Tuberculosis (TB) is the world's foremost cause of death from a single infectious agent and annually there are about 3 million deaths from TB all over the world with about 15% of these occurring in India alone\textsuperscript{1-3}. The brunt of the disease is borne by those in the age group of 15-59 years\textsuperscript{4}. Approximately 6.7% of all deaths and 18.5% of deaths in the above age group, in the developing world are attributable to TB\textsuperscript{5,6}. An estimated one-third of the world population is infected by \textit{M. tuberculosis}, with 95% of TB cases occurring in developing countries. Among more than 1000 million people in India today, every second adult is infected with the tuberculous mycobacteria and each year more than 2 million people develop active TB. India alone accounts for nearly one third of the global burden of this disease\textsuperscript{6}.

TB is largely a disease of adults. Within adults, it is prevalent more in older adults than younger adults and more among males than females\textsuperscript{7}. Although morbidity and mortality in any age group have significant economic and social consequences, no community can afford to lose its citizens in prime years of life since these are not only the productive years in terms of wage earning but also a period of shouldering family and social responsibilities.

Before 1950, it was widely believed that the problem of TB was only localised to big cities. The first disease survey carried out by Dr Frimodt Moller in the villages of Madanapalle district revealed that TB was prevalent in rural areas also\textsuperscript{8}. The strategic importance of TB control in rural areas of the country was recognised when the National Sample Survey (NSS) indicated that 70-80\% of TB cases resided in rural areas since TB was as prevalent in rural areas as in urban areas\textsuperscript{9}. Most of the later surveys carried out in various parts of rural India reveal that TB continues to be as highly prevalent in these areas as ever before\textsuperscript{7-16} (Table 1) and that only a small proportion of rural population escapes infection through good luck or innate resistance.

Annually, more than three lakh TB deaths take place in rural areas out of the total 4.5 lakh TB deaths in the country\textsuperscript{17}. About 5 to 6\% of all deaths in rural India are contributed by TB\textsuperscript{17}. The age and sex distribution of deaths due to TB in rural India is given in table-2\textsuperscript{17}.

### Table 1: Prevalence of pulmonary TB in rural parts of India

<table>
<thead>
<tr>
<th>Area &amp; year</th>
<th>Sample size</th>
<th>Prevalence of pulmonary TB/1000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bacillary</td>
</tr>
<tr>
<td>Madanapalle\textsuperscript{8} (1950)</td>
<td>20,307 (all ages)</td>
<td>M (\cdot) 3.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F (\cdot) 1.5</td>
</tr>
<tr>
<td>National Sample Survey\textsuperscript{'}</td>
<td>1,22,907 (&gt; 4 years)</td>
<td>3.44 (2.29 to 6.11)\textsuperscript{*}</td>
</tr>
<tr>
<td>Tumkur district, Karnataka\textsuperscript{9} (1960-61)</td>
<td>21,021 (&gt;9 years)</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M (\cdot) 5.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F (\cdot) 2.5</td>
</tr>
<tr>
<td>Rural Bangalore\textsuperscript{10} (4 surveys between 1961-68)</td>
<td>41,000-43,000 (&gt;4 years)</td>
<td>3.4 (\cdot) 4.0</td>
</tr>
<tr>
<td>Chingleput (Tamil Nadu)\textsuperscript{11} (1968-71)</td>
<td>2,06,609 (&gt;9 years)</td>
<td>10.68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M (\cdot) 17.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F (\cdot) 4.39</td>
</tr>
</tbody>
</table>

\* Senior Epidemiologist, ** Former Director, National TB Institute, 8, Bellary Road, Bangalore \(\bullet\) 560 003.
<table>
<thead>
<tr>
<th>Area &amp; year</th>
<th>Sample size</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bacillary</td>
</tr>
<tr>
<td>Wardha(^{12}) (1982-88)</td>
<td>187,654 (&gt;4 years)</td>
<td>1.98</td>
</tr>
<tr>
<td>North Arcot (Tamil Nadu)(^{13})</td>
<td>18,688 (&gt;4 years)</td>
<td>2.41 (by smear alone)</td>
</tr>
<tr>
<td>Rural Bangalore(^{14}) (1984-86)</td>
<td>21,924 (&gt;9 years)</td>
<td>4.4 M : 6.4 F = 2.3</td>
</tr>
<tr>
<td>Morena district, Madhya Pradesh(^{15})</td>
<td>11,097 (&gt;14 years)</td>
<td>12.7</td>
</tr>
<tr>
<td>Raichur district, Karnataka(^{16}) (1988-89)</td>
<td>40,000 (&gt;14 years)</td>
<td>10.7</td>
</tr>
</tbody>
</table>

* Prevalence varied from place to place in this range

Table 2 : Total TB deaths in rural India by age and sex (000s)

<table>
<thead>
<tr>
<th>Age group</th>
<th>Rural areas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
</tr>
<tr>
<td>0-4</td>
<td>4.5</td>
</tr>
<tr>
<td>5-14</td>
<td>2.5</td>
</tr>
<tr>
<td>15-44</td>
<td>85.6</td>
</tr>
<tr>
<td>45-59</td>
<td>76.3</td>
</tr>
<tr>
<td>60+</td>
<td>65.1</td>
</tr>
<tr>
<td>Total TB deaths</td>
<td>234</td>
</tr>
</tbody>
</table>

Though TB deaths are more common amongst males, it is pertinent to mention that TB kills more women than all other infectious diseases and maternal deaths combined\(^\text{18}\). An analysis of the TB problem among rural women requires understanding in an socio-economic context. The rural women are, often ignored in terms of preference and priorities in getting medical facilities. It is only when the situation worsens and they are unable to take up household activities that they are brought for the treatment. Women are also disadvantaged in terms of nutritional status, multiple responsibilities and specific household tasks such as cooking in the ill-ventilated enclosures. All these conditions make rural women more conducive to make them fall an easy victim of the disease.

In the rural areas of the country, TB is still considered to be a socially outcaste disease. The patients suffering from the disease often do not disclose it for a long time. It has partly to do with their lack of knowledge of the symptoms of the disease and also due to the negative reactions that they fear from the people around them.

In a study conducted in Pune district, one out of every three TB cases were found to be engaged as agricultural labourers\(^\text{19}\). In another study conducted among farm workers of Uttar Pradesh, one out of every five workers suffered from some kind of respiratory disease and one-fifth of the respiratory diseases was due to pulmonary TB\(^\text{20}\).

The agricultural occupation is associated with an increased risk of TB because it attracts workers in a high-risk category for TB since most of them have poor nutritional status and live in poor housing conditions. Farm workers are often migrant labourers, they are often not in full time employment and are thus in a low socio-economic stratum. They may also be predominantly male. These characteristics are all associated with increased risk of TB. Many a time, the agriculture and farm workers have to work under dusty conditions leading to high incidence of silicosis among them. Since the patients with silicosis are at a higher risk of developing TB\(^\text{21}\), the agricultural workers specially those exposed to dust storms comprise a high-risk group for developing TB. Humans usually acquire TB infection from their immediate environment rather than from an animal source. However, there is a real risk that agricultural people living in closer contact with cattle may acquire the infection from them.

In the survey carried out in the central Indian district of Wardha in Maharashtra, it was found that 42% of the rural population aged 5 years and above was engaged in agriculture. About 85% of the
working population in rural areas and 20% in urban areas were engaged in agriculture related activities. One out of every two chest symptomatics found in the survey was an agricultural worker and a higher proportion of them (3.1%) had symptoms of cough with more than 2 weeks duration, chest pain, prolonged fever or history of haemoptysis compared to 1.9% of the overall population. About half (46%) of the total disease prevalence in the district was contributed by agricultural workers.

On extrapolating the above data nationally, it can be surmised that about four million agricultural workers suffer from TB at any given point of time, one million of them are infectious in nature and spread the disease to their family members, neighbours and co-workers. The time off from work prior to diagnosis and during treatment is an economic loss to their families and many of the caregivers also have to take time off from work to assist them. Therefore, the high prevalence of TB in India has serious and adverse consequences on the agriculture produce and thus on overall economy of the nation. Also, the deaths of these workers in the prime of their age have a particularly onerous burden and its consequences on children and other dependants can be disastrous. Being from lower socio-economic strata, they are also the people who are least able to cope up with the disease. Thus the effects of the disease on agricultural families can be devastating both financially and emotionally.

With the population growth, the absolute number of TB cases in the country has been on the increase. The advent of HIV epidemic has already facilitated the return of TB to wealthy nations. In the developing countries where the disease was never controlled, the situation is expected to worsen in the future as a result of the increasing HIV seroprevalence rates since HIV infection is the single most important risk factor for developing TB.

A National Tuberculosis Programme (NTP) has been implemented in the country as an integral part of the general health services since 1962. The programme was evolved by the National Tuberculosis Institute (NTI), Bangalore after the valuable research studies carried out by it threw light on the epidemiological and operational aspects of the programme. Earlier, it had been established by Tuberculosis Chemotherapy Centre, Chennai that the efficacy of domiciliary treatment was as good as treating them at the sanatoria. It was decided that the programme should be felt-need based since a majority of the patients seek treatment at various health institutions. The objectives of NTP were as under:

1. To reduce deaths due to TB.
2. To detect as large a number of TB patients as possible and treat them effectively so that the infectious patients are rendered non-infectious and active and non-infectious cases do not become infectious.

To achieve the above objectives, following components were considered necessary:

1. Sputum diagnoses of all cases at the primary health care level.
2. Domiciliary treatment of the detected cases.
3. Provision of basic facilities and basic record keeping at the Peripheral Health Institutions (PHIs) which include Primary Health Centers (PHCs) and Community Health Centers (CHCs).
4. Improvised referral services and the access to specialized services for more complicated cases.
5. Having a District TB Centre (DTC) at each district, which would not only be responsible for implementing NTP in the district but also provide referral services to the PHCs and CHCs, which form a part of the health service delivery system in the rural areas.

Case-finding activities in NTP are undertaken by examining the symptomatics attending the various Health Institutions. Under the programme, the treatment of sputum positive TB patients has been accorded priority over that of sputum negative cases in order to cut the chain of transmission. Treatment is decentralized and is offered on a domiciliary basis. Anti-TB drugs are issued free and retrieval action is taken in respect of TB patients who interrupt treatment. Management of NTP covers planning, implementation and maintenance of various activities under DTP and the responsibility of this rests with the District TB Officer (DTO) assisted by his key staff.

CONSTRAINTS IN TB CONTROL

TB still tops the list of causes of deaths and disease in this country and the problem in rural areas of the country has not declined from the situation 50 years ago in spite of the advent of anti-TB drugs and implementation of the NTP. Even the case fatality rates have remained high as shown by the surveys conducted by NTI before implementing the
One of the most significant obstacles of achieving TB control is the challenge of implementing TB control activities in rural populations as the health care infrastructure in most rural areas of the country is still not fully developed. Accessibility is affected by the factors such as distance to the nearest place where the patient could go for treatment, which is usually far away in rural areas. It often takes one full day for the patient to make a single visit especially in view of general lack of transport facilities. Many of the rural TB patients do not present themselves to medical facilities in time with the result that there is a delay in diagnosis. This delay may be because of financial barriers that include the cost of transportation and loss of wages besides the fact that a significant proportion does not feel sick enough to seek care. Many of the cases are not even aware of the availability of treatment in public health services.

Many a time, the patients on approaching a medical facility are returned undiagnosed and some incur sizeable expenditure on general antibiotics before they are diagnosed as TB.

There has been an overemphasis on using X-rays for diagnosing TB, which leads to overestimation of cases. X-ray, as a case-finding tool has severe limitations and is about 7-10 times costlier than sputum microscopy, which is also a more reliable diagnostic tool.

Inability of the health providers to administer complete and regular treatment for 6-8 months has been a major impediment to controlling TB. Irregular supply of drugs especially to PHCs, low image of public health services, lack of patient-doctor rapport and high cost of care which include travel cost, loss of wages and doctor’s fees and cost of drugs when taking treatment from the private sector are some of the important reasons.

The rural PHIs lacked the administrative and technical support from the DTC and implemented the TB programme in a perfunctory manner. Many a times, there has been shortage of basic supplies like sputum cups, slides, strain and drugs. Little attention was paid to patient’s education and there was general lack of accountability of all categories of health persons.

Under the National TB Programme, antitubercular drugs were to be provided free of cost to the patients. However, there was perpetual shortage of drugs in the government pharmacies and the patients had to incur high cost of procuring drugs at the market price. Thus, even in a programme offering free service, there were direct and indirect costs to the patients, which encouraged drug defaulting in the long run.

Almost half of the patients depend upon public health services for relief. However, the services were not satisfactory in many parts of the country with the result that patients have to seek relief from private health agencies. In addition to high service charges, these private agencies rely more on X-ray of the chest for diagnosis and may not adhere to the standard drug regimens, leading to financial losses for the patient and increased possibility of drug resistance. A high proportion of the TB patients incur debt being unable to bear the expenses of the treatment.

The key staff of the DTC seemed rather satisfied being engrossed in providing clinical services and paid little attention to management and supervision of the programme in the district. Recording and reporting under the programme was equally bad to give any reliable information on either epidemiology of the disease or efficiency of the case finding and treatment.

In the presence of inefficient case-finding and poor treatment completion rates, the problem due to the disease continued to be unabated. Less than 50% of the patients adhered to complete the course of treatment. When the treatment is not completed, not only is the patient’s life jeopardized but also the patient continues to infect others in the community and such infections have a greater likelihood of becoming multi-drug resistant. The cost of treating such patients is so enormous that it is beyond the scope of any health programme. One of the alternatives adopted to overcome the problem of drug default has been the gradual replacement of the 12-month long course treatment with a shorter and more effective six month Short Course Chemotherapy (SCC), which leads to better compliance resulting in higher cure rates.

Since the group of agricultural workers is one from lower socio-economic strata, many a times these workers have, to move from one place to another seeking livelihood. These characteristics pose particular problems especially when they migrate to urban areas where they have to live in sub-standard
housing conditions, which is a further risk for developing TB. Increased rates of TB have often been observed in migrant populations.

**APPROACHES FOR IMPROVEMENT OF TB CONTROL ACTIVITIES**

Several innovative approaches would have to be developed to overcome these problems in implementation of TB control activities especially for achieving and sustaining high cure rates for all rural patients with infectious TB.

The importance of prescribing appropriate anti-tubercular drug regimens and preventing treatment default cannot be over-emphasized. Effective TB treatment not only cures current cases but also prevents future cases, which are indirect benefits of chemotherapy. One of the major determinants for successfully treating TB is the level and intensity of supervision by the health care delivery system. The approach that has been adopted by TB programmes all over the world is to ensure that each dose is administered to the patient under the supervision of a health worker or a dedicated health volunteer. Direct observation of treatment is an essential component of DOTS strategy, and has yielded high cure rates of about 85% in many countries including our own.

DOTS is the only way of ensuring high cure rates and thus has the benefits of reduction in transmission of infection by rendering infectious cases non-infectious. There are additional savings in future due to lower numbers of relapses and preventing development of resistance to antibiotics in both of which situations, treatment is much costlier.

The Revised National Tuberculosis Control Programme (RNTCP) takes advantage of the technology revolution, which took place by the introduction of DOTS. In countries like Tanzania, it was shown that DOTS had enhanced the rate of reduction in infectors (diseased) and infected (potential) by 50% in 15 years. The RNTCP also effectively utilizes the enhanced availability of infrastructure and manpower that has developed in the primary health care system over the years, but has not been utilised under the NTP.

The objectives of the revised strategy are as under:

1) To cure at least 85% of all newly detected cases of pulmonary TB with supervised SCC.

2) To detect at least 70% of the estimated incidence of smear positive pulmonary TB cases.

A chest symptomatic reports to the nearest health facility, where his sputum is tested. In case sputum examination facility is not available here, then the patient is referred to the nearest Microscopy Centre. After three sputum samples have been examined, the patient is put on anti-TB treatment in case at least two of the three samples are positive. If only one sample is positive, an X-ray is taken. The medical officer decides the treatment to be given on the basis of X-ray and clinical examination. If all the three sputum specimens are negative, then the patient is given a course of antibiotics for 7-10 days. In case symptoms still persist, then X-ray is taken and the medical officer decides on the subsequent treatment.

Anti-TB treatment is administered depending upon category of the patient. During intensive phase, DOTS is administered with the help of a peripheral health functionary; while in continuation phase a patient collects the drugs on weekly or fortnightly basis. Drugs are taken 3 times a week throughout. The provision and maintenance of uninterrupted drug supply of anti-TB drugs has contributed to improving compliance and cure rates.

Drug administration is appropriately recorded on the treatment cards, which are prepared and kept at the place of diagnosis and treatment. The information from the treatment card is transferred to the TB Register, which is kept at the sub-district level and is updated from time to time by the Senior Treatment Supervisor (STS). Quarterly reports on case-finding and treatment outcomes are prepared at the sub-district level and sent to the district level for compilation and onward submission to State and Central levels. Analysis of data would take place at district, state and central level and information would flow back to the sub-districts for corrective actions.

The RNTCP has already been extended to about 500 million and is expected to cover the whole country in the course of the next five years.

Other suggested inputs needed to intensify TB control efforts are as under.

TB mortality and morbidity would decline only if increased financial support is made available each year to TB control programmes in developing
A strong political will and advocacy, is required to appreciate the enormity of the problems due to TB and to allocate appropriate budgets for TB control programmes. Enhanced finances are needed to enable the TB programmes to undertake training programmes, improve registration systems and monitoring tools, to finance medicines, microscopes and improve the modest infrastructure so that these programmes work efficiently. Additional resources are also required to cater to the increasing number of patients having HIV and TB as these patients may also require expenses due to hospitalization.

Accurate knowledge and increased awareness among the general public especially the high risk groups such as agricultural workers needs to be communicated to remove their misconceptions and modify their help-seeking behaviour favourably. They must be educated that TB is curable with complete and regular treatment and that sputum microscopy is the most reliable tool for diagnosing TB. Informing people about the programme must receive the top most priority, since a sustained awareness programme can go a long way in more and more people reporting for treatment. Community participation in the programme especially in detection and referral of chest symptomatics for sputum examination and supervising treatment must be encouraged.

Diagnosis of TB, its treatment and follow-up of patients till they are cured can all be effectively undertaken at the level of PHC. Therefore, PHCs must be strengthened in respect of leadership, management, drugs & supplies and record keeping.

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

Improvement in socio-economic conditions of rural populations including agricultural workers will reduce the burden of the disease as had been observed in western countries where the incidence of the disease declined in the beginning of this century prior to the anti-tubercular therapy era.

As TB control programme evolves into the next millennium, the public health community should take all appropriate actions aimed at intensifying the TB control efforts in order to reduce the enormous burden imposed by this disease.

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