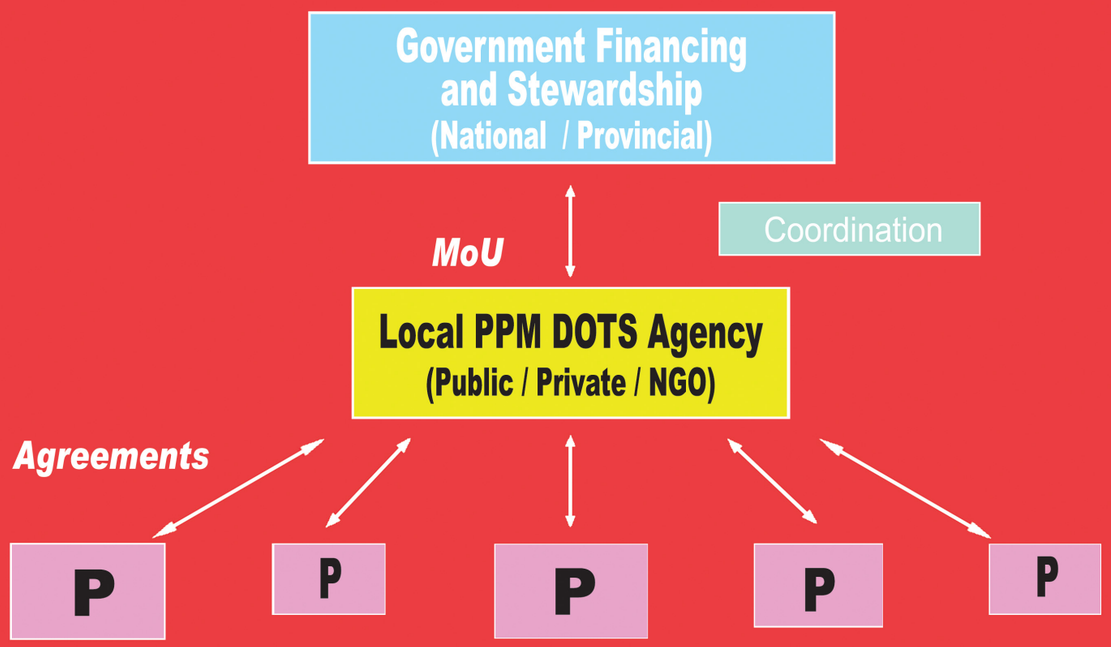
A generic PPM structure emerging from PPM DOTS field projects



The national government formulates a PPM policy in consultation with the stakeholders. A coordination mechanism helps to bring the public and the private sectors together, agree on implementation schemes and maintain dialogue. A local DOTS agency – public, private or voluntary – implements DOTS through a network of willing health care providers in an area. P indicates public, private or other providers.

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DOTS EXPANSION WORKING GROUP

WHO/HTM/TB/2004.337

Cost and cost–effectiveness of Public–Private Mix DOTS:

Evidence from two pilot projects in India

World Health Organization

Stop TB Partnership

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PUBLIC - PRIVATE MIX FOR DOTS EXPANSION

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STOP TB PARTNERSHIP

Stop TB Partnership

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Contents

Acronyms and abbreviations

CIDA	Canadian International Development Agency
DMA	Delhi Medical Association
DOTS	the internationally recommended strategy for TB control
DTUS	Delhi Tapedik Unmulan Samity/Society, a district TB control society
LRS	L.R.S. Institute of Tuberculosis and Allied Diseases, Delhi
MPHS	multi-purpose health supervisor
NA	not applicable
PMW	paramedical health worker
NTP	national TB control programme
RNTCP	revised national TB control programme
STDC	state TB training and demonstration centre
STLS	senior TB laboratory supervisor
STS	senior treatment supervisor
TU	tuberculosis unit
WHA	World Health Assembly
WHO	World Health Organization

Summary

General background

The global targets for tuberculosis (TB) control established by the World Health Assembly (WHA) are to detect 70% of new smear-positive cases and to successfully treat 85% of all detected cases by 2005. The internationally-recommended strategy for achievement of these targets is DOTS, and 20 of the 22 high-burden countries that collectively account for 80% of global cases have committed to achieving the WHA targets through implementation and expansion of the DOTS strategy. However, while 82% of new smear-positive cases enrolled in DOTS programmes in the year 2000 cohort were successfully treated, the case detection target is far from being met. In 2001, only 43% of estimated new smear-positive cases were detected. Identifying new strategies and interventions that can enable the case detection target to be met has become an important global TB control priority.

Health expenditure in the private sector is substantial in high-burden countries, and it has been documented that many TB cases are detected and treated in this sector, but not notified to public authorities and therefore not recorded as detected cases in official statistics. Treatment outcomes are generally poor in the private sector. Therefore, one strategy that has the potential to increase case detection rates, improve successful treatment rates and reduce costs for patients is involvement of the private sector in delivery of DOTS.

The PPM-DOTS strategy

Based on the outcomes of field projects in diverse settings, the Stop TB Department in WHO has developed a strategy called “Public–Private Mix DOTS” (PPM-DOTS). The strategy consists of DOTS implementation in the private sector according to WHO guidelines, provision of free drugs and some financial support by the government, strengthened collaboration between public and private providers through improved referral and information systems, contracts between the public and private sectors, and continuous dialogue. Several pilot projects have been established to assess the feasibility, effectiveness, cost and cost-effectiveness of PPM-DOTS.

The need for economic evaluation of PPM-DOTS

Assessment of the cost and cost-effectiveness of PPM-DOTS is essential for three main reasons. First, if PPM-DOTS works in increasing case detection and successful treatment rates, costs need to be quantified so that appropriate budgets for PPM-DOTS implementation can be included in countries’ annual and medium-term DOTS expansion plans. Second, it is important to identify whether PPM-DOTS is an efficient approach to increasing case detection and cure rates, i.e. does it make cost-effective use of the limited resources available to improve TB control, or would other options offer better value for money? Third, evidence that PPM-DOTS is affordable and cost-effective can be used to assist resource mobilization both domestically and from international donor agencies. To date, however, no analyses of the cost and cost-effectiveness of PPM-DOTS have been reported. The Joint Secretary for Health in India, leaders of PPM-DOTS pilot projects, donors – particularly CIDA (Canadian International Development Agency) – and the PPM-DOTS Subgroup of the DOTS Expansion Working Group all requested that an economic evaluation of pilot projects be undertaken.

This report assesses the effectiveness, cost and cost-effectiveness of PPM-DOTS in two pilot projects in India – one in Hyderabad, and one in Delhi. India accounts for about one-fifth of TB cases globally, has a rapidly expanding and successful public sector DOTS programme implemented by the revised national tuberculosis control programme (RNTCP), a large private sector, and two of the first pilot PPM-DOTS projects to be implemented.

Description of projects evaluated

The PPM-DOTS project in Hyderabad has been in effect since 1995, in an area called Mahavir. The Delhi project was implemented for 18 months, starting 1 January 2001, in South Delhi. Both projects serve a population of around 500 000 people, and the geographical area covered is one tuberculosis unit (TU) – the standard planning unit for the RNTCP. In each case, a private sector institution is responsible for managing PPM-DOTS implementation – Mahavir Charitable Hospital in the Hyderabad project and the Delhi Medical Association in the Delhi project. These institutions are provided with a budget by the public sector, which it is their responsibility to manage. Both projects are also supplied with inputs (as opposed to funds) by the public sector – drugs, laboratory supplies, training and a motorcycle in the Hyderabad project, and drugs, laboratory supplies, training and microscopes in the Delhi project. The major difference between the two projects – which had important implications for how they were evaluated – is whether DOTS in the private sector *supplements* or *substitutes for* DOTS services provided in the public sector. In the TU where the Hyderabad project is implemented, DOTS services are provided by the private sector only, i.e. the private sector is a full substitute for the public sector, and there is no public sector provision of DOTS services. In Delhi, DOTS in the private sector supplements DOTS provided in public sector government facilities, i.e. it builds on existing public sector DOTS services but does not substitute for them. Not surprisingly, this is reflected in the numbers of patients treated in each project. The Hyderabad project treats around 550–600 cases per year, while the Delhi project treats around 175 cases per year.

Methods used to evaluate projects

Effectiveness, costs and cost-effectiveness were evaluated for each project. Two measures of effectiveness were assessed: the number of cases detected, and the number of cases successfully treated. The total and average annual costs of each project during the full period of DOTS implementation were assessed, as was the average cost per patient treated (i.e. total costs divided by total number of patients treated). A standard cost-effectiveness indicator – the average cost per patient successfully treated – was assessed as the total cost of the project divided by the total number of patients successfully treated.[1]

The evaluation of any project requires comparison with a relevant alternative to the project. Typically, PPM-DOTS would be expected to supplement existing public sector DOTS services within a given TU, and thus evaluation of PPM-DOTS would typically involve comparison with the costs, effects and cost-effectiveness that would apply if DOTS were implemented through public sector facilities only. This was the comparison that was made to evaluate the Delhi PPM-DOTS project. For the Hyderabad project, however, this was not possible because there has never been any public sector provision of DOTS in the TU where PPM-DOTS is implemented. We therefore compared costs, effects and cost-effectiveness in the TU in which PPM-DOTS was implemented (i.e. Mahavir) with costs, effects and cost-effectiveness in a second TU (Osmania). Osmania has a demographic and socioeconomic profile similar to that of Mahavir, but DOTS services are provided almost entirely through the public sector and no PPM-DOTS project has been implemented. We then calculated a second cost-effectiveness indicator – the cost per additional patient successfully treated as a result of the implementation of PPM-DOTS.[2] This is calculated as the net increase in cost compared with a situation in which PPM-DOTS is not implemented divided by the net increase in effectiveness compared with a situation in which PPM-DOTS is not implemented.

[1]The average cost per patient treated and the average cost per patient successfully treated are sometimes confused. In the former, total costs are divided by the total number of patients treated. In the latter, total costs are divided by the total number of patients *successfully* treated, which is always lower than the total number of patients treated.

[2]This indicator allows for the fact that, without PPM-DOTS, cases could be treated in the private non-DOTS sector, that there would be costs associated with such treatment, and that some cases would be successfully treated. It may differ from the average cost per patient successfully treated because (a) both the net increase in costs and the net increase in effects are lower than the total costs and total effects used to calculate the average cost per patient successfully treated, and (b) the extent to which costs and effects are lower may be different. See Sections 1 and 2 for a full explanation.

Results

Our results show that PPM-DOTS projects can achieve a large increase in the number of cases detected and successfully treated, at acceptable cost.

Effectiveness: case detection and treatment outcomes

- The PPM-DOTS project in Hyderabad detected 26% more cases than the comparison area without a PPM-DOTS project. In Delhi, case detection by private practitioners resulted in a 47% increase in the number of cases detected, and contributed about one-third of all cases detected in the project area.
- The successful treatment rate exceeded or was close to the WHO target of 85% in both PPM-DOTS projects.

Costs

- The average cost per patient treated in both PPM-DOTS projects was similar to that of treating a patient in the public sector DOTS programme. The average cost per patient treated was around US$ 55–70 when only provider costs (i.e. costs to the public sector plus the value of resources supplied free of charge by private practitioners) were considered and around US$ 120 when both provider and patient/attendant costs were considered. When only costs to the public sector were considered, the average cost per patient treated in the PPM-DOTS projects was US$ 25–30 compared with US$ 65 for DOTS provided through public sector facilities. This reflected the high value (around US$ 30–40 per patient) of resources supplied by private practitioners at no charge to patients (primarily staff time and clinic space) in both PPM-DOTS projects. All average cost-per-patient-treated figures are very low by international standards;
- For patients and their attendants, treatment in DOTS programmes in the public sector and in PPM-DOTS projects allows a substantial reduction in costs compared with those associated with treatment in the private non-DOTS sector. DOTS implementation thus lessens the socioeconomic impact of TB on households.

Cost-effectiveness

- The average cost per patient successfully treated in both PPM-DOTS projects was around US$ 30–40 when only public sector costs are considered, US$ 60–85 when total provider costs (i.e. both public sector costs plus the value of resources supplied by private practitioners at no charge to patients) are considered, and around US$ 120–145 when all costs, including those incurred by patients and their attendants, are considered. Like the figures for average cost per patient treated, these figures are very low by international standards.
- When cost-effectiveness is measured more strictly as the cost per additional patient successfully treated through the implementation of PPM-DOTS, the results for the Hyderabad PPM-DOTS model were striking. Compared with what it can be estimated would occur with standard implementation of DOTS through the public sector, total public sector costs were lower and the total number of cases successfully treated higher – meaning that there were no additional costs to the public sector for the extra cases successfully treated. This finding reflected a) a lower average cost per patient treated than the public sector DOTS programme, with staff salaries in particular lower in the private sector and b) the high value of resources supplied at no charge by the private sector in the PPM-DOTS project (primarily staff time and clinic space) – resources that have to be paid for by the public sector when DOTS is implemented in public sector facilities. When total provider costs were considered (i.e. costs to the public sector plus the value of inputs supplied by private practitioners), the cost per additional patient successfully treated due to PPM-DOTS implementation was US$ 24 (and US$ 140 if staff salaries in the PPM-DOTS TU are assumed to be the same as those in the public sector). When all costs (i.e. those borne by the public sector, by private practitioners, and by patients/attendants) were considered, PPM-DOTS was associated with a net reduction in costs and a net increase in effectiveness, because of the high cost of treatment in the private non-DOTS sector and the fact that, with implementation of PPM-DOTS, these costs were substantially lowered and partially transferred to the public sector and private practitioners.

- In the Delhi PPM-DOTS project, the cost per additional patient successfully treated through PPM-DOTS implementation was US$ 87 when only public sector costs were considered and US$ 202 when both public sector costs and the value of resources supplied by private practitioners at no charge were considered. However, as in Hyderabad, when patient and attendant costs were also considered, PPM-DOTS resulted in an overall reduction in costs and an improvement in the number of cases successfully treated. This reflected the high costs incurred by patients diagnosed and treated in the private non-DOTS sector, and the fact that, with implementation of PPM-DOTS, these costs were substantially lowered and partially transferred to the public sector and private practitioners.

Conclusions

PPM-DOTS can be an effective, affordable and cost-effective approach to improving TB control in India. Successful approaches to PPM-DOTS should be scaled up alongside continued implementation and expansion of the public sector RNTCP DOTS programme.

Introduction

The global targets for tuberculosis (TB) control established by the World Health Assembly (WHA) are to detect 70% of new smear-positive cases and to successfully treat 85% of all detected cases by 2005 (*1*). The internationally recommended strategy for achievement of these targets is DOTS, which consists of five essential elements: political commitment; diagnosis by sputum smear microscopy, mostly among self-referring cases; short-course chemotherapy with first-line drugs using regimens of 6 or 8 months, with direct observation for at least the first 2 months; a regular and uninterrupted drug supply; and a recording and reporting system allowing evaluation of the outcomes for each individual patient and the programme as a whole.

There are 22 high-burden countries (HBCs) that collectively account for about 80% of all estimated cases (*2*). In the Amsterdam Declaration of March 2000, 20 of these countries committed to achieving the WHA targets through implementation and expansion of the DOTS strategy (*3*). However, reaching the targets is a substantial challenge. While 82% of new smear-positive cases enrolled in DOTS programmes in the year 2000 cohort were successfully treated (close to the target level), in 2001 only 32% of estimated new smear-positive cases were detected by DOTS programmes; when non-DOTS programmes are included, the figure was 43% (*4*). Recent analysis indicates that, if progress continues at the pace achieved during the period 1994–2001, the case detection target will not be met until 2013 (*4*). Identifying new strategies and interventions that will enable the case detection target to be met has therefore become an important global priority.

Health expenditure in the private sector is substantial in high-burden countries, and it has been documented that many TB cases are detected and treated in this sector, but not notified to public authorities and therefore not recorded as detected cases in official statistics (5). Treatment outcomes are generally poor in the private sector. Therefore, one strategy that has the potential to increase case detection rates, improve successful treatment rates and reduce costs for patients is involvement of the private sector in delivery of DOTS.

In recognition of the importance of the private sector and the need to improve case detection and successful treatment among patients using the private sector, WHO initiated work on "public–private mix" DOTS (PPM-DOTS) in 1997. A PPM-DOTS Subgroup has been created within the DOTS Expansion Working Group of the international Stop TB Partnership, and several PPM-DOTS pilot projects have been established (*6*). The PPM-DOTS strategy consists of DOTS implementation in the private sector according to WHO guidelines, provision of free drugs and some financial support by the government, strengthened collaboration between public and private providers through improved referral and information systems, contracts between the public and private sectors, and continuous dialogue. Several pilot projects have been established to assess the feasibility, effectiveness, cost and cost-effectiveness of PPM-DOTS.

Previous evaluations of PPM-DOTS have shown the approach to be both feasible and effective (*7*–*13*). However, before PPM-DOTS is recommended on a wider scale, assessment of its cost and cost-effectiveness is essential for three main reasons. First, if PPM-DOTS works in increasing case detection and successful treatment rates, costs need to be quantified so that appropriate budgets for PPM-DOTS implementation can be included in countries' annual and medium-term DOTS expansion plans. Second, it is important to identify whether PPM-DOTS is an efficient approach to increasing case detection and cure rates, i.e. whether it makes cost-effective use of the limited resources available to improve TB control, or whether other options would offer better value for money. Third, evidence that PPM-DOTS is affordable and cost-effective can be used to assist resource mobilization, both domestically and from international donor agencies. To date, however, no analyses of the cost and cost-effectiveness of PPM-DOTS have been reported. By 2002, the Joint Secretary for Health in India, leaders of PPM-DOTS pilot projects, donors (including CIDA in particular), and the PPM-DOTS Subgroup of the DOTS Expansion Working Group had all requested that an economic evaluation of pilot projects be undertaken.

This report concerns an evaluation of the effectiveness, cost and cost-effectiveness of two pilot PPM-DOTS projects in India. India accounts for about one fifth of TB cases globally, has a rapidly expanding and successful public sector DOTS programme, and a large private sector. One of the pilot PPM-DOTS projects is in Hyderabad, the capital city of Andhra Pradesh State in southern India. The second project is in Delhi.

The PPM-DOTS project in Hyderabad has been implemented since 1995. The Delhi project was implemented for 18 months, starting January 1st 2001. The two projects have some important similarities and differences (Table 1).

Table 1. Comparison of PPM-DOTS projects in Hyderabad and Delhi

Variable	Hyderabad	Delhi
Geographical area	1 tuberculosis unit	1 tuberculosis unit
Population covered	500 000	500 000
Private sector agency responsible for managing DOTS implementation in private sector	Mahavir Charitable Hospital	Delhi Medical Association
Budget provided by public sector to private sector agency	~ US$ 7000 per year, mainly for staff	~ US$ 5500 per year, mainly for staff, fuel, office maintenance and supplies
Inputs supplied by public sector	Drugs, laboratory supplies, training, motorcycle	Drugs, laboratory supplies, training, microscopes
Private sector contribution to DOTS services in the TU	Sole provider of DOTS services – there are virtually no government services in the area. The private sector is thus a full *substitute* for the public sector.	Both public and private sectors provide DOTS, with DOTS implemented in public sector facilities since 1998. DOTS in the private sector *supplements* DOTS provided in public facilities
Number of cases treated per year	~ 550–600	~ 175

Both projects serve a population of around 500 000 people, and the geographical area covered is one tuberculosis unit (TU) – the standard planning unit for the RNTCP. In each case, a private sector institution is responsible for managing PPM-DOTS implementation – Mahavir Charitable Hospital in the Hyderabad project, and the Delhi Medical Association in the Delhi project. These institutions are provided with a budget by the public sector, which it is their responsibility to manage. Both projects are also supplied with inputs (as opposed to funds) by the public sector – drugs, laboratory supplies, training and a motorcycle in the Hyderabad project, and drugs, laboratory supplies, training and microscopes in the Delhi project. The major difference between the two projects – which had important implications for how they were evaluated – is whether DOTS in the private sector *supplements* or *substitutes for* DOTS services provided in the public sector. In the TU where the Hyderabad project is implemented, DOTS services are provided by the private sector only, i.e. the private sector is a full substitute for the public sector, and there is no public sector provision of DOTS services. In Delhi, DOTS in the private sector supplements DOTS provided in public sector government facilities, i.e. it builds on existing public sector DOTS services but does not substitute for

them.[1] Not surprisingly, this is reflected in the numbers of patients treated in each project. The Hyderabad project treats around 550–600 cases per year, while the Delhi project treats around 175 cases per year.

The report is structured in five chapters:

1. **Methods used to evaluate PPM-DOTS in Mahavir.** This covers a description of the project setting, the objective of the analysis, the alternative strategies that it was relevant to compare and a description of their key components, the type of patients and timeframe considered in the analysis, the measure of effectiveness used, the evidence used to assess effectiveness, the perspective from which costs were considered, how cost data were collected and analysed, and how cost-effectiveness was computed;

2. **Methods used to evaluate PPM-DOTS in Delhi.** This covers the same issues as those listed above for Mahavir;

3. **Results for PPM-DOTS project in Mahavir.** This chapter has four sub-sections: effectiveness, costs, cost-effectiveness, and sensitivity analysis. The effectiveness sub-section covers:
   - the total and average annual number of cases detected since PPM-DOTS implementation started in Mahavir TU and since RNTCP-DOTS implementation started in the comparison TU of Osmania;
   - an assessment of the impact of PPM-DOTS on case detection;
   - the total and average annual number of cases successfully treated since PPM-DOTS implementation started in Mahavir TU and the total and average annual number of cases successfully treated since RNTCP-DOTS implementation began in the comparison TU of Osmania;
   - among the extra patients treated in Mahavir TU compared with the comparison TU of Osmania, an estimate of how many of these cases would have been successfully treated if they had been seen by the private non-DOTS sector; and
   - the estimated increase in the number of cases successfully treated as a result of PPM-DOTS implementation in Mahavir.

   The cost sub-section covers:
   - the average cost per patient treated in the PPM-DOTS project and the comparison TU of Osmania (with costs shown overall as well as from the perspective of the public sector, private practitioners and patients/attendants);
   - the estimated costs of diagnosis and treatment in the private sector when DOTS is not implemented; and
   - total and average annual costs in the PPM-DOTS project and the comparison TU of Osmania.

   The cost-effectiveness sub-section presents two measures of cost-effectiveness – the average cost per patient successfully treated, and the cost per additional patient successfully treated through PPM-DOTS. The sensitivity analysis presents data based on alternative assumptions regarding the variables that most influence the results.

4. **Results for PPM-DOTS project in Delhi.** This covers the same set of data as those listed for Mahavir, except that no results are presented for a comparison TU where DOTS is implemented in RNTCP public facilities only (since this was not relevant to the evaluation). In addition, an estimate of the number of cases that would have been successfully treated by the private practitioners involved in the project if DOTS had not been implemented is presented;

5. **Discussion.** This summarizes and interprets the key results, considers the limitations of the analysis, the generalizability of findings to other settings and the need for further data, and assesses the implications of the analysis for policy on PPM-DOTS.

[1] Although as with the public sector, it acts as a substitute for conventional non-DOTS treatment in the private sector i.e. non-standardized, non-subsidised, and non-notified treatment.

1. Methods used to evaluate PPM-DOTS in Mahavir

1.1 Study objective

The objective of the study was to assess the effectiveness, cost and cost-effectiveness of the Mahavir PPM-DOTS pilot project.

1.2 Description of project setting

A detailed description of the PPM-DOTS project is available elsewhere (*7*). In brief, Mahavir Hospital is located in Hyderabad city in Andhra Pradesh State, India. It functions as a TU covering a population of approximately 500 000 people, most of whom live in slum areas. Most employed residents work as daily wage labourers or as street hawkers. There are virtually no government health facilities in the area. In 1995, a PPM-DOTS pilot project started in an area covering a population of 100 000. This was expanded to the entire population of 500 000 – the standard size for a TU within the RNTCP – in October 1998. All service provision is by the private sector, involving Mahavir Charitable Hospital, nursing homes, individual private practitioner clinics, and private laboratories. Some funding is provided by the public sector through the RNTCP, but other resources (such as staff time and clinic space) are supplied by the private sector at no charge and with no reimbursement by the public sector.

Assessment of the effectiveness, cost and cost-effectiveness of PPM-DOTS requires comparison with a relevant alternative strategy. This would typically be implementing DOTS through the public sector only in Mahavir TU, with the question being what is the additional cost per patient successfully treated as a result of the implementation of PPM-DOTS. Unusually, implementation of DOTS is entirely by the private sector in Mahavir, and it is therefore impossible to estimate the additional costs and effects associated with PPM-DOTS, compared with what the public sector alone can achieve, by restricting the analysis to Mahavir TU. Effects, costs and cost-effectiveness therefore needed to be studied in a second TU in Hyderabad. We chose Osmania TU because it has a demographic and socioeconomic profile similar to that of Mahavir, and TB incidence is assumed to be the same. The RNTCP began implementation of DOTS in Osmania in October 1999. DOTS is funded and implemented through the public sector, although there is some involvement of private practitioners in DOT.

1.3 Description of alternative strategies to be compared

Two strategies were compared: PPM-DOTS in Mahavir, and RNTCP-DOTS, predominantly through the public sector, in Osmania. The main components of each strategy are summarized in Table 2. The drug regimens, use of smear microscopy for diagnosis and monitoring, training, health education, and recording and reporting are the same in both areas. The main differences (Table 3) are that all DOTS implementation is in the private sector in Mahavir whereas almost all implementation is through public sector facilities in Osmania, much more intensive orientation of private practitioners has occurred in Mahavir (more than 300 private practitioners visited, while 19 have been included in the DOTS programme in Osmania), and the number of dedicated TB staff is higher in Osmania. In addition, public funding for DOTS in Mahavir mainly covers staff salaries for a medical officer and 4 paramedical health workers (PMWs), drugs, and a motorcycle for supervision, whereas it covers all inputs in Osmania. DOT is provided in Mahavir Hospital TB clinic and a network of 35 neighbourhood DOTS centres in Mahavir. In Osmania all inputs except the time of private practitioners for DOT are funded by the public sector, and most patients (>50%) use Osmania Hospital TB clinic for DOT. In both TUs, patients can be treated in the private non-DOTS sector. With more patients treated under DOTS in Mahavir despite a similar population and presumed similarity in TB incidence, it appears that more patients are treated in the private non-DOTS sector in Osmania. This is important for the cost and effectiveness analysis (see below).

Table 2. Summary of main components of alternative strategies compared

Strategy component	Mahavir – PPM-DOTS pilot project	Osmania – RNTCP, public sector
Mapping and orientation of private providers	Pharmaceutical companies were asked to provide a list of private practitioners in Mahavir. Since this was not complete, the medical officer responsible for tuberculosis control and 4 PMWs identified the location of all doctors on the list, added to the list when it was not complete, and visited all identified private practitioners. This took 2–3 hours morning and afternoon 2–3 times per week for 3 months for both the medical officer and the PMWs. Public transport was used. About 30 minutes were spent with each private practitioner.	Orientation of 19 private practitioners, about 20–30 minutes spent with each private practitioner.
Routine interaction with private practitioners	The medical officer responsible for TB control explains to private practitioners about the availability of treatment, and assures them they will not lose clients. The medical officer also has a monthly meeting with private practitioners in different places for each ward, i.e. 6 meetings per month. Telephone calls as made as necessary. Any referrals to Mahavir TB clinic by private practitioners are acknowledged and the PMW provides feedback regarding the treatment outcome, using standard referral acknowledgement and feedback forms. Private practitioners are informed about the patient's progress throughout treatment.	Any private practitioner providing DOT is visited once per week.
Sputum smears	Smears for any TB suspect, 3 samples done over 2 days. For monitoring of smear+ cases, two smears are examined at 2, 4 and 6 months.	
Drugs	As per RNTCP guidelines e.g. 2HRZE 3x per week in intensive phase, 4HR 3x per week in continuation phase for new sm+ cases.	
DOT and other clinic visits	All suspects are referred by individual private practitioners to Mahavir Charitable Hospital TB clinic, where they are reviewed by the TB medical officer. The diagnosis is made, and communicated to the referring private practitioner. The patient may choose to receive treatment at either Mahavir Charitable Hospital TB clinic or one of 35 neighbourhood DOTS centres. All intensive-phase doses are observed. In the continuation phase, 1 dose per week is observed. In Mahavir clinic; a PMW and a pharmacist provide DOT. In the 35 neighbourhood DOTS centres, it is usually a staff nurse who provides DOT.	The two TB cells have medical officers who see TB suspects and review patients during treatment. The 2 medical officers spend around 70–80% of their time on this work. Frequency of DOT as for Mahavir. Whoever is available provides DOT, e.g. pharmacist, PMW. In the two TB cells (in Osmania and Golkonda), it is mainly a pharmacist and a nurse, respectively, that provide DOT.
Training	RNTCP standard training package.	
Laboratory supervision	One STLS works full-time on laboratory supervision. Slides are checked on a weekly basis, while Mahavir Hospital laboratory checks slides on a monthly basis. All slides are checked centrally. The STS visits microscopy centres where smears are collected for monitoring patient progress as part of general supervision work (as microscopy centres are also neighbourhood DOTS centres).	One STLS works full-time on laboratory supervision., visiting microscopy centres (of which there are 2) regularly. Slides are periodically taken to STDC for quality assurance.
General programme supervision and management, including recording and reporting	The medical officer responsible for TB control and the STS are responsible for supervision. 50% of the medical officer's time is spent on this, the STS is full time, and the 4 PMWs spend approximately 95% of their time on visiting DOTS centres (around 3 are visited per day) and tracing defaulters. The PMWs use bicycles, the STS uses a motorbike. The STS does recording and reporting.	Involves 1 STS (about 95% of their time), 1 MPHS (full-time, uses public transport), 2 medical officers (around 30% and 15% of their time respectively). The medical officers use a vehicle 7 days per month. The STS uses a motorcycle. The STS does recording and reporting.
Programme leader	Generates ideas, plans logistics (e.g. organizes meetings), and sensitized private practitioners (2–3 hours morning and afternoon 3 times per week for 2–3 months) at the start of PPM-DOTS. Sometimes involved in complaints/difficult cases. 50% of time spent on project in last quarter of 1998 and first quarter of 1999, since then 10–20% of time.	NA – this position does not exist.

Table 3. Main similarities and differences between DOTS in Mahavir and Osmania

Variable	Mahavir	Osmania
Geographical area	1 tuberculosis unit	1 tuberculosis unit
Population covered	500 000	500 000
Who provides DOTS treatment in the TU?	Private sector only	Mainly public sector; 19 private practitioners involved in DOT
Number of cases treated per year	About 560	About 450
Number of dedicated TB staff	4 PMWs, 1 STS and 1 STLS. All other staff (e.g. medical officer in Mahavir Charitable Hospital, cleaners) are part-time	Two TB cells (Osmania and Golkonda). Osmania TB cell has 1 medical officer, 1 pharmacist, 1 MPHS, 2 cleaners, 1 STS, 1 STLS and 1 laboratory technician. Golkonda TB cell has 1 medical officer, 1 MPHS, 1 nurse, 1 cleaner and 1 laboratory technician
Number of dedicated TB facilities	One TB clinic at Mahavir Charitable Hospital	Two TB cells, one in Osmania and one in Golkonda
Salaries	Lower than in public sector	Higher than in private sector
Public funding	Covers drugs, motorcycle, laboratory supplies, training, staff salaries of 1 medical officer and 4 PHWs, and a few miscellaneous recurrent items. Does not cover time contributed by project leader, or cost of clinic space and staff time supplied by private practitioners involved in the project at no charge to patients	Covers all inputs except time of private practitioners involved in DOT

1.4 Timeframe for analysis

The analysis considered the period from when DOTS covered a population of 500 000 in each TU through to the end of 2002, i.e. the period October 1998 to end 2002 was considered in Mahavir, and the period October 1999 to end 2002 was considered in Osmania.

1.5 Patients considered

All patients enrolled in the DOTS programme were considered in the analysis. Patients treated in the private non-DOTS sector were also considered.

1.6 Effectiveness measure

Successful treatment was chosen as the measure of effectiveness because this is the indicator of programme success recommended by WHO (*1*).

1.7 Effectiveness data collection and analysis

For Mahavir and Osmania, notification and treatment outcome data under DOTS were collected from the standard recording and reporting system, in which the number of notifications for each type of case, and treatment outcomes according to standard WHO reporting categories, are recorded on a quarterly basis. These data were used to calculate the total number of each type of case detected under DOTS, and the total number of cases successfully treated under DOTS, on a quarterly and annual basis and for the full time period

being considered (i.e. last quarter 1998 to end 2002 for Mahavir, last quarter 1999 to end 2002 for Osmania).

The impact of PPM-DOTS on case detection was estimated as the difference between the number of cases detected in the PPM-DOTS TU of Mahavir and the RNTCP TU of Osmania.

One way to assess the impact of PPM-DOTS on successful treatment would be to estimate it as the difference between the number of cases successfully treated under DOTS in the PPM-DOTS TU and the number of cases successfully treated under DOTS in the comparison TU of Osmania. However, this underestimates the number of cases successfully treated in both TUs, because there will be patients who are not detected under DOTS but who are nonetheless successfully treated in the private non-DOTS sector. The number successfully treated in the private non-DOTS sector in Osmania is, all other things being equal, higher than in Mahavir (given our assumption that TB incidence in the 2 TUs is the same and that few patients are treated under DOTS in Osmania). We estimated the extra number of cases successfully treated in the private non-DOTS sector in Osmania as the successful treatment rate in the private non-DOTS sector multiplied by the difference between the two TUs in the number of patients treated under DOTS. Existing studies suggest that the successful treatment rate in the private non-DOTS sector is around or less than 50% (*14*–*17*), and our analysis thus made the assumption of a 50% successful treatment rate. While further patients were probably treated in the private non-DOTS sector in both TUs, these were not considered in the analysis because the numbers were presumed to be the same.

1.8 Costing perspective

Costs were considered from the perspective of patients, patients' attendants, the public sector and private sector practitioners, i.e. a societal perspective in which all costs are considered was adopted.

1.9 Cost data collection and analysis

Costs were assessed in year 2002 US$ prices using standard methods (*18*, *19*). The costs associated with RNTCP training were not included in the analysis, since the approach was the same in each TU. The cost of screening suspects was also not included because these were believed to be similar in both TUs and because it is difficult to assess the time private practitioners spend on this activity in Mahavir.

Costs were assessed in four steps.

First, the different components of each treatment strategy that needed to be costed were identified.

Before diagnosis, and during treatment in the private non-DOTS sector, costs were identified as:

- patient expenditures on drugs, consultations, investigations, and transport; and
- days that patients and attendants lost from work, and the resulting wage losses.

During the diagnostic process in a DOTS facility and treatment under DOTS, the costs were identified as:

- patient and attendant expenditures on transport;
- patient and attendant time spent visiting a clinic for DOT and monitoring;
- days that patients and attendants lost from work, and the resulting wage losses;
- drugs;
- smears for diagnosis and monitoring;
- DOT;
- clinic visits for follow-up of confirmed patients;
- initial mapping and orientation of private practitioners;
- routine interaction with private practitioners;
- laboratory supervision; and
- general programme management.

Second, the total and average cost of each of these components was calculated for the full period of DOTS implementation in both Mahavir and Osmania. This was done in different ways, according to the cost item:

- **Costs before diagnosis**. These were estimated on a per patient basis using a structured questionnaire that was administered to a random sample of 50 patients in each TU (see Appendix 1). Total costs were estimated as the number of patients treated multiplied by the average cost per patient;
- **Patient and attendant expenditures on transport, patient and attendant time spent visiting a clinic for DOT and monitoring, and days that patients and attendants lost from work, and the resulting wage losses, during treatment under DOTS**. These were estimated on a per patient basis using a structured questionnaire that was administered to a random sample of 50 patients in each TU (see Appendix 2). Time costs were converted to a monetary value based on the average reported income among interviewed patients, as recommended in recent guidelines (*19*). Total costs were estimated as the number of patients treated multiplied by the average cost per patient;
- **Initial mapping and orientation of private practitioners, routine interaction with private practitioners, clinic visits for follow-up of confirmed patients, smears for diagnosis and monitoring, drugs, DOT, laboratory supervision and general programme management under DOTS**. Wherever possible, total costs were calculated for each item by combining data on the total quantity of resources used (e.g. time spent by different types of staff, vehicles used) with their unit prices (e.g. cost per hour for a medical officer, purchase price of a vehicle in 2002) i.e. an "ingredients" approach to costing was used. The one exception was non-personnel recurrent expenditure in clinics, for which only aggregated expenditure data were available. Joint costs (i.e. costs shared across more than one use or activity, such as staff costs) were allocated according to time spent. It was assumed that an outpatient visit to a neighbourhood DOTS centre in Mahavir cost the same as a visit to the TB clinic in Mahavir Charitable Hospital, and that Osmania General Hospital TB clinic was representative of DOT costs in the public sector. Capital costs were annualized using the internationally recommended discount rate of 3% (*20*) and the assumption that the expected years of useful life was 50 years for buildings and 5–10 years (depending on the item) for vehicles and equipment. The average cost of each treatment component per patient was calculated by dividing total costs by the total number of patients treated during the full period of DOTS implementation. The costs per new smear-positive patient, new smear-negative pulmonary/extrapulmonary patient and re-treatment patient were also calculated separately by making appropriate adjustments to the number of smears done, the cost of the drug regimen, and the number of DOT visits. Sources of data included budget and expenditure files for the PPM-DOTS project and Mahavir Charitable Hospital, staff cost data provided by the RNTCP and the PPM-DOTS project, laboratory records, and interviews with relevant staff;
- **Patient expenditures on drugs, consultations, investigations, and transport, and days that patients and attendants lost from work, and the resulting wage losses, during treatment in the private non-DOTS sector**. The cost on a per-patient basis was estimated using data from a survey of patients carried out in Hyderabad in 1997 (*16*), with costs adjusted to year 2002 prices. For the purposes of the analysis, these costs were relevant to Osmania TU only. This was because fewer patients per year were treated under DOTS in Osmania compared with Mahavir (see Table 3), despite a similar population size and assumed similar incidence of TB. It was assumed that the additional number of patients treated under PPM-DOTS in Mahavir would have been treated in the private non-DOTS sector in Osmania. Total costs in Osmania were therefore estimated as the cost per patient treated in the private non-DOTS sector multiplied by the difference in the number of patients treated between Mahavir and Osmania. While further patients were probably treated in the private non-DOTS sector in both TUs, these were not considered in the analysis because the numbers were presumed to be the same.

Third, for each cost item, costs were split into three categories:

- costs covered by public funds;
- resources supplied by the private sector at no charge to patients; and
- costs incurred by patients/attendants.

Fourth, to facilitate comparison between TUs, an annual average total cost was calculated. This was done by dividing total costs for the number of quarters during which DOTS had been implemented (i.e. 17 in Mahavir and 13 in Osmania) and then multiplying by 4.

1.10 Cost-effectiveness analysis

Two cost-effectiveness indicators were assessed. The first was the average cost per patient successfully treated. This was calculated for PPM-DOTS in Mahavir, for RNTCP public sector DOTS in Osmania, for treatment in the private non-DOTS sector, and overall for each TU, using the following equation:

> total annual costs / total annual number of patients successfully treated

This is equivalent to assessing the cost-effectiveness of TB treatment compared with a situation in which there is no treatment at all. It is the way in which the cost-effectiveness of TB treatment is usually computed in published cost-effectiveness studies in developing countries. This indicator therefore allows fair comparisons with other published data.

However, a stricter analysis of the cost-effectiveness of PPM-DOTS should account for the fact that, without PPM-DOTS, cases are likely to be treated in the private non-DOTS sector rather than remaining untreated, that there will be costs associated with this treatment, and that some cases will be successfully treated.

We therefore used a second indicator – the cost per additional patient successfully treated through PPM-DOTS – to make a stricter assessment of the cost-effectiveness of PPM-DOTS. This indicator was estimated according to the following equation:

> (total annual cost of PPM-DOTS in Mahavir – total annual cost of RNTCP-DOTS in Osmania – total estimated costs for the extra cases treated in the private non-DOTS sector in Osmania) / (total annual number of cases successfully treated under DOTS in Mahavir – total annual number of cases successfully treated under DOTS in Osmania – total estimated annual number of cases successfully treated among the extra cases treated in the private non-DOTS sector in Osmania)

This can be more simply expressed as follows:

> net increase in costs due to PPM-DOTS implementation / Net increase in annual number of cases successfully treated due to PPM-DOTS implementation

Calculations were done from different costing perspectives: the public sector, providers (both public and private sector practitioners), and societal (in which costs to patients, attendants, the public sector and private sector practitioners are all considered).

2. Methods used to evaluate PPM-DOTS in Delhi

2.1 Study objective

The objective of the study was to assess the effectiveness, cost, and cost-effectiveness of PPM-DOTS in Delhi.

2.2 Description of project setting

Delhi is the capital city of India, with a population of about 14 million. In 2001, the Delhi Medical Association and the Ministry of Health designed three different approaches to involving the private sector in DOTS implementation (known as Models 1, 2 and 3). These were implemented in selected areas of South Delhi (Sarva Priya Vihar, Kalkaji and Saket) and East Delhi (Karawal Nagar, Shahdara and New Delhi Chest Clinic areas), which have a combined population of about 1 million. The analysis in this report is restricted to the project (Model 3) for which all the data required for an economic evaluation were available. This was implemented in South Delhi only, and covered a population of about 500 000.

2.3 Description of alternative strategies to be compared

Two strategies were compared for the same geographical area of South Delhi:

- PPM-DOTS, with private sector implementation of DOTS supplementing RNTCP DOTS in the public sector, and
- RNTCP DOTS implementation in the public sector only, with no private sector implementation of DOTS. i.e. what would occur in the absence of PPM-DOTS.

Implementation of the PPM-DOTS pilot project changed nothing about how RNTCP-DOTS was implemented in the public sector; rather, it added new elements to facilitate DOTS implementation in the private sector. These new elements included initial sensitization and orientation of the Delhi Medical Association (DMA), formal training of private practitioners, ongoing dialogue between the public sector and private sector medical association and practitioners, the establishment of a coordination committee and the recruitment of a senior TB laboratory supervisor (STLS) for laboratory supervision. The drug regimens, use of smear microscopy for diagnosis and monitoring, and training were identical to those used in the public sector DOTS programme, but involved additional costs to the public sector compared with what would have occurred without PPM-DOTS implementation. All other elements represented new activities and new costs. The main components of PPM-DOTS are shown in Table 4.

2.4 Timeframe for analysis

The analysis considered the full period during which the pilot project was implemented, i.e. 1 January 2001 to 30 June 2002.

2.5 Patients considered

All patients enrolled in the PPM-DOTS project were considered in the analysis.

Table 4. Summary of main components of Delhi PPM-DOTS pilot project

Strategy component	Description
Orientation/sensitization of private practitioners	A core committee of the Delhi Medical Association (DMA) (26 doctors) was given an orientation for 2 days by LRS Institute staff (Director, Assistant Medical Superintendent, 2 senior medical officers).
Training of private practitioners by RNTCP	Five training sessions were undertaken, three for doctors, one each for laboratory technicians and DOT providers. Training was provided by senior medical officers and microbiologists (laboratory technicians). Ten doctors were trained in Model 3, in a training session run by two medical officer facilitators; five laboratory technicians were trained as part of a joint training programme with the Model 2 pilot project. There were two facilitators for the laboratory technician training.
Ongoing dialogue between public sector and private practitioners/DMA	This had three aspects: 1) continuous dialogue with the President and Secretary of the DMA, due to changes of personnel in DMA. Director of LRS or assistant medical superintendent would go to the DMA office or come to LRS. This happened about 10 times, for about 2–3 hours each time; 2) discussion between DTUS and DMA for release of quarterly instalment of funds; 3) individual level interaction with private practitioners, e.g. if private practitioners had questions they would call DTUS or LRS. This occurred about 15–20 times, taking a total of about 15 hours.
Drugs	Category I, II, III according to type of TB patient, as per RNTCP guidelines.
Sputum smears for screening and diagnosis	As per RNTCP guidelines, i.e. 3 smears for any symptomatic.
Sputum smears for monitoring	As per RNTCP guidelines, e.g. 2 smears for new sm+ patients at 2, 4, 6 months.
DOT visits	Three times per week in intensive phase, then once per week for the remainder of treatment.
Default retrieval and initial visit to patient's home	Once per patient for initial visit and once per patient for defaulting patients, on average (did not , in fact, always occur).
Laboratory supervision by government	Minimal – approximately 15 hours of the public sector STLS's time over 18 months.
Laboratory supervision by DMA	One full-time STLS, who used a private van provided by the DMA Chairman.
General programme supervision and management by DMA	The Chairman of the DMA was the main person responsible for programme management. He also worked with the President and Secretary of the DMA. Private practitioners were visited and provided with financial and logistic support, i.e. microscopes, treatment boxes, reagents, stationery. About 4–5 hours per day were spent on these activities during the first 2–3 months of the project, then 1–2 hours per day.
General management and supervision by public sector	The public sector asked for quarterly reports. Sometimes data would not tally, and the STS and STLS employed by the DMA were therefore invited 6–8 times to discuss the correct way to complete the forms. LRS, and the public sector STS and STLS, worked with them.
Coordination committee	Included one person from the Government of India (as observer), one person from LRS, three from DMA (president, secretary, chairman), one from DTUS (government of Delhi). Meetings were to be held in different places. According to the Memorandum of Understanding, there should have been one meeting per quarter. In practice, there were six meetings, each lasting 2–3 hours, in the DMA office. Visits to the model area happened only once or twice instead of six times.

2.6 Effectiveness measure
Successful treatment was chosen as the measure of effectiveness because this is the indicator of programme success recommended by WHO.

2.7 Effectiveness data collection and analysis
Notification and treatment outcome data in the PPM-DOTS pilot project were collected from the standard recording and reporting system, in which the number of notifications for each type of case, and treatment outcomes according to standard WHO reporting categories, were recorded on a quarterly basis. These data were used to calculate the total number of each type of case detected under DOTS in the private sector, and the total number of cases successfully treated under DOTS in the private sector, during the period 1 January 2001 to 30 June 2002.

The impact of PPM-DOTS on case detection has been assessed in a separate study (*8*, *9*). We report a brief summary of this analysis in the results section.

The number of cases that would have been successfully treated in the absence of the PPM-DOTS project was estimated by assuming that, in its absence, all patients treated in the PPM-DOTS project would have been treated in the private non-DOTS sector. This was justified on the basis that the study of the impact of PPM-DOTS on case detection suggests that PPM-DOTS did not divert patients from public sector services – by extension, they must have been diverted from the private non-DOTS sector (or from no treatment at all, which is less likely). Further, it was assumed that the successful treatment rate in the private non-DOTS sector was 50% (*14*–*17*).

2.8 Costing perspective
Costs were considered from the perspective of patients, patients' attendants, the public sector and private sector practitioners i.e. a societal perspective in which all costs are considered was adopted.

2.9 Cost data collection and analysis
Costs were assessed in year 2002 US$ prices using standard methods (*18*, 19). All new costs associated with the implementation of PPM-DOTS were considered.

Costs were assessed in three steps. First, the different components of PPM-DOTS that needed to be costed were identified.

Before diagnosis, and during treatment in the private non-DOTS sector, costs were identified as:
- patient expenditures on drugs, consultations, investigations, and transport; and
- days that patients and attendants lost from work, and the resulting wage losses.

During the diagnostic process in a DOTS facility and treatment under DOTS, the costs were identified as:
- patient and attendant expenditures on transport;
- patient and attendant time spent visiting a clinic for DOT and monitoring;
- days that patients and attendants lost from work, and the resulting wage losses;
- drugs;
- smears for diagnosis and monitoring;
- DOT;
- initial orientation of private practitioners;
- routine interaction with private practitioners;
- laboratory supervision; and
- general programme management.

Second, the total and average cost of each of these components was calculated for the full period of DOTS implementation. This was done in different ways, according to the cost item:
- **Costs before diagnosis**. These were estimated on a per-patient basis using structured questionnaires. For patients treated in the PPM-DOTS project, the questionnaire was the

same as that used in Hyderabad (see Appendix 1). For patients treated in the private non-DOTS sector, a slight modification of this questionnaire was used (Appendix 3). Both questionnaires were administered to a random sample of 35 patients. Total costs were estimated as the number of patients treated multiplied by the average cost per patient.

- **Patient and attendant expenditures on transport, patient and attendant time spent visiting a clinic for DOT and monitoring, and days that patients and attendants lost from work, and the resulting wage losses, during treatment under DOTS**. These were estimated on a per-patient basis by administering the same structured questionnaire as that used in Hyderabad (see Appendix 2) to a random sample of 35 patients. Time costs were converted to a monetary value based on the average reported income among interviewed patients, as recommended in recent guidelines (19). Total costs were estimated as the number of patients treated multiplied by the average cost per patient.
- **Initial orientation of private practitioners, routine interaction with private practitioners, smears for diagnosis and monitoring, drugs, DOT, laboratory supervision and general programme management under DOTS**. Wherever possible, total costs were calculated for each item by combining data on the total quantity of resources used (e.g. time spent by different types of staff, vehicles used) with their unit prices (e.g. cost per hour for a medical officer, purchase price of a vehicle in 2002), i.e. an "ingredients" approach to costing was used. The one exception was non-personnel recurrent expenditure, for which only aggregated expenditure data were available. Joint costs (i.e. costs shared across more than one use or activity, such as staff costs) were allocated according to time spent. Capital costs were annualized using the internationally recommended discount rate of 3% (*20*) and the assumption that the expected years of useful life was 50 years for buildings and 5–10 years (depending on the item) for vehicles and equipment. The average cost of each treatment component per patient was calculated by dividing total costs by the total number of patients treated during the full period of DOTS implementation. The cost per new smear-positive patient, new smear-negative pulmonary/extrapulmonary patient and re-treatment patient were also calculated separately by making appropriate adjustments to the number of smears done, the cost of the drug regimen, and the number of DOT visits. Sources of data included budget and expenditure files for the PPM-DOTS project, staff cost data provided by the RNTCP and the PPM-DOTS project, laboratory workload records, and interviews with relevant staff;
- **Patient expenditures on drugs, consultations, investigations, and transport, and days that patients and attendants lost from work, and the resulting wage losses, during treatment in the private non-DOTS sector**. The cost on a per patient basis was estimated by administering a structured questionnaire to a random sample of 35 patients currently being treated in the private non-DOTS sector (see Appendix 4).

Third, for each cost item, costs were split according to three categories:

- costs covered by public funds;
- resources supplied by the private sector at no charge to patients; and
- costs incurred by patients/attendants.

2.10 Cost-effectiveness analysis

Two cost-effectiveness indicators were assessed. The first was the average cost per patient successfully treated. This was calculated using the following equation:

total cost of PPM-DOTS project / total number of patients successfully treated in PPM-DOTS project

This is equivalent to assessing the cost-effectiveness of TB treatment compared with a situation in which there is no treatment at all. It is the way in which the cost-effectiveness of TB treatment is usually computed in published cost-effectiveness studies in developing countries. This indicator therefore allows fair comparisons with other published data.

However, as noted in section 2.7, our analysis assumed that, in the absence of the PPM-DOTS project, cases would have been treated in the private non-DOTS sector rather than remaining untreated. We therefore used a second indicator – the cost per additional patient successfully treated through PPM-DOTS – to make a stricter assessment of the cost-effectiveness of PPM-DOTS. This indicator was estimated as follows:

(total cost of PPM-DOTS project – total estimated cost of treatment in the private non-DOTS sector for the number of patients treated in the PPM-DOTS project) / (total number of cases successfully treated in PPM-DOTS project – total estimated number of cases that would have been successfully treated had they received treatment in the private non-DOTS sector)

3. Results for PPM-DOTS project in Mahavir

3.1 Effectiveness

3.1.1 Total and average annual number of cases detected

The numbers of cases detected in the Mahavir PPM-DOTS project and in the RNTCP TU of Osmania since DOTS implementation began are shown in Table 5. From the last quarter of 1998 through to the end of 2002, a total of 2392 cases were detected in Mahavir. This is equivalent to an annual average of 563 cases. In Osmania, a total of 1451 cases were detected from the last quarter of 1999 until the end of 2002, an annual average of 446 cases. The annual average number of new smear-negative and extrapulmonary cases detected was similar in both TUs (257 in Osmania and 266 in Mahavir). The main reason for the difference in the average annual total was the difference in the number of new smear-positive cases detected (annual average of 223 in Mahavir compared with 143 in Osmania, or 56% more cases detected in Mahavir compared with Osmania).

3.1.2 Impact of PPM-DOTS on case detection

The number of cases detected under DOTS each year in the PPM-DOTS TU of Mahavir was 26% higher than in the comparison TU of Osmania (563 vs 446 per year). The number of new smear-positive cases detected under DOTS in the PPM-DOTS TU of Mahavir was 56% higher than in the comparison TU of Osmania (223 vs 143 per year).

3.1.3 Total and average annual number of cases successfully treated

The numbers of cases successfully treated in the Mahavir PPM-DOTS project and in the RNTCP TU of Osmania are shown in Table 6. In the Mahavir PPM-DOTS project, 2251 patients were successfully treated between the last quarter of 1998 and the end of 2002. This is equivalent to an annual average of 530 cases. In Osmania, 1211 patients were successfully treated between the last quarter of 1999 and the end of 2002, equivalent to an annual average of 373 cases. The successful treatment rate was 94% in Mahavir and 83% in Osmania. The average annual number of new smear-positive cases successfully treated was 214 in Mahavir and 117 in Osmania.

3.1.4 Estimated number of patients that would have been detected and successfully treated in the private non-DOTS sector in Osmania

The data in Table 5 show that more patients were treated under DOTS in Mahavir compared with Osmania – an extra 117 patients per year. Assuming that an equivalent number of patients would have been treated in the private non-DOTS sector in Osmania, and that 50% of these patients would have been successfully treated, it may be estimated that, for the purposes of fair comparison between the two TUs, the total average annual number of patients successfully treated in Osmania was 373 + (117 x 0.5) = 432 patients.

Table 5. Total and annual average number of patients detected since start of DOTS implementation, Mahavir and Osmania

Time period	Mahavir					Osmania				
	New sm+	New sm–/EPTB	Re-treatment	Total new	Total all	New sm+	New sm–/EPTB	Re-treatment	Total new	Total all
Q4 1998	42	30	15	72	87	NA	NA	NA	NA	NA
Q1 1999	60	48	14	108	122	NA	NA	NA	NA	NA
Q2 1999	63	55	12	118	130	NA	NA	NA	NA	NA
Q3 1999	51	47	10	98	108	NA	NA	NA	NA	NA
Q4 1999	60	41	21	101	122	30	38	28	68	96
Q1 2000	51	68	21	119	140	45	50	27	95	122
Q2 2000	60	82	15	142	157	47	71	9	118	127
Q3 2000	48	64	13	112	125	33	60	10	93	103
Q4 2000	47	74	20	121	141	28	65	8	93	101
Q1 2001	55	69	22	124	146	33	60	6	93	99
Q2 2001	59	95	17	154	171	45	82	9	127	136
Q3 2001	54	68	13	122	135	40	60	9	100	109
Q4 2001	56	56	27	112	139	25	69	3	94	97
Q1 2002	68	78	13	146	159	31	77	8	108	116
Q2 2002	66	76	29	142	171	33	74	16	107	123
Q3 2002	51	92	30	143	173	36	57	11	93	104
Q4 2002	56	86	24	142	166	38	71	9	109	118
Total	**947**	**1129**	**316**	**2076**	**2392**	**464**	**834**	**153**	**1298**	**1451**
Annual average	**223**	**266**	**74**	**488**	**563**	**143**	**257**	**47**	**399**	**446**

Table 6. Total and annual average number of patients successfully treated since start of DOTS implementation, Mahavir and Osmania

Time period	Mahavir					Osmania				
	New sm+	New sm–/EPTB	Re-treatment	Total new	Total all	New sm+	New sm–/EPTB	Re-treatment	Total new	Total all
Q4 1998	41	28	12	69	81	NA	NA	NA	NA	NA
Q1 1999	58	47	11	105	116	NA	NA	NA	NA	NA
Q2 1999	61	54	9	115	124	NA	NA	NA	NA	NA
Q3 1999	50	47	8	97	105	NA	NA	NA	NA	NA
Q4 1999	57	38	17	95	112	24	32	19	56	75
Q1 2000	46	65	17	111	128	37	48	18	85	103
Q2 2000	60	81	12	141	153	38	64	7	102	109
Q3 2000	47	64	10	111	121	31	51	6	82	88
Q4 2000	46	68	16	114	130	23	57	6	80	86
Q1 2001	52	66	17	118	135	30	50	6	80	86
Q2 2001	55	93	13	148	161	33	71	6	104	110
Q3 2001	50	66	10	116	126	31	52	5	83	88
Q4 2001	54	55	21	109	130	20	59	2	79	81
Q1 2002[a]	65	76	10	141	151	25	67	6	92	97
Q2 2002[a]	63	74	23	137	160	27	65	11	91	103
Q3 2002[a]	49	89	24	138	162	29	50	8	79	87
Q4 2002[a]	54	83	19	137	156	31	62	6	93	98
Total	**908**	**1094**	**250**	**2001**	**2251**	**380**	**727**	**105**	**1106**	**1211**
Annual average	**214**	**257**	**59**	**471**	**530**	**117**	**224**	**32**	**341**	**373**
Successful treatment rate	0.96	0.97	0.79	0.96	0.94	0.82	0.87	0.69	0.85	0.83

[a] Numbers in these rows assume that the average successful treatment rate for 1998–2001 applied in 2002 (treatment outcome data are not yet available for this year).

3.1.5 Estimated increase in number of cases successfully treated due to PPM-DOTS implementation in Mahavir

The annual increase in the number of cases successfully treated through PPM-DOTS implementation can be estimated as the difference between the annual number of cases successfully treated in Mahavir and, for the same number of patients, the estimated total number of cases successfully treated in Osmania. According to the data and assumptions in sections 3.1.1–3.1.4, it can be estimated that 530 patients are successfully treated each year in Mahavir compared with 432 in Osmania, i.e. the increase in the number of cases successfully treated due to PPM-DOTS implementation in Mahavir is 98 per year.

3.2 Costs

3.2.1 Average cost per patient diagnosed and treated

The average patient and attendant costs prior to diagnosis and treatment are shown in Table 7. Before diagnosis, patient and attendant costs amounted to US$ 21.90 in Mahavir and US$ 27.70 in Osmania, with the most important costs being lost wages, investigations and drugs. During treatment, the average cost was US$ 35.20 in Mahavir and US$ 24.20 in Osmania, most of which was for expenditures on transport. The total cost per patient was US$ 57.10 in Mahavir and US$ 51.90 in Osmania.

Table 7. Average patient and attendant costs (US$) before diagnosis and during treatment under DOTS, Mahavir and Osmania

Cost item	Mahavir	Osmania
Before diagnosis		
Drugs	3.6	5.8
Consultations	2.5	2.4
Investigations	3.9	5.4
Transport	1.3	1.3
Lost wages	10.4 (7 days)	12.8 (16 days)
Other	0.2	0
Subtotal, before diagnosis	*21.9*	*27.7*
During treatment		
Transport (for 42 clinic visits)	31.4	14.5
Lost wages	0	0
Time spent travelling to clinic	3.8 (10 hours)	9.7 (22 hours)
Subtotal, treatment	*35.2*	*24.2*
Total	**57.1**	**51.9**

The average cost per patient treated from the perspective of providers of DOTS diagnosis and treatment (i.e. public sector services and private sector facilities and practitioners) is shown in Table 8.

The average cost per patient was US$ 54.30 in Mahavir compared with US$ 63.20 in Osmania. In Mahavir, the cost to the public sector was US$ 24.30, with US$ 30 representing resources (mainly staff time and clinic space) supplied at no charge by private hospitals and practitioners.

Table 8. Average provider costs (US$) per patient diagnosed and treated under DOTS, Mahavir and Osmania

Cost item	Mahavir			Osmania
	Total	Costs funded by public sector	Resources supplied by private sector at no charge to patients	Total (all costs funded by public sector)
Programme management	20.3	7.4	12.9	23.8
Drugs	11.4	11.4	0	10.5
DOT	10	1.7	8.3	15.7
TB clinic visits not for DOT	1.5	1.3	0.2	3.4
Smears	4.8	0.3	4.5	6.5
Routine interaction with PPs	3.8	0.4	3.4	Negligible[a]
Mapping/orientation of PPs	1	0.3	0.7	0.1
Laboratory supervision	1.5	1.5	0	3.2
Total	**54.3**	**24.3**	**30**	**63.2**

PPs = Private Practitioners

[a] Visits to private practitioners providing DOT done as part of routine general supervision activities at negligible additional cost.

Costs for the different types of patients are shown in Table 9. As expected, costs in both TUs were highest for re-treatment patients and lowest for new smear-negative and extrapulmonary patients.

Table 9. Average cost (US$) per patient treated, by patient category

Type of patient	Mahavir	Osmania
New sm+	55.2	65.1
New sm-/EPTB	49.1	59.4
Re-treatment	67.8	79.3
All	**54.3**	**63.2**

The estimated cost per patient for treatment in the private non-DOTS sector is shown in Table 10. The cost amounts to US$ 100.80, with drugs the most important item.

Table 10. Estimated patient cost (US$) for treatment in the private non-DOTS sector

Cost item	Cost per month	Total cost[a]
Consultation fees	3.9	23.4
Drugs	9.7	58.2
Transport	3.2	19.2
Total	**16.8**	**100.8**

[a] Based on average reported treatment period of 6 months.

3.2.2 Total costs and average annual costs during DOTS implementation

The total and average annual costs associated with DOTS implementation are shown for both Mahavir and Osmania in Table 11. Total costs for the 17 quarters between October 1998 and the end of 2002 in Mahavir were US$ 266 469. Of this total, more than half (US$ 71 760) was accounted for by costs incurred by patients and their attendants. Costs funded by the public sector were US$ 58 126, with the remaining US$ 71 760 representing the value of resources supplied at no charge by the private sector. These total costs translate into an annual average cost of US$ 62 699, of which US$ 32 137 is borne by patients and their attendants, US$ 13 677 by the public sector, and US$ 16 885 is the value of resources supplied by the private sector. For the thirteen quarters between October 1999 and the end of 2002, total costs in

Osmania were US$ 215,840. An even higher proportion of these costs was borne by patients and their attendants than in Mahavir (58%), with the remainder borne by the public sector.

Average annual total costs were lower in Mahavir than Osmania (US$ 62 699 vs US$ 66 412). Costs were lower in Mahavir from the perspective both of the public sector and of patients and attendants, despite a higher annual number of patients being treated. When total provider costs are considered (i.e. costs borne by the public sector plus the resources supplied by the private sector at no charge to patients), costs are higher in Mahavir (US$ 30 561 vs US$ 28 216).

Table 11. Total costs (US$) during period of DOTS implementation and average annual total cost, Mahavir and Osmania

Cost category	Mahavir (last quarter 1998 to end 2002)	Osmania (last quarter 1999 to end 2002)
Costs borne by patients/attendants		
Before diagnosis	52 385 (*n* = 2392)	50 719 (*n* = 1831)[a]
During DOTS treatment	84 198 (*n* = 2392)	35 114 (*n* = 1451)
Treatment in non-DOTS private sector	NA	38 304 (*n* = 380)[b]
Subtotal	136 583	124 137
Costs funded by public sector		
Diagnosis and treatment under DOTS	58 126 (*n* = 2392)	91 703 (*n* = 1451)
Resources supplied by private sector at no charge to patients		
Diagnosis and treatment under DOTS	71 760 (*n* = 2392)	Negligible
All categories	**266 469**	**215 840**
Annual average, patients and attendants	32 137	38 196
Annual average, public sector	13 677	28 216
Annual average, private sector	16 885	Negligible
Annual average, public and private sectors	30 561	28 216
Annual average, all categories	**62 699**	**66 412**

[a] 1451 treated under DOTS plus estimated 380 treated in private non-DOTS sector.
[b] 117 per year, equivalent to 380 over the 13 quarters of DOTS implementation.

3.3 Cost-effectiveness

3.3.1 Cost per patient successfully treated, public sector perspective

The costs per patient successfully treated when only costs to the public sector are considered are shown in Table 12. The average cost per patient successfully treated in Mahavir was US$ 26, compared with US$ 65 in Osmania. From the perspective of the public sector, there were no additional costs associated with the extra cases treated in the PPM-DOTS project: rather, total costs were lower and the total number of patients successfully treated higher in Mahavir.

Table 12. Cost (US$) per patient successfully treated, public sector perspective

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost	13 677	28 216	0	28 216
Total average annual number of cases successfully treated	530	373	59	432
Average cost per patient successfully treated	26	76	NA	65
Average cost per additional patient successfully treated as a result of PPM-DOTS	NA	NA	NA	NA

3.3.2 Cost per patient successfully treated, provider perspective

The costs per patient successfully treated when both costs funded by the public sector and the value of resources supplied free of charge to patients by the private sector (i.e. total provider costs) are considered, are shown in Table 13. The average cost per patient successfully treated is US$ 58 in Mahavir and US$ 65 in Osmania. The cost per additional patient successfully treated as a result of implementation of PPM-DOTS is US$ 24.

Table 13. Cost (US$) per patient successfully treated, provider cost perspective

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost	30 561	28 216	0	28 216
Total average annual number of cases successfully treated	530	373	59	432
Average cost per patient successfully treated	58	76	NA	65
Average cost per additional patient successfully treated as a result of PPM-DOTS	24	NA	NA	NA

3.3.3 Cost per patient successfully treated, societal perspective

When provider and patient/attendant costs are both considered, i.e. costs are considered from a societal perspective, the average cost per patient successfully treated is US$ 118 in Mahavir and US$ 154 in Osmania Table 4). Since the PPM-DOTS project is associated with lower total costs and higher total effectiveness relative to the comparison TU of Osmania, it is not relevant to calculate the cost per additional patient successfully treated.

Table 14. Cost(US$) per patient successfully treated, societal cost perspective

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost	62 699	51 387	15 025	66 412
Total average annual number of cases successfully treated	530	373	59	432
Average cost per patient successfully treated	118	138	255	154
Average cost per additional patient successfully treated as a result of PPM-DOTS	NA	NA	NA	NA

3.4 Sensitivity analysis

3.4.1 Staff costs identical in public and private sector

One important finding from the cost analysis was that staff costs in the public sector in Osmania are considerably higher than those in the private sector in Mahavir. Staff account for a large percentage of all costs (73% in Osmania), and higher costs per staff member may therefore have an important impact on the results of the analysis. Table 15 shows the cost per

patient treated from the perspective of the public sector when the monthly cost of each type of staff (e.g. medical officer, pharmacist, cleaner) is assumed to be the same as that in Mahavir. The cost per patient treated is reduced to US$ 37.80 (compared with US$ 63.20).

Table 15. Public sector cost (US$) per patient treated in Osmania when monthly staff costs are assumed to be the same as those in Mahavir

Cost item	Cost
Programme management	10.70
Drugs	10.50
DOT	4.80
TB clinic visits other than for DOT	2.00
Smears	6.50
Initial orientation of private practitioners	0.10
Laboratory supervision	3.20
Total	**37.80**

The implications of this reduced cost per patient for the cost-effectiveness results are shown in Tables 16a–16c.

Table 16a. Cost-effectiveness, public sector perspective, when monthly staff costs are assumed to be the same as those in Mahavir

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost (US$)	13 677	16 876	0	16 876
Total average annual number of cases successfully treated	530	373	59	432
Average cost per patient successfully treated (US$)	26	45	NA	39
Average cost per additional patient successfully treated as a result of PPM-DOTS (US$)	NA	NA	NA	NA

From the perspective of the public sector, total costs fall substantially for Osmania, and the average cost per patient successfully treated is US$ 39 (Table 16a). However, total costs are still higher than those in Mahavir, and total effectiveness is lower.

When total provider costs are considered, the assumption of lower staff costs in Osmania means that total costs are substantially lower than those in Mahavir (Table 16b). This means that the cost per additional patient successfully treated in Mahavir increases to US$ 140 (compared with US$ 24 in the baseline analysis).

Table 16b. Cost-effectiveness, provider perspective, when monthly staff costs are assumed to be the same as those in Mahavir

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost (US$)	30 561	16 876	0	16 876
Total average annual number of cases successfully treated	530	373	59	432
Average cost per patient successfully treated (US$)	58	45	NA	39
Average cost per additional patient successfully treated as a result of PPM-DOTS (US$)	140	NA	NA	NA

When costs are considered from a societal perspective, total costs in Osmania are lower, and the cost per additional patient successfully treated as a result of PPM-DOTS is US$ 78 (Table 16c).

Table 16c. Cost-effectiveness, societal perspective, when monthly staff costs are assumed to be the same as those in Mahavir

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost (US$)	62 699	40 047	15 025	55 072
Total average annual number of cases successfully treated	530	373	59	432
Average cost per patient successfully treated (US$)	118	107	255	127
Average cost per additional patient successfully treated as a result of PPM-DOTS (US$)	78	NA	NA	NA

3.4.2 Additional cases treated in Mahavir would not have been treated in the private sector in Osmania

A key assumption in the baseline analysis is that the additional cases treated under DOTS in Mahavir would have been treated in the private non-DOTS sector in Osmania. It is possible that this would not have happened, and that cases would have gone untreated. Tables 17a–17c show the cost-effectiveness results that apply when this assumption is not made: in other words, the total number of patients successfully treated in Osmania is equivalent to the total number of patients successfully treated under DOTS.

Table 17a. Cost-effectiveness, public sector perspective, assuming that additional cases treated in Mahavir would not have been treated in the private sector in Osmania

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost (US$)	13,677	28,216	0	28,216
Total average annual number of cases successfully treated	530	373	0	373
Average cost per patient successfully treated (US$)	26	76	NA	76
Average cost per additional patient successfully treated as a result of PPM-DOTS (US$)	NA	NA	NA	NA

This assumption does not change costs from the perspective of the public sector or for providers as a whole, but does lower total effectiveness in Osmania (Tables 17a and 17b). This makes the results look more favourable for PPM-DOTS - for example, from a provider cost perspective, the cost per additional patient successfully treated as a result of PPM-DOTS is only US$ 15.

Table 17b. Cost-effectiveness, provider perspective, assuming that additional cases treated in Mahavir would not have been treated in the private sector in Osmania

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost (US$)	30 561	28 216	0	28 216
Total average annual number of cases successfully treated	530	373	0	373
Average cost per patient successfully treated (US$)	58	76	NA	76
Average cost per additional patient successfully treated as a result of PPM-DOTS (US$)	15	NA	NA	NA

The assumption that the additional cases are not treated in the private non-DOTS sector does, however, lower total costs in Osmania when a societal perspective is chosen (since, if

patients are not treated, patient/attendant costs are lower). Total costs are higher in Mahavir, and the cost per additional patient successfully treated is US$ 72.

Table 17c. Cost-effectiveness, societal perspective, assuming that additional cases treated in Mahavir would not have been treated in the private sector in Osmania

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost (US$)	62,699	51,387	0	53,709
Total average annual number of cases successfully treated	530	373	0	373
Average cost per patient successfully treated (US$)	118	138	NA	144
Average cost per additional patient successfully treated as a result of PPM-DOTS (US$)	72	NA	NA	NA

3.4.3 Patient and attendant costs in non-DOTS private sector 50% of level estimated in baseline analysis

The baseline analysis used data on the costs of treatment in the private non-DOTS sector from another study undertaken in Hyderabad in 1997. The results in the baseline analysis favour Mahavir, while Osmania is the only site where total costs are affected by the assumptions regarding costs in the private non-DOTS sector. Therefore, it is only relevant to consider what impact a reduction (and not an increase) in patient costs in the private non-DOTS sector would have on the results.

Table 18 shows that, on the assumption that patient/attendant costs are 50% of the level assumed in the baseline analysis, total costs from a societal perspective are lower in Osmania than in Mahavir. The cost per additional patient successfully treated as a result of PPM-DOTS is US$ 39.

Table 18. Cost-effectiveness, societal perspective, assuming that patient costs in private sector are 50% of level estimated in baseline analysis

Costs/effects/cost-effectiveness	Mahavir	Osmania		
		DOTS	Non-DOTS	DOTS + Non-DOTS
Total average annual cost (US$)	62 699	51 387	7 512	58 899
Total average annual number of cases successfully treated	530	373	59	432
Average cost per patient successfully treated (US$)	118	138	127	136
Average cost per additional patient successfully treated as a result of PPM-DOTS (US$)	39	NA	NA	NA

4. Results for PPM-DOTS project in Delhi

4.1 Effectiveness

4.1.1 Total and average annual number of cases detected and successfully treated
The numbers of cases detected in the Model 3 PPM-DOTS project in Delhi are shown in Table 19. Between 1 January 2001 and 30 June 2002, a total of 357 cases were detected. This is equivalent to an annual average of 238 cases. A large percentage of cases were new smear-negative or extrapulmonary cases (54% of all cases, 66% of new cases).

A total of 306 cases were successfully treated – an annual average of 204. The successful treatment rate was 84% among new smear-positive cases, 89% among all new cases, and 86% among all cases.

Table 18. Number of cases detected and successfully treated in Model 3 pilot project, January 2001-June 2002

Type of case	Number detected	Number successfully treated
New sm+	101	84
New sm-/EPTB	193	178
Re-treatment	63	44
Total, new cases	294	262
Total, all cases	357	306

4.1.2 Impact of PPM-DOTS on case detection
We did not assess the impact of PPM-DOTS on case detection as part of the economic evaluation because an analysis had already been undertaken in 2002 (*8*, *9*). This analysis assessed the increase in case detection attributable to PPM-DOTS by using data from a sub-area of South Delhi in which the catchment population of private practitioners involved in the project corresponded to that of a government chest clinic (the catchment area had a population of 100 000). The analysis also compared the change in case detection in the PPM-DOTS area with that of a control area with no PPM-DOTS.

The main results of the analysis are summarized in Table 19. They show that PPM-DOTS contributed about one-third of the total cases detected in 2001 and increased case detection by 47% compared with what would have occurred without the project (i.e. 106 PPM-DOTS cases added to the 226 detected in RNTCP facilities in 2001). There was no evidence of any diversion of patients from the public sector to PPM-DOTS – the number of patients detected in public sector facilities increased during the period of DOTS implementation, and by more than the increase witnessed in the control area. This suggests that, if anything, PPM-DOTS might have increased case detection in the public sector, and that the figure of 47% for the increase in case detection attributable to PPM-DOTS is an underestimate of its total impact.

Table19. Impact of PPM-DOTS on case detection

Number of cases detected by year	PPM-DOTS (catchment area population 100,000)	RNTCP government facilities in same catchment area as PPM-DOTS (pop. 100 000)	Control area (no PPM-DOTS, population 100,000)
All new cases			
2000 (no PPM-DOTS)	NA	144	125
2001 (PPM-DOTS implemented)	106	226	157
2002 (1 January —30 June)	68	151	Not assessed
% of total cases detected in the catchment area	32	68	100
% increase 2000–2001	NA	+57	+26
New sm+ cases			
2000 (no PPM-DOTS)	NA	62	64
2001 (PPM-DOTS implemented)	22	76	78
2002 (1 January —30 June)	14	45	Not assessed
% of total cases detected in the catchment area	23	67	100
% increase 2000–2001	NA	+23	+22

4.1.3 Estimated number of patients who would have been successfully treated in the private non-DOTS sector in the absence of the PPM-DOTS project

On the assumption that, in the absence of the PPM-DOTS project, all patients would have been treated in the private non-DOTS sector, and that the successful treatment rate would have been 50%, it may be estimated that 179 of the 357 patients would have been successfully treated if the PPM-DOTS project had not been implemented.

4.1.4 Estimated increase in number of cases successfully treated as a result of PPM-DOTS implementation

The annual increase in the number of cases successfully treated as the result of implementation of the pilot PPM-DOTS project can be estimated as the difference between the annual number of cases successfully treated in the project in practice, and the number that would have been successfully treated in the private non-DOTS sector had the PPM-DOTS project not existed. According to the data and assumptions in 4.1.1 and 4.1.3, it can be estimated that the PPM-DOTS project led to an extra 127 patients being successfully treated (i.e. 306 – 179).

4.2 Costs

4.2.1 Average cost per patient diagnosed and treated

The average patient and attendant costs before diagnosis and during treatment in the PPM-DOTS project and in the private non-DOTS sector are shown in Table 20.

For patients treated in the PPM-DOTS project, costs before diagnosis amounted to US$ 24.40, with the most important costs being drugs, lost wages and investigations. During treatment, the average cost was US$ 27.30, which was roughly split between expenditure on transport and time spent on visits for DOT. The total cost per patient was US$ 51.70.

For patients treated in the private non-DOTS sector, costs were much higher. Before diagnosis, costs amounted to US$ 43.20, with the most important items being drugs and lost wages. During treatment, the total cost was US$ 129, with the largest costs being for drugs, lost wages and investigations.

The average cost per patient treated from the perspective of providers of DOTS diagnosis and treatment (i.e. public sector services and private sector facilities and practitioners) is shown in Table 21. The average cost per patient was US$ 72. The cost to the public sector was US$ 31, with US$ 41 representing resources supplied at no charge to patients by private hospitals and practitioners (mostly staff time and clinic space).

Costs for the different types of patients are shown in Table 22. As expected, costs were highest for re-treatment patients and lowest for new smear-negative and extrapulmonary patients.

Table 20. Average patient and attendant costs (US$) before diagnosis and during treatment under DOTS

Cost item	Patients treated in PPM-DOTS project	Patients treated in private non-DOTS sector
Before diagnosis		
Drugs	10.3	16.2
Consultations	2.1	6.2
Investigations	2.9	7.7
Transport	0.8	1.5
Lost wages	8.1[a]	11.4
Other	0.2	0.2
Subtotal, before diagnosis	*24.4*	*43.2*
During treatment		
Drugs	0	60.0
Consultations	0	12.6
Investigations	0	21.0
Transport	15.5	3.6
Lost wages	0	31.8 [c]
Time spent travelling for DOT visits	11.8 [b]	NA
Subtotal, treatment	**27.3**	**129.0**
Total	**51.7**	**172.2**

[a] 1.7 days for patients, 1.8 for attendants for patients treated in PPM-DOTS project; 3 days for patients and 1.9 days for attendants for patients treated in the private non-DOTS sector.
[b] Total of 30 hours.
[c] 13.2 days.

Table 21. Average provider costs (US$) per patient diagnosed and treated under DOTS

Cost item	Total	Costs funded by public sector	Resources supplied by private sector at no charge to patients
General programme management	30	15	15
Drugs	9	9	0
DOT	23	0	23
Smears	4	3	1
Initial orientation and training of private practitioners	3	2	1
Laboratory supervision	2	2	0
Other	1	0	1
Total	**72**	**31**	**41**

Table 22. Average cost (US$) per patient treated, by patient category

Type of patient	Cost
New sm+	72
New sm–/EPTB	70
Re-treatment	77
All	72

4.2.2 Total costs and average annual costs during DOTS implementation

The total and average annual costs associated with PPM-DOTS implementation and treatment in the private non-DOTS sector (for the same number of patients as were treated in the PPM-DOTS project, i.e. 357 over an 18-month period) are shown in Table 23.

In the PPM-DOTS pilot project, total costs for the period 1 January 2001 to 30 June 30 2002 were US$ 44 161. Of this total, 42% (US$ 18 457) was accounted for by costs incurred by patients and their attendants. Costs funded by the public sector were small in comparison, at US$ 11 067, with the remaining US$ 14 637 representing the value of resources supplied at no charge to patients by the private sector. These total costs translate into an annual average cost of US$ 29 441, of which US$ 12 305 is borne by patients and their attendants and US$ 7378 by the public sector, and US$ 9758 is the value of resources supplied by the private sector.

Treatment for the same number of patients in the private non-DOTS sector is estimated to be higher, at US$ 61 475 over the same 18-month period (equivalent to an annual average of US$ 40 984). All costs are financed by patients and their attendants.

Table 23. Total costs (US$) during period of DOTS implementation and average annual total cost, PPM-DOTS and private non-DOTS sector

Cost category	PPM-DOTS pilot project (January 1st 2001 to June 30th 2002)	Private non-DOTS sector (January 1st 2001 to June 30th 2002)
Costs borne by patients/attendants		
Costs prior to diagnosis	8 711	15 422
Costs during treatment under DOTS	9 746	NA
Costs during treatment in non-DOTS private sector	NA	46 053
Subtotal	18 457	61 475
Costs funded by public sector		
Diagnosis and treatment under DOTS	11 067	0
Resources supplied by private sector at no charge to patients		
Diagnosis and treatment under DOTS	14 637	0
All categories	***44 161***	***61 475***
Annual average, patient and attendant costs	12 305	40 984
Annual average, costs borne by public sector	7 378	0
Annual average, resources supplied by private sector at no charge to patients	9 758	0
Annual average, public and private sector provider costs	17 136	0
Annual average, all categories	29 441	40 984

4.3 Cost-effectiveness

4.3.1 Cost per patient successfully treated, public sector perspective

The costs per patient successfully treated when only costs to the public sector are considered are shown in Table 24. The average cost per patient successfully treated in the PPM-DOTS project is US$ 36, while the cost per additional patient successfully treated as a result of PPM-DOTS is US$ 87.

Table 24. Cost (US$) per patient successfully treated, public sector perspective

Costs/effects/cost-effectiveness	PPM-DOTS project	Private non-DOTS sector
Total cost	11 067	0
Total number of cases successfully treated	306	179
Average cost per patient successfully treated	36	0
Average cost per additional patient successfully treated as a result of PPM-DOTS	87	NA

4.3.2 Cost per patient successfully treated, provider perspective

When costs funded by the public sector, and the value of the resources provided by the private sector at no charge to patients are considered, i.e. a provider perspective is adopted, the average cost per patient successfully treated under PPM-DOTS is US$ 87 (Table 25). The cost per additional patient successfully treated due to PPM-DOTS is US$ 202.

Table 25. Cost (US$) per patient successfully treated, provider perspective

Costs/effects/cost-effectiveness	PPM-DOTS project	Private non-DOTS sector
Total cost	25 704	0
Total number of cases successfully treated	306	179
Average cost per patient successfully treated	87	0
Average cost per additional patient successfully treated as a result of PPM-DOTS	202	NA

4.3.3 Cost per patient successfully treated, societal perspective

When costs are considered from a societal perspective, the average cost per patient successfully treated in the PPM-DOTS project is US$ 144 (Table 26). The large reduction in costs incurred by patients and attendants when patients shift from the private non-DOTS sector to PPM-DOTS means that, from a societal perspective, PPM-DOTS results in both a reduction in total costs and an increase in effectiveness.

Table26. Cost (US$) per patient successfully treated, societal perspective

Costs/effects/cost-effectiveness	PPM-DOTS project	Private non-DOTS sector
Total cost	44 161	61 475
Total number of cases successfully treated	306	179
Average cost per patient successfully treated	144	343
Average cost per additional patient successfully treated due to PPM-DOTS	NA [a]	NA

[a] Not applicable because PPM-DOTS from a societal perspective is both cheaper and more effective.

4.4 Sensitivity analysis

4.4.1 Public funding covers DOT costs

During an assessment undertaken about 16 months after project initiation in mid-2002, 87% of private practitioners who participated in the PPM-DOTS pilot project said that they wanted to continue to be involved in the project (*8*). The majority said that they did not make any direct profit from participation but wanted to continue because their contribution to society through the project was important. Many felt that being involved in the project was a good investment for their practice, since it enhanced their reputation among patients and the community: each successfully treated patient is an advertisement for the practice. In addition, patients treated free of charge for TB could be treated for other illnesses rather than being lost to other providers.

Nevertheless, during visits to private sector practitioners participating in the PPM-DOTS project undertaken as part of the economic evaluation in January 2003, it became clear that some practitioners felt that additional public funding was required to make sustained participation attractive. The results above also demonstrate that, in practice, the value of resources supplied free of charge by private practitioners was large compared with public sector funding. One possibility would be for the public sector to provide funds that would compensate for the costs that private practitioners incur to provide DOT. The consequences for costs and cost-effectiveness of doing this are shown in Table 27. The cost per additional patient successfully treated through PPM-DOTS would increase to US$ 152. The average cost per patient successfully treated would be US$ 63.

Table 27. Cost (US$) per patient successfully treated, public sector perspective, if public sector covers DOT costs

Costs/effects/cost-effectiveness	PPM-DOTS project	Private non-DOTS sector
Total cost	19 278	0
Total number of cases successfully treated	306	179
Average cost per patient successfully treated	63	0
Average cost per additional patient successfully treated as a result of PPM-DOTS	152	NA

4.4.2 Patient and attendant costs in non-DOTS private sector 50% of level estimated in baseline analysis

As with the analysis for Hyderabad, patient and attendant costs in the private non-DOTS sector were estimated to be comparatively high. Table 28 shows the results that would apply if these costs were 50% of the level estimated through the patient survey. The cost per additional patient successfully treated through PPM-DOTS would be US$ 106.

Table 28. Cost (US$) per patient successfully treated, societal perspective, if patient and attendant costs in the non-DOTS private are 50% of the level estimated in the baseline analysis

Costs/effects/cost-effectiveness	PPM-DOTS project	Private non-DOTS sector
Total cost	44 161	30 738
Total number of cases successfully treated	306	179
Average cost per patient successfully treated	144	172
Average cost per additional patient successfully treated as a result of PPM-DOTS	106	NA

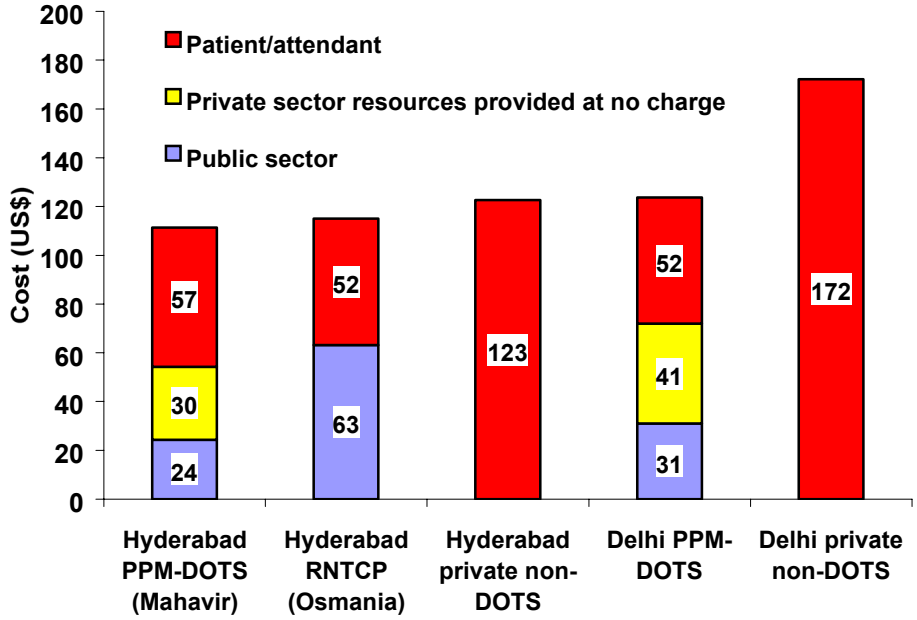
5. Discussion

5.1 Main findings

Globally, the PPM-DOTS projects in Hyderabad and Delhi are the first to have been evaluated from an economic perspective. They show that PPM-DOTS projects can achieve a large increase in the number of cases detected and successfully treated, at acceptable cost. The Mahavir PPM-DOTS project detected 26% more cases than the comparison area without a PPM-DOTS project, and in Delhi PPM-DOTS increased case detection by 47% compared with the level achieved by public sector facilities only. The successful treatment rate exceeded or was close to the WHO target of 85%, at over 90% in Mahavir and 84% in Delhi. From the public sector's perspective, the average cost per patient treated[1] in the PPM-DOTS projects was less than the cost per patient in existing RNTCP public sector DOTS services. For patients and their attendants, treatment in DOTS programmes in the public sector or in PPM-DOTS schemes facilitated a substantial reduction in costs compared with those associated with treatment in the private non-DOTS sector, thus lessening the socioeconomic impact of TB on households.

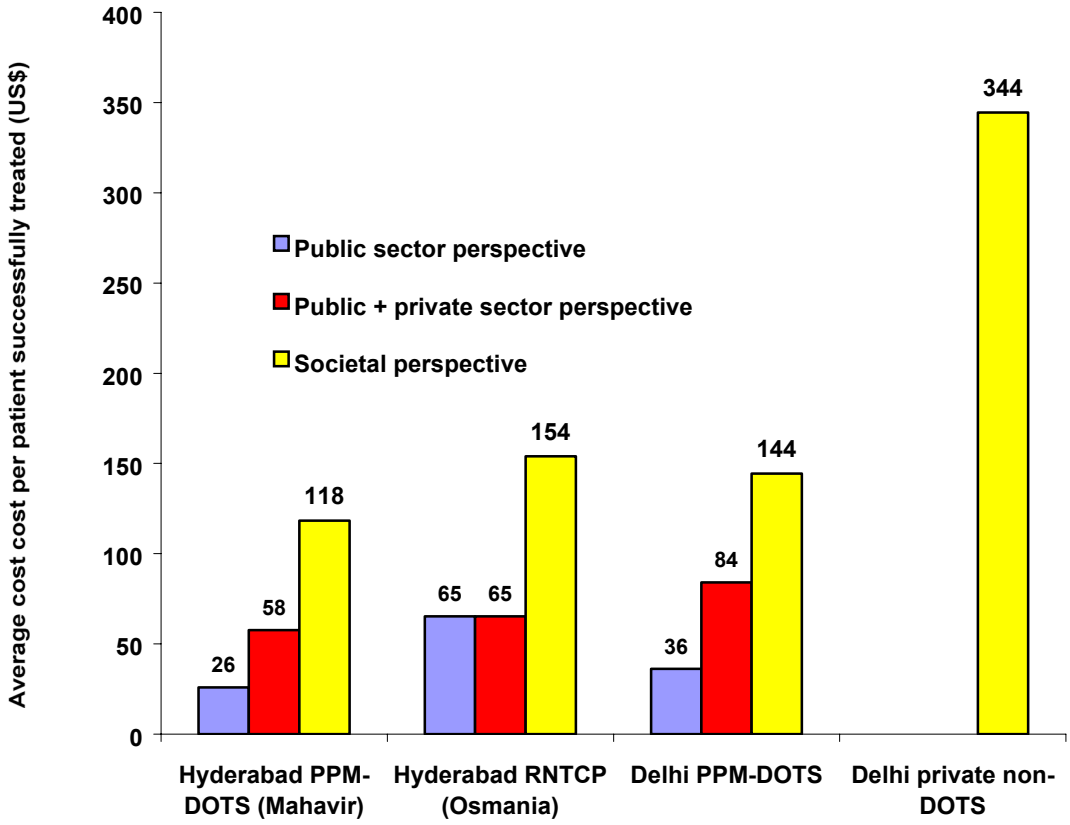
The average cost per patient treated in a PPM-DOTS project or in the public sector RNTCP was broadly similar, at around US$ 55–70 when patient/attendant costs were excluded, and around US$ 110–120 when patient and attendant costs were included (Fig. 1). When only public sector costs were considered, the cost was around US$ 25–30 per patient – much less than the cost of public sector provision of DOTS in Hyderabad, which was around US$ 65 per patient. This reflects the fact that, in both PPM-DOTS projects, the value of resources (primarily staff time and clinic space) supplied by the private sector at no charge to patients was high, at US$ 30–40 per patient treated. All average cost-per-patient-treated figures are low by international standards. From the perspective of the public sector, the average cost per patient treated in DOTS programmes in other low-income high-TB-burden countries is estimated as US$ 100–200, except for Cambodia (US$ 258) (*4*).

Fig. 1 Summary of average cost per patient treated, and who bears costs, in PPM-DOTS projects, the RNTCP public sector DOTS programme, and the private non-DOTS sector



[1]The average cost per patient treated, and the average cost per patient successfully treated, are sometimes confused. In the former, total costs are divided by the total number of patients treated. In the latter, total costs are divided by the total number of patients successfully treated, which is always lower than the total number of patients treated.

Fig. 2. Average cost-effectiveness in PPM-DOTS projects, the RNTCP public sector DOTS programme, and the private non-DOTS sector



The cost-effectiveness results show that the average cost per patient successfully treated in PPM-DOTS projects is around US$ 30–40 when only public sector costs are considered, around US$ 60–85 when both public sector costs and the value of resources supplied by private practitioners at no charge to patients are considered, and around US$ 120–145 when all costs, including those incurred by patients and their attendants, are considered (Fig. 2). Like the cost-per-patient-treated figures, these figures are low by international standards. When both patient and provider costs are considered, recent evaluations have reported an average cost per patient successfully treated of US$ 164–310 in Pakistan (*21*), US$ 201–456 in Malawi (*22*), US$ 239–696 in Kenya (*23*), and US$ 391–911 in Uganda (*24*).

When cost-effectiveness is measured more strictly as the cost per additional patient successfully treated through the implementation of PPM-DOTS, the results in Mahavir are striking. Compared with what it can be estimated would occur without the PPM-DOTS project (i.e. standard public sector implementation of the RNTCP), total public sector costs are lower and the total number of cases successfully treated higher – meaning that there are no additional costs for the extra cases successfully treated. The same is true when all costs (i.e. those borne by the public sector, by private practitioners, and by patients/attendants) are considered. These findings reflect lower costs than the public sector DOTS programme, especially for staff, and the high cost of treatment in the private non-DOTS sector.

In the Delhi PPM-DOTS project, the cost per additional patient successfully treated was higher, at US$ 87 when public sector costs only are considered and US$ 202 when both public sector costs and the value of resources supplied by private practitioners at no charge to patients are considered. However, as in Mahavir, when patient and attendant costs were also considered, PPM-DOTS in Delhi resulted in an overall reduction in costs and an improvement in the number of cases successfully treated. This reflects the high costs incurred by patients diagnosed and treated in the private non-DOTS sector, and the fact that, with

implementation of PPM-DOTS, these costs were substantially lowered and partially transferred to the public sector and private practitioners.

The cost-effectiveness results highlight two important methodological issues. First, the costing perspective chosen for an economic evaluation can make a big difference to the absolute value of the cost and cost-effectiveness figures and to their interpretation. For example, the cost per patient treated from the perspective of the public sector is much lower than the cost per patient treated when costs to the public sector, private practitioners, patients and attendants are all considered. Second, the average cost per patient successfully treated in PPM-DOTS projects can be different from the cost per additional patient successfully treated as a result of the implementation of PPM-DOTS. The former is more comparable with published economic evaluations, most of which focus on average costs and do not allow for the fact that some cases successfully treated in the public sector would, in the absence of public sector services, have been successfully treated in the private non-DOTS sector. The latter is a more strict assessment of the cost-effectiveness of PPM-DOTS, but could lead to unfair comparisons with other published data. If donors wish to specify a threshold cost-effectiveness figure that PPM-DOTS projects must meet to qualify for funding, these methodological issues need careful consideration.

5.2 Limitations

The analyses have two major limitations, both related to the assessment of effectiveness. One is that we had very limited evidence about the successful treatment rates achieved in the private non-DOTS sector. However, our assumption of a 50% successful treatment rate is consistent with the available literature, which comes from a variety of settings in different countries including India (*14*–*17*).

The second limitation is that we had to make assumptions about the number of patients who would have been detected and treated in the public and private sectors in the absence of a PPM-DOTS project. For Mahavir, we estimated numbers by assuming that a TU with a similar demographic and socioeconomic profile reflected the situation that would exist in the absence of PPM-DOTS, and that any patients not treated in the public sector DOTS programme would be treated in the private non-DOTS sector. This is reasonable to the extent that the comparison TU that we chose – Osmania – is truly similar to Mahavir TU and that cases do not go untreated. If it is assumed that cases not treated under DOTS are not treated at all, the sensitivity analysis shows that this makes the results look more favourable for PPM-DOTS. Even if Osmania TU is not truly comparable with Mahavir, the finding that PPM-DOTS is cheaper for the public sector than RNTCP-DOTS provided through the public sector, and that the average cost per patient successfully treated compares favourably with RNTCP-DOTS in India and figures for other low-income countries, still holds. This is because the average figures are not affected by the assumptions regarding effectiveness, which affect only the calculation of the cost per additional patient successfully treated through implementation of PPM-DOTS.

For Delhi, we assumed that the number of patients treated in the public sector was not affected by the implementation of PPM-DOTS, and that all patients treated in the PPM-DOTS project would have been treated in the private non-DOTS sector in the absence of the project. The available data suggest that, if anything, these assumptions underestimate the real impact of PPM-DOTS, and that our analysis is therefore conservative in its assessment of the effectiveness of PPM-DOTS. The number of patients detected by the public sector increased more rapidly in the PPM-DOTS area during the period of PPM-DOTS implementation –- an increase of 57% for all cases and 23% for new smear-positive cases in the PPM-DOTS area between 2000 and 2001 compared with increases of 26% and 22% respectively in the area where PPM-DOTS was not implemented (*8*, *9*). This indicates that the patients detected in the private sector through the PPM-DOTS project represent a real increase in detection rather than a diversion of some patients from the public sector to the private sector, and that, if anything, the PPM-DOTS project may have increased the number of cases detected by public sector facilities – for example because private practitioners became more aware of the RNTCP public sector DOTS programme and referred more patients to it than previously.

We also acknowledge that our analysis does not answer the question of whether it is more cost-effective to increase case detection through further strengthening of existing public sector DOTS services than through implementation of PPM-DOTS. It was not possible to conduct such an analysis because we had no data on the additional costs and additional effectiveness that would be associated with further strengthening of DOTS services provided through public sector facilities. However, the fact that the average cost per patient treated and the average cost per patient successfully treated are similar to or lower than figures for existing public sector DOTS services does suggest that DOTS expansion through PPM-DOTS can be at least as cost-effective as further expansion, or further strengthening, of publicly delivered DOTS services.

5.3 Generalizability

Our results derive from only two pilot projects, so an important issue is the extent to which they can be generalized. The project in Mahavir, Hyderabad, implemented PPM-DOTS in an area with no public sector DOTS services. As such, it will be most replicable in areas where public sector DOTS services are either non-existent or insufficient to cover the existing population. For example, when the Mahavir PPM-DOTS TU was established, there were only seven TUs in Hyderabad serving a population of around 5 million. According to RNTCP guidelines, a population of this size requires 10 TUs, and this was an important justification for the establishment of Mahavir TU. A similar situation may apply in other Indian cities that have experienced rapid population growth since the initial establishment of TUs several years ago. Situational analyses of current population size and distribution, and the availability of public health services, can be used to identify locations where this is the case. The Delhi model is most replicable in areas where public sector DOTS is already available but many patients are still being treated in the private sector.

In terms of effectiveness, it is important to be clear that the results apply to particular approaches to PPM-DOTS. In Mahavir, a dedicated team at a charitable private hospital to organizes and manages PPM-DOTS, with leadership from a senior private chest physician. Great care is taken to ensure that all private practitioners receive regular feedback about referred patients and have the opportunity to provide treatment to the patient themselves. In Delhi, the local branches of the Delhi Medical Association managed PPM-DOTS, with support from a national research institute. Both projects actively mobilized private practitioners, training was provided by the RNTCP, and drug costs were funded by the public sector. In Delhi, the public sector also provided participating private sector microscopy centres with new microscopes and funded laboratory refurbishment.

Other approaches to PPM-DOTS are possible but may not work. Therefore, if results from Mahavir and Delhi are to be replicated elsewhere, it is essential to identify and emulate the factors that explain their success. A recent analysis comparing the successes of four different PPM-DOTS projects suggested that, on the provider side, an effective PPM-DOTS intervention package should include four components (*13*). These are: (1) improved referral and information systems through simple practical tools; (2) training and sensitization of private practitioners as well as NTP staff; (3) sufficient supervision and monitoring of private practitioners by the government sector; and (4) a free supply of drugs from the NTP to private practitioners, which are then provided free of charge to patients. The analysis also indicated that, if such an intervention package is to be legitimized and accepted by all stakeholders, and thus lead to real changes in private practitioners' practices, it is important that the government sector is strongly committed to funding, supervising and evaluating PPM-DOTS. However, using a not-for-profit private institution, such as an NGO or medical association, as "neutral ground" for the implementation of PPM-DOTS may facilitate collaboration. It is also important that time be invested in dialogue among all stakeholders so that trust is built and there is agreement on the goals of PPM-DOTS. With an increasing number of projects now being implemented in India and elsewhere, careful evaluation of successful, less successful and unsuccessful projects should continue, so that further evidence about the factors that explain success and failure in PPM-DOTS projects becomes available.

The cost results for patients and their attendants are consistent with other studies in India, which suggest costs of around US$ 100–180 (in year 2002 US$) per patient during treatment

in the private sector (*25*–*28*). The cost to the public sector of providing DOTS in government facilities, at US$ 65 in Hyderabad, is consistent with a recent national estimate of US$ 72 (*4*). The value of resources supplied at no charge by private practitioners was based on consultation fees that could be earned per hour of time in private practice (for the time supplied by physicians), salaries paid to assistants (for defaulter tracing) and the rental cost of clinic space (for space used for DOT visits). The consultation fees and salaries were similar in both projects and may be broadly typical of other parts of urban India. Rental costs were much higher in Delhi than in Hyderabad and explain the relatively high cost of DOT visits in this project (they accounted for 70% of the US$ 0.50 cost of a DOT visit). DOT costs in other parts of India may becloser to those in Hyderabad (US$ 0.20 per visit). The cost of the resources funded by the public sector in both PPM-DOTS projects should be generalizable to the rest of the country, since the prices of the major inputs provided (drugs, RNTCP training, laboratory supplies, STSs, STLSs and motorcycless) are fairly standard.

While the total cost-per-patient figures may be broadly generalizable for PPM-DOTS projects with characteristics similar to those implemented in Delhi and Hyderabad, it is not clear whether the *distribution* of costs is either sustainable or generalizable. The value of resources supplied by private practitioners at no charge to patients and with no reimbursement from the public sector was large in both projects, at US$ 30–40 per patient. The Mahavir project has been implemented for five years and in this sense does appear sustainable. Private practitioners have been willing to participate without any direct monetary incentive, and the project leader has continued to donate much of his time free of charge. However, whether project leaders with successful private practices willing to donate as much of their time free of charge could be found elsewhere is not clear. In Delhi, informal discussions with private practitioners indicated some dissatisfaction with the existing level of input required, especially for DOT and defaulter tracing, and with the new government policy of paying an incentive of 175 rupees (around US$ 3.50) per patient treated. On the other hand, the PPM-DOTS project in Delhi has continued to function successfully after the initial 18-month “pilot” phase evaluated in this report. In addition, existing evidence suggests that many private practitioners view participation in PPM-DOTS schemes as a good investment that enhances the reputation of their clinic and in turn can generate extra clients. More research is needed to improve our understanding of the incentive structure of private practitioners and how this affects their decision to participate in PPM-DOTS.

It is difficult, if not impossible, to generalize beyond India. Nevertheless, it is noteworthy that salaries in other countries may be higher in the private sector than in the public sector, rather than the reverse which was the case in India. Meanwhile, expansion of PPM-DOTS in India will allow further assessment of generalizability as well as comparisons of different approaches to PPM-DOTS. Comparison with other approaches to increasing case detection – such as implementing DOTS in public sector facilities that are not yet part of the RNTCP – should also be undertaken.

5.4 Policy implications

What are the policy implications of the results? One interpretation of the results could be that all DOTS implementation should shift towards PPM-DOTS mode, given that costs from the public sector perspective were lower in the two pilot PPM-DOTS projects than in the RNTCP operating through the public sector only. This interpretation would be incorrect for three reasons. First, the results apply only to a situation in which PPM-DOTS implementation is building on a strong RNTCP public sector programme with strong management and monitoring capacity, not to a situation in which there is no RNTCP public sector programme. The results might be very different if PPM-DOTS only were implemented. Second, convincing the private sector to become involved in delivery of DOTS may require the existence of a strong public sector programme that has demonstrated success. Third, the level of resources supplied free of charge by the private sector may not be sustainable or generalizable to other sites, in which case the costs of PPM-DOTS and public sector only DOTS might be rather similar.

A second interpretation could be that the Hyderabad model should be promoted because it was of lower average cost and superior cost-effectiveness compared with the Delhi project.

This would also be incorrect. When the influence of higher clinic rental costs in Delhi is removed (i.e. DOT visit costs are assumed to be identical in the two projects), the two projects have similar average costs per patient (US$ 54 for Hyderabad and US$ 59 for Delhi). The successful treatment rate was higher in the Hyderabad project, but not because DOTS implementation is solely through the private sector (successful treatment rates in the private sector were lower in Delhi compared to Hyderabad). The differences in the cost-effectiveness indicator cost per additional patient successfully treated through implementation of PPM-DOTS arise mainly from the fact that the comparisons being made to evaluate the two projects were different.

The results do indicate that PPM-DOTS should be expanded as part of RNTCP activities in India – thus supporting existing policy. They also suggest that a review of the existing policies of paying an incentive of around US$ 3.50 for each patient who successfully completes treatment in the private sector and providing a budget of US$ 7200 per year to the private institution responsible for managing DOTS implementation in a standard TU (i.e. catchment population of 500 000) is warranted. These policies were developed when there were no data available regarding the costs that private practitioners incur when implementing DOTS. Our economic analysis shows that these costs are much higher than both the incentive and the budget. Based on the the data currently available, it is reasonable to suggest that the public sector should consider making a larger financial contribution to PPM-DOTS than that made in Hyderabad and Delhi. It it is important to consider whether the public sector cost of a PPM-DOTS scheme should be closer to that of DOTS implementation in public sector facilities, so that the cost to private providers is reduced and, presumably, the sustainability of private practitioner involvement improved.

5.5 Conclusions

PPM-DOTS can be an effective, affordable and cost-effective approach to improving TB control in India. Successful approaches to PPM-DOTS should be scaled up alongside continued implementation and expansion of the public sector RNTCP DOTS programme.

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Appendix 1

Questionnaire for Patient and Attendant Costs Before Diagnosis in a PPM-DOTS project

Questions to patient

1. TB no. _____
2. Sex _____
3. Age _____
4. Marital status _____
5. Occupation _____
6. Monthly income _____
7. No. of people earning in household _____ total income per month _____
8. No. of providers visited before diagnosis of TB _____
9. Total cost of consultation fees _____
10. Total cost of investigations (laboratory tests, X-rays etc.) _____
11. Total cost of drugs purchased_____
12. Total cost of transportation _____
13. Total no. of days lost from work _____
14. Amount of wages lost for each day lost from work_____
15. Total other costs _____

Questions to attendant

16. Sex ____
17. Age ____
18. Occupation _____
19. Monthly income _____
20. Transport cost if different from patient _____
21. Expenditure (other)_____
22. No. of days lost from work to accompany patient _____.
23. Amount of wages lost per day _____

Appendix 2

Questionnaire for Patient and Attendant Costs During Treatment in a PPM-DOTS project

Questions to patient

1. TB no. _____
2. Sex _____
3. Age _____
4. Marital status _____
5. Occupation _____
6. Monthly income _____
7. No. of people earning in household _____ total income per month _____
8. Cost of transportation to private practitioner per trip (to and from) _____
9. Time taken (in minutes) for each visit to private practitioner (to and from) _____
10. No. of visits for treatment _____
11. Amount of work lost per visit (whole day/hours/none) _____
12. Amount of wages lost per visit _____
13. (From treatment card) No. of months on treatment _____

Questions to attendant

14. Sex ____
15. Age ____
16. Occupation _____
17. Monthly income _____
18. Transport cost if different from patient _____
19. Expenditure (other) _____
20. No. of days lost from work to accompany patient _____
21. Amount of wages lost per day _____

Appendix 3

Questionnaire for Patient and Attendant Costs Before Diagnosis in the Private non-DOTS Sector

Questions to patient

1. Name _____
2. Private practitioner providing treatment at time of interview _____
3. Sex _____
4. Age _____
5. Marital status _____
6. Occupation _____
7. Monthly income _____
8. No. of people earning in household _____ total income per month _____
9. No. of providers visited before diagnosis of TB _____
10. Total cost of consultation fees _____
11. Total cost of investigations (laboratory tests, X-rays etc.) _____
12. Total cost of drugs purchased _____
13. Total cost of transportation _____
14. Total no. of days lost from work _____
15. Amount of wages lost for each day lost from work _____
16. Total other costs _____

Questions to attendant

17. Sex ____
18. Age ____
19. Occupation _____
20. Monthly income_____
21. Transport cost if different from patient _____
22. Expenditure (other)_____
23. No. of days lost from work to accompany patient _____.
24. Amount of wages lost per day_____

Appendix 4

Questionnaire for Patient and Attendant Costs During Treatment in the Private non-DOTS Sector

Questions to patient

1. Name _____
2. Private practitioner providing treatment at time of interview _____
3. Sex _____
4. Age _____
5. Marital status _____
6. Occupation _____
7. Monthly income _____
8. No. of people earning in household _____ total income per month _____
9. No. of consultations with private practitioner in last month _____
10. Time taken (to and from) per visit to private practitioner _____
11. Total cost of consultation fees in last month _____
12. Total cost of investigations in past month (laboratory tests, X-rays etc.) _____
13. Total cost of drugs purchased in past month_____
14. Total cost of one month's supply of drugs _____
15. Total cost of transport for visits to private practitioner in past month _____
16. Total no. of days lost from work in last month due to TB _____
17. Total amount of wages lost per day _____
18. Total other costs associated with TB treatment in past month _____

Questions to attendant

19. Sex ____
20. Age ____
21. Occupation _____
22. Monthly income _____
23. Transport cost if different from patient _____
24. Expenditure (other)_____
25. No. of days lost from work to accompany patient _____
26. Amount of wages lost per day _____