EPIDEMIOLOGY

001 *NL Bordia, Anton Geser, J Maclary, I Mundt & Kul Bhushan*: TUBERCULIN SENSITIVITY IN YOUNG CHILDREN (0-4 YEARS OLD) AS AN INDEX OF TUBERCULOSIS IN THE COMMUNITY.
Indian J TB 1960, 8, 25-43.

The purpose of this study was to find out whether the prevalence of infection in young children might be used as an index of the tuberculosis problem in a population. Tuberculin testing was done in a random sample of 2,883 children (0-4 years) in Bangalore city, of those 2,589 (89.8%) actually completed testing. A total of 4340 children were registered in 59 villages and of these 4090 (94.2%) were tuberculin tested. The villages were from Bangalore, Kolar and Mandya as these districts were within 100 miles from Bangalore city. The team went from house to house and made a complete registration of the children 0-4 years in the selected houses. Information on socio-economic status, density of population etc., was also collected before giving tuberculin 1 TU RT 23 with Tween 80.

The results of the study showed that prevalence of infection in 0-4 years age group of cantonment area was 1.6% and in the crowded city area 4.1% at 14mm induration level. In the rural population, the prevalence of tuberculosis infection was 2%. In the city, a positive correlation between tuberculosis infection and socio-economic condition was obtained while it was not seen in rural areas. It was not possible to establish any correlation between tuberculosis disease and infection either in rural or urban areas, as the population was not examined for the prevalence of tuberculosis disease.

KEY WORDS: PREVALENCE, INFECTION, CHILDREN, RURAL, URBAN, COMMUNITY.

002 *Raj Narain*: SIZE & EXTENT OF TB PROBLEM IN URBAN & RURAL INDIA
Indian J TB 1962, 9, 147-50 & also in Proceed Natl TB & Chest Dis Workers Conf 1962, 155-68.

The aim of modern Public Health Programmes, is a reduction in the total amount of disease in the community.

The unit for treatment and cure is not an individual but a sick community. With this new aim, it becomes essential to know the size and extent of tuberculosis in the community as it will be helpful not for purposes of planning only but essentially for the assessment of their effect on the problem. An attempt is made to review the important features of the available knowledge about infection, morbidity and mortality through various surveys. (i) **Prevalence of Infection**: Tuberculosis infection is widespread in both urban and rural areas of almost all parts of the country. Nearly 40% of the population are infected. To avoid the effect of non specific allergy and get a more reliable demarcation, tuberculin reactions of 14mm and more were considered as positive by National Tuberculosis Institute. (ii) **Prevalence of morbidity**: The prevalence of radiologically active tuberculosis in the population is likely to be 1.5%, Prevalence of bacteriologically confirmed diseases is 0.4%. Based on single sample of sputum examination, the prevalence of infectious cases in the country is probably an under estimate. About two million are infectious at any one point of time. (iii) **Mortality:** Deaths from tuberculosis in the country is not definitely known. The impression of clinicians that death due to tuberculosis have fallen sharply may not be true. Half a million deaths will appear an underestimate. About 250 per 1,00,000 persons i.e., one million deaths due to tuberculosis per year seems to be a reasonable estimate. (iv) **Bovine Tuberculosis**: Only a few cases in man caused by the bovine tubercle bacillus have been reported although 2.75% to 25% of cattle have been found tuberculin reactors.

To put in a nut shell, the problem of tuberculosis in India is a gigantic one and our means of fighting it with the single tool of BCG, do not even touch the fringe of the problem.

KEY WORDS: INFECTION, SUSPECT CASE, CASE, MORTALITY, COMMUNITY.

003 *Raj Narain, MV Jambunathan & M Subramanian*: RESURVEY OF 15 VILLAGES FROM THE MADANPALLE ZONE OF NATIONAL SAMPLE SURVEY ON TUBERCULOSIS

Proceed Natl TB & Chest Diseases Workers' Conf, Bangalore, 1962, 34-47.

A study was undertaken with the following objectives: (1) To estimate the proportion of population that would be available for resurvey after 5 years. (2) To ascertain five years later the fate of persons with X-ray pathology. (3) To compare the prevalence of tuberculosis in the villages at an interval of 5 years. Population of 15 of the 31 villages from the Madanapalle zone, was selected for this study. About 9,500 persons were registered and 7,200 were X-rayed at the initial survey. Five years later the same population was re-examined and nearly 70% were available for X-ray examination. Sputa were collected from persons with abnormal X-ray shadows interpreted as such by either of the two readers. Two spot samples were collected within an interval of 1-3 days and were examined by direct smear and by culture.

Analysis of the data shadow showed that: (1) There was no significant difference in the prevalence rates i.e., 3.6 and 4.6 per thousand respectively at two points of time. (2) During the interval, 30% of active cases had died and 20% were still active at the end of 5 years. (3) There was almost complete turn over of the bacillary cases during the 5 years interval.

KEY WORDS: RESURVEY, COVERAGE, PREVALENCE, MORBIDITY, MORTALITY.

004 *Raj Narain & M Subramanian*: LIMITATIONS OF SINGLE PICTURE INTERPRETATION IN MASS RADIOGRAPHY
Proceed Natl TB & Chest Dis Workers' Conf, Bangalore, 1962, 64-106.

Survey with MMR remains as one of the most important methods available for measuring the size and extent of tuberculosis, specially in developing countries. Its value in case-finding programmes is well recognised. Nevertheless, mass miniature radiography with a single picture of the chest has a wide margin of error owing to the intra & inter-individual differences in X-ray reading. A study was undertaken to know the errors involved by repeating an X-ray picture after an interval of 3 to 4 months and judging the first picture in the light of a comparative reading of the two pictures. It is postulated that two pictures taken at an interval, may afford better judgement regarding the assessment of a case than a single picture only. A prevalence survey was carried out in

Tumkur district in 1960-61, among 62 villages and 4 towns; 20 villages were selected for this study. A total of 8,000 persons were registered, 5,300 of them were X-rayed and re-read by two readers. Photofluorograms were repeated after three and a half months after the first picture. At the time of repeat X-ray, a spot sample of sputum was collected from persons with abnormal shadows.

Briefly the findings of the study were: (1) About 20% of bacillary cases were among those with inactive or non tubercular shadows on the basis of a single X-ray film. (2) Inter-individual agreement for X-ray active cases was of the order of 50%. (3) Intra-individual agreement for X-ray active cases was 52% for one reader and 69% for the two readers. (4) Mass miniature radiography with a single film, in spite of its inherent limitations, is the best available method both for surveys as well as for case-finding programmes due to its ability to find cases as well as potential cases in a short time. (5) Even the agreement between two sputum samples collected within an interval of 1-3 days was 42% for positive results.

KEY WORDS: X-RAY READING, LIMITATIONS, SINGLE PICTURE, MMR, RURAL COMMUNITY.

005 *HT Waaler, Anton Geser & S Andersen*: THE USE OF MATHEMATICAL MODELS IN THE STUDY OF EPIDEMIOLOGY OF TUBERCULOSIS
Ame J Public Health 1962, 52, 1002-13.

The paper has illustrated the use of mathematical model (epidemetric model) for the prediction of the trend of tuberculosis in a given situation with or without the influence of specific tuberculosis control programme. The paper also advocates the use of models for evolving applicable control measures by reflecting their interference in the natural trend of tuberculosis in control areas. These models were constructed by applying methods which have been developed and utilised in other social sciences.

The precise estimates of the various parameters entering the model must be available if realistic long term results are to be achieved through model methodology. The need for exact data regarding prevalence and incidence of infection and disease, necessitates longitudinal surveys in

large random population groups. It is, however, the present authors firm opinion that it would be fruitful for almost any health department, to compare their best available epidemiological knowledge in a system of relationships in order to quantify their concept of the situation. Such an exercise in mathematics would, in any case, serve to sharpen the epidemiologists thinking and would lead them to appreciate what data they need most urgently. The model may help in predicting the trend of tuberculosis in a given situation.

KEY WORDS: EPIDEMETRIC MODEL, SURVEY, TREND, CONTROL PROGRAMME.

006 *Raj Narain, A Geser, MV Jambunathan & M Subramanian*: SOME ASPECTS OF A TB PREVALENCE SURVEY IN A SOUTH INDIAN DISTRICT
Bull WHO 1963, 29, 641-64 & Indian J TB 1963, 9, 85-116.

The objective was to establish the prevalence rates for tuberculosis infection, radiologically active pulmonary tuberculosis and bacteriologically confirmed diseases for different age and sex groups. Tumkur District in Mysore State consisting of 2,392 villages, 10 towns of was selected for the study. The district headquarter town Tumkur was excluded from the survey. Random sample of 62 villages and 4 town blocks having a population of 34,746 persons constituted the study population. All the individuals available in the registered population were given a Mantoux test with 1 TU RT 23 with Tween 80. Longitudinal diameter of induration was read 3-4 days after the test. At the time of tuberculin test, all persons aged 10 years and above were offered a single 70mm photofluorogram. For each picture read as abnormal, a spot specimen of sputum of the individual concerned was collected at the time of reading the tuberculin test. Age and sex distribution of infection and disease were studied.

Various parameters concerning the prevalence of infection and disease in the community were reported. Prevalence rate of infection in all ages and both sexes of the population was found to be 38.3%, radiologically active tuberculosis 1.86% and 0.41% sputum positive disease. The infection and disease increased with age; of the total diseased, half were in age group 40 years and more and about 2/3 among males.

KEY WORDS: SURVEY, PREVALENCE, INFECTION, DISEASE, CASE, COMMIUNITY, RURAL, URBAN.

007 *Raj Narain, SS Nair & P Chandrasekhar*: A COMPARISON OF THE RELATIVE VALUE OF SINGLE AND DOUBLE PICTURE TECHNIQUES IN TB PREVALANCE SURVEYS
Indian J TB 1964, 11, 145-53.

Limitations of a single X-ray picture for locating and interpreting shadows in the chest had been studied earlier. In order to reduce these limitations, it was suggested that two pictures of each person be taken where the second picture was to be taken after a vertical displacement of X-ray tube, up or down by about 4 to 5cms. The advantages of taking two pictures simultaneously as compared to a single picture have not been studied so far. Two mobile X-ray units each with an odelca camera were alternated for the single and double picture examinations. A total of about 2,000 persons were X-rayed and were read independently by 3 readers. A spot sample of sputum was collected 3-4 days later from persons with abnormal X-ray shadows and was examined by direct smear microscopy.

Comparison of the readings of the two sets of pictures did not show a **better agreement** between different (inter-individual) readers or between two different readings of the same reader (intra-individual) when the two picture technique was used. The X-ray cases detected by double picture only by any one reader were not confirmed, more often than those detected by single picture only. The X-ray pictures of the bacillary cases were also not interpreted more often as active tuberculosis by the two picture technique. It was concluded that the double picture technique does not offer any advantage over the single picture technique.

KEY WORDS: SURVEY, PREVALENCE, X-RAY READING, X-RAY FILM, SINGLE PICTURE, DOUBLE PICTURE.

008 *Raj Narain, SS Nair, P Chandrasekhar & G Ramanatha Rao*: PROBLEMS CONNECTED WITH ESTIMATION OF THE INCIDENCE OF TUBERCULOSIS INFECTION
Indian J TB 1965, 13, 5-23.

The incidence of infection with mycobacterium tuberculosis is an index of the risk of infection to which a community is exposed. An accurate estimation of incidence rate is of considerable importance in understanding the epidemiology of tuberculosis in organising control measures. A new method of estimating incidence of infection is discussed. The material from 3 studies of National TB Institute has been utilized. **Study I**: is a part of a survey of a random sample of 134 villages. No previous tuberculin testing or BCG vaccination had been carried out in the area, but each person was examined for BCG scar in order to exclude persons vaccinated probably from other areas. After a complete census, a Mantoux test with 1 TU of PPD RT 23 with Tween 80 given on two occasions (Round I and II). Those with reaction of 13mm or less at Round I were offered a test with 20 TU with Tween 80 within a week of 1 TU test. The interval between the rounds was about 18 months. From the analysis of the data from the first 50 villages for which complete information for both rounds was available, it was seen that there was a general increase in the size of reactions elicited in the second round. **Study 2:** tuberculin testing was carried out with 1 TU and 20 TU among selected 'control' groups which provided the data regarding the "enhancing of tuberculin allergy" seen in repeat tuberculin tests. **Study 3**: in the course of the longitudinal "survey reader assessments" were carried out periodically to judge the standards of the tuberculin test readers. Inter & intra reader comparisons were made. The findings have been used to estimate the magnitude of reader variation. The data was also used to study variations in the technique of testing and reading.

It was estimated that on an average inter & intra reader variations between the rounds were unlikely to exceed 6mm or more in more than 5% of the observations. The reading errors have an equal chance of being positive or negative except at extreme ends of the distribution where zero readings of Round I can only show an increase, and the very large reactions had a greater chance of showing only a decrease at a subsequent round. The study mainly concerns with the problems of estimating the incidence of tuberculous infection in a community. Calculations based on age-specific prevalence rates or on rates of tuberculin conversion or both subject to gross error, leading to unreliable epidemiological conclusions. For estimating the newly infected, a new approach has been

suggested based on the drawing of a curve for the distribution of differences in reaction size from one round of tuberculin testing to another. It is assumed that if new infection causes a distinct rise in the degree of tuberculin sensitivity which is greater than the combined rise due to enhancement and reader variation, the **distribution of differences between the rounds** should indicate the **newly** infected. It is shown that the newly infected probably constitute a homogeneous group with an increase in mean reaction size of about 24mm and standard deviation of 4mm. Accordingly, 98% of the newly infected show an **increase in reaction size of 16mm or more.**

KEY WORDS: RISK OF INFECTION, TUBERCULIN ALLERGY, ENHANCEMENT, INCIDENCE, INFECTION.

009 *Raj Narain, SS Nair, G Ramanatha Rao, P Chandrasekhar & Pyare Lal*: ENHANCING OF TUBERCULIN ALLERGY BY PREVIOUS TUBERCULIN TESTS
Indian J TB 1966, 13, 43-56; Tables i-vii.

Tuberculin tests repeated after an interval of time, at a different site have been reported to elicit reactions larger than the first test. A study was undertaken where reactors of 13mm or less to 1 TU have been tested with 20TU for the study of low grade reactions. Study was carried out in a previously untested and unvaccinated rural population (Longitudinal Survey), where only about 25% of the population showed 14mm or more to 1 TU and the remaining about 60% showed 10mm or larger reactions to 20 TU. These results confirm the high prevalence of non-specific allergy in the area.

It was found that a tuberculin test does enhance the allergy elicited by a subsequent test. The enhancing effect is associated with the initial allergy i,e., 8-13mm to 1 TU tuberculin, especially those elicited by a 20 TU test, increase being almost confined to those with 10mm and larger reactions to 20 TU. The enhancing effect increases with increase in age especially among those with 10mm or bigger reactions to 20 TU. It is possible that the enhancing effect is more in communities with high prevalence of non-specific allergy.

KEY WORDS: TUBERCULIN REACTION, ENHANCEMENT, NON SPECIFIC ALLERGY, INFECTION, M.TUBERCULOSIS, NTM.

010 *Raj Narain, SS Nair, G Ramanatha Rao & P Chandrasekhar*: DISTRIBUTION OF INFECTION AND DISEASE AMONG HOUSEHOLDS IN A RURAL COMMUNITY

Bull WHO 1966, 34, 639-54 & Indian J TB 1966, 13, 129-46.

Studies on the distribution of tuberculous infection and disease in households have mostly been restricted to the examination of contacts of known cases. Clinical experience has lead to a strong belief that tuberculosis is a family disease and contact examination is a “must” for case-finding programmes. A representative picture of the distribution of infection and disease in households can be obtained only from a tuberculosis prevalence survey.

This paper reports an investigation, based on a prevalence survey in a rural community in south India. The survey techniques and study population have been described in an earlier report. Briefly, the defacto population was given a tuberculin test with 1 TU of PPD RT 23 with Tween 80 and those aged 10 years and above were examined by 70mm photofluorography. All the X-ray pictures were read by two independent readers. Those with any abnormal shadows by either of the two readers were eligible for examination of a single spot specimen of sputum by direct smear and culture. The defacto population numbered 29,813 and tuberculin test results were available for 27,115. After excluding BCG scars, the study population of 24,474 was distributed over 5,266 households which were further classified as “bacillary case household” with atleast one bacteriologically confirmed case, “X-ray case household” with atleast one radiologically active case but with no bacillary cases and ‘non-case household’ with neither a bacillary nor an X-ray case. Total bacillary cases were 77 and were distributed in 75 household. 74 households had one case each and one household had 3 bacillary cases.

The findings of the study have thrown considerable doubt on the usefulness of contact examination in tuberculosis control; (1) over 80% of the total number of infected persons, in any age group, occurred in households without cases, (2) cases of tuberculosis occurred mostly singly in households, and the chance of finding an additional case by contact examination in the same household is extremely small, (3) a common belief has been that prevalence of infection in children in 0-4 age group is a good index of disease in households, but in this study

about 32% of households with cases of tuberculosis had no children in this age group, (4) in houses with bacteriologically confirmed case only 12% of the children in 0-4 age group showed evidence of infection, a possible explanation of such a low intensity of infection could be that there is resistance to infection. It is well known that some children even after repeated BCG vaccination do not become tuberculin positive. It is felt that a large number of children do inhale tubercle bacilli, but a primary complex does not develop or even if it develops, the children remain tuberculin negative. A hypothesis has been made that in addition to resistance to infection, there is something known as “resistance to disease”. Otherwise, it is difficult to explain why under conditions of heavy exposure in infection, only some individuals develop evidence of infection and very few develop disease thereafter.

KEY WORDS: PREVALENCE, INFECTION, DISEASE, CONTACT EXAMINATION, HOUSEHOLD, RURAL COMMUNITY.

011 *Raj Narain, G Ramanatha Rao, G Chandrasekhar & Pyare Lal*: FATE OF CASES DIAGNOSED IN A SURVEY
Proceed Natl TB & Chest Dis Workers’ Conf, Calcutta, 1966,72-78.

The report describes the changes that occurred during second survey carried out after an interval of one and half years in the cases diagnosed at the first survey done during 1961-62 from among a total population of about 62,000 in 119 villages in Bangalore District. It was observed that (1) Of the 62 sputum smear positive cases also having suggestive chest X-ray shadows, 34% had died, 35% were sputum positive and 31% had become culture negative after 1½ years. Of the 10 smear positive cases who were X-ray normal, none was culture positive at the start and 7 were negative by culture and smear after 1½ years. Of the 67 scanty smear positive cases (1 to 3 bacilli seen), only 3 were sputum positive, 10 were having X-ray shadows and half were tuberculin negative after 1½ years. (2) Of the 88 culture only positive cases (20 or more colonies and with X-ray evidence of disease) 31% had died and 47% continued to be sputum positive after 1½ years. A much smaller proportion of these changes occurred among culture positive cases with less than 20 colonies. (3) There were 457 persons having radiologically active tuberculosis on

the basis of interpretation of a single X-ray picture by two independent readers but whose sputum were negative for AFB (suspect cases). Of these, 38% were tuberculin negative also. Of those suspect cases who were tuberculin positive, 9% become sputum positive after 1½ years, while only 2% of the tuberculin negative suspect cases became sputum positive.

It is concluded that there is a lot of variation in fate among the different categories of cases of pulmonary tuberculosis. Further, attention has been drawn to the possibility of self healing in about 30% of the bacillary cases after 1½ years.

KEY WORDS: FATE, CASE, SUSPECT CASE, NATURAL CURE, PREVALENCE.

012 *Raj Narain, P Chandrasekhar, Pyare Lal and RA Satyanarayanachar*: PREVALENCE, FATE, SOURCE AND INFECTIVITY OF RESISTANT IN MYCOBACTERIUM TUBERCULOSIS
Proceed Natl TB & Chest Dis Workers' Conf, Hyderabad, 1967, 37-51.

The material on resistant strains of mycobacterium tuberculosis is derived from the longitudinal survey conducted from 1961-68 in a random sample of 133 villages of 3 taluks of Bangalore district. About 54,000 persons aged five years or more were surveyed 3 times at an interval of 18 months, two samples of sputum were collected from persons whose chest X-rays were judged to have abnormal shadows. The sputum specimens were examined by direct smear and culture and sensitivity tests were performed.

An attempt is made to study prevalence, fate, source and infectivity of resistant mycobacterium tuberculosis in three rounds. **PREVALENCE:** In the 3 rounds, 199, 194 and 176 cases respectively yielded positive cultures; Of them, 30, 36 and 53 cases were having resistant strains. At round III, the number of culture positive cases has not fallen significantly, but the number of strains resistant to INH alone has sharply increased (13, 18 & 35). Both findings are likely to be due to the treatment with INH alone offered at round II and also due to the fact that treatment was taken very irregularly. **FATE**: Over period of 3 years, of the cases with INH resistant strains, more than

1/3rd were dead, 1/4th continued to remain positive and resistant, and 1/4th became culture negative. Whereas, of the cases with strains sensitive to INH, less than 1/3rd were dead, 1/3rd became negative and the remaining were positive, 1/2 with sensitive strains and 1/2 with resistant strains. **SOURCE OF CASES:** The prevalence of cases with resistant strains at any one round is not due to the persistence of such cases from previous rounds but by development of new cases with such strains at each round. **INFECTIVITY:** The incidence of infection among contacts with sensitive strain was significantly more than among the contacts of cases with resistant strain. It is inferred that the infectivity of sensitive strains is more than that of the resistant strains.

KEY WORDS: M.TUBERCULOSIS, SENSITIVE STRAINS, RESISTANT STRAINS, CASE, FATE, PREVALENCE, INFECTIVITY.

013 *Raj Narain, SS Nair, K Naganna, P Chandrasekhar, G Ramanatha Rao & Pyare Lal*: PROBLEMS IN DEFINING A “CASE” OF PULMONARY TUBERCULOSIS IN PREVALENCE SURVEYS
Bull WHO 1968, 39, 701-29.

Generally there is no acceptable definition of the term “case of pulmonary tuberculosis”, although such a definition is of fundamental importance both in clinical medicine where results of various chemotherapeutic regimens are compared, as well as for the comparison of different epidemiological data. The main purpose of this paper is to focus attention on the difficulties of defining a case on the basis of bacteriological examination, X-ray examination and tuberculin test. Data from two successive prevalence surveys in a random sample of 134 villages in Bangalore district with a population 70,000 have been utilized to illustrate some of the difficulties in defining a “case” of pulmonary tuberculosis for reporting the prevalence or incidence of the diseases. The entire population was tuberculin tested with 1 TU RT 23 with Tween 80 at both rounds and those 5 years of age and older were examined by 70mm photofluorogram. The sputum specimens (spot and overnight) were collected from those with any abnormality on X-ray as recorded by either of the two independent readers. Both the specimens were examined by fluorescent microscopy and Ziehl Neelsen technique and by culture.

Analysis of data has shown that the term “a case of pulmonary tuberculosis” does not represent a single uniform entity, but embraces cases of several types, differing considerably in their tuberculin sensitivity, results of X-ray and sputum examination, in the reliability of their diagnosis and mortality experience. The status of cases found at initial and subsequent surveys showed changes with time, and such changes show considerable differences for the various types of cases. It was felt that a single straight-forward definition of a case was not possible to suit all situations. One has to use more than one definition. Although theoretically, finding a single bacillus in sputum should be adequate proof of pulmonary tuberculosis, it was shown that finding of a few bacilli (3 or less) was very often due to artifacts and should not be the basis for a diagnosis. It has also been found that positive radiological findings, in the absence of bacteriological confirmation, indicate only a high risk of the disease and not necessarily pulmonary tuberculosis. Direct microscopy appears to be a consistent index of disease but in community surveys has the limitation of missing a substantial proportion of cases and of adding some false ones.

In view of the difficulty of providing a single definition of a case of tuberculosis, four indices have been suggested. (1) Cases definitely positive by direct smear; (2) Cases definitely positive by culture; (3) All cases positive by culture (including less than twenty colonies); (4) Sputum positive cases which are radiologically active. Each of these could be used for different situations. However, it was concluded that, there seems to be no option but to use more than one definition for assessing the prevalence and incidence of disease.

KEY WORDS: CASE-DEFINITION, SURVEY, PREVALENCE, DISEASE.

014 *Raj Narain, P Chandrasekhar, RA Satyanarayanachar & Pyare Lal*: RESISTANT AND SENSITIVE STRAINS OF MYCOBACTERIUM TUBERCULOSIS FOUND IN REPEATED SURVEYS AMONG A SOUTH INDIAN RURAL POPULATION
Bull WHO 1968, 39, 681-99.

The degree of the risk of infection and disease in man from drug resistant strains of mycobacterium tuberculosis

is not clear. An increase in the prevalence of **primary resistance** indicates the extent of such risk while an increase of secondary or **acquired resistance** could be considered as a problem of the individual patient and may reflect limitations of his treatment.

The present report describes the prevalence of strains with acquired or primary resistance or of sensitive strains found in 3 successive surveys in a sizable random sample of village in a south Indian district. Changes in the status of cases with such strains from one survey to another and their infectivity among household contacts are also described. The prevalence of tuberculosis infection among household contacts of cases with acquired resistance to isoniazid was significantly higher than those with primary resistance or with sensitive culture. This was probably due to the longer duration of sputum positivity of isoniazid resistant strains at the time of diagnosis. But infectivity as judged by the incidence of new infection among household contacts was generally less for cases with acquired or primary resistance than for cases with sensitive cultures, though the difference observed was not statistically significant. A large number of culture positive cases especially those with primary resistance had no radiological evidence of active pulmonary tuberculosis. The prevalence of primary resistance was high in certain categories of cases and the differences between cases with primary resistance and those with acquired resistance were many and large. It was suggested that this could be due to the primary resistant cultures being those of atypical mycobacteria, despite positivity in the niacin test. There was a significant increase in the number of cases with acquired resistance to isoniazid at the third survey owing to the irregular treatment and supply of INH alone after the second round. The prevalence of primary resistance at the three rounds was almost the same.

KEY WORDS: DRUG RESISTANCE, M.TUBERCULOSIS, RURAL POPULATION, INFECTIVITY, SURVEY.

015 *P Chandrasekhar, SS Nair, K Padmanabha Rao, G Ramanatha Rao & Pyare Lal*: EXAMINATION OF MULTIPLE SPUTIUM SPECIMENS IN A TUBERCULOSIS SURVEY
Tubercle, 1970, 51, 255-62.

Prevalence surveys are useful for estimating the tuberculosis problem in different countries. Three techniques are commonly used in surveys, tuberculin test, mass miniature radiography and sputum examination. Each has its own limitations. A limitation of sputum examination is that all the sputum positive cases in the community cannot be diagnosed when only one sample of sputum is examined from each eligible person. Multiple sputum examinations are not often possible under field conditions of surveys covering the whole community. It would be worthwhile to have some idea of the extent of under-diagnosis in sputum examination. For this purpose, during an epidemiological survey, four specimens of sputum were collected within seven days of X-ray examination from each person with an abnormal chest X-ray in 30 villages of a district of south India. Each specimen was examined by Fluorescent Microscopy (FM), Ziehl Neelson (ZN) technique and culture.

There were 34 culture positive cases among 2,164 persons for whom all the four culture examination results were available. Of them, 21 (62%) were found positive on one specimen. The second specimen increased the positivity to 32 (95%). Thus, for detecting both smear and culture positive cases two specimens are adequate. A third specimen is helpful for detecting cases positive by culture alone. An estimate of prevalence obtained from one sputum specimen can be estimated for the prevalence obtained from many specimens by applying correction factor of 1.67 and estimates based on two specimens by applying 1.26. Of the remaining 37 smear positive cases detected by one specimen, 20 were smear positive and culture negative. Of the remaining 17 smear positive and culture positive, 14(82%) were detected by one smear examination only.

ZN positives not confirmed by culture (mostly with less than four bacilli reported in the smear) increased from 7 from the first specimen to 18 from all four specimens, while positives confirmed by culture method showed only a marginal increase from 13 to 15. FM did not have this disadvantage as only two were culture negative among the 18 smear positive results by FM method. Examination of two specimens by FM detected about 95% of cases demonstrable by this method. But with the ZN technique additional specimens may add more “false positives”. Thus, for detecting cases both smear and culture-positive two specimens appear adequate. A third

specimen is helpful for detecting cases positive on culture only.

KEY WORDS: SPUTUM EXAMINATION, MULTIPLE SPUTUM SPECIMEN, SURVEY, RURAL, ZIEHL NEELSON, FLUORESCENT, CULTURE.

016 *GD Gothi, SS Nair & Pyare Lal*: SOME EPIDEMIOLOGICAL ASPECTS OF TUBERCULOUS DISEASE AND INFECTION IN PAEDIATRIC AGE GROUP IN A RURAL COMMUNITY
Indian Paediatrics 1971, 8, 186-94.

The prevalence and incidence rates of tuberculous infection and disease in the community are known in the age group 10 years and above from several surveys carried out so far. The present paper provides various parameters of tuberculosis in particular in the pediatric age group. A random sample of 119 villages in 3 taluks of Bangalore district were surveyed 4 times from May 1961 to July 1968 at intervals of 18 months, 3 years and 5 years of the initial survey. Tuberculin test was done for the entire available population with 1 TU PPD RT 23 with Tween 80, and 70mm X-ray for all available persons aged 5 years and above. Two samples of sputum were obtained from the X-ray abnormals, and examined by smear and culture.

It was found that prevalence of infection increased with age from 2.1% at 0-4 year age group to 16.5% at 10-14 year age group, compared to 47% at 15 years and above age group. Prevalence of disease in 5-14 year age group was considerably lower than in age group 15 years or more. Tuberculosis morbidity increased with the size of tuberculin reaction and it was high among children with reaction 20mm or more. Incidence of infection increased with age from 0.9% per year in age group 0-4 years to 2.8% per year among that of 15 years and above. Incidence of disease also showed the same phenomenon, rising from 0.5% in age group 5-9 to 4% per year in the age group 15 years and above. There were 10 sputum positive cases in 5-14 years of age in first survey, of them, 8 became negative and one died. While from among 152 cases in 15 years and above age group, 48 became negative, 72 died and 32 remained positive. The fate of cases of pulmonary tuberculosis in 5-14 years age was not as serious as in 15 years and above age group. The survey had no means of examining miliary and meningeal tuberculosis.

Children as well as adults with larger reaction of 20mm or more to tuberculin test had higher mortality. This could be considered due to tuberculous infection after taking into account death due to non tuberculous reasons in both the infected and uninfected groups. Use of chemoprophylaxis might be considered for those who give history of contact with open cases and have tuberculin reaction size 20mm or more.

KEYWORDS: CHILDREN, RURAL COMMUNITY, PREVALANCE, INCIDENCE, INFECTION, DISEASE, TUBERCULIN, INDURATION SIZE, MORTALITY, CHEMOPROPHYLAXIS.

017 *SS Nair, G Ramanatha Rao & P Chandrasekhar:* DISTRIBUTION OF TUBERCULOUS INFECTION AND DISEASE IN CLUSTERS OF RURAL HOUSEHOLDS
Indian J TB 1971, 18, 3-9.

Data from 62 randomly selected villages in a district of south India, which formed part of a prevalence survey carried out by the National Tuberculosis Institute, Bangalore, during 1960-61, has been made use of. The survey covered 29,813 persons in 5,266 households. There were 70 cases with bacilli demonstrable either in smear or culture and 300 suspect cases. Using the village map (prepared by survey staff), ‘case clusters’ were formed first, with each case household as nucleus and adjacent households within a maximum distance of about 20 meters on either side of the case households. Households closest to the nucleus household on either side have been called as 1st neighbourhood and those coming next in proximity on either side as a 2nd neighbourhood and so on. The case household and its four neighbourhood together was called a cluster. If another case household was found within 4th neighbourhood of the first case the cluster was extended by including the 4th neighbourhood of the new case also. Such clusters were called composite case clusters and clusters with only one case household as simple case clusters. Similarly, suspect case clusters were formed and differentiated as simple suspect clusters or composite suspect clusters. Further, to serve as a control group, non-case clusters were constituted from a systematic sample of 10% households that were not included in case or suspect case clusters.

Out of 60 case clusters formed, only 7 have multiple cases showing that there was no evidence of high concentration of disease in case clusters. While the percentage of child contacts (0-14 years) infected was considerably higher in case clusters (25.8%), there was not much difference between suspect case clusters (14.9%) and non-case clusters (9.8%). Similarly, there was not much difference between simple and composite clusters. Infection among child contacts was higher in case households as compared to their neighbourhoods. To get some idea of the zone of influence of a case or suspect case, prevalence of infection was studied for 10 neighbourhoods, in simple clusters to avoid the influence of multiple cases. It appeared that the zone of influence of a case may extend at least upto the 10th neighbourhood. It was also noted that there was very little difference between zones of influence of suspect cases and non-cases. Case clusters in which the nucleus case had shown activity of lung lesion (evident on X-ray reading) or had cough showed significantly higher infection among child contacts. Clusters around cases positive on both smear and culture did not show higher infection than those around cases positive on culture only. (This may be due to sputum examination of single specimen only).

Out of the total infected persons in the community, only 2% were in case households and 7% in suspect case households, over 90% being in non-case households. The zone of influence of a case extending at least upto the 10th neighbourhood and the overlapping of such zones of influence of cases, present and past, seems to be the most probable explanation for the wide scatter of infection in the community. Prevalence of infection among child contacts was definitely higher in case clusters. But, the significance of this could be understood only from a study of the incidence of disease during subsequent years in different types of clusters. It is significant that only 10% of the total infected persons in the community were found in case clusters. The case yield in general population, cluster contacts, household contacts and symptomatics attending general health institutions have been also compared. The case yield in the last group (10%) is much higher than the case yield from both types of contacts (0.7% and 0.6%) which where only slightly higher than the case yield from the general population (0.4%).

KEYWORDS: RURAL, HOUSEHOLDS, CLUSTERS, CASE, SUSPECT CASE, CONTACT, PREVALENCE, INFECTION, DISEASE, SURVEY.

018 *Kul Bhushan, MN Mukherjee, SP Chattopadhya & KT Ganapathy*: A COMPARISON BETWEEN LONGITUDINAL AND TRANSVERSE DIAMETERS OF TUBERCULIN TEST INDURATIONS
Indian J Med Res 1972, 60, 1724-30.

In the epidemiological surveys carried out by the National Tuberculosis Institute (NTI), Bangalore, instead of reading the tuberculin reactions (indurations) by measuring their transverse diameters as is done conventionally, the longitudinal diameters were read. Later on, as the longitudinal diameters were observed to be larger than the transverse diameters, an investigation was carried out to study whether this difference would affect the estimation of infection rates. Out of 1,240 tuberculin tested persons, for 1,189 both transverse and longitudinal diameters were read by each of two readers, one accustomed to read the longitudinal diameter and the other, the transverse diameter. All care was taken to avoid bias on the part of the readers. All four reading were available for 1,075 persons (87%).

It was found that longitudinal diameters were larger than the transverse diameters for all ranges (of sizes) of reactions when either diameter for each reader was taken as standard. The prevalence of infection, considering 10mm+ reactions as the minimum level for those infected, were almost the same for both the diameters and for both the readers. Analysis according to age sex gave similar results. Variations between the readers are known to be of much higher magnitude than those observed between the diameters in this study. The levels of post-vaccination allergy calculated on the basis of longitudinal diameters, however, will be larger than those for transverse diameters. In view of the above results, the findings of the NTI epidemiological surveys wherein longitudinal diameters of tuberculin reaction are read, will not only be comparable with other studies conducted by NTI but also with studies done by other organizations-national or international.

KEY WORDS: TUBERCULIN, INDURATION SIZE, TRANSVERSE DIAMETER, LONGITUDINAL DIAMETER.

019 *MS Krishnamurthy, KR Rangaswamy, AN Shashidhara & GC Banerjee:* SOME ASPECTS OF CHANGES IN RURAL POPULATION AND FATE OF TB CASES AFTER AN INTERVAL OF TWELVE YEARS
NTI Newsletter, 1974, 11, 1-7.

During second epidemiological survey carried out in 1972-73, special efforts were made in 21 of 62 villages belonging to first survey (1961-62) to study the demographic changes and fate of TB cases after an interval of 12 years.

The findings were: The increase of dejure population was about 20% over a period of 12 years i.e., an annual increase of 1.7%. The age structure had altered mainly due to significant increase in the age group 60 years and above – 51% to 64% indicating aging of population. The loss of original population after 12 years was 44%, of which 33% was due to migration and 11% due to death. The overall migration was more among females. The migration rate was higher in younger age group, being highest in 10-19 years (49%), next in 0-9 years (38%). Thus, overall migration in 0-19 years was 43%. The death rate was highest in 60 years and above (58%). It varied from 4-9% in age group 0-39 years. Original population available after 12 years for re-examination was 56%. Distribution in different age groups were; 0-9yr = 57%, 10-19yrs = 47%, 20-49yrs = 66%, 50-59yrs = 44%, 60yrs and more = 28%.

Out of 88 X-ray suspect cases of earlier survey, 87 could be identified and present status of 72 were known. Of them, 16 were normal, 12 and 4 found to be suspect cases and bacillary cases respectively and 40 had died. Of the remaining fifteen, 11 migrated and 4 not examined. Out of 14 bacillary cases, 13 could be identified. Of them, 3 were sputum negatives (2 normal and 1 suspect case) 9 had died and 1 migrated.

KEYWORDS: FATE, CASE, SUSPECT CASE, MORTALITY, MIGRATION, RURAL POPULATION, DEMOGRAPHIC CHANGES, SURVEY.

020 *SS Nair*: SIGNIFICANCE OF PATIENTS WITH X-RAY EVIDENCE OF ACTIVE TUBERCULOSIS NOT BACTERIOLOGICALLY CONFIRMED
Indian J TB, 1974, 21, 3-5.

Available data from longitudinal study (1961-68) from several different situations have been reviewed to

understand the significance of patients showing radiological evidence of pulmonary tuberculosis without bacteriological confirmation. SITUATION IN GENERAL POPULATION: Few of the smear negative but X-ray active tuberculous patients (suspect cases) found in a survey of rural population done by National TB Institute, were culture positive (7-10%). On follow up for 18 months, only 3% of them became culture positive under conditions where intervention with specific treatment was absent or minimum. It is thus concluded that most of the cases diagnosed as active tuberculosis on the basis of single X-ray are not likely to be cases of tuberculosis. SITUATION AMONG SYMPTOMATICS ATTENDING HEALTH INSTITUTIONS: Data from the State TB Demonstration and Training Centres (STDTC) and the District Tuberculosis Programmes (DTP) have been presented. The New Delhi Tuberculosis Centre records (1970) show that only 27% of microscopy negative radiologically positive patients were confirmed on culture. For Bangalore and Agra STDTC, the proportions so confirmed were 20% and 25% respectively. It has been calculated that in the DTPs, not more than 30% of the microscopy negative radiologically positive patients could be the real cases of tuberculosis. In the DTP situation not more than 10% of the suspect cases may develop bacteriologically confirmed disease. Thus, not many of the suspect cases could be real cases of tuberculosis either on the basis of confirmation by culture or on the basis of development of bacteriologically positive disease in future.

Are the cases diagnosed 'early' by radiology? The hypothesis that X-ray discovers cases in the early stages has not yet been put to a scientific test. Further, the large differences even between experienced readers in interpreting X-ray shadows, render the method of X-ray diagnosis questionable. **Is anti tuberculosis treatment of suspect cases warranted?** The possible advantage of considering treatment of suspect cases as chemoprophylaxis has to be weighed against conservation of resources for treatment of infectious cases and the possible harmful effects of anti TB drugs to persons who are not suffering from tuberculosis.

KEY WORDS: CHEST SYMPTOMATICS, RURAL COIMMUNITY, SUSPECT CASE.

021 *GD Gothi, AK Chakraborty & GC Banerjee:* INTERPRETATION OF PHOTOFLUOROGRAMS OF ACTIVE PULMONARY TB PATIENTS FOUND IN EPIDEMIOLOGICAL SURVEY AND THEIR FIVE YEAR FATE
Indian J TB 1974, 21, 90-97.

In this study the material from “Five year study of Epidemiology of Tuberculosis” (1961-68) has been analysed to find out an improved method of interpretation of chest X-rays to get accurate estimation of prevalence of “suspects” in the community. The population of a random sample of 119 villages from the three taluks of Bangalore district was surveyed four times with intervals of 1½ to 2 years by tuberculin testing, 70mm chest photofluorography and sputum bacteriology. Out of 45,434 persons X-rayed during the first survey, 590 were read as active pulmonary tuberculosis on the basis of single picture interpretation by two independent readers. Of them, 460 being sputum culture negative were classified as initial “suspects” and these were reviewed in this study by the panel of three readers together by the method of “joint reading”. The interpretation was done comparing the serial X-rays of individuals taken at intervals along with other available examination results and personal data. Out of 460 initial suspects only 110 (23.9%) were confirmed as “suspects”, the remaining were judged as non-tuberculous and/or inactive tuberculous (62.2%) and normals (13.9%).

Fates on five year follow up were compared between 85 “confirmed suspects” and 385 “initial suspects”. The mortality and sputum positive status were found more among the former group i.e., 23.5 and 25.5 and 14% and 7.2% respectively. Radiologically, 48.7% of the confirmed suspects and only 10% of the initial suspects could be classified as suspects at 5th year follow up. Incidence of bacillary disease among the confirmed suspects was also found higher. On the basis of “joint reading” and five year follow up study, the limitations of single picture interpretation resulting in considerable over diagnosis were clearly seen. The comparative reading of serial X-rays along with other examination results did help in the better assessment of etiology and activity status of disease. Of the X-rays read as non-tuberculous and inactive tuberculous when reviewed by “joint reading” method, about 67 more suspects could be added. Even then the estimates of prevalence of “suspects” based on single film interpretation which are widely used in India appear to be about 3 times the actual prevalence.

KEY WORDS: FATE, SUSPECT CASE, X-RAY, JOINT READING, SINGLE PICTURE, OVER DIAGNOSIS.

022 *HT Waaler, GD Gothi, GVJ Baily and SS Nair*: TUBERCULOSIS IN RURAL SOUTH INDIA: A STUDY OF POSSIBLE TRENDS AND THE POTENTIAL IMPACT OF ANTI-TUBERCULOSIS PROGRAMMES.
Bull WHO 1974, 51, 263-71.

This paper estimates the natural trend of tuberculosis in rural south India and the potential epidemiological **impact** of a few **selected programmes on this trend**, by using the values of important variables and parameters derived from a longitudinal epidemiological study conducted in 1961-68 in Bangalore district by the National Tuberculosis Institute (NTI), Bangalore. The values are fed into an epidemetric model and the final outputs of computerization derived are incidence of disease (in both absolute and relative terms) and cumulative future prevalence of disease.

(1) An annual average input of new generations of 3.16% has been derived for a population of 1 million by using a simplified fertility rate formula. A constant reduction 0f 1% per year has been assumed until fertility rate has reached 50% of its starting value. The assumption is that any **reduction in fertility** due to current family planning programmes will have a considerable impact on the size of the population and on the epidemiological situation. Further demographic assumptions are, excess mortality applied to groups of active cases and fatality among untreated cases. (2) The population is subdivided into the following epidemiological groups: (i) non infected, (ii) infected for – (a)< 5 years, (b) 5 years, (iii) protected by BCG, (iv) active cases - (a) non-infectious, (b) infectious and (v) previous cases. Initially groups (iii) and (v) are given zero values. The future risk of infection is adjusted to the force of infection, which is assumed to be reduced to $1/7^{th}$ when a case is successfully treated. Morbidity rates include transfers from infected group to active cases group during 5 year periods. (3) **A spontaneous healing** rate of 50% and a cure rate of 80% after chemotherapy are assumed. **Protective effect of BCG** is given three values: 30%, 50% and 80%, with uniform annual reduction of 1% (4) **Case**

detection and treatment (CF/T) is given two values: 66% and 20%. Coverage for BCG limited to 0-20 years is assumed to be 66% or 30%.

The computer simulation output for natural trend shows that the absolute number of new cases increases considerably while the incidence rate do not warrant firm conclusions about any long term trend. All programmes considered have considerable potential impact. The CF/T programmes will reduce the incidence after 25 years by only 12% compared to reduction of 17% by the BCG programme. In general, the effect of CF/T will be more immediate and of BCG will be seen much later. To avoid the drawbacks of incidence as an indicator of tuberculosis situation, the cumulated future prevalence is taken as the tuberculosis problem. To adjust for the present significance of future cases as part of the problem certain discount rate have been applied. The CF/T programme and the BCG programme with 50% protection lead to 69% problem reduction, if not discounted. With increasing discount rates, CF/T has an advantage over BCG. The actual problem reduction will be higher than that estimated if improvements in the standard of living are expected during the coming years.

In conclusion, data on the dynamics of tuberculosis situation in rural south India, obtained by NTI, Bangalore when fed into a mathematical model, many predictions about the future tuberculosis situation were made under a wide range of hypothetical assumptions.

KEY WORDS: TREND, MODEL, BCG PROGRAMME, RURAL POPULATION, IMPACT, CONTROL PROGRAMME.

023 *National Tuberculosis Institute, Bangalore:* TUBERCULOSIS IN A RURAL POPULATION OF SOUTH INDIA: A FIVE YEAR EPIDEMIOLOGICAL STUDY
Bull WHO 1974, 51, 473-88.

A rural population of 65,000 belonging to 119 randomly selected villages of Bangalore district was repeatedly examined four times during 1961 to 1968, by tuberculin test, X-ray and sputum examinations, to study the epidemiology of tuberculosis without any active anti-tuberculosis measures. The interval between the first and the fourth examination was 5 years. The coverage of various examinations at different surveys were very high.

The main findings of the study are: **Prevalence rate of tuberculous infection** in the population was **about 30%** (among females 25% and males 35%). The overall prevalence rates of infection were fairly constant at all the four surveys, but a steady decrease in the prevalence of infection was observed in the age group 0-24 years. **Annual incidence rate of infection** on the average was **about 1%.** During the study period, the incidence of infection showed a decline from 1.63% to 0.8% for all ages combined. **Prevalence rate of disease** ranged from **337 to 406 per 1,00,000** population during the study period, the highest being at the time of first survey and lowest at the time of third survey. For the younger age group of 5-34 years, the rates showed continuous decrease during the study period. **Annual incidence rate of disease** ranged from **79 to 132 per 1,00,000** population, highest being between first and second surveys and lowest between second and third surveys. The incidence rate in younger age groups below 35 years showed a decline during the study period. Those with **tuberculin test induration of 20mm or more had highest annual incidence rate of disease**. The annual incidence rate of bacteriologically confirmed disease in the three radiological groups of population was (i) 185 per 1,00,000 with **normal X-rays**, (ii) 958 per 1,00,000 with **abnormal shadows** judged as inactive tuberculous are non-tuberculous and (iii) 4,530 per 1,00,000 with abnormal shadows judged as **active or probably active tuberculous** but bacteriologically not confirmed. The third group constituted 1% of the total population and contributed 34% of the total incidence cases. In each of the above three radiological groups, the incidence of disease was highest among those with tuberculin test induration of 20mm or more to 1 TU RT 23 with Tween 80. Those with 20mm or more tuberculin test induration in the third radiological group constituted 0.45% of the total population but contributed 27% of the total incidence cases. Incidence rate for males was nearly double that of females. More than half of the new male cases were 35 years of age, whereas more than half the females were below the age of 35 years. Out of 126 cases followed up at three subsequent surveys over a period of 5 years, **49.2% died, 32.5% got cured** and **18.3% continued to remain sputum positive**. Both death and cure rates were highest during the first one and a half year period.

About 30% of newly detected cases come from population uninfected at an earlier survey. Both infection and

disease showed a decline in the younger age group. There was no evidence of an increase in drug resistance among newly diagnosed cases. Incidence of cases showed a higher natural cure. These findings indicate that tuberculosis cases are not a uniform entity. There can be different gradations from the point of view of diagnosis and ability to benefit from treatment. The differences between male and female patients with regard to death and cure rates support this view.

KEY WORDS: TREND, RURAL POPULATION, PREVALENCE, INCIDENCE, INFECTION, DISEASE, LONGITUDINAL SURVEY.

024 *R Rajalakshmi & SS Nair:* ESTIMATION OF NUMBER OF REPEAT EXAMINATIONS REQUIRED TO DETECT ALL TB CASES IN THE COMMUNITY
Indian J Public Health 1976, 20, 118-21.

Examination of only one sputum sample cannot detect all the sputum positive cases in the community. To obtain better estimates of the prevalence of bacteriologically confirmed disease in the community, a study was conducted to find out the additional yield of cases through collection and examination of **eight sputum specimens** and also in order to work out correction factors for estimates based on one or two sputum samples, as collecting multiple sputa is very difficult. The study was carried out in 77 villages in Nelamangala Taluk of Bangalore. In all, 5826 persons were referred for sputum examinations.

Results of all the eight culture examinations were available for 2973 (51% of the eligibles). Of these 64 persons were positive by culture of atleast one specimen. Each of the eight specimens has the chance of detecting a case and any one of them could be considered as first or second specimen etc. To overcome this difficulty 80 permutations were randomly chosen out of the total 40,320 permutations possible. Cases from first specimen and additional cases from subsequent specimens were calculated through four mathematical equations. The first equation namely Y = KXm (28.66 x-1.40) has been considered as providing the best fit to the observed data. On the basis of this equation it appears that additional positives could be obtained upto the 1Oth specimen. Out of 64 culture positive cases, only 72% of positives could be detected by first two samples. To get about 95% of the cases, it is necessary to examine at least **six specimens** from each

individual. Multiple samples are rewarding for detecting even high grade cultures.

KEY WORDS: MULTIPLE SPUTUM SPECIMEN, SPUTUM EXAMINATION, CASE YIELD, PREVALENCE, CASE, SURVEY.

025 *SS Nair, GD Gothi, N Naganathan, K Padmanabha Rao, GC Banerjee & R Rajalakshmi*: PRECISION OF ESTIMATES OF PREVALENCE OF BACTERIOLOGICALLY CONFIRMED PULMONARY TUBERCULOSIS IN GENERAL POPULATION
Indian J TB 1976, 23, 152-59.

This paper reports on a study conducted in the year 1975 to estimate yield of tuberculosis cases from multiple sputum specimens, and work out correction factors to be applied to estimates based on small number of specimens. Eight sputum specimens were collected within a fortnight from each person with an abnormal chest X-ray during an epidemiological survey in 77 villages in a district of south India. Each specimen was examined by Ziehl-Neelsen technique of microscopy and culture. In all, 3,199 persons were referred for sputum examination and results of all the eight specimens were available for 1,652. Of the latter, 64 were culture positive.

The **first specimen detected 58% of the culture positives** and the additional positives by later specimens generally decreased. The contribution from the first specimen was 71% for cultures showing good growth and 19% for cultures with scanty growth. Similarly for positives on both culture and microscopy, first specimen detected 87% whereas the corresponding proportion was 32% for those positive only on culture. The type of specimen (viz., spot or overnight) and age or sex of the case did not influence the yield from multiple examinations. The precision of an estimate of prevalence will depend on the number of specimens on which it is based and the coverage obtained in the collection and examination of specimens. Correction factors to be applied to such estimates based on one or two specimens, for various levels of coverage have been presented. For example, an estimate of prevalence based on one sputum specimen with 90% coverage will have to be nearly doubled to get a more precise estimate. Using these correction factors, revised estimates of prevalence have been presented for a number of prevalence surveys conducted in India. It has been estimated that the total number of infectious cases in India at present may be at least 3 million, as against 2 million according to earlier estimates.

KEY WORDS: PREVALENCE, CASE, RURAL POPULATION, MULTIPLE SPUTUM SPECIMEN, ESTIMATES, SPUTUM EXAMINATION.

026 *VV Krishnamurthy, SS Nair, GD Gothi & AK Chakraborty*: INCIDENCE OF TUBERCULOSIS AMONG NEWLY INFECTED POPULATION AND IN RELATION TO THE DURATION OF INFECTED STATUS
Indian J TB 1976, 23, 3-7.

Some of the parameters relating to duration of infected status and incidence of disease have been measured by analysing the data collected from the five year study. Between 1961-68, 119 villages in Bangalore district with total average population of about 62,000 were surveyed at intervals of 1, 3 and 5 years from the first survey. All persons were tuberculin tested with 1 TU RT 23 and those aged 5 years or more were X-rayed. Sputum of those persons showing any X-ray abnormality were collected and examined for AFB. Persons with X-ray abnormality but bacteriologically negative or with normal X-ray in all the preceding surveys, and who became culture positive with X-ray abnormality in the current survey were termed as "New cases". New cases who had shown 10 mm or more reaction to 1 TU RT 23 at I Survey were considered infected previously. New cases, tuberculin negative at I survey but who showed an increase of 16 mm or more between two consecutive surveys were considered infected midway between the two surveys.

Of the 42 new cases diagnosed from among the newly infected during 5 years, 81% came from those infected within one year. Incidence rate of cases among those who were infected within one year was about 5 times more than those infected earlier than one year. Incidence of cases steadily decreased with the increase in the duration of infection. Further, it was found that one fourth of all newly diagnosed cases came from the newly infected persons. However, the size of the pool of previously infected persons in a community being much larger, at least 72% of the new cases came from the reservoir of previously infected persons. The incidence of disease among the newly infected was almost the same in the three age groups i.e., 5-14, 15-34 and 35 years or more. But, the ratio of the incidence rates for the newly infected and the previously infected decreased from 13 for the age group 5-14 to 3 for the age group 35 years and above. In other words, the incidence of disease among the newly infected in the age group 5-14 was thirteen times more than for the previously infected in the same age-group whereas in the age-group 35 years and above, the incidence among newly infected was only thrice that among the previously infected.

Out of the 160 new cases diagnosed during the three repeat surveys, 21 per cent cases came from among those who were infected on the average for one year or less. This is almost in conformity with the hypothesis that one-fourth of all new active cases come from new infections less than a year old.

KEY WORDS: INCIDENCE, INFECTION, CASE, TUBERCULIN STATUS.

027 *AK Chakraborty & GD Gothi*: RELAPSE AMONG NATURALLY CURED CASES OF PULMONARY TUBERCULOSIS
Indian J TB 1976, 23, 8-13.

The five year longitudinal epidemiological study in south India (1961-68) showed that a considerable proportion of bacteriologically proven cases found in a survey got cured naturally without the facility of organised treatment in the survey area. This "natural cure" could be an epidemiologically significant phenomenon depending on the stability of such a cure or in other words, the frequency of relapses among the naturally cured. In all, 108 naturally cured cases of tuberculosis out of a total of 269 cases, from among about 62,000 persons surveyed twice, were followed up for varying periods of 1 to 3½ years.

It was observed that the average relapse rate was 85.4 per 1000 person years of observation, there being no difference between the two sexes. Relapse rates were however higher in persons aged 20 and more compared to those 5-10 years old. Relapses were not dependent on the bacteriological status at initial diagnosis i.e., whether positive by culture alone or positive by smear and culture. The death rate among the naturally cured was 42.7 per 1000 person years and together with relapse constituted the unfavourable fate after natural cure. It has been calculated that as an input, adding to the pool of bacillary cases in the community, the ratio of relapse cases to cases arising afresh from the general population in a year would roughly be in the order of 1:16. It is concluded that the naturally cured status could be considered as an epidemiologically favourable situation, though much less so when compared to the chemotherapeutically achieved cure.

KEY WORDS: RELAPSE, NATURAL CURE, CASE, RURAL POPULATION, SURVEY.

028 *GD Gothi, SS Nair, AK Chakraborty & KT Ganapathy*: FIVE YEAR INCIDENCE OF TUBERCULOSIS AND CRUDE MORTALITY IN RELATION TO NON SPECIFIC TUBERCULIN SENSITIVITY
Indian J TB 1976, 23, 58-63.

The study was undertaken in a sample of 103 villages of 3 sub divisions of Bangalore district as a part of the 5 year study of epidemiology of tuberculosis between 1961-68. The follow ups were done at **1.5, 3 & 5** years after the first survey. The entire population was offered tuberculin test with 1 TU RT 23, a second test with 20 TU RT 23 to those persons who were having reactions of 0-13 mm to 1 TU. All aged 5 years or more were offered 70mm photofluorograms at each survey. Two specimens of sputum were collected from persons having abnormal X-ray shadows for examination of tubercle bacilli. Procedures were uniform at each survey. The population was divided into three groups on the basis of their tuberculin reactions: (a) reactors to 1 TU (infected with M.tuberculosis), b) non-reactors to 1 TU but reactors to 20 TU (infected with atypical mycobacteria), c) non reactors to both 1 TU & 20 TU (not infected with either M.tuberculosis or other mycobacteria). Incidence of disease and crude mortality were studied separately among these groups.

The five year incidence of culture positive disease was the highest among 1 TU reactors and the least among reactors to 20 TU. In the younger age group (5-14 years) the five year incidence of culture positive disease among reactors to 20 TU was significantly lower compared with that among 20 TU non-reactors. The reduction of incidence of culture positive cases in the former group over that in the latter was 75% for culture positive cases and 61% for combined culture positive and negative disease. As regards crude mortality, the overall rate was significantly lower among 20 TU reactors compared with non-reactors. Even if the significance of the finding on crude mortality is debatable, it could be concluded that non-specific infection provides some protection against development of tuberculosis, at least in younger age groups.

KEY WORDS: INCIDENCE, DISEASE, MORTALITY, NTM, RURAL POPULATION.

029 *AK Chakraborty, KT Ganapathy, SS Nair & Kul Bhushan*: PREVALENCE OF NON-SPECIFIC SENSITIVITY TO TUBERCULIN IN A SOUTH INDIAN RURAL POPULATION
Indian J Med Res 1976, 64, 639-51.

The data from a tuberculosis prevalence survey carried out in three taluks of Bangalore district in south India during 1961-68 were analysed to study (i) the prevalence of non-specific sensitivity in the community i.e., prevalence of infection with mycobacteria other than M.tuberculosis, as found by testing the population with tuberculin RT 23 of a lower strength (1 TU) and higher strength (20 TU), both with Tween 80 and (ii) additional boosting if any, resulting from testing with higher dose of tuberculin, immediately following a test with 1 TU RT 23.

The level of demarcation between infected and uninfected with 1 TU was 0-9 mm induration size and this negative group tested with 20 TU dose induration of 8 mm or more was considered positive. Prevalence of infection with M.tuberculosis in the community were 2.1% in 0-4 years, 7.9% in 5-9 years, 16.5% in 10-14 years, 33.2% in 15-24 years and overall 14.5% in 0-24 years of age group. Infection rate with other mycobacteria were 12.9%, 44.9%, 66.2%, 62.4% and 45.7% respectively in the above stated different age groups.

Testing the population with 20 TU RT 23 following a 1 TU test was found not to boost the tuberculin reactions over that observed on a single test with 1 TU only.

KEY WORDS: NTM, PREVALENCE, INFECTION, BOOSTING, TUBERCULIN REACTION, RURAL POPULATION.

030 *GD Gothi, Radha Narayan, SS Nair, AK Chakraborty & N Srikantaramu*: ESTIMATION OF PREVALENCE OF BACILLARY TUBERCULOSIS ON THE BASIS OF CHEST X-RAY AND/OR SYMPTOMATIC SCREENING
Indian J Med Res 1976, 64, 1150-59.

The study was undertaken among 22,957 persons belonging to 55 randomly selected villages of Nelamangala taluk of Bangalore district in 1975, to find out precise estimates of prevalence of bacillary disease. Symptom screening was done by well experienced social investigators, according to a brief interview schedule. Sputum was collected from all above the age of 5 years reporting chest symptoms for seven or more number of days during the previous two months. Within two weeks after symptom questioning, all were tuberculin tested and all 5 years and above were X-rayed. Additional sputum collection was done for those asymptomatics who had abnormal shadows in their chest X-rays.

The overall prevalence rate of culture confirmed bacillary cases by symptom and/or X-ray screening was 0.32 percent. Same prevalence was seen with X-ray alone also. But the overall prevalence rate based on symptom screening alone was 0.21 percent which is significantly lower than that of symptom and/or X-ray screening, or X-ray screening alone. The prevalence rates by age and sex based on symptom screening were about two-thirds that of rate based on X-ray and/or symptom screening. Hence to obtain prevalence rate according to X-ray and/or symptom screening, a correction factor of 1.52 should be applied to the prevalence rates obtained by symptom screening alone. This correction factor is fairly good for most of the age groups. It was also estimated that the cost of surveying the population by symptom screening alone is about half that of surveying the population by X-ray screening.

KEY WORDS: PREVALENCE, CASE, SYMPTOM SCREENING, X-RAY EXAMINATION, RURAL COMMUNITY.

031 *GD Gothi, Benjamin Isaac, AK Chakraborty, R Rajalakshmi & Sukant Singh*: TUBERCULOSIS IN CHILDREN IN A SLUM COMMUNITY
Indian J TB 1977, 24, 68-74.

A study was conducted in a slum area of Bangalore, to get information on the prevalence of all forms of tuberculosis in 0-4 year age group, respiratory tuberculosis in 5-14 year age group and the proportion of respiratory tuberculosis among total respiratory diseases in 0-14 year age group. Entire population in a slum area was investigated. Children aged 0-9 years were given tuberculin test and their nutritional status assessed. All persons were X-rayed. Sputum specimens were collected from those having radiological abnormality in chest, chest symptoms of one week or more in 0-4 years, in addition from those with any kind of sickness, malnutrition and tuberculin reactors.

In 0-9 year age group, 5.5% were tuberculin positive (without BCG lesions), in 0-4 years, 1.8% and 5-9 years, 11.3%. Among the X-rayed children, 47.4% had some kind of sickness, the proportion being significantly high in 0-4 year age group. The respiratory sickness is the commonest among children of all ages followed by malnutrition (21%). Among children with chest symptoms, upper respiratory infections were 33%. Chest X-ray abnormalities were present in 4.5% of children and of these 82.5% had non-specific pneumonitis. Of 71 persons with respiratory disease, about 7% were tuberculous. Out of 1408 children, only 5 had active primary tuberculosis, giving a prevalence of 0.35%.

None in 0-4 year age had sputum positive disease or extra pulmonary tuberculosis.

It has been highlighted that nontuberculous chest diseases are common in pediatric age group and many of these may be wrongly classified as active tuberculous in practice. It is concluded that tuberculosis in the pediatric age group in this community is not a serious public health problem.

KEY WORDS: CHILDREN, SLUM COMMUNITY, PREVALENCE, INFECTION, PEDIATRIC TUBERCULOSIS.

032 *S Dwarakanath, Sukant Singh and R Rajalakshmi*: REPORT ON THE FIRST AND SECOND PASSIVE FOLLOW-UPS OF CHILD POPULATION IN 0-14 YEARS AGE GROUP IN A SLUM AREA OF BANGALORE
NTI Newsletter 1977, 14, 97-104.

The findings of the two follow-ups conducted passively, in a slum area of Bangalore city, each at an interval of one year, are presented here. The objectives of the follow-ups were to study the migration, episodes of sickness and health status of sick people of initial survey over a period of time in the pediatric age group. The information was collected by two ways: (1) by visiting each house to collect information on sickness among them during the preceding year as per the questionnaire. (2) Going through the records of the Area Health Centre about various morbidities among the residents of the area pertaining to symptoms, diagnosis and treatment during any year noted.

Migration had occurred upto 7% in 0-9 year age group within first year and no migration during second year in 0-4 year age group. Out of 400 children belonging to 0-14 years, had symptoms related to respiratory system. In all, 5 children were diagnosed as case of active primary tuberculosis, none died in two years and one had persistent respiratory symptoms. Hospital records showed that only 1 out of 5 had attended any health facility with respiratory symptoms. The usefulness of passive follow-up without clinical investigations as a tool, needs to be reviewed. Most of the symptomatics do not go to hospital. Diagnosis cannot be arrived at by passive follow-up. It may be necessary to decrease the interval of follow-ups if it is desired to get precise idea on frequency of episodes of sickness, as most of the sicknesses are forgotten by the population with passage of time.

KEY WORDS: PASSIVE FOLLOW-UP, URBAN, SLUM COMMUNITY, CHILDREN, SICKNESS, MIGRATION.

033 *GD Gothi, AK Chakraborty, MJ Jayalakshmi & KT Ganapathy:* USE OF 20 TU RT 23 AND 5 TU BATTEY ANTIGEN FOR ESTIMATION OF PREVALENCE OF NON-SPECIFIC TUBERCULIN SENSITIVITY
Indian J Med Res 1977, 66, 389-97.

Estimates of prevalence of non-specific tuberculin sensitivity in south Indian population are based on studies using large doses of tuberculin prepared from Mycobacterium tuberculosis. In the present study, comparison of tuberculin test done on 2168 children aged 0-9 years with 20 TU RT 23 and 5 TU Battey antigen, belonging to rural areas, have been done. The distribution of induration to 20 TU RT 23 test has been compared to that of 5 TU Battey test, to see whether estimates of prevalence of non-specific tuberculin sensitivity based on the former could be compared with those based on tests with antigen derived from other mycobacteria.

It was seen that distributions of reactions, mean size of indurations as well as percentages of positive reactors to either test were not significantly different in the two randomly selected groups i.e., one tested with Battey antigen and the other with 20 TU RT 23. The prevalence of non-specific sensitivity in 0-4 years age group based on Battey test was 18.4 per cent and that with 20 TU test, 16.6 per cent. In the age group 5-9 years corresponding rates were 54.2 and 60.1 per cent. From these observations, it is suggested that if other antigens are not available, 20 TU RT 23 could be used for estimation of non-specific sensitivity.

KEY WORDS: BATTEY ANTIGEN, PREVALENCE, NON SPECIFIC INFECTION.

034 *KS Aneja & AK Chakraborty*: IS TUBERCULOSIS DECLINING IN INDIA?
NTI Newsletter 1978, 15, 9-14

Because of slow nature of decline and the long span of the declining phase spread over a couple of centuries it is difficult to obtain direct evidences of decline by conducting studies over relatively short period of time and comparing the rates so obtained. Therefore, one has to take into account the total current epidemiological situation by considering both indirect and direct evidences to know the

trend of disease; A) *Indirect Evidence* i) tuberculosis morbidity being largely confined to older age groups, prevalence rates being similar in both rural and urban areas and a wide gap between infection and disease rates (38% and 0.4% respectively). ii) Information on tuberculosis mortality although not very reliable, still appears to suggest that the disease, since the turn of the century, has taken a declining course. It has been observed to be 253 for 100,000 persons in 1949 in Madanapalle and 84 per 100,000 in Bangalore during 1961-68. There might he some regional variations but there is definite suggestion of decline in the mortality. iii) Considerable change in clinical presentation from more acute and exuberative to a more chronic disease and a shift in age during last quarter of the century, a marked decrease of the concomitant problems of pulmonary tuberculosis, are all indirect indicators of decline. B) *Direct evidences* are: i) Information available from various epidemiological surveys in India indicates no change in the prevalence rates of bacillary tuberculosis in the country during the last two decades. ii) The longitudinal survey conducted in south India and the other in Delhi have shown a declining trend of the disease specially in the younger age group. However, to see that the trend is secular or not, these surveys have to be continued for a longer period of time - atleast 15-20 years.

From the above evidences it may be reasonable to infer that there is a gradual but slow natural declining trend of tuberculosis in the country. To hasten the process of natural decline and to give relief to a large number of prevailing cases, anti tuberculosis measures should be further strengthened.

KEY WORDS: TREND, SURVEY, INDICATORS.

035 *GD Gothi, Wander Tuberculosis Association of India Oration:* NATURAL HISTORY OF TUBERCULOSIS
Delivered at 32nd National Tuberculosis & Chest Diseases Workers' Conference at Trivandrum, 1977, Indian J TB 1978, 25, Supplementum.

Concept of the Natural History of Tuberculosis in individuals and community is derived from a large number of studies conducted in India and abroad. The entire course of infection to disease in an individual is divided into five phases which occur at different times subsequent to infection: Phase I of Primary Infection, Phase II of Primary Illness, Phase III of generalised dissemination, Phase IV of localised extra pulmonary tuberculosis and

Phase V of Satellite foci or of adult type of disease. The individuals passing through any one or all of the first four phases are incapable of transmission of infection. From the community angle, persons in Phase V with adult type of disease, being the only source of dissemination of infection are responsible to perpetuate the cycle of infection. About 5-8% of the total infected people may develop primary or post primary disease.

Natural History of Tuberculosis in the community also known as epidemiology of tuberculosis aims at understanding the basic laws which govern all the events that take place between tubercle bacilli and the community under natural conditions without active interference in the form of organised control measures. At the start of the principal epidemic wave in a community, the disease takes high toll of children and young adults. A constant feature is the high mortality in males at the two extremes of life, infancy and old age, while in females it is high around 20 years of age. The generalised clinical forms of tuberculosis at the beginning of epidemiological wave and localised chronic disease towards the end of wave are common features. The time span required to attain low levels of prevalence and incidence of infection and disease and mortality are related to the degree of opportunities for transmission of infection and other determinants. The changes in epidemiological situation with relation to time are classified into three phases. i) the epidemic phase (ii) transitional phase and (iii) endemic phase. The epidemic of tuberculosis spans into centuries. The anti-tuberculosis measures specially drugs in particular, have not only changed the outlook for individual patient but by reducing infectivity period, have speeded up the decline of tuberculosis in the community as seen in Japan and Eskimos in Canada. The epidemic course is determined by natural causes which could be modified by human interventions, changes in virulence of agent, susceptibility of host and environmental factors. Tuberculosis is a social disease also and it is essential to create a social environment that wards off infection. Since the tubercle bacilli cannot be extirpated we will have to live with it in symbiosis but keeping it in its place.

The epidemic course of the disease in a particular country can be studied through an epidemic model which is nothing but a mathematical representation of the epidemiological situation in a community. The model is set up by dividing population in various epidemiological classes. The inputs required are: (A) Demographic information, such as (i) division of population into small age groups, (ii) birth rate, (iii) the age-specific death

rates. (B) Epidemiological indices such as (i) the division of population by age - the epidemiological classes of: non-infected, infected, inactive lesion, sputum negative active disease and sputum positive active disease, (ii) age and specific incidence of infection and morbidity in various classes, (iii) probability of cure of cases and relapses.

The following information i.e., the tuberculosis situation viz., future prevalence and incidence of the infection, the disease and its trend can be predicted without undertaking repeated surveys. The model could be used for (i) prediction of future tuberculosis situation, (ii) assessment of tuberculosis programme, by matching the actual performance against the predicted natural trend or predicted expectations of the programme, (iii) selection of a suitable anti-tuberculosis programme for problem reduction from amongst a series of alternative programmes, keeping cost in mind, (iv) gathering the type of observation needed for epidemiological studies.

KEY WORDS: NATURAL HISTORY, EPIDEMIC PHASE, EPIDEMETRIC MODEL, INDICATORS.

036 *GD Gothi, AK Chakraborty & MJ Jayalakshmi*: INCIDENCE OF SPUTUM POSITIVE TUBERCULOSIS IN DIFFERENT EPIDEMIOLOGICAL GROUPS DURING FIVE YEAR FOLLOW UP OF A RURAL POPULATION IN SOUTH INDIA
Indian J TB 1978, 25, 83-91.

Out of 56,146 persons without BCG scar examined at the first survey in 119 villages of Bangalore district (1961-63), 22,468 were subsequently examined 3 times over a period of five years by tuberculin test, X-ray and sputum at intervals of 1½ years to 2 years. No organized anti-tuberculosis services were provided in the study area. On the basis of tuberculin status and chest X-ray interpretations, the population was classified into **6 sub groups** for the study of risk of sputum positive disease viz., Normal X-ray **(N),** Inactive Tuberculosis **(AB)** & Probably Active Tuberculosis **(CD)** and each of these into **tuberculin positives** and **negatives.**

The annual incidence of sputum positive disease observed was 1.45 per thousand among 18,207 eligible persons aged 5 years and more. The **incidence** of the disease in tuberculin positive group was **7 times** as compared to that among tuberculin negatives. The incidence rate of bacteriological disease was 0.79 per thousand among X-ray

normals (N) of the first survey; it was 3.73 per thousand among persons with inactive tuberculous lesion and non-tuberculous shadows (AB) and 26.04 per thousand among the group of persons with active or probably tuberculous shadows (CD). Of the total incidence cases, 76% were contributed by the tuberculin positives. The group of active or probably active shadows (CD) contributed 26.6% of the total new cases. The population without any radiological abnormality (N) contributed 48.2% of the new cases.

KEY WORDS: INCIDENCE, SPUTUM POSITIVE CASE, RURAL POPULATION, EPIDEMIOLOGICAL GROUPS, LONGITUDINAL SURVEY

037 *GD Gothi, AK Chakraborty, VV Krishnamurthy & GC Banerjee:* PREVALENCE AND INCIDENCE OF SPUTUM NEGATIVE ACTIVE PULMONARY TUBERCULOSIS AND FATE OF PULMONARY RADIOLOGICAL ABNORMALITIES FOUND IN A RURAL POPULATION

Indian J TB 1978, 25, 122-31.

A study was carried out mainly to find out the prevalence and incidence of sputum negative active pulmonary tuberculosis (suspect cases) among 35,876 persons aged 5 years and above in rural areas of Bangalore district during 1968-72. Two surveys (I & II) at an interval of 3 months, succeeded by a follow up examination of the X-ray abnormals of the earlier surveys, were conducted in the same villages. Examinations at each survey consisted of tuberculin test, X-ray and sputum examinations. X-rays were interpreted individually at the time of each survey by single picture interpretation method and subsequently by **Joint Parallel Reading** (JPR) method to arrive to a diagnosis. In the JPR method X-ray readings and their comparison was done by a panel of three X-ray readers with full knowledge of age, sex, result of sputum examination and tuberculin test of each person with chest abnormality at any of the three surveys.

On a **single picture interpretation** the overall prevalence rate of suspect disease was found to be 5.4 per thousand at I survey and 4.59 per thousand at II survey. There was no significant difference in the overall age and sex specific prevalence rates of suspect disease between I & II surveys. Incidence of suspect disease at the end of 3 months was 2.24 per thousand. By JPR method the prevalence rates of suspect disease was 3.2 per thousand at I survey and 3.6 per thousand at II survey. The prevalence rates by single picture method were overestimated to the extent of

38% at I survey and 19% at II survey when compared with those found by JPR method. At I survey prevalence rates on JPR method was significantly lower than by single picture method. This was not so at II survey. Similarly, incidence rate of 0.2 per thousand of suspect disease on JPR was about 1/10th of that found by single picture method.

The incidence of bacteriologically positive cases in 6 months from among suspect cases on JPR was found to be 28%. Majority (76%) of non-tuberculous or inactive tuberculous shadows continued to remain as such after 6 months and about a quarter (23%) became normal. Incidence of bacteriologically positive cases from this group was minimal. Of 19,640 persons with normal X-rays 134 (0.7%) developed new shadows in 3 months; 103 (0.5%) cleared after 2-12 weeks (fleeting shadows). Mis-interpretation of the latter as active tuberculous may falsely boost the estimates of suspect disease to the extent of about 5%.

KEY WORDS: SUSPECT CASE, PREVALENCE, INCIDENCE, RURAL POPULATION, FATE.

038 *VV Krishnamurthy, SS Nair & GD Gothi*: A COMPARISON OF NEW CASES (INCIDENCE CASES) WHO HAD COME FROM DIFFERENT EPIDEMIOLOGICAL GROUPS IN THE POPULATION
Indian J TB 1978, 25, 144-46.

In a **five** year epidemiological survey conducted by National Tuberculosis Institute (NTI) from 1961 to 1968, the population was mainly classified into three epidemiological groups (i) with no radiological abnormalities seen in the lungs (Group N) (ii) having X-ray shadows of non-tuberculous etiology or tuberculosis etiology but judged as inactive (Group M) and (iii) with shadows of tuberculosis etiology judged possibly or definitely active but negative on culture (Group S). The objective of this paper is to compare the characteristics of cases coming from the above three groups (N, M and S) in respect to bacillary disease status (a) at the time of diagnosis and (b) after a lapse of time (Fate). Out of the total 172 new cases diagnosed during three follow ups, 70 were diagnosed between I & II surveys, 40 between II and III and 62 between III-IV surveys. In the two 18 months follow up periods, 45 of the total new cases had come from Group N, 31 cases from Group M and 34 cases from Group S, corresponding figures for 24 months follow up (III & IV surveys) were 26, 26 and 10 respectively.

In the 18 months follow up it was observed that proportion of new cases positive on culture in the three groups were not significantly different. Comparison of fate

of cases coming from three groups were similar in terms of cure, death and culture positivity. The findings point out clearly that not only development of disease but also the fate of cases is independent of pre diagnosis status of the new cases.

From all the 3 groups, disease developed more rapidly in some cases than in others. This reveals that tuberculosis cases are not an uniform entity from the point of view of development of the disease and cure.

KEY WORDS: INCIDENCE, CASE, EPIDEMIOLOGICAL GROUPS, RURAL POPULATION.

039 *AK Chakraborty, GD Gothi, S Dwarakanath & Hardan Singh:* TUBERCULOSIS MORTALITY RATE IN A SOUTH INDIAN RURAL POPULATION
Indian J TB 1978, 25, 181-86.

Information on cause specific mortality rates due to tuberculosis in India is inadequate. In the study under report, these have been estimated based on the data obtained from a five year epidemiological study of 119 villages of Bangalore district in south India. For this purpose, the estimated number of excess deaths due to causes other than tuberculosis among patients of tuberculosis, have been attributed to the disease.

The annual mortality due to all causes on 5 year observation could be calculated as 893 per 1,00,000 population (9%) aged 5 years and above. Agewise as well as overall mortality rates were not different from survey I & II, II & III & III & IV. The average rate of the periods is calculated to be 84 per 1,00,000 annually. The death rates were the highest in 55 years and above age groups, lower in 5-14 years and showed an increasing trend with age. Compared to the estimates of tuberculous deaths in India available for 1949 (about 250/1,00,000), the present rates were lower.

KEY WORDS: MORTALITY, RURAL POPULATION, LONGITUDINAL SURVEY.

040 *GD Gothi, AK Chakraborty, K Parthasarathy & VV Krishnamurthy:* INCIDENCE OF PULMONARY TUBERCULOSIS AND CHANGE IN BACTERIOLOGICAL STATUS OF CASES AT SHORTER INTERVALS
Indian J Med Res 1978, 68, 564-74.

The incidence rates of sputum positive pulmonary tuberculosis (cases) from the five year follow ups of a rural population done by National Tuberculosis Institute were reported on the basis of studies at intervals of one and a half to two years. Information on fate of cases was also likewise reported. These parameters appear to be imprecise since incidence and fate of cases at shorter intervals were not taken into account. Thus, the information on incidence of pulmonary tuberculosis in India is meager as compared to that on prevalence of disease. Therefore, a study mainly to find out the incidence and fate of cases at shorter intervals of 3-6 months was undertaken in 87 randomly selected villages of Nelamangala sub-division, Bangalore district which was one of the 3 sub-divisions where repeated epidemiological surveys had been conducted between 1961-68. The sample of villages in the present investigation was other than that included in the earlier report. Organized case finding, anti-tuberculosis treatment and BCG vaccination neither existed nor could be provided in the area till the completion of the study. The present study was conducted between 1968-1972.

This study conducted among 30,576 persons has shown that incidence of cases over a period of three months was 0.99 per thousand and was not much different from the annual rate of 1.03 per thousand reported on the basis of repeated surveys at longer intervals. That the three months rates were not a quarter of the annual rates meant that the procedure of calculating incidence rates on the basis of surveys done at varying intervals after adjusting for the interval had to be used with great caution. The study of fate of cases showed that cases converted or reverted even at shorter intervals and this appeared to be going on continually in the community. However, incidence of cases and cure and death from among the existing as well as the fresh cases kept on balancing each other so that the prevalence rates of cases studied at shorter or at longer intervals did not show variations.

KEY WORDS: INCIDENCE, FATE, CASE, RURAL POPULATION, SURVEY, SHORTER INTERVALS

041 *AK Chakraborty, GD Gothi, Benjamin Issac, KR Rangaswamy, MS Krishnamurthy & R Rajalakshmi*: CHEST DISEASES AND TUBERCULOSIS IN A SLUM COMMUNITY AND PROBLEMS IN ESTIMATING THEIR PREVALENCE

Indian J Public Health 1979, 23, 88-99.

The entire population of a slum area of Bangalore city, comprising of 3313 persons was registered, questioned

for symptoms and offered chest X-ray at a centre located in the slum itself. Those, who had any chest symptom and/or X-ray abnormality, were offered detailed examinations, viz., clinical examinations, repeated examinations of sputum for tubercle bacilli, and further chest X-rays. Of the total 2855 persons X-rayed and/or questioned, 1039 needed detailed examinations and about a fifth of the latter required referral to a consultant panel for diagnosis of chest diseases. Further, about 60% of those referred to consultants needed special investigations. Thus, the study of prevalence of chest diseases in the community needed considerable facilities and were operationally difficult. It is envisaged that similar problems will also be faced if peripheral dispensaries are to make proper diagnosis of chest diseases, due to the need for referral of large number of patients and provision of complicated diagnostic facilities at the referral hospitals. The study seeks to quantify the problem of chest diseases and tuberculosis in the slum community.

The prevalence of sickness in the population at any point of time were 49.5%. Sickness related to the respiratory system was 13.3%. It increased with age and was highest (42.6%) in those aged 55 years and above. Among 2855 persons X-rayed, 145(5.1%) had any radiological abnormality in chest. It is seen that respiratory systems symptoms were commonest in all the age groups. A total of 172 patients were diagnosed to have respiratory system abnormalities with or without X-ray lesions. Of them, 75% had non tuberculous etiology, 7.6% had active pulmonary tuberculosis and the remaining 17.4% had inactive tuberculosis. Prevalence of sputum positive cases was 0.26% and prevalence of total active pulmonary tuberculosis was 0.44%. The problem of arriving at final diagnosis was dependent on application of complicated special investigation tools to a large community. In view of the low coverage (47.4%) for the special investigations, prevalence of different chest diseases in the community could not be investigated.

It is concluded that in the community under study, the size of the problem of non tuberculous diseases of the chest and operational problems in their diagnosis were considerable.

KEY WORDS: PREVALENCE, URBAN, SLUM COMMUNITY, CHEST DISEASES, CASE.

042 *Raj Narain, GD Gothi, KT Ganapathy & CV Shyama Sunder*: EFFECT ON TUBERCULIN ALLERGY OF TUBERCULIN TESTS GIVEN 18 MONTHS EARLIER

Indian J Med Res 1979, 69, 886-92.

Enhancing effect of tuberculin allergy as a result of repeat tests with 1 TU RT 23 on groups tested with I TU, 20 TU and placebo was studied by random allocation among population not vaccinated with BCG in 8 villages. In all, 2357 persons were tested with 1 TU and 759 with normal saline at first round. Based on testing at three rounds the study population could be divided into eight different groups and were labelled with alphabets 'a' to 'h' having been tested once, twice or thrice. The groups 'a', 'c', 'e' & ’g' were tested at 2 months, round two with 1 TU RT 23 and remaining half were not tested. However, all available persons in the 8 groups were retested at the third round, 18 months after the initial test. Thus, eight groups cannot be treated as independent samples but representative of the whole population.

The study did not show enhancing effect due to previous tuberculin test with 1 TU alone among groups tested once, twice or thrice after an interval of 18 months. Part of population was tested with 20 TU at round one; boosting effect was seen at 2 months when test was repeated. However, it was not seen after 18 months but when exactly the boosting effect disappeared was not known. Thus, there was no increase in reaction even among those who were tested with a higher dose of 20 TU earlier after 18 months. The groups provided the largest number for comparison between tested and the control groups. It is inferred from the study that boosting with high dose or repeat tests with the same dose does not persist after 18 months. Hence, for classifying positive tuberculin reactors, no correction is required to the same individuals/population after an interval of 18 months or more, as no boosting effect after 18 months has been observed, on the basis of this analysis.

KEY WORDS: TUBERCULIN TEST, TUBERCULIN ALLERGY, BOOSTING.

043 *AK Chakraborty, KT Ganapathy & GD Gothi*: PREVALENCE OF INFECTION AMONG UNVACCINATED CHILDREN FOR TUBERCULOSIS SURVEILLANCE
Indian J TB 1980, 72, 7-12.

A survey was carried out among 12,535 children in the age group 0-9 years of 90 villages in Doddballapur sub-division of Bangalore district to study the possible variation in the prevalence of tuberculous infection among the unvaccinated children in a village depending upon the varying prevalence of BCG scars in the same population. In each village, all the children in the age group of 0-9 years were registered and examined for the presence or

absence of the BCG scar. Of the 12,535 children, 6269 (50%) who did not have BCG scars were eligible for tuberculin test, while 6045 were actually tested. Each child without BCG scar was tuberculin tested with 1 TU RT 23 with tween 80 and the reaction read between 72 and 96 hours. Two proportions were calculated in each village viz., a) the proportion with BCG scars and b) that of infected children among those without scar and the villages were distributed by these two proportions.

On the basis of distribution of tuberculin reactions, 10 and 12 mm induration was the demarcation between positive and negative reactors. Prevalence of infection among 0-9 years was 4.9%, 2.6% among 0-4 years and 8.9% among 5-9 years. Distribution of villages according to two variables i.e., prevalence of BCG scars and prevalence of infection among unvaccinated children did not show any correlation with the prevalence of infection among the unvaccinated in the same villages.

It is seen from the study that exclusions of various proportions of children with BCG scars did not have any correlation with the prevalence of infection among the unvaccinated in the same villages.

In none of the villages any association was seen between these two. In view of this finding, it is felt that the simple method of periodic tuberculin testing of the population in younger age groups could be developed into a method of tuberculosis surveillance even in areas where direct mass BCG vaccination is given. This would appear to be the cheapest, practicable and technically appropriate method of studying the overall tuberculosis situation.

KEY WORDS: PREVALENCE, INFECTION, BCG SCAR, SURVEILLANCE.

044 *AK Chakraborty, Hardan Singh & P Jagota:* INCIDENCE OF TUBERCULOSIS CASES IN CONTACTS - A SIMPLE MODEL

Indian J Prev & Soc Med 1980, 11, 108-11.

Contact examination is not recommended as a routine procedure for case finding in the District Tuberculosis Programme. The rationale for not including contact examination as a routine case finding measure is: (1) prevalence rate of tuberculosis among the contacts is not much higher than in the general population (2) at the time of diagnosis of an index case, a second case may not be found in the same household. Though more prevalence cases

cannot be diagnosed by contact examination, is it possible that by keeping the household contacts, as a group, under surveillance, future incidence of cases in the community can be substantially prevented? A model situation has been created by using hypothesis derived from various studies conducted in India, designed to answer the question. Variables used in the model are: 40% of the general population are infected at any point of time, there is only one prevalence case of TB at any given point of time in an average household of five, 40% of the noninfected population in a contact household are infected per year, incidence of disease among newly infected group is seven, times of the incidence among previously infected, incidence of disease in general population is 0.13% and from among previously infected persons 0.3% per year develop sputum disease.

At an incidence rate of 0.13% per year among general population aged >5 years, it is expected that 111 cases would arise in a year in the population of 1,00,000 under study. Thus, of the 111 cases occurring in the community, 101 arise from those who are not contacts.

The proportional contribution of new cases from the contact group to the total incidence cases in the entire community is so small, that even if all the contacts are kept under surveillance, BCG vaccinated or placed on chemoprophylaxis, still over 90% of incidence cases cannot be prevented from occurring. This is apart from the fact that keeping them under surveillance will be highly costly and is an operational problem of considerable magnitude.

KEY WORDS: INCIDENCE, CASE, CONTACTS, MODEL

045 *AK Chakraborty*: THE USE OF SCREENING TOOLS FOR THE ESTIMATION OF TUBERCULOSIS CASE RATES IN A COMMUNITY
Indian J Public Health 1980, 24, 115-20.

The problem in using simple tools e.g. chest symptoms for epidemiological surveys, designed to quantify the problem is that estimates from these simple surveys are considerable underestimates. Recent research has, however, paved the way for the use of these simpler tools for use in estimating tuberculosis case prevalence rates in the community. A tool which is simple, convenient to use and maintain, cheap but highly sensitive is called "screening tool". Such tools are used for making initial selection of the given population. Tuberculin test, X-ray & symptom

elicitation are the main screening tools used for epidemiological surveys and TB Control Programme. In the programme, symptom elicitation and X-ray examination are the screening tools of choice for case finding. In the survey, tuberculin and X-ray are the only two tools used, although tuberculin is not a good screening tool (40% population infected). Use of symptom screening in surveys, however, is restricted in the absence of adequate information on comparison of prevalence rates obtained by this method of screening with the best estimate. The performance of symptom screening with either culture or smear microscopy have been attempted. They showed that by applying suitable correction factors they may be rendered comparable to the best estimate. The symptoms may be useful in the survey as a screening tool and may give the rates as proximate to the true rates as possible. They will enable considerable simplification of epidemiological studies in tuberculosis without compromising on the precision of the estimates arrived at.

KEY WORDS: SCREENING TOOLS, ESTIMATES, CASE RATE, SYMPTOMS, X-RAY, TUBERCULIN, SURVEY.

046 *AK Chakraborty, KT Ganapathy & R Rajalakshmi:* EFFECT OF NUTRITIONAL STATUS ON DELAYED HYPERSENSITIVITY DUE TO TUBERCULIN TEST IN CHILDREN OF AN URBAN SLUM COMMUNITY
Indian J TB 1980, 27, 115-19.

Prevalence of tuberculous infection in young children is an important surveillance measure. However, the hypersensitivity may be depressed by malnutrition and thus interfere with the interpretation of tuberculin test leading to underestimation of the infection rate. Objective of this investigation was to study the relationship between tuberculin reaction with 1 TU RT 23 and nutritional status of children. The study was carried out in 1974 among children aged 1-9 years of age living in an urban slum area of Bangalore city and who were not given BCG vaccination.

Of the 1151 registered children aged 0-9 years, 482 in the age group 1-4 and 526 in 5-9 years formed the study group. Of these 1008 children, 980 had both clinical evaluation and anthropometric measurement for nutritional status and 963 had both tuberculin test readings and anthropometric measurements carried out for them. Of the 482 children aged 1-4 years, 230 were classified as suffering from Protein Calorie Malnutrition (PCM) and of the 498 in the 5-9 years of age, 227 were classified as suffering from PCM. Distribution of tuberculin test indurations in mm among the normals and the undernourished were compared; no significant difference in the mean size

of tuberculin indurations as well as in the distributions of these indurations was observed, regardless of the method used for arriving at the classification.

KEY WORDS: NUTRITIONAL STATUS, TUBERCULIN REACTION, SLUM COMMUNITY, INFECTION.

047:*VV Krishna Murthy:* MORTALITY AND CASE FATALITY OF TUBERCULOSIS CASES DIAGNOSED IN A RURAL POPULATION OF SOUTH INDIA
NTI Newsletter 1982, 19, 8-13.

Mortality from tuberculosis is an important epidemiological parameter for defining the problem of tuberculosis in any country. But due to lack of systematic recording and reporting system, precise information on cause of death is not available in our country. An attempt has been made to estimate the case fatality of tuberculosis cases as well as mortality of cases diagnosed in a longitudinal study conducted from 1961-68 in Bangalore district. **Crude mortality** of cases is defined as the ratio of total deaths observed among cases to the total number of cases observed, while **case fatality** is defined as the ratio of deaths that have occurred due to tuberculosis to the total number of cases investigated.

The overall observed annual crude mortality was 14.8%, while among culture positive smear positive (C+S+) it was 21%. An upward trend was seen with the increase in the age. The overall annual crude mortality among culture positive smear negative (C+S-) cases was 9.5% which is significantly lower than that among C+S+ cases. The death rates among old and new cases at the end of 18 months were 16.7% and 13.7% respectively. No statistical difference was found in the crude mortality either among old and new cases or in relation to the interval of diagnosis. Case fatality due to tuberculosis was computed by calculating the deaths among non-tuberculosis population of the same area and during same period and eliminated from the total deaths observed among tuberculosis cases. The case fatality of tuberculosis was found to be 13.3%. It was further observed that out of the total 38 deaths among cases, 89% were due to tuberculosis and 11% were due to non-tuberculosis causes.

KEY WORDS: MORTALITY, CASE FATALITY, CASE, RURAL POPULATION, SURVEY.

048 *VV Krishna Murthy*: PREVALENCE, INCIDENCE AND FATE OF SUSPECT CASES OF TUBERCULOSIS IN A RURAL POPULATION OF SOUTH INDIA

NTI Newsletter 1982, 19, 75-80.

The data from a longitudinal survey conducted in Bangalore district from 1961-1968 by National Tuberculosis Institute was analysed to find out the **prevalence, incidence** and **fate** of **suspect cases.** In brief, the survey was conducted in 119 randomly selected villages in three taluks of Bangalore district and repeated within the next five years. At each survey, eligible population was subjected to tuberculin, X-ray & sputum smear and culture examinations.

The overall prevalence rate of suspect cases among persons aged five years and more was 1.06% at I survey, 0.68%, 0.49% and 0.43% at II, III and IV survey respectively. In males, the prevalence rate was 1.19% at I survey & 0.62% at IV survey corresponding figures for females were 0.94% and 0.24% respectively. A decline of prevalence of suspect cases from 1.06% at I survey to 0.43% at IV survey was observed. The overall incidence of suspect cases was 0.16% between I & II surveys, 0.10% between II & III, and 0.06% between III & IV surveys. The overall as well as age specific annual incidence rates between III & IV surveys were significantly less than that between I & II surveys. At all the three intervals the incidence increased with the age. Incidence of suspect cases in males was more than that in females. Change in disease status over a period of time is termed as **"fate"**. The disease status was classified as (i) cure (ii) continued to be suspect case (iii) converted into bacillary cases and (iv) dead. The percentage of cure (51.9%, 53.2% and 50.3%) and conversion into bacillary cases(7.2%,5.8% and 5.4%) were almost the same at all the three intervals. But the percentage of those who remained suspect cases reduced from 33.5% at the end of 18 months to 17.5% at the end of 60 months. On the other hand, the death rate increased from 7.4% at the end of 18 months to 26.8% at the end of 60 months. The decreasing trend of continuing to be suspect cases at the rate of 10% between two observations, appears to be corresponding to the increasing trend in the death rate as seen from the observations made at the three intervals.

KEY WORDS: PREVALENCE, INCIDENCE, FATE, SUSPECT CASE, RURAL COMMUNITY, LONGITUDINAL SURVEY.

049 *AK Chakraborty, Hardan Singh, K Srikantan, KR Rangaswamy, MS Krishnamurthy & JA Steaphen*: TUBERCULOSIS IN A RURAL POPULATION OF SOUTH INDIA: REPORT ON FIVE SURVEYS
Indian J TB 1982, 29, 153-67.

The trend of tuberculosis in a sample of 22 villages of Bangalore district observed over a period of about 16 years (1961-77) is reported. Distribution of tuberculin indurations did not show a clear cut demarcation between infected and non infected. The method adopted to demarcate the cut off point has been described herewith: Distribution of tuberculin induration size of 0-14 years was attempted and extrapolated to higher age groups. Even in these younger age groups the antimodes were not clearly defined, so the antimode was arrived by fitting two normal curves as two likely modes.

The choice of demarcation level, therefore, is somewhat arbitrarily made on the basis of the distributions and these varied from survey to survey; between 10 mm at survey I and 16 mm at survey V. The actual and standardized infection rates showed more or less declining trend in 0-4 years, 5-9 years and 10-14 years age groups. The prevalence of cases was not significantly different from survey to survey (varying from 3.96 to 4.92 per thousand from first to fifth survey). However, there was a shift in the mean age of cases, and better survival rate of cases diagnosed at later surveys.

KEY WORDS: TREND, CASE, INFECTION, PREVALENCE, TUBERCULIN READING METHOD, LONGITUDINAL SURVEY.

050 *KT Ganapathy, AK Chakraborty*: DOES MALNUTRITION AFFECT TUBERCULIN HYPERSENSITIVITY REACTION IN THE COMMUNITY
Indian J Pediatrics 1982, 49, 377-82

Distribution of tuberculin test indurations were studied in relation to nutritional status of 930 rural children aged 1-4 years and 796 aged 5-9 years. Using Quetlet's Index, it has been observed that the distribution of indurations were similar in normal and malnourished children. By following Jelliffe's criteria of grading nutrition, no correlation was observed between the size of induration and degree of malnutrition. It is concluded that malnutrition in the community may not influence the prevalence rates of tuberculin infection based on such testing.

KEY WORDS: MALNUTRITION, TUBERCULIN REACTION, COMMUNITY.

051 *R Channabasavaiah & AK Chakraborty:* DISTRIBUTION OF TUBERCULOSIS CASES AMONG FAMIILY RELATIONS IN A RURAL COMMUNITY
NTI Newsletter 1984, 20, 63-72.

Material from a community survey carried out in rural areas of Karnataka by the National Tuberculosis Institute, Bangalore, has been analysed in an attempt to identify significant categories of the population that may yield higher proportion of cases. In all, 170 cases diagnosed among 61,581 persons have been distributed by their role, i.e., head of family (HOF) or not, kinship, (relationship to the HOF) by age and sex.

It has been observed that a comparatively small size of HOF male population (16.9%) would contain 55.9% of the total cases prevalent in the entire X-rayed population. On the other hand, the broad category other than HOF-male, would have case content relatively much less in proportion to their population size. Implications of the finding for house-to-house case finding by Multi-purpose Health Workers (HWs) are discussed here. It is possible to obtain higher case yield from the group having a higher case content which is aged 20 years and above and constitutes about 30% of the total population by confining to symptom screening. On the other hand, since cases are mostly in the HOF-males, would make it difficult for HWs to contact them in their normal visiting hours during day, as most of HOF-males may not be at home. Determined efforts have to be made by HWs to contact them during their beat schedule.

KEY WORDS: CASE, FAMILY, RURAL COMMUNITY.

052 *AG Kurthkoti & Hardan Singh*: CHANGES IN THE PREVALENCE RATES OF INFECTION IN YOUNGER AGE GROUPS IN A RURAL POPULATION OF BANGALORE DISTRICT OVER A PERIOD OF 5 YEARS
NTI Newsletter 1985, 21, 28-40.

The utility of repeated estimates of prevalence rates of infection in children as a tool for surveillance in tuberculosis is now well recognized. Two prevalence surveys at an interval of 5 years were conducted by National Tuberculosis Institute, Bangalore, with the main objective of studying changes in prevalence rate of infection among

children in the age group of 0-9 years. A total population of 42,343 residing in 90 randomly selected villages of Doddaballapur taluk, Bangalore, were registered; of them, 12,535 were children in the age group of 0-9 years. Children were further classified into two sub groups 0-4 and 5-9 years, with or without BCG scars. The unvaccinated children in these two age groups formed the study population.

The population in the study area during the 2nd repeat survey was similar to that of first survey with regard to age, sex distribution, except that a growth rate of 1.1% per year was registered. The BCG scar rate, among children in the age group 0-4, 5-9 years, was 8% & 39% respectively at survey I. All the unvaccinated children below 10 years were given tuberculin test with 1 TU PPD RT 23 and reactions were read 72 to 96 hours after tuberculin testing. In the first survey, level of demarcation to classify the infected children was 10 mm and above, while in II survey it was 12 mm and above. It was observed that the prevalence rate of infection from I survey to II survey was not altered (2.58% & 2.46%) in the 0-4 years of age, while there was an increase in the rate from 8.93% to 12.3% in 5-9 years of age in the II survey. The increase in the infection rate could be attributed to the rising trend of infection, over reading by tuberculin-readers', skills of both tuberculin tester and reader, boosting of tuberculin reaction or scarless BCG vaccination. In conclusion, the study of changes in the prevalence rate of infection in the younger age group is simple, cheap, less time consuming. The data can be used for calculating annual risk of infection as well trend of transmission of infection.

KEY WORDS: TREND, RISK OF INFECTION, PREVALENCE, SURVEILLANCE, RURAL COMMUNITY.

053 *VV Krishna Murthy & KT Ganapathy*: ARE THE ABSENTEES FOR EXAMINATIONS IN THE EPIDEMIOLOGICAL SURVEY OF TUBERCULOSIS DIFFERENT FROM THOSE EXAMINED?
NTI Newsletter 1989, 25, 15-21.

It is a common observation that in epidemiological surveys all those eligible for various examinations (tuberculin, X-ray and sputum examinations) do not attend them. If the 'non-attenders' differ from the 'attenders' the true situation of the problem may not be known. In this paper, the prevalence of infection, bacillary cases and suspect cases at II survey for both attenders and non-attenders of the I survey from longitudinal study conducted by National Tuberculosis Institute, Bangalore, are compared.

It was observed that in spite of repeated attempts, nearly 1/5th of the population did not attend examinations. The non response group during I survey was examined at the subsequent survey and both response and non response groups at the preceding survey were compared. It was found that in respect of prevalence of infection and bacillary disease, the two groups did not differ, but the mortality and emigration was higher among the non response group. Higher mortality among non-attenders may be due to the fact that the group contained more sick people. The higher emigration among non-attenders due to small error even to the extent of 0.5% at the stage of census taking by registering a non-resident as permanent resident of the village would highly boost the rate of emigration among non attenders. The difference in the indices of crude mortality and emigration rates becomes narrower and narrower as coverages for examinations increase. The analysis indicates that every attempt should be made to obtain as high a coverage as possible in order to obtain valid estimates of epidemiological indices in a population survey.

KEY WORDS: SURVEY, ABSENTEES, CRUDE MORTALITY, EMIGRATION.

054 *MS Krishna Murthy, AN Shashidhara, R Channabasavaiah, RV Kale, & J Chakravarty*: ROLE OF TUBERCULIN TEST IN SURVEILLANCE OF TUBERCULOSIS

Proceed of Indo US Workshop on major advances in TB Research, Madras, 4-7 Dec 1989, 111-17.

The National Tuberculosis Control Programme is in operation since 1962, and its quantitative achievement is being monitored indirectly through records and reports received from District Tuberculosis Centres. For direct evidence of impact of the programme, tuberculin surveys are useful in reflecting the recent epidemiological situations prevailing in the area. Tuberculosis being a disease of secular nature, a periodic follow up with five years (arbitrary) interval may be preferred over the continuous follow up, for finding the trend of tuberculosis situations in an area.

Keeping in view the importance of tuberculin surveys, National TB Institute (NTI) has evolved a surveillance system which can be adopted by any state in India. The state teams can be trained at NTI in registering population, tuberculin testing & reading, so as to carry out the surveillance in their respective areas. It is

essential to create a central organisation for surveillance of tuberculosis using the tuberculin test. The centre would be responsible for technical & administrative support and monitoring. NTI could provide technical expertise in formulating the surveillance system, a training methodology and an in service training to the designated staff.

KEY WORDS: SURVEILLANCE, TUBERCULIN TEST, TREND, PROGRAMME, COMMUNITY.

055 *National Tuberculosis Institute, Bangalore-3*: ON CONDUCTING TUBERCULOSIS SURVEYS
NTI Newsletter 1990, 26, 25-27.

A methodology in brief about conducting Classical Tuberculosis Sample Survey and Tuberculosis Surveillance is given below:

I. CLASSICAL TUBERCULOSIS SAMPLE SURVEY

A tuberculosis prevalence survey to measure the problem of tuberculosis in the community is a challenging assignment especially so when it is to be conducted by an organisation not created with the specific objectives of carrying out research work e.g., the District Tuberculosis Centre, State Tuberculosis Centre, etc. However, following procedure is described in brief: (1) Selection of district for the study, (2) Collection of basic data like size and distribution of population, number of towns and villages, (3) Selection of sample population for survey by valid statistical methods, (4) Census enumeration of study population by trained census takers - preparation of cards for all the individuals, (5) Tuberculin testing & reading of all subjects under study, (6) BCG scar survey, (7) X-ray examination of the eligible population (> 10 years or > 15 years). Interpretation of X-rays by standard readers, (8) Collection of sputum from chest symptomatics and X-ray abnormal individuals, (9) Transportation of sputum to central laboratory (necessary precaution to be taken during storing and transportation), (10) Sputum to be examined by trained staff, (11) Compilation, analysis and interpretation of data. Number of working teams with full complement of staff depends upon the size of the study population and the time frame of the study. An average survey team may have the following personnel on its strength: Medical Officer - One, Census Takers - Three, Tuberculin Tester & Reader (one each) - Two, Lab Technician - One, Lab Asst. - One, X-ray Technician. - One, Dark room attender - One. Equipment required: Mobile X-ray unit - mounted on a jeep along with the generator mounted on

another jeep, Laboratory infrastructure, Vehicles preferably jeep.

Apart from the above, the team may need part time assistance of a Statistician and a few Statistical Computers. In case a state is interested to carry out an epidemiological survey, it may need to create the above infrastructure. Once arranged, it may request the National TB Institute (NTI) to train the required staff on standard survey techniques under field situations which is very essential.

II. TUBERCULOSIS SURVEILLANCE

In contrast to the more complex methodology involved in a classical survey described above, an alternative, much simpler and indirect method to assess the problem of tuberculosis in the community is by finding out the infection rate, through tuberculin surveys. It may be possible to estimate the prevalence of sputum smear positive disease from infection rate. Such survey is conducted by subjecting the age-specific unvaccinated population to tuberculin test periodically. For carrying out the work, one to two teams composed of three to four properly trained tuberculin testers and readers are needed along with at least two vehicles and a standby vehicle per team. Budgetary support for petrol, travelling and daily allowance of staff, and for minor miscellaneous expenditure like stationery, spirit, etc., may be required to be provided. Training could be imparted to such personnel at NTI and their services utilised exclusively for carrying out tuberculin surveys as a regular ongoing surveillance activity. If this methodology is found suitable, one may take action to create posts of tuberculin testers and readers in suitable scales and draft them for training in tuberculin survey methodology. The Institute will be happy to train the required personnel for the purpose, as well as analyse the data so collected for use by the states.

KEY WORDS: CLASSICAL SURVEY, SURVEILLANCE, TUBERCULIN TEST, ASSESSMENT, METHODOLOGY.

056 *VV Krishna Murthy & K Chaudhuri*: RISK OF PULMONARY TUBERCULOSIS ASSOCIATED WITH EXOGENOUS REINFECTION AND ENDOGENOUS REACTIVATION IN A SOUTH INDIAN RURAL POPULATION - A MATHEMATICAL ESTIMATE
Indian J TB 1990, 37, 63-67.

It has been reported that a substantial proportion of the new cases arise from the previously infected population. Hence, it appears that exogenous reinfection

and/or endogenous reactivation play a major role in the development of post-primary disease. Though the risk of disease associated with exogenous reinfection and endogenous reactivation has not been computed in Indian conditions, the data collected during a longitudinal study by National TB Institute, Bangalore was analysed to estimate the above mentioned risk rates.

The risk of disease associated with exogenous reinfection was 6.55% per year compared with 0.21% yearly due to endogenous reactivation. To test the validity of the computed risk rates these were applied to the interval between the 3rd and 4th surveys. It was then estimated that 64 new cases should have been diagnosed in that survey interval as against 57 cases actually diagnosed. It was also estimated that 1.9% of the total population would be having recent infection, 1.3% would be previously infected with recent reinfection and 32.7% with previous infection but no recent infection leaving 64.1% who are not infected at all (uninfected). Among the new cases diagnosed, 28% would have progressive primary disease, 41% cases arise due to exogenous reinfection and 31% due to endogenous reactivation. In other words, the 1.9% population with recent infection contributes 28% of the total new cases, the 1.3% reinfected population contributes 41% and the 32.7% previously infected population contributes the remaining 31% of the total new cases.

KEY WORDS: RISK OF INFECTION, INCIDENCE OF INFECTION, EXOGENOUS REINFECTION, ENDOGENOUS REACTIVATION, RURAL COMMUNITY, MATHEMATICAL ESTIMATE.

057 *MS Krishna Murthy, R Channabasavaiah, AV Nagaraj & P Chandrasekhar*: INCIDENCE OF TUBERCULOSIS INFECTION IN A SOUTH INDIAN VILLAGE WITH A SINGLE SPUTUM POSITIVE CASE: AN EPIDEMIOLOGICAL CASE STUDY
Indian J TB 1991, 38, 123-30.

During a longitudinal survey, carried out in 119 randomly selected villages of Bangalore district for studying the time trend of tuberculosis, the average infectivity of a case over a period of one and a half years was found to be six. In 1986 i.e., 25 years after the start of I survey, 61 persons belonging to one village called Nunnur who were found newly infected between I & II surveys, were interviewed. Further, a general study of the layout of the houses and public facilities in the village was made. However, in Nunnur, there was just a single bacteriological case (index case) identified at the I survey. This index case was resident of household numbered 80 in the main village. This case study investigates the

background of the observed high infectivity. The incidence rate of infection in Nunnur was 9.5% in 1½ years which is higher than the overall average rate of 4% as well as rate for 30 other single case villages i.e., 3.5%. The investigation reveals that at least 21 persons., found newly infected at II survey, had varying levels of contact with the index case. The remaining 40 infected persons could not be linked, either directly or indirectly, to any other known bacteriological case including the index case in the village. All the persons identified as infected at II survey were distributed throughout the village, beyond the likely zone of infection of the index case.

KEY WORDS: SINGLE CASE STUDY, INFECTIVITY, INCIDENCE, INFECTION, RURAL POPULATION.

058 *K Chaudhuri, MS Krishna Murthy, AN Shashidhara, R Channabasavaiah, TR Sreenivas & AK Chakraborty*: TUBERCULIN TESTING IN THE COMMUNITY THROUGH GENERAL HEALTH SERVICES IN PREPARATION FOR TUBERCULOSIS SURVEILLANCE - A STUDY OF FEASIBILITY

Indian J TB 1991, 38, 131-37.

A study was conducted in 1983-84 by the National TB Institute (NTI) in the districts of Dharmapuri (Tamil Nadu) & Ananthapur (Andhra Pradesh). Thirteen health personnel were trained in census taking, tuberculin testing & reading and data keeping etc., at the NTI according to the standard methodology. The trainees were repeatedly assessed and only those who achieved a reasonably high inter-reader correlation with the standard reader were chosen for the field work. Field work was carried out by these health workers and supervised by the team leaders of NTI. Children between 0-9 years were tested with 1 TU RT 23 with Tween 80 in tuberculin testing centres specially set up in each village and the reactions were read between 48 & 72 hours after the test. The tuberculin testing/reading coverage was very high. Of 6702 eligible children, 5904 (97%) were tuberculin test read.

Individual reading assessment carried out at Ananthapur and Dharmapuri for the State Field Workers (SFWs) showed that agreement with Standard Reader (SR) of NTI at three induration levels i.e., 10+ mm, 14+ mm and 18+ mm were very high. The demarcation line between infected and uninfected appeared to be about 18 mm. In Ananthapur, the agreement at 18+ mm was 99% and at Dharmapuri it was 100% for SFW, and 98.4% for SFW-2. The estimates of prevalence rate of infection were 9.3% - SFW V/s 9.7% - SR at Anantapur, 5.2% - SFW V/s 5.2% - SR and 7.2% - SFW.2 V/s

7.2% - SR at Dharmapuri. The study further showed that it was possible to train general health workers, within a period of 3 months to attain a high level of efficiency. The general health services can successfully organise on their own a programme of tuberculin testing in the community with proper liaison and supervision by some nodal agency. The training and field supervision responsibilities may be shouldered initially by NTI or another suitable organisation, till these nodal agencies come up.

KEY WORDS: SURVEILLANCE, TUBERCULIN TEST, HEALTH SERVICES, FEASIBILITY, COMMUNITY.

059 *National Tuberculosis Institute, Bangalore*: TUBERCULIN TESTING IN A PARTLY BCG VACCINATED POPULATION
Indian J TB 1992, 39, 149-58.

To obtain precise information for computing the indices of tuberculosis situation in a community, with passage of time, reliance has been placed on tuberculosis infection rates obtained by carrying out tuberculin surveys. In most developing countries, covered extensively by BCG vaccination without prior tuberculin testing, the tuberculin test has problems of interpretation for demarcating the infected persons from the uninfected. To overcome the problem, therefore, the test results are analysed among persons who do not show a BCG scar and are, thus, considered as normal population. In this paper, an attempt is made to show that BCG vaccination not always lead to the formation of a scar, and also that the scar resulting from BCG vaccination may fade away with time and the person, thus, may be wrongly included in the unvaccinated group. It has also been found that there is greater fading of scars in the younger age groups: in children 0-2 years of age, upto 52% of the scars faded away within 21 months of vaccination. This proportion steadily decreased to about 8% in the 10-14 years age group.

The implication of the finding is that the demarcation line between uninfected and infected persons may require to be shifted from survey to survey, based on the distributions among the 'no scar' population. Moreover, in a totally vaccinated community, the differences of reactions may provide the answer to the problem of identifying the newly infected persons.

KEY WORDS: TUBERCULIN TEST, BCG SCAR, INFECTION, WANING.

060 *AK Chakraborty*: CASE FOR A REPEAT EPIDEMIOLOGICAL SURVEY IN INDIA
Indian J TB 1992, 39, 209-12.

The question of carrying out a repeat epidemiological survey in India has been engaging the attention of many for quite some time. The first nationwide tuberculosis prevalence survey was conducted in India during 1955-58. It served as an eye opener and produced data which were profitably used by the planners to decide about the form and state of national control programme. Doing a repeat survey will be useful only if it would be capable of yielding epidemiological information on the future course of action. At the time of formulation of the District Tuberculosis Programme (DTP), it was perhaps presumed that programme would work with optimum efficiency as in the operational studies and as such the real performance was not envisaged. Secondly, due to low prevalence rates of tuberculosis as shown in all the surveys could reflect a small rate of change or no change at all, thus these longitudinal surveys with inadequate samples, did not have enough discriminatory power to observe a statistically valid change with time.

It is now globally realised that instead of looking at mortality rates or small changes in the prevalence rates of cases, it is the Annual Risk of Infection (ARI) which holds the key to epidemiological trend in a community. However, through a model recently constructed at the National Tuberculosis Institute, it is possible to extrapolate the findings of well planned small surveys in certain areas. It gives an idea what to expect over a period of 50 years - **a slow decline.** Therefore, when the present efficiency of case finding programme is about 33%, treatment efficiency also of the same order or even worse and with persistent rise in the population, it is futile to talk of epidemiological assessment through repeat surveys. Instead, we should concentrate on raising the efficiency of the DTP as near to the level which could be called the critical level of efficiency. Till then **nation wide surveillance** through the calculation of ARI is the only choice.

KEY WORDS: REPEAT SURVEY, ASSESSMENT, DECLINE, RISK OF INFECTION.

061 *R Channabasavaiah, V Murali Mohan, HV Suryanarayana, MS Krishna Murthy, & AN Shashidhara*: WANING OF BCG SCAR AND ITS IMPLICATIONS
Indian J TB 1993, 40, 137-44.

It has been postulated that BCG scar disappears in a good number of children and some of the vaccinated children

will get included in the non vaccinated group and cause difficulty in interpreting the results of tuberculin test. It was decided to analyse information on BCG scar status in the younger population of a rural community in 3 taluks of Bangalore district with an objective to find out whether disappearance of BCG scar is dependent on the age of the child, size of post vaccination induration at initial survey and tuberculin sensitivity status of children in whom BCG scar has disappeared, in comparison with children in whom the BCG scar has not disappeared. In all, 1095 children aged 0 to 14 years were found with BCG scar in 119 randomly selected villages during an epidemiological survey done in 1961 at the time of intake. Following two groups of children were studied for disappearance of the scar. Of them, a) 796 children who had BCG scar at the first survey, and whose BCG scar status was available at 4th survey, b) 299 who showed no BCG scar at first survey but were found with BCG scar at 2nd survey and whose BCG scar status was available at 4th survey.

Of the BCG scars recorded at intake, 26.4% and 32.5% disappeared subsequently during three and a half and five year periods respectively. The **waning of BCG scars** was independent of age of the child and tuberculin sensitivity status at intake. Tuberculin sensitivity status in children in whom scar had disappeared was the same as that found in children in whom scar had persisted at intake and after five years. The misclassification of children, in whom scars have disappeared, as unvaccinated leads to a difficulty in interpreting the results of tuberculin test done for the purpose of computation of the **Annual Risk of Infection.** Further, the extent of misclassification increases in proportion with the increase in BCG coverage of the population. This finding justifies the practice of identifying the demarcation level on the basis of the distribution of tuberculin induration sizes for classifying the infected persons in a population in each survey.

KEY WORDS: BCG SCAR, WANING, RURAL POPULATION, RISK OF INFECTION.

062 *AK Chakraborty*: TUBERCULOSIS SITUATION IN INDIA MEASURING IT THROUGH TIME
Indian J TB 1993, 40, 215-25.

In a chronic disease like tuberculosis, the exact levels of prevalence or incidence of infection and disease are of lesser importance than its time trend. Surveys should be conducted repeatedly if possible, in order to study the latter. Longitudinal surveys, conducted by

National Tuberculosis Institute (NTI) & New Delhi TB Centre, could provide information only on the incidence and prevalence of the disease & infection and not on the time trend due to inadequate sample size of the population selected for the surveys. To measure an annual decline of 1% after 12 years, NTI should have taken a population of 4,45,000 for Tumkur survey instead of 35,000 actually taken. An attempt to measure the trend with the help of epidemetric model also suffers from the inherent infirmity of the small population size. It gave little statistical support to the coefficient of variations of the observed rates, thus imparting little discriminatory power to the observed rates. The error of taking inadequate sample size of the population for these surveys, could be attributed to: (1) The statistical concept of epidemiological assessment through repeated measurement of TB problem had not yet concretised in the minds of the Epidemiologists and Programme Planners. (2) A very high rate of decline was expected after the implementation of the District TB Programme (DTP). (3) The purpose of longitudinal surveys was to get information only on the incidence of infection & disease and not to measure the change. (4) It was not envisaged in 1962 when DTP was being formulated, that there would be no change situation in the prevalence rate of tuberculosis after implementation of DTP from that found in National Sample Survey carried out during 1955-58. The hypothesis underlying static situation was formulated by the Indian epidemiologists later taking their clue from Grigg's momentous work.

Mean time it was established that the Annual Risk of Infection (ARI) holds the key for evaluating the epidemiological trend in a community. From the available data from Longitudinal Survey of NTI it has been found that almost identical rates of ARI were calculated as incidence rates of infection actually observed during the initial surveys. Over a period of 23 years, there has been an annual decline in the risk of infection for the area at the rate of 3.2%. Estimation of incidence of smear positive cases on the basis of the ARI could be made (1% ARI being equivalent of 50 cases per 100,000 population). The findings commensurate with observations made 23 years later, wherein incidence of cases was observed 23/100,000 population and ARI of 0.6% (a parametric relationship seen). The programme operation of average 33% efficiency for nearly three decades would give an annual declining trend of the following extent: 1.4% in case rate, 2.0% in smear positive case rate and 3.2% in ARI. Alternatively the above trend could also represent the natural dynamics.

KEY WORDS: LONGITUDINAL SURVEY, TREND, PROBLEM, MEASUREMENT.

063 *AK Chakraborty, R Channabasavaiah, MS Krishna Murthy, AN Shashidhara, VV Krishna Murthy & K Chaudhuri*: PREVALENCE OF PULMONARY TUBERCULOSIS IN A PERI-URBAN COMMUNITY OF BANGALORE UNDER VARIOUS METHODS OF POPULATION SCREENING
Indian J TB 1994, 41, 17-27.

Screening of the population by Mass Miniature Radiography (MMR) followed by sputum examination by culture of the X-ray abnormals is the customary method for arriving at the prevalence rate of cases in the community. It is not possible to use this methodology by states to carry out prevalence surveys in these areas, even if they desire to evaluate the effect of anti tuberculosis measures implemented by them. Therefore, simpler means of screening population through chest symptom for sputum examination has been studied by National Tuberculosis Institute (NTI). The objectives of the present investigation were to find out the prevalence of bacillary cases by screening the population through identification of chest symptomatics by Social Investigators (Sls) or General Health Workers (GHWs) compared to that by MMR. In a peri urban area 10 kms away and around Bangalore city all the villages were listed and of the 60 villages were selected on the basis of a sample random sample. Of them, 30 were covered by Sls of NTI and the other 30 by GHWs of the state government. The methodology adopted was that (1) After census taking and registration of the entire population aged 15 years and above, Sls questioned the persons house to house for presence of cardinal chest symptoms of any duration. All chest symptomatics were subjected to MMR and sputum examination. (2) Similar methodology was adopted by GHWs in the other 30 villages allotted to them. (3) Without knowing the symptom status of all the registered persons, aged 15 years and more belonging to all the 60 villages, were subjected to MMR and from among those having X-ray abnormalities, to sputum examination.

It was found that GHWs had identified the same proportion of the persons either having general symptoms or having chest symptoms from the general population, as Sls. Prevalence rates of culture positive as well as smear positive cases were similar by any of the three methods i.e., 0.18%, 0.23% & 0.25% respectively. Prevalence rates of smear positive cases obtained through symptom questioning, either by Sls or GHWs, were more or less similar to the estimates obtained by the more comprehensive screening method of MMR and/or symptom questioning. The culture positive prevalence rate following MMR screening was 0.25%, which was lower than the rates observed in other surveys. The paper discusses the possible hypothesis that could explain the observation. It also presents correction factors to compute rates comparable to the best estimate

i.e., that obtained through comprehensive screening by MMR and/or symptom questioning, followed by sputum culture.

KEY WORDS: SCREENING TOOLS, CHEST SYMPTOMATICS, MMR, PREVALENCE, CASE, PERI URBAN COMMUNITY.

064 *AK Chakraborty, HV Suryanarayana, VV Krishna Murthy, MS Krishna Murthy & AN Shashidhara*: PREVALENCE OF TUBERCULOSIS IN A RURAL AREA BY AN ALTERNATIVE SURVEY METHOD WITHOUT PRIOR RADIOGRAPHIC SCREENING OF THE POPULATION
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Mass miniature radiography (MMR) is the usual tool for population screening in tuberculosis case prevalence surveys. However, this facility is not available at most centres in India. An attempt was made to study the feasibility of carrying out sputum positive case prevalence survey in a population by introducing methodological variation in the screening, in order to select those eligible for sputum test without resorting to the customary use of MMR for the purpose. The study was carried out in Bangalore rural district during 1984-1986. The area was the same as for six earlier prevalence surveys conducted since 1961. The population aged up to 44 years was tuberculin tested. Persons with test induration size of 10 mm were eligible for sputum examination, besides all those aged over 45 years were eligible. It was observed that 78.4% of the registered population (29400) in the age group 10 years and above were required to undergo sputum examination by the present method of screening leading to a very high work load of sputum examination necessitating deployment of additional sputum cultures. Thus, the purpose of pre selection for sputum examination was hardly fulfilled. Further, a high contamination rate was observed. The changed screening procedure in this survey made comparison with the earlier data difficult.

The overall prevalence rate of cases was 438/100,000 in persons aged 10 years and above, while smear positive prevalence rate was 68/100,000. The observed prevalence rate was similar to earlier surveys, while smear positive prevalence rate was much lower. In conclusion, the screening methodology was found to be operationally unfeasible, ineffective and counterproductive to complicate the survey procedure in the quest for simplicity

KEY WORDS: SURVEY, SCREENING PROCEDURE, SYMPTOMS.