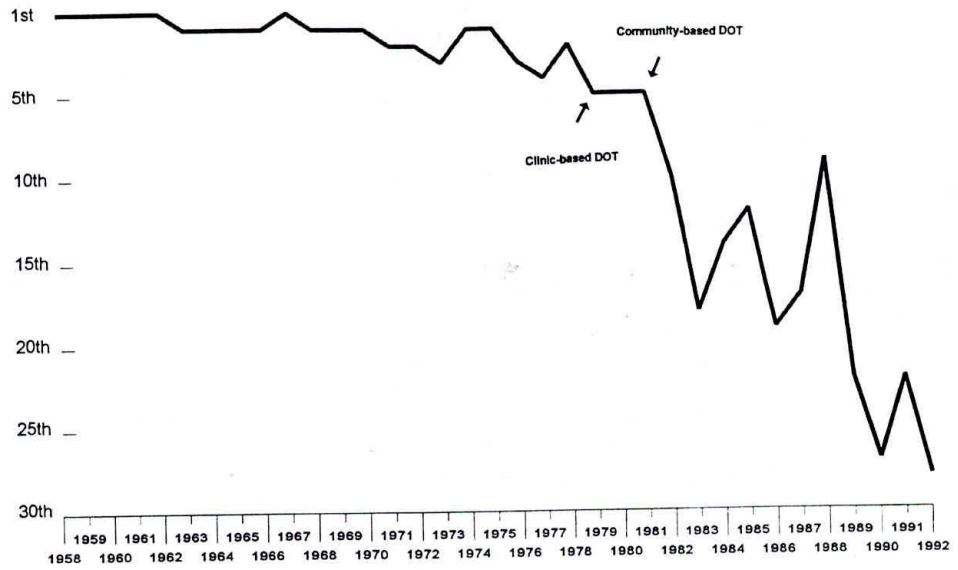

Figure 1 Baltimore's ranking for tuberculosis incidence among all US cities with over 250 000 residents between 1958 and 1992.

1992, when some 64 000 more TB cases were reported than predicted by earlier trends.[3]

Although many putative factors have been cited for this resurgence, including AIDS,[4] immigration from countries endemic with TB,[5] and clinical mismanagement,[6] the failure of TB patients to complete a recommended course of antibiotic therapy has been cited as the biggest obstacle to effective TB control.[7]

The CDC estimates that between 1987 and 1991 roughly 30% of reported TB cases in the largest US cities did not complete their anti-TB therapy within the recommended 12-month period.[8] Analysis of 1993 TB surveillance data suggests that only 66% of patients completed therapy by 12 months, while many others took nearly two years to meet this goal.[9] These trends contrast with the recommendations of the Advisory Council for the Elimination of Tuberculosis (ACET) and the CDC that at least 90% of active cases complete therapy within 12 months.[10,11]

DOT has been recommended by virtually all leading US TB control organizations and by the WHO in order to maximize treatment completion.[10,12–14] DOT is predicated on the theory that watching patients ingest all their TB medications results in greater treatment completion. When recommended antibiotic regimens are completed, over 95% of patients infected with susceptible TB organisms should be cured, and the spread of infection to others reduced.[15]

A growing body of evidence supports the relative effectiveness of a community-based approach to DOT. It has been associated with higher treatment completion rates than any other strategy, particularly self-administered therapy,[16] TB reductions in US settings where the prevalence of TB risk factors such as AIDS, poverty, substance abuse, and immigration are rising,[2,17] and the prevention of multidrug-resistant TB (MDR-TB).[18] DOT also appears cost-effective compared to self-administered therapy.[19–21]

We re-examined Baltimore's TB trend under DOT between 1978 and 1992 to estimate the epidemiologic and economic impact of not using DOT in Baltimore. In doing so, we provide what we believe is the first quantitative measure of the preventive effects of DOT in a high incidence city. These findings, when coupled with existing cost-effectiveness studies, may be instructive at a time when national TB rates are declining and the renewed focus on TB control instituted during the 1990s may seem less compelling today.

Program selection

Baltimore's TB control program presents a unique opportunity to assess DOT since BCHD has comprehensive epidemiologic, economic and programmatic data available. Moreover, the decline in TB and fall in city ranking for TB following adoption of DOT occurred in a city where TB historically had been problematic, suggesting that this TB decline was otherwise unexpected.

Baltimore also experienced a rise in TB risk factors such as unemployment, injection drug use, poverty, and especially AIDS, similar to other large US cities where TB rates rose.[2] Between 1985 and 1992, for example, Baltimore's AIDS case rate rose by 171.5%, making it the leading cause of death in Baltimore for young men and women, and Baltimore one of the highest ranking cities for AIDS-related mortality.[22]

Finally, an expanding, community-based DOT strategy was the only major change in the city's TB control effort. During this period there were no major alterations in hospital control practices, case finding, screening or prevention activities related to TB which

might otherwise provide a programmatic explanation for the decline of TB in Baltimore.

METHODS

We assumed that without DOT between 1978 and 1992, Baltimore's TB trend would have been different. We hypothesized that this alternative trend would most likely have fallen within a range defined by two other actual TB trends during this period: the TB trend for the US (US TB trend), and the TB trend for all US cities with over 250 000 residents (large US city TB trend).

The actual Baltimore, US, and large US city TB trends were identified based on annual TB incidence reported in the CDC Annual Tuberculosis Statistics: States and Cities (Figure 2).[23] We terminated these trends at 1992 because the CDC ceased reporting large city data in 1993, and instead began reporting TB incidence for large cities by metropolitan statistical area (MSA).

Based on these trends we used Lotus 1,2,3 Version 5 to model a range of additional TB cases and health care costs if there been no DOT in Baltimore.[24] This general approach has been used to model other US TB trends.[25,26]

Using the 1978 incidence of TB in Baltimore (48.3/100 000) as the starting point for our model, we then compared the observed number of TB cases for the study period (the actual number of reported TB cases in Baltimore between 1978 and 1992) with the expected number of TB cases derived by applying the US and large US city TB trends to Baltimore's 1978 starting point.

We subtracted the hypothetical increase in the TB rate under the US TB trend (low estimate), and the hypothetical increase in the TB rate under the large US city TB trend (high estimate) from the actual Baltimore rate. This rate difference was converted to cases by back-calculating the annual TB rates reported by the CDC with Baltimore's annual population which

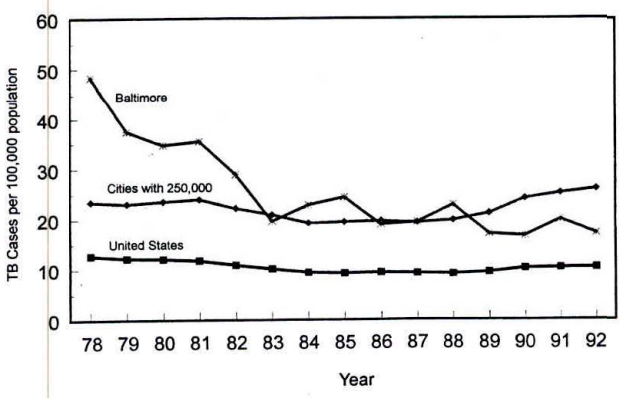

Figure 2 Observed tuberculosis rates 1978–1992 for Baltimore, all US cities with over 250 000 residents, and the US.

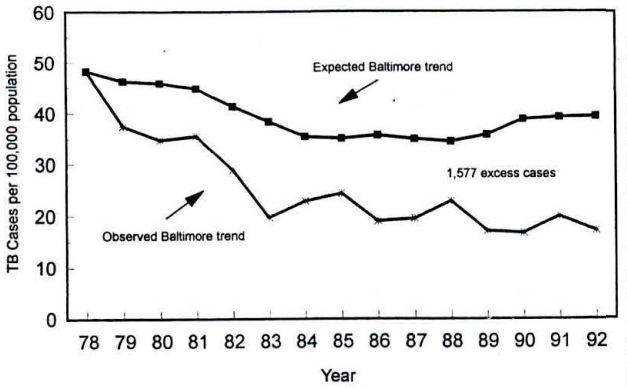

Figure 3 Estimated excess tuberculosis cases (TB) in Baltimore if Baltimore's observed TB trend for 1978–1992 were replaced by the trend for the US.

then served as our estimate of the range of additional cases.

Finally, health care expenditures for treating these hypothetical cases were calculated using cost data from the published literature. We used rounded treatment estimates of $13 500 per case for DOT and $12 700 per case for non-supervised therapy from a prior study of Baltimore's DOT program that assumed full drug susceptibility (i.e., no mono- or multidrug-resistant cases).[7]

RESULTS

Our low estimate, replacing Baltimore's TB trend under DOT with the US TB trend at the Baltimore starting point, predicts 1577 more cases without DOT than observed in Baltimore (Figure 3). Instead of the 2940 cases reported in Baltimore between 1978 and 1992, there would have been 4517, or 53.6%, more cases.

Our high estimate, replacing Baltimore's TB trend under DOT with the large US city TB trend at the Baltimore starting point, predicts 2233 more cases without DOT then actually observed in Baltimore (Figure 4). Thus, instead of the 2940 cases reported between

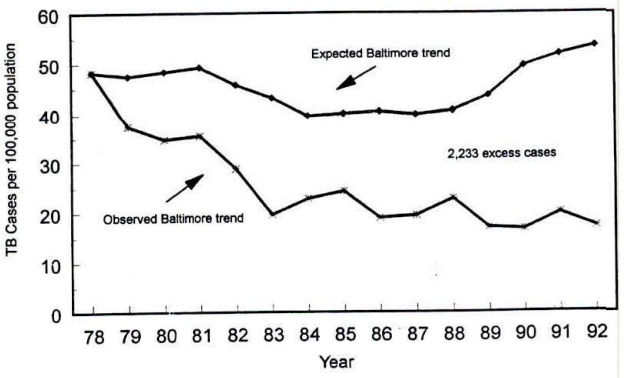

Figure 4 Estimated excess tuberculosis cases (TB) in Baltimore if Baltimore's observed TB trend for 1978–1992 were replaced by the trend for all US cities with over 250 000 residents.

Table Annual proportion of all tuberculosis (TB) cases in Baltimore managed through directly observed therapy, estimated cases prevented and treatment costs saved if the TB trend in Baltimore was replaced by the TB trend for large US cities, 1978–1992

Year	1978*	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
% DOT cases†	25	26	26	29	32	40	54	55	54	60	60	59	58	55	76
Cases prevented per year‡	—	78	109	106	128	176	127	117	160	154	134	198	244	234	268
Costs (thousands, US$) saved per year§	—	988	1387	1344	1626	2234	1605	1482	2035	1946	1694	2511	3089	2961	3391

* Starting year for directly observed therapy (DOT); assumes no cases prevented, therefore no costs saved.
† Proportion of all pulmonary tuberculosis cases in Baltimore managed under DOT.
‡ Estimated number of cases prevented each year based on large US city trend replacing observed Baltimore trend for pulmonary tuberculosis.
§ Estimated gross annual treatment costs saved based on cases prevented due to directly observed therapy. This totals $28 292 800 less offsetting cost increases of $1 122 000, for net savings of $27 170 000.

1978 and 1992, there would have been 5173, or 75.9% more cases.

The Table displays the annual proportion of all TB cases in Baltimore managed under DOT with the estimated annual number of additional cases and concomitant costs based on the large US city TB trend analysis. Total additional treatment costs would range from $18.8 million (US TB trend) to $27.1 million (large US city TB trend).

DISCUSSION AND CONCLUSION

Effective TB control is anchored by several critical public health activities—timely case finding and reporting, targeted screening and preventive therapy, and effective management of active cases.[27] Among these activities, treating infectious cases first is the most important public health goal.

Our analysis focused on Baltimore's TB case management strategy, where an expanding urban DOT program emphasizing aggressive community outreach and patient-centered therapy was accompanied by a 64% reduction in TB at a time when comparable US cities were experiencing a rise in TB. The relative significance of this decline in TB is demonstrated by Baltimore's drop in city TB ranking from second highest to twenty-eighth.

Although modeling can be vulnerable to imprecision, it is commonly used to predict expected from observed TB trends. Here we used TB cases reported to the CDC to estimate a possible range in TB cases prevented due to DOT in Baltimore. Our approach benefited from using actual Baltimore, US, and large US city rates, rather than hypothetical TB rates.

Our findings suggest that in the absence of DOT case management there would have been substantially more TB cases in Baltimore—as many as 2233 more—than observed, with additional health care expenditures of roughly $27 million. The number of cases prevented per year appears to increase pari passu with DOT participation. We note that the estimated annual expenditures to treat these additional cases would have been twice Baltimore City's total TB control budget during the study period.

Since Baltimore often ranked highest among large US cities prior to implementing DOT, we believe that, of the two alternative trends, the one based on the large US city cohort may be most appropriate.

There may be limitations to our analysis. Fundamentally, we are only simulating the assumed interaction between programs (DOT) and outcomes (TB incidence). For example, our hypothesis may be incorrect: the TB trend in Baltimore between 1978 and 1992 might have been essentially the same even without DOT. However, this is unlikely since the observed TB decline would be counterfactual to Baltimore's documented high 20-year TB trend prior to DOT. Moreover, implementation of comprehensive DOT elsewhere has also been followed by declines in TB.[18,28]

Even if our findings are valid for Baltimore, they may have limited generalizability to other cities, as local TB control programs vary in resources, priorities, and staffing. Overall program capacity and performance, quite apart from DOT, also influence local TB trends. For example, poor (late) case finding and reporting would counter even 100% DOT participation since undiagnosed infectious cases would continue to spread TB throughout the community.

On the other hand, our model underestimates the impact of DOT. For one thing, our large city trend is based on an average incidence rate for these cities which should yield lower estimated savings given Baltimore's high ranking among these cities prior to DOT. Optional trends for our analysis might be constructed based on rates of a 'comparable' city or on the city ranking second highest for TB (since Baltimore ranked second at the start of our trend). However, the length of our analysis (nearly 15 years) precludes the use of a single city for our analysis. Over such a time frame, city demographics and populations at risk for TB vary, while TB programs, resources, and clinical expertise change.

Second, the US and large US city trends include the observed Baltimore trend which should, if anything, dampen the effect of DOT. Also, a few of the large US cities employed DOT at least during the latter portion of our study period, although in a more limited fashion.[29–31] Removing any DOT effect in these cities and the Baltimore trend from this cohort should increase our savings estimates.

Significantly, between 1985 and 1992, AIDS rose by 172% in Baltimore, making Baltimore one of the highest cities for AIDS-related mortality. Thus, this relative growth in AIDS cases should have been accompanied by a growth in TB similar to many other large US cities impacted by AIDS during this period rather than the observed decline in TB.

Also, expansion of DOT from the clinic-based through the community-based phase was done incrementally, taking nearly 14 years. We believe these TB control results would have been accelerated if a higher proportion of patients had been recruited into DOT therapy at the program's beginning. Applying DOT to a larger proportion of cases at the start should prevent even more cases, as failure to treat even a single case of TB can produce mini-epidemics.[32–35]

We terminated our analysis at 1992 because of changes in surveillance practices and did not extend our analysis to capture savings beyond 1992 in Baltimore. Between 1993 and 1996, for example, annual DOT participation rates exceeded 90%, while one-year treatment completion rates were 92%, 94% and 96% for the years 1993, 1994 and 1995. For the larger period from 1978–1996, Baltimore's TB rate declined by 69.1%. An extended trend would therefore support additional savings.

Our cost assumptions are also conservative since we excluded indirect costs and did not estimate losses (economic) from TB deaths prevented.[36] Also, we could not account for the economic impact of an increasing proportion of cases nationally that were multidrug-resistant and which were more prevalent during the latter portion of these trends, particularly in large cities. Estimated cases prevented since the mid-1980s, when TB was undergoing its greatest upswing, are more likely to involve MDR-TB and would be considerably more expensive to treat (averaging as much as $225 000 per case, or over 10 times the per case estimate in our model).[6] Conversely, in Baltimore, DOT appears to have been helpful in avoiding significant drug resistance problems, as the rate of MDR-TB was below 0.06% during the study period.[2]

Finally, we used our model to examine the implications of modeling Baltimore's trend nationally, i.e., what effect similar (incremental) implementation of DOT might have had if adopted nationally or by the largest US cities where reported treatment completion rates have been the lowest.

We therefore reversed our analyses for this period, replacing the large city and US TB trends with the Baltimore TB trend at their respective incidence rates of 1978. The number of cases prevented nationally would have been 134 521, and the number prevented in the largest cities would have been 62 272. Treatment costs saved would be $1500M and $728M, respectively. Assuming, arguendo, that the Baltimore experience could be reasonably replicated, these projections may be conservative since our model assumes applying DOT to approximately 25% of all cases initially, and only then incrementally expanding it to a large proportion of cases over the next 14 years. Nonetheless, these reverse scenarios may be instructive for discussions over the feasibility of TB elimination, while similar trend analysis might guide TB program evaluation in other urban settings.

Baltimore's TB trend under DOT suggests that making DOT available to as many patients as possible had significant public health and economic benefits, dramatically reducing both the incidence and costs of tuberculosis in Baltimore. However, as noted in a previous study,[2] Baltimore's TB incidence trend in recent years may be assuming an asymptotic shape, suggesting that more focused screening and prevention activities and case-finding must supplement DOT if substantial reductions in TB are to continue to occur in Baltimore. Thus, although DOT appears to be a key management tool for active cases, it is but one component of a comprehensive TB control program. Other essential components include effective associate and contact investigation, screening and preventive therapy for high risk populations, and comprehensive community surveillance, case finding, and disease tracking.[27,37]

Further research should focus on developing more cost-effective delivery mechanisms, particularly in communities containing diverse populations of foreign-born and new immigrants. Research should also identify ways to capture treatment savings which can then be used to sustain community-based interventions.

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RÉSUMÉ

CADRE : Entre 1958 et 1978, Baltimore a conservé les taux les plus élevés de tuberculose (TB) pulmonaire aux Etats Unis. Mais de 1978 à 1992, son taux de TB a décliné de 64,3% et en matière de TB parmi les grandes villes des Etats Unis, elle est passée de la deuxième à la vingt-huitième place. Cette tendance de la TB a coïncidé avec la mise en œuvre par le Département de la Santé de Baltimore d'un programme agressif de traitement directement observé (DOT).

OBJECTIF : Nous avons utilisé la modélisation pour estimer les marges de cas de TB prévenus à Baltimore pendant le DOT. Les estimations de cas représentent la différence entre le nombre observé de cas de TB à Baltimore et le nombre attendu si la tendance de la TB à Baltimore avait été remplacée par la tendance de la TB aux Etats Unis (estimation faible) ou par la tendance de la TB pour l'ensemble des villes de plus de 250 000 résidents aux Etats Unis (estimation élevée). Les économies qui en ont résulté ont été estimées.

RÉSULTATS : Sans DOT, nous estimons qu'il y aurait eu entre 1577 (53,6%) et 2223 (75,9%) de cas supplémentaires de TB à Baltimore, représentant un coût de 18,8 à 27,1 millions de dollars. Le nombre de cas prévenus ainsi que les dépenses évitées ont augmenté avec une augmentation de la participation au DOT.

CONCLUSION : Notre modèle prédit que le déclin de la TB à Baltimore accompagnant le DOT a entraîné des économies en soins de santé égalant à deux fois le budget

total de lutte antituberculeuse à Baltimore pendant cette période. Il est le plus plausible que ces résultats soient dus au DOT, puisque celui-ci a constitué la seule modification majeure du programme de lutte antituberculeuse à Baltimore et puisque l'augmentation des facteurs de risque de la TB (SIDA, drogues par voie intraveineuse et pauvreté) dans une ville où la TB avait été épidémique aurait dû entraîner une augmentation de la TB comme dans les villes comparables des Etats Unis plutôt que le déclin qui a été observé. Comme les taux nationaux de TB continuent à décliner, il sera important d'identifier les façons de récupérer ces économies et de réinvestir dans le soutien à des programmes efficaces de lutte antituberculeuse.

RESUMEN

MARCO DE REFERENCIA: Entre 1958 y 1978, Baltimore poseía una de las tasas más altas de tuberculosis pulmonar (TB) en los EEUU. Pero desde 1978 a 1992 su tasa de TB declinó en 64,3% y en la escala jerárquica descendió del segundo puesto entre las ciudades más pobladas de los EEUU al puesto 28. Esta tendencia de la TB coincidió con la implementación de un programa agresivo de tratamiento directamente observado (DOT) por parte del Departamento de Salud de Baltimore.

OBJETIVO: Utilizamos la modelización para estimar el rango de casos de TB que se previnieron en Baltimore con el DOT. Los casos estimados resultan de la diferencia entre el número de casos de TB observados en Baltimore y el número esperado si la tendencia de TB en Baltimore fuera reemplazada por la tendencia de la TB en los EEUU (estimación baja) o la tendencia de la TB para todas las ciudades de los EEUU con más de 250 000 habitantes (estimación alta). Se estimaron los ahorros económicos.

RESULTADOS: Hemos estimado que sin DOT hubiera habido entre 1.577 (53,6%) y 2.233 (75,9%) casos suplementarios de TB en Baltimore con un costo de 18,8 a 27,1 millones de dólares. Los casos evitados y los gastos ahorrados ascendieron con el aumento de la participación en el DOT.

CONCLUSIÓN: Nuestro modelo predice que la declinación de la TB en Baltimore que acompañó al DOT resultó en ahorros en salud iguales al doble del presupuesto del control total de la TB en este período. Es más plausible que estos resultados sean debidos al DOT ya que fue el único cambio en el programa de control de la TB en Baltimore y a que los factores de aumento de riesgos de la TB (SIDA, uso de drogas inyectables, probreza) en una ciudad donde la TB ha sido epidémica hubieran desencadenado un aumento de la TB como en otras ciudades de los EEUU en lugar de la declinación observada. A medida que las tasas nacionales de TB continúen declinando será importante identificar las formas de acumular y reinvertir estos ahorros para apoyar un programa efectivo de control de la TB.