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Epidemiology of Tuberculosis in Malawi

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Methodology of this review

This review is a result of a literature search on published data in peer reviewed or grey publications on tuberculosis in Malawi. A Pubmed search yielded 214 publications, none were found in Popline. For grey literature the existing documentation at the National TB Control Program (NTP) in Malawi was used including operational research publications, case finding, cohort analyses and global documents. News articles and personal accounts are not included in the review.

General introduction on TB

Below is a general introduction about tuberculosis (TB), based on the textbook 'Clinical tuberculosis' by Crofton and colleagues and the Manual of the NTP of the Ministry of Health in Malawi. [1,2]

Bacteriological, immunological and pathogenic aspects of TB

Most cases of TB worldwide are caused by *Mycobacterium tuberculosis*. Other mycobacteria, e.g. *Mycobacterium bovis*, are of minor importance. About 75-80% of TB involves the lungs (pulmonary TB) and 20-25% occurs in other organs. Tubercle bacilli are most often transmitted by inhalation of droplets produced by a patient who has pulmonary TB, through coughing, talking or spitting. Those whose sputum is positive on direct smear are much more infectious than those with sputum positive only on culture. Chemotherapy rapidly reduces infectiousness. That is why the combination of diagnosis of sputum positive patients and complete treatment is the most effective method of TB prevention in the population.

Whether someone develops disease is dependent on the size of the infecting dose and on the level of host defences. In non-immunocompromised populations, only about 5% of infected people develop the disease within a year and a further 5% during their lifetime. TB in most adults is due to reactivation of organisms seeded during primary infection. Clinical TB is classified as "primary TB" and "reactivation TB". Primary TB is typically seen in childhood infection, but does also occur in adults, particularly in association with HIV infection.

Clinical Manifestation of TB

TB in adults

Primary TB in adults.

Primary TB in adults causes fever, often lasting weeks, retrosternal discomfort or pain due to mediastinal lymph node enlargement and pleuritic pain. The most common radiographic manifestation is hilar lymphadenopathy. Pleural effusions occur in a third of adults. Pulmonary changes are present in most patients within 3 months of infection, most commonly involving the perihilar areas.

Occasionally lower lobe TB may occur and may be mistaken for pneumonia. Acute miliary TB following primary infection in adults has increased due to HIV.

Reactivation TB in adults

Symptoms vary from a gradual insidious onset with anorexia, weight loss, fatigue and low-grade fever to acute onset with fever, night sweats, productive cough and dyspnoea. Sputum is often blood streaked, and rarely massive haemoptysis may occur. However many patients with active pulmonary TB may be completely asymptomatic.

The chest X ray in reactivation TB typically shows upper lobe infiltrates with or without cavitation. Miliary TB in adults is usually due to reactivation and results in cough, progressive dyspnoea and fever. The chest X ray shows a miliary pattern at presentation in half of cases, but may initially appear normal.

Pulmonary TB in adults is classified into sputum smear positive PTB and smear negative PTB as follows.

Smear-positive PTB (sm+ PTB):

A patient with:

- at least two sputum specimens positive for acid-fast bacilli (AFB) on microscopy

OR

- at least one sputum *specimen* positive for AFB on microscopy and radiographic abnormalities consistent with pulmonary TB

OR

- at least one sputum specimen positive for AFB on microscopy, which is culture positive for *Mycobacterium tuberculosis*

Smear-negative PTB (sm- PTB):

- coughing for > 3 weeks with at least two sputum specimens negative for AFB on microscopy, lack of clinical response to one week of broad-spectrum antibiotics, and radiographic abnormalities consistent with TB

OR

- severely ill with at least two sputum specimens negative for AFB on microscopy and radiographic abnormalities consistent with extensive PTB (interstitial or miliary).

Extra-pulmonary TB (EPTB):

Refers to disease outside the lungs, including

- pleural effusion
- pericardial disease
- lymphadenopathy
- peritonitis and/or gastrointestinal disease
- meningitis
- spinal or bone disease
- genito-urinary disease
- skin disease

TB in children

TB in children differs from that in adults in a number of ways. The younger the child, the greater the risk of developing active disease following infection. Lymphatic and blood spread occurs more commonly, resulting in greater risk of extrapulmonary TB (EPTB) especially miliary TB or TB meningitis in the young. Although PTB is the most common manifestation in children, cavitation is unusual and sputum is usually smear-negative.

The diagnosis of TB in children is difficult and is further compounded by HIV infection. Children usually present with pulmonary symptoms and the diagnosis is based on clinical features, chest X-ray (CXR), tuberculin skin test (TST) and a positive history of close contact with an adult or older child with smear-positive PTB. Children rarely cough up sputum, so confirmation by smear examination is often impossible. The most common forms of EPTB in children are lymphadenopathy, pleural effusion, spinal disease and pericardial disease.

Diagnosis

The most important diagnostic test for TB is identification of tubercle bacilli. Microscopic examination of sputum smears using the Ziehl-Neelsen staining method, has a reasonable diagnostic yield (about 40 % in non-cavitatary and up to 80 % in cavitatary disease). The optimal number of specimens is 3 preferably collected first thing in the morning. Culture improves the yield.

In resource-poor settings like Malawi, the standard examination of the smear is by the Ziehl-Neelsen method. Culture is only possible in research labs and in the reference laboratory in Lilongwe and priority is given to relapse cases, defaulters, treatment failures and any patient going onto a retreatment regimen.

A CXR should be obtained if possible in suspected cases of PTB. Appearances vary depending upon the stage of the disease. A midzone infiltrate with hilar adenopathy suggests primary disease. Bronchopneumonia may be present with progressive primary disease, and apical consolidation with or without cavitation typifies reactivation disease. CXR in miliary TB may initially be normal and should be repeated a week or so later if TB is clinically suspected, or sooner if indicated. Pleural effusions should be considered to be TB in the absence of another cause.

Plain anterior-posterior and lateral X-Ray of the thoraco-

lumbar spine should be done in patients with persistent or progressive back pain who may be suspected of having spinal TB (Potts disease). Plain films show vertebral destruction and loss of disc space. There may be angulation of the spine, and a paraspinal mass may be seen. Intestinal and peritoneal TB although uncommon, may be more likely in HIV positive individuals and should be considered in the differential diagnosis of unexplained abdominal symptoms, weight loss or ascites.

Unfortunately microscopy of pleural and ascitic fluid is rarely diagnostic and specimens should be cultured, should this be possible. Culture of pleural biopsy material is positive in over 90 %, and granuloma are often seen microscopy. In TB lymphadenitis needle aspiration of superficial lymphnodes is positive for acid-fats bacilli in over 70 % of cases.

Cerebro-spinal fluid (CSF) in tuberculous meningitis is similar to partially treated bacterial meningitis, fungal meningitis or syphilitic meningitis. There is often a CSF lymphocytosis and an elevated CSF protein. CSF glucose may be normal, and is rarely as low as it is in bacterial meningitis. Microscopy and culture of CSF are seldom diagnostic.

TST is of little diagnostic value for TB in adults in endemic areas but is useful in children. The Mantoux test is the most reliable and, in children at high risk (contacts of smear positive adults, HIV positive, or with clinical features of TB), 5 mm induration should be considered diagnostic.

Gastric aspiration for culture is positive in 40% of children with pulmonary TB and is the procedure of choice in children younger than 10 years. Gastric aspiration is performed first thing in the morning after an 8 hour fast.

Distribution of TB in Malawi

The NTP in Malawi collects its data through registers maintained at district level and kept by District TB Officers . The registers are of 3 types: A chronic Cough Register where details of patients who submitted sputa for examination are recorded, a laboratory TB register where sputum smear results are recorded and a TB register where diagnosed TB cases are recorded for commencement of treatment. District TB Officers collate data on a quarterly basis before forwarding it to Regional TB Officers, who in turn send regional summaries to the Central Unit of the NTP at the Community Health Sciences Unit.

Incidence

The NTP uses passive case finding, i.e. patients present to health facilities for TB diagnosis, which is the most inexpensive way of managing and controlling TB in a community. This results in incidence data being based on notified cases. However, there is a problem of under-reporting of TB cases with this approach and many patients with active TB are undiagnosed. In Thyolo district where the majority of TB patients are HIV-positive, it has been shown that active case finding among household contacts yields up to nine times more TB cases and is an opportunity for reducing TB morbidity and mortality.[3]

Since 1985, reported TB cases in Malawi have been on the increase. There has been a 45 % increase in prevalence of notified cases between 1994 and 2003, and a doubling in the number of cases that have relapsed after treatment. (Table 1)

Multi drug resistance TB (MDR-TB) in a part of Malawi with a good surveillance system has remained low in the period from 1986-1998.[4] This is probably a reflection of the TB control performance in Malawi.

For years the NTP has collected data such as sex and age for smear positive TB cases only, because of their public health importance as the source of majority of TB infections in the community. However, from 2002 onwards such information started being collected on patients with other forms of TB and the data should be available in the near future. Figure 1 shows the sex and age distribution of smear positive patients diagnosed between 1999 and 2002 (excluding 2001 data whose data have gone missing).

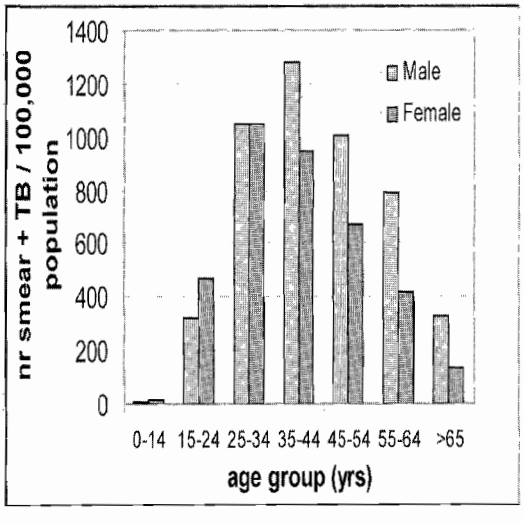
Attack rates (new cases per 100,000 population) were highest in people between 25 and 44 years. The age group of 25 – 34 contributed about 40% of all smear positive TB cases while 20% of the cases were from the 15 – 24 and 35 – 44 age groups. Thus 80% of the cases were aged between 15 and 44.

Table 1 TB Case Notifications – 1994 to 2003 (source: NTP, MoH - Malawi)

Year	Total	Smpos(%)	Smneg(%)	EPTB(%)	Smpos(%)	Other (%)
		new PTB	new PTB	new	PTB relapse	
1994	19496	5988(31)	8958(46)	4046(21)	504(2)	-
1995	19155	6295(33)	7054(37)	5255(27)	551(3)	-
1996	20630	6703(32)	8070(39)	5328(26)	529(3)	-
1997	20676	7587(37)	7481(36)	5101(25)	507(2)	-
1998	22674	8765(39)	8311(37)	4993(22)	605(2)	-
1999	24396	8132(33)	10013(41)	5583(23)	668(3)	-
2000	24846	8267(33)	8799 (35)	5723(23)	758(3)	1299(6)
2001	27672	8309(30)	10763(39)	6145(22)	877(3)	1578(6)
2002	26532	7687(29)	10660(40)	5377(20)	872(3)	1936(8)
2003	28234	7716(27)	11246(40)	5829(21)	1050(4)	2393(8)

Smpos = sputum smear positive, Smneg = sputum smear negative, PTB = pulmonary TB, other = all recurrent TB cases not included as smear positive relapse

Figure 1 Rate of smear positive TB diagnosed between 1999 and 2002, by sex and age group.

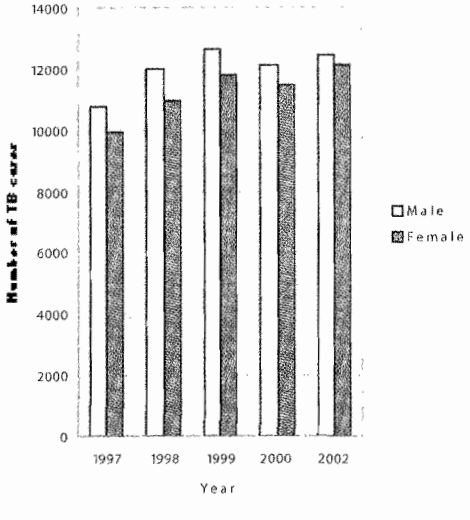


Between the ages of 0 and 24 there are more females with smear positive TB than males, the distribution being equal in the ages of 25 to 34 and more men than women after the age of 34. This distribution follows the same pattern as the HIV seroprevalence among Malawian population (see Chapter on HIV/AIDS in adults).

The diagnosis of TB in children is difficult, especially in HIV endemic areas like Malawi.[5] The estimated rates of TB in children were 78/100,000 in children under one year, 83/100,000 in children aged 1-4 years and 33/100,000 in those aged 5-14 years. Because half of Malawi's population is aged below 15, despite these lower attack rates, children still formed 12% of all reported TB cases in 1999.[6]

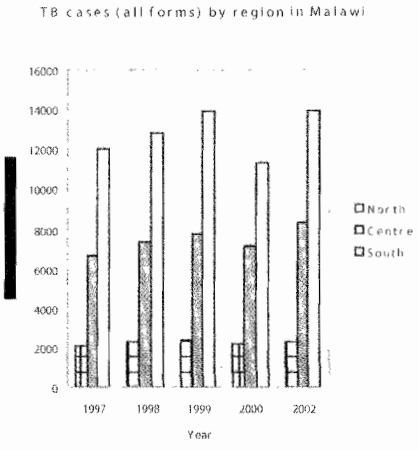
In general the ratio of men to women among TB patients in Malawi from NTP data is 1.1. This implies that there are no significant gender differences among TB patients[7] although a study in northern Malawi has shown that in the HIV era the ratio has decreased from 1.3 to 0.8. The minor differences are illustrated in figure 2, based on NTP data.

Figure 2 Distribution of TB cases by sex in Malawi



Spatial distribution of TB cases in Malawi depends on

Figure 3 TB cases (all forms) by region in Malawi



the size of each catchment population. The distribution of diagnostic services and differences in health seeking behavior among different populations may also be contributing factors but these have not been studied. In general the southern region districts of Malawi contribute about 60% of all known TB cases in the country. These differences are largely due to differences in population sizes between the regions. However the impact of urbanisation and high HIV rates in large urban districts can be added factors. The regional differences in TB cases from 1997-2002 are illustrated in figure 3.

Prevalence

The actual prevalence of TB in Malawi is not known. Modeling work done by the World Health Organisation (WHO) predicts that Malawi only diagnoses around 48% of the prevalent TB cases and 36% of the prevalent smear positive TB cases.[8] Although passive case finding may lead to missing cases the WHO figure can not presently be contested in the absence of a prevalence survey. Such a survey is currently being designed in Malawi.

One way of estimating the smear positive prevalence rate, the major source of TB infections, has been through calculating the Annual Risk of Infection (ARI). The average annual risk of infection is calculated from the proportion of 6 year-old children, who have not been vaccinated with BCG, who are tuberculin skin test positive in a particular area. This is done in form of a community survey. The method for calculating ARI is as follows[9]:

Let b = Calendar year sampled children were born, a = age of the children when survey was done, Pa+b = prevalence of infection in the cohort of the sampled children and R = average annual risk of infection between time b and a. For such a cohort the probability of escaping infection:

At birth:	$= 1 - P_b$	$= 1$
At age of 1	$= 1 - P_{b+1}$	$= 1(1 - R)_1$
At age of 2	$= 1 - P_{b+2}$	$= 1(1 - R)_1 (1 - R)_2$
At age of a	$= 1 - P_{b+a}$	$= 1(1 - R)_1 (1 - R)_2 \ldots (1 - R)_a$
	$1 - P_{b+a}$	$= (1 - R)^a$
	$(1 - P_{b+a})^{1/a}$	$= (1 - R)$
	R	$= 1 - (1 - P_b)^{1/a}$

It was long established that an ARI of 1 represents a prevalence of 50 smear positive case per 100,000 population in that community. Each case if untreated infects up to 20 individual in a year. The only community survey in Malawi was conducted in 1994 and it showed an ARI in Malawi of 0.9.[10] This meant a predicted prevalence of 45 smear positive cases per 100,000 population. In 1988 Malawi reported 2665 new smear positive and 184 relapse TB cases while in 1994 there were 5988 new smear positive cases and 504 relapse TB cases reported. Assuming a country population of 8 million (1998 census) this translates into a smear positive TB prevalence of 36/100 000 in 1988 and 81/100 000 in 1994. The 1994 case finding exceeds the expected smear positive prevalence; and exceeds the expectation even more when one considers that the 1998 pre-census population was less than 8 million. This observation is common where HIV influences the TB epidemic and in such areas the ARI becomes unreliable as a measure for estimating TB prevalence. In a country like Tanzania where serial ARI surveys have been conducted between 1984 and 1995 the ARI has gradually declined while the number of reported cases has increased nationally (IJTLD, 2001). This emphasises the impact of HIV on interpreting ARI. The impact of HIV on the Epidemiology of TB is discussed in the section below.

Distribution of determinants for TB in Malawi

Every person in the community is at risk of TB infection because it is an airborne infection from sputum smear positive TB patients when they speak, sneeze and cough. The risk of infection depends on the concentration of the expelled bacilli from the patient, the level of ventilation

Summary: Distribution of TB

TB data in Malawi on incidence is obtained from quarterly reports from hospitals that diagnose TB passively in the country. The incidence of TB in Malawi in the recent years has had the following characteristics:

- Annual increases in TB cases of all forms
- Increased caseload is among people aged 15 to 44
- The ratio of men to women is 1.1
- The age-sex distribution resembles that of HIV/AIDS: there are more women among TB patients of younger ages and more men among TB patients of older ages
- 60% of all TB cases come from the southern region of Malawi

WHO reports that Malawi detects only 48% of existing cases and only 36% of existing smear positive TB cases. However there are problems in estimating prevalence due to:

- Lack of a proper prevalence survey to validate this modeling estimate
- Inadequate Annual Risk of Infection surveys and the unreliability of such surveys in the face of the HIV epidemic

in households and the duration of exposure of the uninfected individual to the patient.

The risks of developing disease, usually years after one is infected are known. Globally the TB epidemic re-surfaced in the last two decades due to increased poverty in the world, increased overcrowding, increases in ageing populations, relaxed vigilance by countries to TB control and the impact of HIV/AIDS.[11] Two of these factors do not apply to Malawi: there is no increase in ageing population because the average life expectancy at birth is 38 (UNDP, 2003) and the NTP is one of the model programs in the world that has been following the DOTS strategy that is recommended for better TB control since 1984.

Biological determinants

Sex

Globally it is known that beyond the age of 15 there are more men reported with TB than women and that in the pre-HIV era young to early-middle-aged women progressed to disease with greater frequency than men of the same ages.[12] The data presented in section 1 show that in Malawi there are more female TB patients in younger age groups and more men in older age groups, although an active case finding survey needs to be done to see if these data are affected by bias due to differential access to health care. In all age groups combined, sex is not a strong risk factor for being diagnosed with TB in Malawi even in the presence of the HIV epidemic.[13]

Age

As illustrated above data from Malawi shows that TB peaks in the age group between 25 and 34. There is a higher risk for young women than men.[13] This correlates with the HIV infection rates in this age group. HIV as a risk factor is discussed in the section below.

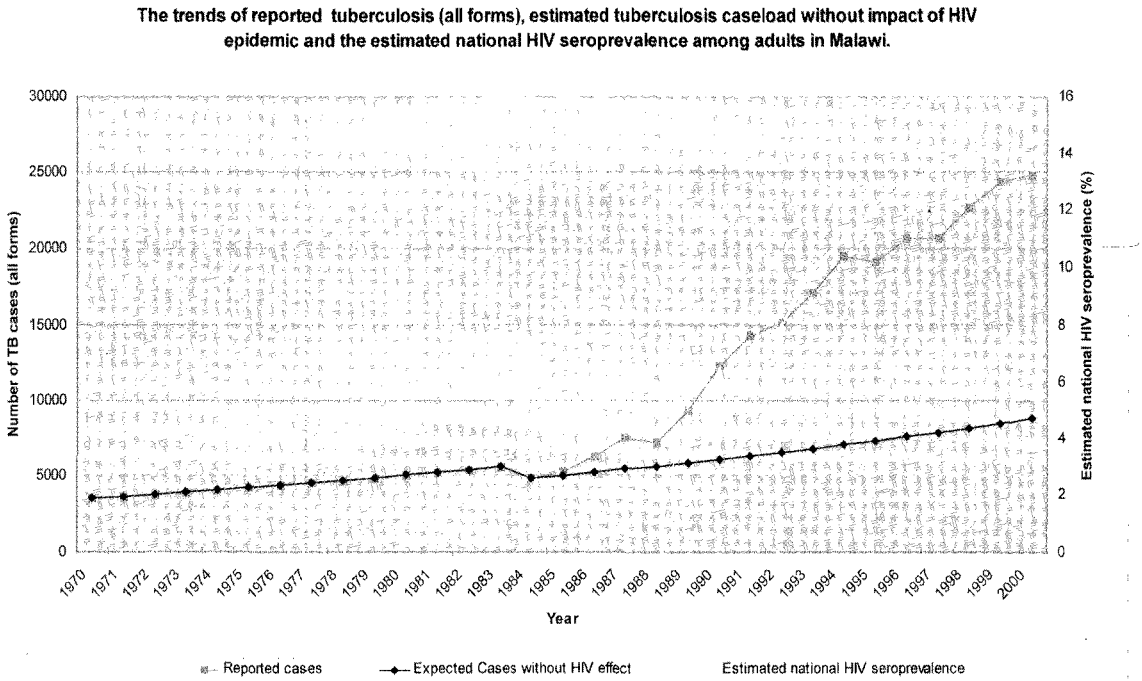
Immune status

Immunodeficiency is the strongest biological risk factor in TB infection and developing the disease. The most common cause of immuno-suppression in Malawi is HIV infection that leads to AIDS. HIV infection leads to rapid progression from TB infection to disease and increases the risk of re-activation of old infection into active disease. The lifetime risk of developing TB of HIV non-infected individuals is between 5 to 10% while that of infected individuals is between 30 to 50% or 5 to 15% per year.[11] Currently 14% of the adult Malawian population is estimated to have HIV infection.

Several studies conducted in Malawi have shown the link between the HIV and TB especially during the period when TB cases have increased considerably[15,16,17,18,19,20]

Figure 4 shows the relationship between reported HIV national seroprevalence and the number of reported TB cases

Figure 4 Relationship between HIV seroprevalence and reported TB cases, 1970-2000



The figure shows that between 1970 and 1984 TB cases increased by an average of 3.8% (range: -21.8 to 35.6) per year. From 1985 to 2000 the average yearly increase was 11.5% (range: -4.4 to 31.1). The first AIDS case in Malawi was reported in 1985. From that year the rise in the estimated HIV national seroprevalence follows the same upward trend as the TB case notifications. The chart also shows the hypothetical trend should the TB average increase have remained at 3.8%.

According to the two National TB-HIV surveys done in the past, HIV infection among TB patients was 63% in 1993 and 77% in 2001.[19]

HIV is associated with increased reported cases of smear negative and extra-pulmonary TB in Malawi.[18,21] Despite concerns of overdiagnosis of smear negative TB in Malawi, one broncho-aveolar lavage study has shown that among such patients sent for TB treatment registration, TB is the most commonly confirmed diagnosis.[22]

It has also been shown that in Malawi some febrile HIV patients have TB bacteraemia.[23]

Behavioural determinants

Parent – child relationship

Children, who are usually household contacts, are the most vulnerable to new infections from infectious adults. Very few children develop smear positive TB because they do not produce sputum for confirmation of diagnosis. High frequency of TB cases has been shown in household contacts of index TB patients in Malawi.[24,25] NTP has a policy of treating any child that is breastfed during the period a mother has smear positive TB.

Alcohol and smoking

There is no documented evidence that alcoholism or cigarette smoking increases the risk of developing TB. Behaviour that predisposes an individual to high HIV infection risk is, in the long

term, a risk factor for developing TB as explained above.

Occupational exposure

Certain occupations seem to be associated with the development of TB amongst the group of individuals undertaking them. Health workers in Malawi have been shown to have a higher risk of developing TB than the general public.[26]

Summary – Determinants for TB

In the epidemiology of TB in Malawi the strongest risk factors for developing disease are:

- Poverty
- HIV infection
- Household contact with index case
- Overcrowding
- Younger age

Sociocultural determinants

Poverty

TB is a poverty related disease; associated with poor living conditions, poor nutritional status and, poor access to health services. The majority of countries that have a heavy TB burden are classified as low income (GDP below 760 US $) and also within countries -even the richer industrialised ones- the prevalence of TB is higher among the poor.[27] Malawi is among the 10 poorest countries in the world (UN Development Report). The GDP is around US$200 per capita and 60% of the population lives below the poverty line. A few studies have been done on the relationship between poverty and disease burden in Malawi. Social science research has shown that TB patients have greater financial problems in relation to their income.[28] Not only does TB disease reduce the economic productivity of the patients, but the path to diagnosis and finishing treatment is long and costly both to the patients and their immediate families. Kemp et al. compared TB and chronic cough case rates between area 18 in Lilongwe (relatively wealthy, high density, planned settlement) and area 56 (relatively poor, high density, unplanned squatter settlement) and showed that TB cases seem to be missing in the latter, indicating limited access to health services related to poverty.[29]

Overcrowding

Malawi has experienced urbanisation and overcrowding in the last two decades. About half of all TB cases in Malawi are reported from the urban districts of Blantyre, Zomba, Lilongwe and Mzuzu where most of the Malawi population is found. This rise may be attributed to overcrowding although HIV seroprevalence that is higher in the urban areas is a contributing factor. As explained above both HIV and overcrowding are linked to poverty. High TB rates have been found in Malawian prisons.[30],[31],[32]where overcrowding is a common problem.

Impact of TB in Malawi

Mortality & life expectancy

Mortality among TB patients in Malawi has changed from less than 10% in early 1980s to present average of 20% among new smear positive TB patients and 30 to 50% among smear negative and extra-pulmonary TB patients. Table 2 below shows the treatment outcomes that include mortality, of new smear positive TB patients registered from 1993 to 2002.

Data on TB deaths for new smear negative TB patients and new extra-pulmonary TB patients is limited because the NTP started documenting treatment outcomes for these patients in 2001. Table 3 illustrates the treatment outcomes that include deaths for these types of TB in 2001. Tables 2 and 3 show how high mortality among TB patients has been in the last decade.

One study showed that about 40% of TB deaths in Malawi occur in the first two months of treatment.[33] There is also evidence that high mortality amongst patients occurs months or years after TB treatment.[34] This may be due to HIV complications. However malnutrition among TB patients has also been shown to be associated with early patient deaths.[35]

Recent operational research has shown that treatment outcome among children is poor, particularly in very young children and in those with smear-negative TB.[6]

Morbidity & Quality of life

Few studies have been published of assessment of quality of life among TB patients in Malawi. The table 4 below shows the percentage of disability adjusted life years

Table 2 Outcome of new smear-positive pulmonary TB patients 1993 to first quarter of 2002

Year	No.	Cured (%)	TC (%)	F (%)	D (%)	Def (%)	TO (%)
1993	5462	3741 (68)	319 (6)	56 (1)	874 (16)	274 (5)	198 (4)
1994	6285	4256 (68)	318 (5)	53 (1)	1039 (16)	430 (7)	189 (3)
1995	6278	4061 (65)	382 (6)	70 (1)	1178 (19)	344 (5)	243 (4)
1996	6702	4222 (63)	345 (5)	47 (1)	1390 (21)	387 (6)	311 (4)
1997	7567	5181 (69)	187 (2)	67 (1)	1576 (21)	318 (4)	238 (3)
1998	8824	5828 (66)	249 (3)	91 (1)	1974 (22)	362 (4)	320 (4)
1999	8185	5636 (69)	212 (2)	79 (1)	1704 (21)	294 (4)	260 (3)
2000	8297	5791 (70)	225 (3)	88 (1)	1591(19)	358 (4)	244 (3)
2001	8313	5598 (67)	223 (3)	142 (2)	1591 (19)	493 (6)	266 (3)
2002	7897	5527 (70)	102 (1)	206 (3)	1516 (19)	346 (4)	208 (3)

TC = treatment completed: finished treatment but final smear result is unknown, F = treatment failure, D = died, Def = defaulted treatment, TO = Transferred to new treatment centers

Table 3 Treatment outcomes of new smear negative and new EPTB patients registered from January to September 2001.

TB Type	Total	TC (%)	D (%)	Def (%)	TO (%)	Unknown (%)
Smear neg	7534	4605(61%)	1492(20%)	421(5%)	265(4%)	751(10%)
EPTB	4541	2784(61%)	908(20%)	162(3%)	205(5%)	482(11%)

TC = treatment completed: (mean as above in Table 2), D = died, Def = defaulted treatment, TO = Transferred to new treatment centers, Unknown = no information and in some cases missing treatment cards. In this category there is no "cure" as sputum smears are not routinely done at the end of treatment of such cases.

because of TB among other health conditions, globally.

Table 4 Global ranking of percentage of DALY

Rank	Condition	% DALY
1	Lower respiratory infections	6.1
2	HIV/AIDS	6.0
3	Unipolar depressive disorders	4.5
4	Diarrhoeal diseases	4.1
5	Ischaemic heart diseases	4.0
6	Childhood diseases	3.3
7	Cerebrovascular disease	3.1
8	Malaria	2.9
9	Road traffic accidents	2.6
10	Tuberculosis	2.5

Source: WHO – Geneva. Refer to "Burden of Disease" chapter for a full explanation of DALYs.

Morbidity patterns according to TB notifications in Malawi have already been presented in the preceding sections. Globally the DALY for TB has been calculated at 2.5% and 90% of this is due to death of a TB patient. TB kills more patients from one single infection than all other infectious diseases combined.

Infant and child morbidity and mortality in households affected by the disease

The impact of adult TB disease on infant and child mortality or morbidity at household level in Malawi is an under-researched area. Future research is needed to address this aspect of TB.

Economic & social

Both the diagnostic pathway and treatment of TB are long. The costs of accessing care are generally higher before than after diagnosis, because patients do not access

Summary – Impact of TB in Malawi

- 20-50% of TB infected patients dies
- Treatment outcome among children is poor, especially among smear negative and very young children
- TB accounts for 2.5% of the global burden of disease, mainly due to premature death
- Patients spend 1.2-2.5 times their monthly income to obtain a TB diagnosis.
- TB causes higher disease rates among health workers and attrition due to deaths

the TB services soon after symptom onset. Mann et al calculated that total direct costs and opportunity costs due to days lost before obtaining a TB diagnosis were 11 US$ and 4.6 US$ for poor patients and 17.7 US$ and 28.7 US$ for non-poor patients. However, the relative impact was much higher for poor patients, because they spent on average 248% of their monthly income (or 584% of the monthly income that remained after food has been bought), compared with 124% for non-poor patients (or 176% of montly income after food expenditure). About one-third of the direct costs was spent on transport and half on fees and drugs.[36]

Health services

Before 2001 TB wards in Malawi were congested with TB patients during their admission phase of the first 1 or 2 months of TB treatment. In the urban hospitals the congestion was particularly bad with bed occupancy rates of between 140 to 160%.[37] These rates have gone down since 2002 when the national policy changed to giving patients options of receiving initial phase treatment from hospital wards or health centers or guardians at their homes.

Operational research conducted in 1999 showed that the rates of TB among health care workers were higher than of the general public.[26] TB is also among the causes of attrition due to death among health care workers in Malawi.

Effective interventions and their implementation in Malawi

Biological interventions

Vaccination

Immunisation during childhood with bacilli Calmette-Guérin (BCG) is likely to reduce the burden of severe forms of TB such as military TB and TBM among vaccinated children in some regions. The expanded program on immunisation (EPI) policy in Malawi recommends that one dose of 0.1 ml of BCG vaccine be given intradermally to children soon after birth. Studies done in northern Malawi published between 1986 and 1992 showed that BCG protects Malawians more against Leprosy than against TB.[38,39] It is difficult to determine the influence of these estimates of relative efficacy of BCG on the current childhood and adult TB rates in Malawi.

Because it is a live attenuated vaccine it can cause disease in HIV-positive recipients. Research on new and more potent vaccines is in progress in humans, but results will not be available for at least a few years.[40]

Indicators from the EPI itself show that that the coverage has risen from 72% in 1972 to 100% in 1998.[41] The coverage as determined by either vaccination card or mother's report in the 2000 DHS was 92%, ranging from 84% in Machinga district to 96% in Mulanje and Blantyre districts.[42]

Isoniazid preventive therapy

Isoniazid is recommended for the prevention of development of TB amongst HIV infected people.[43] The feasibility of using isoniazid at a large scale in Malawi is still being studied by the NTP. Isoniazid is also recommended for well children under 5 years who are close household contacts of people with smear-positive PTB. In practice, this rarely happens.

Cotrimoxazole adjunctive therapy

In 1999 two studies done in Cote d'Ivoire[44,45] showed that cotrimoxazole reduced morbidity and mortality among HIV infected patients with positive acid-fast bacilli smear TB, prompting the United Nations Joint Program on HIV/AIDS (UNAIDS) to draft this practice as recommended policy in sub-Saharan Africa. In Malawi cotrimoxazole

has been shown to improve survival among HIV infected TB patients ,[46]improve TB treatment outcomes[47] and its roll out to more hospitals in Malawi has been shown to be feasible.[48] See the HIV chapter for a more detailed discussion.

Behavioural interventions

Information, education and communication

Treatment of infectious TB patients is a main component of TB control as this leads to cutting of chains of transmission in a community. Malawi uses passive case finding. The NTP has since 1999 developed an IEC strategy, which passes key messages to the community through several media e.g. radio, calendars, flyers. The key message is: "a cough of more than 3 weeks with little or no improvement on ordinary medication needs investigation to rule out TB". This message encourages the community to seek a TB diagnosis for prompt treatment. The IEC strategy also involves providing continued messages to health workers for continued high suspicion of TB among patients with the key signs for prompt diagnosis and treatment.

The impact of this strategy is yet to be demonstrated.

Social interventions

Directly Observed Treatment – Short Course (DOTS) strategy

The DOTS strategy is the most effective and efficient way of controlling TB. This strategy is recommended by WHO.[49] The strategy has five key components:

a) Government commitment

b) Passive case finding using sputum microscopy for diagnosis

c) Treatment of all active TB cases under direct supervision of treatment (DOT)

d) Provision of a regular and uninterrupted drug supply

e) A monitoring and evaluation system (recording and reporting)

It is envisaged that a DOTS program that puts under treatment 70% of prevalent TB cases and is able to cure at least 85% of them will control TB and reduce it as a public health problem. The NTP in Malawi has been a DOTS program since 1984. DOT had taken place in hospitals during the 1 to 2 month admission period until 2001, after which DOT could be carried out either in hospital, at OPD, at health centers or by guardians at home, according to the patients' choice.[50,51] This approach has been shown to be cheaper to the health service and the community with maintained cost-effectiveness.[52]

TB disease control in high risk groups and congregate settings

The recognised high risk groups in Malawi are children living with TB patients, health workers, prisoners and people living with HIV/AIDS (PLWHA).

NTP recommends that children living in the same household as an adult index case should be investigated for TB where resources are available. Young child contacts who are well should receive isoniazid preventive therapy for 6 months (NTP Manual 5th Edition, 2002).

As explained before, health workers in Malawi have been shown to have a higher risk of developing TB than the general public.[26] The World Health Organization has produced guidelines for TB control among health care workers.[53] This involves health worker training in infection control: patient education, early TB diagnosis amongst patients, safe processing of patient samples, encouraging out-patient TB case management, provision of preventive therapy to HIV sero-positive health care workers and isolation of multi-drug resistant TB patients. These guidelines are yet to be fully implemented in Malawi.

TB is a problem among prisoners in Malawi. The NTP collaborates with national prisons health personnel to control TB in prisons. Any prisoner coughing for one week or more is investigated for TB and patients are put on treatment provided by the program.

Due to the high risk of developing TB among individuals dually infected with HIV and TB, the WHO interim policy recommends active case finding among PLWHA.[54] Those PLWHA without TB should benefit from recommended Isoniazid preventive therapy.[53] This is a new policy and the NTP is working out modalities in implementing this principle within the Malawi expanded HIV voluntary counselling and testing and antiretroviral treatment programmes.

Summary: Interventions for TB

- The 5- component DOTS strategy is the most cost-effective and efficacious intervention in the control of TB. The other interventions in TB control are:
- BCG vaccination
- IEC to improve health seeking behavious and better clinical practice
- Isoniazid preventive therapy for PLWHA and children who are household contacts of smear positive PTB cases
- Cotrimoxazole Prophylaxis to reduce morbidity/mortality among HIV-infected TB patients
- Safe TB case management within healthcare settings
- Active TB case finding among high risk groups (e.g. PLWHA and prisoners).

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