Research

Can Malawi's poor afford free tuberculosis services? Patient and household costs associated with a tuberculosis diagnosis in Lilongwe

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Objective To assess the relative costs of accessing a TB diagnosis for the poor and for women in urban Lilongwe, Malawi, a setting where public health services are accessible within 6 kilometres and provided free of charge.

Methods Patient and household direct and opportunity costs were assessed from a survey of 179 TB patients, systematically sampled from all public and mission health facilities in Lilongwe. Poverty status was determined from the 1998 Malawi Integrated Household Survey (MIHS).

Findings On average, patients spent US$ 13 (MK 996 or 18 days' income) and lost 22 days from work while accessing a TB diagnosis. For non-poor patients, the total costs amounted to 129% of total monthly income, or 184% after food expenditures. For the poor, this cost rose to 248% of monthly income or 574% after food. When a woman or when the poor are sick, the opportunity costs faced by their households are greater.

Conclusion Patient and household costs of TB diagnosis are prohibitively high even where services are provided free of charge. In scaling up TB services to reach the Millennium Development Goals, there is an urgent need to identify strategies for diagnosing TB that are cost-effective for the poor and their households.

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Une traduction en français de ce résumé figure à la fin de l'article. Al final del artículo se facilita una traducción al español. الترجمة العربية لهذه الخلاصة في نهاية النص الكامل لهذه المقالة.

Introduction

In 2005, the UN Millennium Summit and the Commission for Africa highlighted the need for increased global development assistance to make progress towards achieving the United Nations Millennium Development Goals (MDGs) by 2015. However, expanding resource allocations to the health sector and scaling up key interventions are unlikely to primarily benefit the poor.[1] This is because current interventions produce inequitable outcomes, favouring the better-off.[2] Furthermore, health MDGs are stated in terms of population averages; this means that even if efforts do not focus on the poor, there may still be progress against the targets.[1]

MDG 6 addresses the need to combat HIV/AIDS, malaria and other priority communicable diseases, including TB, with World Health Assembly 2005 targets to detect 70% of smear-positive TB cases and to successfully treat 85% of such cases. It has become clear that the case detection target is unlikely to be met without accelerated action.[3] However, the link between poverty and TB is profound. Globally the highest burden of TB is found in poor countries, and within countries the prevalence of TB is higher among the poor.[4] Deprivation associated with poverty, including malnutrition and overcrowding, increases the risks of TB infection and disease.[5] Achieving MDG targets for TB therefore requires the identification of effective ways to reach poor populations.

Several studies have assessed the patient and household costs of TB and cost-effectiveness of different approaches to TB treatment in Africa.[6-17] Malawi's National TB Programme has introduced a guardian-based strategy of direct observation of treatment which has reduced costs for patients.[12] Costs to patients and their households of care-seeking from illness onset to diagnosis are less well-documented.[10,17] Most studies of costs to patients and their households present average patient costs. One study from Thailand disaggregates the costs for the poor and presents them relative to annual income.[18] Interestingly, many studies are conducted in settings where TB services are charged for, although in some cases user fees are subsidized.

To achieve international case-detection rates for TB control it is necessary to reduce the economic burden of a TB diagnosis for the poorest. WHO advocates for exemption of TB diagnosis and

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treatment from cost-recovery strategies so that individuals do not pay for the community benefits of treating TB.[19] However, this paper questions whether removing fees is sufficient to reach the poor. We set out to assess the relative costs of accessing a TB diagnosis for the poor in a setting where public health services are, in theory, universally available: accessible within 6 km and provided free of charge.

Methods

Setting

The study was conducted in urban Lilongwe, which has the highest burden of TB cases in Malawi. Within the public sector, urban TB diagnostic and treatment services are provided through two hospitals and three urban health centres, where consultations, diagnostic tests and drugs are provided free of charge. Additional TB services are provided at a not-for-profit mission hospital, where diagnostic tests and treatment are provided free of charge. In accordance with WHO guidelines, TB suspects are requested to submit three sputum specimens for diagnosis.

Study design

The study comprised a cross-sectional, stratified survey of new pulmonary TB patients in the intensive phase of treatment systematically selected from these health facilities within urban Lilongwe between January and June 2001. The study focused on patient and household costs to access diagnosis, since patient costs of different treatment strategies have been reported previously.[12]

Participants

Eligible patients were defined as aged 16 years or above and normally resident in Lilongwe. Only patients who were in the intensive phase of treatment were included in the sample because they had only recently started treatment and would have a better recall of the pathway to care. Also, they would have been seeking care approximately at the same time, so their costs would be comparable and they would be attending health facilities frequently to receive or collect drugs.

Sampling strategy

At each treatment centre a list of new pulmonary TB patients in the intensive phase of treatment was drawn up in chronological order and numbered. The number of patients systematically sampled from this list was proportional to the total number of TB patients in the intensive treatment phase at the centre.

Statistical methods

Data collection instrument and enumerators

The study questionnaire elicited details of each care-seeking episode and was based on qualitative research conducted between August and December 2000. It was pilot-tested in urban Blantyre. The final questionnaire was translated into Chichewa, the local language; this was checked by back translation into English by an independent translator for quality assurance purposes.

Three graduate social scientists were trained in data collection methods and administered the questionnaires. On each day of data collection, two members of the team acted as interviewers and one as a supervisor. The supervisor checked every questionnaire for completeness and observed all or part of approximately 1 in 10 of the interviews to check the meanings of responses.

Data entry and analysis

Data were double-entered into EpiInfo v.6.04b, cleaned and any discrepancies checked against the original questionnaire. Simple frequencies and distributions were calculated using EpiInfo and MS Excel. Data were converted into SPSS and analysed to obtain confidence intervals (CIs) and significant differences between the poverty and gender subgroups. No further CI analysis was carried out below poverty and gender subgroups (e.g. poor men, poor women) as the sample sizes were too small to yield significant differences.

Analysis of poverty status

A proxy means test was developed based on regression analysis of the 1998 Malawi Integrated Household Survey (MIHS).[20,21] This comprised simple questions to elicit variables predictive of poverty status. Patients whose means test score was below the cut-off point of the urban poverty line from the MIHS (value of household consumption of US$ 0.25 per person per day) were classified as poor.[21]

Analysis of individual costs

Mean and median costs were calculated for patients accessing care after each of up to 13 care-seeking visits (the maximum recorded). The weighted average of these was then taken to assess average costs and time used per patient. Direct costs were derived from consultation fees, drugs, transportation and food costs. Indirect or opportunity costs refer to the value of resources lost[8] and were calculated on the number of days of work lost, multiplied by the estimated daily income. Reported income proved to be unreliable in the pilots. Instead income was taken from the MIHS, a nationally representative living standards survey of over 10 000 households that collected detailed monthly income and consumption information from all households over a period of 12 months.[20] Income was updated for inflation to June 2001 using the consumer price index from the Reserve Bank of Malawi (Table 1).

Costs were identified for the average patient, and then calculated for different groups: women versus men, poor versus non-poor, and poor women, poor men, non-poor women and non-poor men. The income-earning figures were taken to be the same for men and women in equivalent wealth brackets. This may overestimate the women's income, as women are traditionally paid less then men and run lower-income businesses. However the study attempts to attribute the opportunity cost of time away from all activities including reproductive activities, which, despite attracting little or no income, are vital for households. Thus a combined income figure was considered to be a reasonable estimate for these purposes.

Household costs

When a Malawi patient accesses healthcare, and particularly if they are admitted to hospital, they are attended by a guardian, usually someone from their household or family. Guardians' opportunity costs were estimated based on the time they were deemed to have spent with patients, multiplied by their estimated daily income. We assumed that the guardian was from the same wealth bracket as the patient. This may overestimate the guardian's wealth, as a) guardians are often women, who tend to have less income than men, and b) a non-poor person typically will request a poor relative to assist them.

Results

The total sample was 179 patients, split almost evenly between women and men (n = 87 and 92 respectively). Women

had more care-seeking episodes before diagnosis than the men, but not significantly so, (5.4 compared with 5.0). The non-poor women had the highest number of care-seeking episodes (5.7), although this is based on a relatively small sample (23). Government health facilities (hospitals and health centres) were the main sources of care (69% of all visits), but 7% of care-seeking visits were to grocery shops (which sell simple remedies and provide limited health advice[22]), although they accounted for 30% of all first care-seeking episodes. Visits to traditional healers were rare (0.8% of total visits made).

Overall patient costs

The weighted average of costs for different patient groups is given in Table 2 (available at: http://www.who.int/bulletin). Direct costs arose from fees and drug costs paid during care-seeking outside government health facilities, plus transport and food costs during all care-seeking episodes. Routine TB diagnosis requires at least three visits to a health facility. Additional care-seeking episodes to government health facilities may have arisen because of delayed referral for TB diagnosis, or referral for additional sputum smears rather than chest X-rays for suspects found to be smear-negative.[23] On average patients spent US$ 13, Malawi kwacha (MK) 996, accessing a diagnosis, which equates to 18 days of income. In addition to increased expenditure, patients lost time from their daily activities, often resulting in a loss in income. Patients lost an average of 22 days from work, resulting in an average income loss of US$ 16 or MK 1197. The combined impact of increased expenditure and lost income was US$ 29 (MK 2193). Smear-negative patients faced higher direct costs, as they had to visit health facilities more often before obtaining a diagnosis. Smear-positive patients lost more days from work due to illness, even though they had fewer visits (Table 3). No "under the table" payments were reported.

Table 1. **Summary of income data from the 1998 Malawi Integrated Household Survey updated for inflation to June 2001 using the consumer price index from the Reserve Bank of Malawi**

	All urban	Poor urban	Non-poor urban
Daily income	MK 54.06 US$ 0.71 (MK 23.38)	MK 16.00 US$ 0.21 (MK 6.92)	MK 93.38 US$ 1.23 (MK 40.38)
% Spent on food	35.2%	57.5%	29.8%

Note: Income quoted in Malawi kwacha (MK) at June 2001 prices; amounts in brackets are the April 1998 prices quoted in the Poverty Profile of Malawi.[20]
US$ exchange rate, June 2001: 75.7.

Costs for poor patients

The direct and opportunity costs faced by the poor initially appear around three times less than those faced by the non-poor; US$ 15 (MK 1170) compared with US$ 48 (MK 3611). They spent less on fees, transport and food, and had lower levels of opportunity costs. However, relative to total income, the poor were affected twice as much as the non-poor. The poor spent 244% of their total monthly income on TB diagnosis, compared with 129% for the non-poor. It is estimated that the poor must work for 2.5 months to recover the costs of seeking a TB diagnosis.

This impact of care-seeking is accentuated if income available after expenditure on food is taken into account. The poor in Lilongwe spend 57.5% of their income on food, whereas the non-poor only spend 29.8% (Table 1). This meant that when the poor were seeking a TB diagnosis it cost them 574% of their available non-food income (more than 5.5 months' income) compared to 184% for the non-poor.

Gender differences in patient costs

Men's direct costs were higher than women's (US$ 13 for men and US$ 12 for women); although the difference is not statistically significant. Transport costs were the primary cause of this difference, followed by fees. Food costs were lower for men in the overall sample and among the poor. Men reported more time off work and consequently higher opportunity costs than women did, most notably among the poor.

Household costs

Women reported more of their activities being replaced by someone else than men did; 70% of the women's activities were conducted by someone else, compared with only 30% of the men's. Table 4 (available at: http://www.who.int/bulletin), shows the breakdown of these replacement activities. The time they reported spending away from work was attributed to the person replacing them. Children replaced 12.7% of all activities, mostly female children (11.5%).

Table 3. **Costs faced by smear-negative and smear-positive patients**

	Smear-negative		Smear-positive	
Mean number of visits before treatment	5.9		4.5	
	Mean (median)		Mean (median)	
Fees and drugs	MK 887 (MK 340)	US$ 11.72 (US$ 4.49)	MK 310 (MK 103)	US$ 4.10 (US$ 1.36)
Transport costs	MK 317 (MK 200)	US$ 4.19 (US$ 2.64)	MK 222 (MK 95)	US$ 2.93 (US$ 1.25)
Food costs	MK 129 (MK 30)	US$ 1.70 (US$ 0.40)	MK 174 (MK 0)	US$ 2.30 (US$ 0)
Total direct costs	MK 1 302 (MK 670)	US$ 17.20 (US$ 8.85)	MK 692 (MK 343)	US$ 9.14 (US$ 4.53)
Number of work days lost	19.8		24.3	

MK = Malawi kwacha.

Among all women, this resulted in their female children replacing activities for 65 days, possibly lost from school. No data were available on the age and educational status of these children.

Guardians were usually a member of the patient's rather than their spouse's family, and were usually women. Male and female patients were attended by guardians with approximately the same frequency; however, women spent longer per care-seeking visit and were admitted into hospital for longer, so the days lost by guardians caring for women (12.9) were greater than for those caring for men (9.1). A similar pattern was seen among the poor and non-poor, with the guardians of the poor spending longer caring for their relatives. Women are thus more likely to lose income-earning opportunities than men.

Discussion

There is an urgent need to improve international case-detection rates for TB in order to achieve the health-related MDGs. Because of the profound connection between poverty and TB, this is likely to require reducing the economic burden of TB diagnosis for the poor. In this setting, TB services are in theory universally available, as they are accessible within 6 km and provided free of charge, but the actual cost of diagnosis for the patient is high, averaging US$ $29, or 41 days' income. The cost to the poor is staggering; 244% of their total monthly income, which rises to 574% when essential expenditures on food are excluded. This cost reflects the burden on patients who accessed a TB diagnosis, but is also likely to be a barrier for people with TB, particularly the poor, who do not access care at all.[21,23,24,25] This suggests that scaling-up TB services to reach the poor needs to go beyond removal of or exemptions from user fees, and instead transform the way TB diagnostic services are delivered.

The average patient and household costs for TB diagnosis in Malawi are slightly higher (209% mean monthly income) than those reported in Zambia (158%),[17] which also focused on economic costs before diagnosis. Other studies suggest that costs before diagnosis are a significant component of total costs.[9,18,26] In this setting, all public health services are provided free at the point of delivery, and "under the table" payments are rare, so the high costs may reflect overall levels of poverty (the poverty line derived from the MIHS is well below the international standard of measuring people living below one US dollar per day).

The gender impact of the cost of diagnosis is clear. Although direct and opportunity costs of diagnosis are lower for women than men, there are more profound effects on the household. In general, when a woman is sick, the opportunity costs faced by her household are greater. Further, women were most likely to be guardians of sick patients and thus more likely to lose income-earning opportunities. Importantly, female children were expected to take on far more household responsibility than male children. This is likely to have an impact on girls' education and development. It is difficult to quantify these effects because there was no information on the education level of these children. More research needs to be conducted on these long-term impacts of ill health on Malawian households.

How the poor finance the cost of diagnosis is important. The poor have less income yet the same basic food needs as the non-poor, so a higher proportion of their expenditures must go towards food, leaving less money available for health care.[20] When calculating the relative costs of health care it is important to allow for food expenditure to ensure that households are not diverting basic resources to pay for the treatment of one person, and so potentially causing nutritional problems among the others. This is particularly important when considering a chronic illness such as TB. The findings of this study suggest that the poor would be unlikely to be able to finance a TB diagnosis (574% of available monthly income) without diverting basic resources, although this is an area which requires further investigation.

The care-seeking pathways of patients in this study provide an indication of the constrained choices for care, particularly among the poor and women. The main sources of care were public health facilities or non-allopathic providers within the community (grocery stores or traditional healers). To reduce the economic burden and improve case-detection among these poor and vulnerable populations, there is a need to shorten the diagnostic pathway through "one-stop" diagnosis[27–29] and to bring diagnosis closer to where people live. These supply-side initiatives can complement broader social welfare and public health initiatives targeting the poor.[30]

One of this study's limitations is that wealth levels for women were assumed to be equivalent to men in the same wealth bracket. This was considered reasonable to capture reproductive activities, which, although attracting little or no income, are vital for households. Guardians' wealth may similarly be overestimated as guardians are often women, who tend to have less income than men, and a non-poor person typically will request a poor relative to assist them. However, this study showed that overall the opportunity costs faced by the poor are greater than those faced by the non-poor, as more of their lost income would ordinarily be spent on basic needs, in particular food; thus the impact on guardians is likely to be underestimated. Although empirical data were collected in 2001, the analysis draws upon evidence which was published later.[21] Emerging evidence from a National Health Accounts exercise (2006) suggests that out-of-pocket expenditure for health care for the poor remains high (Paul Revill, Ministry of Health, personal communication).

If the MDGs and TB targets are to be attained, there needs to be accelerated action to improve TB case-finding among the poor. Reducing economic barriers to diagnosis will be central to these efforts. This study shows that even in a setting where public health services could be considered to be universally accessible, considerable economic barriers exist for the poor, and impacts are greatest for women within the household. Removing or exempting the poor from user fees is not sufficient: there is an urgent need to identify strategies for diagnosing TB that are cost-effective for the poor and their households. ■

Ethical issues

Informed consent was sought from all study participants. The research protocol was approved by the National Health Sciences Research Committee of Malawi and the Liverpool School of Tropical Medicine Research Ethics Committee.

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Competing interests: None declared.

Résumé

Les habitants pauvres du Malawi ont-ils les moyens de profiter des services gratuits de dépistage de la tuberculose (TB)? Coût réel pour les malades et leurs foyers du diagnostic de la tuberculose dans le district de Lilongwe

Objetivo Evaluer le coût, par rapport à d'autres approches, du diagnostic de la tuberculose pour les personnes pauvres et les femmes du district urbain de Lilongwe au Malawi, où les habitants ont accès à des services de santé publique gratuits à moins de 6 km.

Méthodes Les coûts directs pour les patients et les ménages et les coûts d'opportunité ont été évalués à partir d'une enquête sur un échantillon de 179 personnes tuberculeuses, constitué par tirage systématique parmi l'ensemble des établissements de soins de santé publics et confessionnels du district de Lilongwe. Le niveau de pauvreté a été déterminé à partir de l'Enquête Légère Intégrée auprès des Ménages (EMEP), menée en 1998 au Malawi.

Résultats En moyenne, les patients ont déboursé US $ 13 [996 MK (monnaie malawi) ou 18 jours de revenu] et perdu 22 journées de travail pour bénéficier du diagnostic de la tuberculose. Pour les patients n'appartenant par à la population pauvre, les coûts totaux représentaient 129 % du revenu mensuel total ou 184 % du revenu après déduction des dépenses alimentaires. Pour les pauvres, ces coûts s'élevaient à 248 % du revenu mensuel ou à 574 % de ce revenu après déduction des dépenses alimentaires. Lorsque le malade est une femme ou une personne pauvre, les coûts d'opportunité que supporte son foyer sont plus élevés.

Conclusion Le coût total réel pour les malades et leur foyer du diagnostic de la tuberculose est prohibitif, même lorsque ce service est dispensé gratuitement Dans le cadre du développement des services de lutte contre la TB en vue d'atteindre les objectifs du Millénaire pour le développement, il est urgent de trouver des stratégies pour le diagnostic de la TB qui soient peu onéreuses pour les personnes pauvres et leurs foyers.

Resumen

¿Pueden los pobres de Malawi permitirse el acceso a los servicios gratuitos contra la tuberculosis? Costos del diagnóstico de la tuberculosis para los pacientes y los hogares en Lilongwe

Objetivo Evaluar los costos relativos del acceso al diagnóstico de la tuberculosis para los pobres y para las mujeres en la zona urbana de Lilongwe, Malawi, un entorno donde se puede acceder de forma gratuita a servicios de salud pública que se encuentran a menos de 6 kilómetros.

Métodos Se evaluaron los costos directos y de oportunidad para los pacientes y los hogares mediante una encuesta realizada entre 179 enfermos de tuberculosis, muestreados de manera sistemática a partir de todos los establecimientos de salud públicos y de misión de Lilongwe. El nivel de pobreza se determinó a partir de la Encuesta Integrada de Hogares (MIHS) de Malawi de 1998.

Resultados Por término medio, los pacientes gastaron US$13 (MK 996 o 18 días de ingresos) y perdieron 22 días de trabajo para tener acceso al diagnóstico de tuberculosis. Entre los pacientes que no eran pobres, los costos totales ascendieron al 129% de sus ingresos mensuales totales, o el 184% si se descontaba el gasto en alimentos. Entre los pobres, el costo equivalió al 248% de los ingresos mensuales, o el 574% tras descontar los alimentos. Cuando la persona enferma es pobre o es una mujer, los costos de oportunidad afrontados por la unidad familiar son mayores.

Conclusión Los costos del diagnóstico de la tuberculosis para los pacientes y los hogares son prohibitivamente elevados, incluso allí donde esos servicios se proporcionan de forma gratuita. Como parte de la expansión de los servicios antituberculosos emprendida para alcanzar los Objetivos de Desarrollo del Milenio, es necesario identificar urgentemente estrategias de diagnóstico de la tuberculosis que sean costoeficaces para los pobres y sus familias.

ملخص

هل بمقدور الفقراء تحمُّل تكاليف خدمات تشخيص السل المجانية في ملاوي؟ وهي التكاليف التي يتحمَّلها المريض وأسرته لتشخيص السل في مدينة ليلونغوي

الغرض: استهدفت هذه الدراسة تقييم ما يتكبَّده الفقراء والنساء من تكاليف نسبية للحصول على خدمات تشخيص السل في مدينة ليلونغوي، عاصمة ملاوي، حيث تُتاح خدمات الصحة العمومية مجاناً وفي نطاق 6 كيلو مترات.

الطريقة: تم تقدير التكاليف المباشرة وتكاليف الفرصة البديلة للمرضى والأسر، استناداً إلى مسح شمل 179 مريضاً بالسل يمثلون عينة تم انتقاؤها بأسلوب منهجي من جميع مرافق الصحة العمومية والمرافق الصحية التابعة للإرساليات في مدينة ليلونغوي، في ملاوي. وتم تحديد الوضع المتعلق بمستوى الفقر من خلال المسح الأسري المتكامل الذي أُجري في ملاوي في عام 1998.

الموجودات: بيَّنت النتائج أن المرضى يدفعون، في المتوسط، 13 دولاراً أمريكياً (أي ما يعادل أجر 18 يوم عمل)، ويتغيبون عن العمل 22 يوماً، للحصول على خدمة تشخيص السل. فأما المرضى من غير الفقراء، فقد بلغت التكاليف الكلية لحصولهم على خدمة تشخيص السل 129% من دخلهم الشهري الإجمالي، أو ما يعادل 184% من دخلهم بعد استبعاد ما يُنفق على شراء

الغذاء. وأما الفقراء فقد وصلت هذه التكاليف إلى 248% من دخلهم الشهري أو 574% بعد استبعاد الإنفاق على الغذاء. فإذا وقع الفقير أو المرأة فريسة للمرض، فسوف تزداد تكاليف الفرصة البديلة التي تتكبدها الأسرة.

الاستنتاج: تتسم التكاليف التي يتحمَّلها المريض وأسرته لتشخيص السل بالارتفاع الشديد، ولو في ظل تقديم هذه الخدمة مجاناً. وللنهوض بخدمات تشخيص السل من أجل بلوغ المرامي الإنمائية للألفية، تمس الحاجة إلى وضع استراتيجيات لتشخيص السل تتسم بالفعالية مقابل التكاليف لكلٍّ من الفقير وأسرته.

References

1. Gwatkin DR. How much would poor people gain from faster progress towards the Millennium Development Goals for health? *Lancet* 2005;365:813-7.
2. Gwatkin DR. How well do health programmes reach the poor? *Lancet* 2003; 361:540-1.
3. Dye C, Watt CJ, Bleed DM, Williams BG. What is the limit to case detection under the DOTS strategy for tuberculosis control? *Tuberculosis (Edinb)* 2003; 83:35-43.
4. Nhlema BM, Kemp JR, Steenbergen G, Theobald SJ, Tang S, Squire SB. *Systematic analysis of TB and poverty*. Geneva: Stop TB Partnership; 2002.
5. Rieder HL. *Epidemiological basis of tuberculosis control*. Paris: International Union Against Tuberculosis and Lung Disease; 1999.
6. Wandwalo E, Robberstad B, Morkve O. Cost and cost-effectiveness of community-based and health facility-based directly observed treatment of tuberculosis in Dar es Salaam, Tanzania. *Cost Eff Resour Alloc* 2005;3:6.
7. Okello D, Floyd K, Adatu F, Odeke R, Gargioni G. Cost and cost-effectiveness of community-based care for tuberculosis patients in rural Uganda. *Int J Tuberc Lung Dis* 2003;7:S72-9.
8. Saunderson PR. An economic evaluation of alternative programme designs for tuberculosis control in rural Uganda. *Soc Sci Med* 1995;40:1203-12.
9. Wyss K, Kilima P, Lorenz N. Cost of tuberculosis for households and health care providers in Dar es Salaam, Tanzania. *Trop Med Int Health* 2001;6:60-8.
10. Gibson N, Boillot F, Jalloh H. The cost of tuberculosis to patients in Sierra Leone's war zone. *Int J Tuberc Lung Dis* 1998; 2(9):926:731.
11. Floyd K, Wilkinson D, Gilks C. Comparison of cost-effectiveness of directly observed treatment (DOT) and conventionally delivered treatment for tuberculosis: experience from rural South Africa. *BMJ* 1997; Nov 29; 315(7120):1395-6.
12. Floyd K, Skeva J, Nyirenda T, Gausi F, Salaniponi F. Cost and cost-effectiveness of increased community and primary care facility involvement in tuberculosis care in Lilongwe District, Malawi. *Int J Tuberc Lung Dis* 2003;7:S29-37.
13. Nganda B, Wang'ombe J, Floyd K, Kangangi J. Cost and cost-effectiveness of increased community and primary care involvement in tuberculosis care in Machakos District, Kenya. *Int J Tuberc Lung Dis* 2003;7:S14-20.
14. Sinanovic E, Floyd K, Dudley L, Azevedo V. Cost and cost-effectiveness of community-based care for tuberculosis in Cape Town, South Africa. *Int J Tuberc Lung Dis* 2003;7:S56-62.
15. Moalosi G, Floyd K, Phatshwane J, Moeti T, Binkin N, Kenyon T. Cost-effectiveness of home-based care versus hospital care for chronically ill tuberculosis patients, Francistown, Botswana. *Int J Tuberc Lung Dis* 2003;7: S80-5.
16. Wilkinson D, Floyd K, Gilks CF. Costs and cost-effectiveness of alternative tuberculosis management strategies in South Africa – implications for policy. *S Afr Med J* 1997;87:451-5.
17. Needham DM, Godfrey-Faussett P, Foster SD. Barriers to tuberculosis control in urban Zambia: the economic impact and burden on patients prior to diagnosis. *Int J Tuberc Lung Dis* 1998;2:811-7.
18. Kamolratanakul P, Sawert H, Kongsin S, Lertmaharit S, Sriwongsa J, Na-Songkhla S, et al. Economic impact of tuberculosis at the household level. *Int J Tuberc Lung Dis* 1999;3:596-602.
19. Stop TB Partnership. *Background document prepared for the meeting of the second ad hoc Committee*. Geneva: WHO; 2003.
20. National Economic Council. *Poverty profile of Malawi*. Lilongwe: Government of Malawi; 2000.
21. Nhlema Simwaka B, Benson T, Kishindo P, Salaniponi FML, Theobald SJ, Squire SB, et al. Developing a socio-economic measure to monitor access to tuberculosis services in urban Lilongwe, Malawi. *Int J Tuberc Lung Dis* 2007: 11(1):65–71.
22. Willetts A, Kemp JR, Nhlema B, Joshua B, Lusinje A, Salaniponi F, Squire SB. Integrating self-sustaining community structures, including storekeepers into TB control in Lilongwe, Malawi - a participatory, qualitative approach. *Int J Tuberc Lung Dis* 2003; 7 (11 Suppl 2): S 294.
23. Squire SB, Belaye AK, Kashoti A, Salaniponi FML, Mundy C, Theobald S, et al. "Lost" smear positive pulmonary tuberculosis cases: where are they and why did we lose them? *Int J Tuberc Lung Dis* 2005;9:25-31.
24. Kemp J, Squire SB, Nyasulu IK, Salaniponi FML. Is TB diagnosis a barrier to care? [Abstract]. *R Soc Trop Med Hyg* 1996;90:472.
25. Kemp J, Boxshall M, Nhlema B, Salaniponi FML, Squire SB. Application of a Geographical Information System (GIS) to examine the relationship between socio-economic status and access to care for TB in urban Lilongwe [Abstract]. *Int J Tuberc Lung Disease* 2001;5:S166.
26. Rajeswari R, Balasubramanian R, Muniyandi M, Geetharamani S, Thresa X, Venkatesan P. Socio-economic impact of tuberculosis on patients and family in India. *Int J Tuberc Lung Dis* 1999;3:869-77.
27. Squire SB, Gondwe M, Michongwe J, Salaniponi FML, Mundy C, Kemp J. The feasibility of using a single "on-spot" sputum smear for TB case finding. *Int J Tuberc Lung Dis* 2001;5:S172.
28. Cambanis A, Yassin MA, Ramsay A, Squire SB, Arbide I, Cuevas LE. A one-day method for the diagnosis of pulmonary tuberculosis in rural Ethiopia. *Int J Tuberc Lung Dis* 2006;10:230-2.
29. Yassin MA, Cuevas LE, Gebrexabher H, Squire SB. Efficacy and safety of short-term bleach digestion of sputum in case-finding for pulmonary tuberculosis in Ethiopia. *Int J Tuberc Lung Dis* 2003;7:678-83.
30. Braine T. Reaching Mexico's Poorest. *Bull World Health Organ* 2006;84:593.

Table 2. **Patient costs of accessing a TB diagnosis (US$)**

	All patients	All poor	All non-poor	All women	All men	All poor women	All poor men	All non-poor women	All non-poor men
Number of respondents	**179**	128	51	87	92	64	64	23	28
% of total		72%	28%	49%	51%	36%	36%	13%	16%
Average no visits before treatment	**5.2**	5.1	5.3	5.4	5	5.3	4.9	5.7	5.1
Direct costs of pathway to care (mean)									
Cost of fees and drugs	7.56	6.58	9.78	7.00	8.12	5.85	7.31	9.48	10.26
Cost of transport	3.43	2.59	5.59	2.89	3.98	2.13	3.06	4.98	6.10
Food costs	1.98	1.84	2.29	2.01	1.68	2.46	1.16	1.65	2.69
Total direct costs									
Mean	**13.16**	**10.82**	**19.04**	**12.19**	**13.21**	**9.64**	**11.22**	**15.98**	**18.18**
Direct cost confidence intervals	*(9.81, 16.50)*	*(7.07, 13.55)*	*(14.01, 26.05)*	*(8.58, 15.79)*	*(8.45, 19.69)*				
Median	**7.03**	**5.89**	**12.55**	**6.47**	**7.41**	**5.39**	**5.42**	**11.23**	**10.95**
Opportunity costs									
Days lost	22.14	21.93	23.24	16.53	27.76	14.86	29.69	23.09	23.36
Mean daily income	0.71	0.21	1.23	0.71	0.71	0.21	0.21	1.23	1.23
Total opportunity cost	**15.81**	**4.64**	**28.67**	**11.81**	**19.83**	**3.14**	**6.27**	**28.48**	**28.81**
Total costs	**28.97**	**15.46**	**47.70**	**25.88**	**32.02**	**12.79**	**17.49**	**44.46**	**46.99**
Total cost confidence intervals	*(21.59, 36.34)*	*(10.10, 20.79)*	*(30.10, 65.30)*	*(16.90, 31.09)*	*(20.36, 47.44)*				
Total costs as % of monthly income	**135%**	**244%**	**129%**	**121%**	**149%**	**202%**	**276%**	**120%**	**127%**
% of income not spent on food	*64.8%*	*42.5%*	*70.2%*	*64.80*	*64.8%*	*42.5%*	*42.5%*	*70.2%*	*70.2%*
Total costs as % of monthly income after food expenditure	**209%**	**574%**	**184%**	**186%**	**231%**	**475%**	**649%**	**171%**	**181%**

Notes:
All costs and income are quoted in US$; the Malawi kwacha/US$ exchange rate at end June 2001 was 75.7.
Income figures are taken from Integrated Household Survey data for urban households (NEC 2000),[20] updated for June 2001 prices.
Statistically significant difference at 95% confidence intervals (CI) arise for direct costs between poor and non-poor only.
Statistically significant differences at 95% confidence intervals (CI) for opportunity costs arise between the poor and non-poor because of income levels.
CIs were not calculated for the sub-subgroups as sample sizes were too small to be able to yield significant differences at that level.

Table 4. **Replacement activities**

	All patients	All females	All males	All poor	All non-poor	All poor women	All poor men	All non-poor women[a]	All non-poor men
Number of respondents	**179**	87	92	128	51	64	64	23	28
% of time activities replaced by:									
No one	51.1%	29.7%	69.9%	54.7%	46.5%	42.8%	70.4%	16.9%	68.0%
Other adult	35.7%	39.7%	30.6%	28.7%	42.0%	28.7%	40.9%	41.8%	32.0%
Girl children	11.5%	27.7%	0.4%	15.4%	11.7%	26.4%	0.5%	39.7% (2.1%)	0.0%
Boy children	1.2%	2.5%	0.0%	1.3%	0.8%	2.1%	0.0%	1.6%	0.0%
Child days lost as % of total lost work days	12.7%	30.2%	0.4%	16.7%	12.5%	28.4%	0.5%	41.4% (3.7%)	0.0%
Girls (days lost)	37.9	65.4	1.7	50.5	33.3	57.4	1.7	121.9 (3.9)	0.0
Boys (days lost)	3.9	5.9	0.0	4.4	2.2	4.5	0.0	5.1	0.0
Total child days lost	41.8	71.3	1.7	54.9	35.4	61.9	1.7	127.0 (9.0)	0.0

[a] The figure relating to girl children of non-poor women is skewed by one woman who lost 118 days of work and had only 1 female child replacing her activities. Without her, this figure would have been 3.9 days and the total child days lost for this category 9.0, shown in brackets.