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Public–private mix for tuberculosis in urban health systems in least-developed, low-income and lower–middle-income countries and territories: a systematic review

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ABSTRACT

Objective To evaluate the impact of public–private mix (PPM) models for tuberculosis (TB) on health, process and system outcomes, adopting the WHO's definition of PPM, which is a strategic partnership between national TB programmes and healthcare providers, both public and private, to deliver high-quality TB diagnosis and treatment.

Design Systematic review without meta-analysis using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines.

Data sources EMBASE, MEDLINE, Health Management Information Consortium, Social Sciences Citation Index, Science Citation Index, Emerging Sources Citation Index, CENTRAL, Database of Disability and Inclusion Information Resources, WHO Library Database and 3ie.

Eligibility criteria We included all primary studies examining PPM models delivering TB services in urban health sectors in least-developed, low-income and lower–middle-income countries and territories.

Data extraction and synthesis 17 reviewers were involved in data extraction in COVIDENCE using a prepiloted template. All extractions were completed by a single reviewer and checked by a second reviewer. Quality appraisal was carried out using the mixed-methods appraisal tool, covering mixed-methods, qualitative and quantitative study designs. Narrative synthesis was carried out by tabulating and summarising studies according to PPM models and reported in line with the synthesis without meta-analysis guidelines.

Results Of the 57 included studies, covering quantitative (n=41), qualitative (n=6) and mixed-method (n=10) designs, the majority were from Southeast Asia (n=37). PPM models had overall positive results on TB treatment outcomes, access and coverage and value for money. They are linked with improved TB health workers' skills and service delivery. Most outcomes tended to favour interface models, although with considerable heterogeneity. Inconsistent implementation of national TB guidelines, uncoordinated referrals and lack of trust among partners were identified as areas of improvement. Evidence was lacking on the involvement of informal providers within PPM models.

Conclusions PPM models can be effective and cost-effective for TB care in urban low- and middle-income countries contexts, particularly when levels of mistrust between public and private sectors are addressed through principles of equal partnership. The evidence indicates that this may be more achievable when an interface organisation manages the partnership.

PROSPERO registration number CRD42021289509.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Our searches covered many databases without restrictions on outcome, publication date or language.
⇒ We adopted a collaborative approach within the review team, which enabled cross learning among various disciplines, such as urban and public health, epidemiology, statistics and health economics.
⇒ Most studies included in this review were from South Asia, which limits the extrapolation of our findings to other contexts and scenarios.
⇒ We could not establish a pathway of impact based on public–private mix models due to the heterogeneity of the included studies.
⇒ The review provides limited evidence about informal providers who play a crucial role in tuberculosis care in low- and middle-income countries.

INTRODUCTION

Tuberculosis (TB) remains a major global health problem despite being preventable and treatable. According to the WHO, in 2022, there were 10.6 million cases and 1.6 million deaths due to TB world over.[1] The impacts of COVID-19 have led to increases in TB deaths

for the first time in over a decade.[1] Severe disruptions in routine TB care and services in many countries have set back progress towards achieving the WHO end TB strategy goals of reducing TB deaths and incidence.[2 3] This is to the extent that meeting the sustainable development goal of ending the TB epidemic by 2030 now seems unlikely.[4 5] Many countries also face profound economic and health losses due to the additional TB burden.[4]

If progress is to be made towards the global goal of eradicating TB, expanding access to TB diagnosis and treatment services is clearly a priority action.[6] Between 2015 and 2020, there were an estimated 3–4 million 'missing people with TB'. This refers to the difference between cases reported in national data and estimates of TB prevalence. These 'missing people' are assumed to have been treated in the private sector.[1] It is not surprising, therefore, that a key priority for the global stop TB partnership and the WHO is to scale up public–private mix (PPM) models, with a specific focus on improving TB care and data reporting in the private health sector.[6]

Nowhere is the need to partner with the private sector clearer than in cities in low- and middle-income countries (LMICs). Rapidly growing urban populations have outstripped the capacity of meagre the existing public services to meet healthcare demands.[7] Studies have consistently shown that city dwellers, particularly the poorest, rely on a plethora of private providers (PPs).[8 9] PPs include a wide spectrum of private for-profit, non-governmental organisations (NGOs) and informal, unregistered providers. This is particularly true of TB, which is fuelled by the very determinants that are prevalent in poor urban neighbourhoods, such as overcrowding, poor nutrition and high tobacco use.[10] With the drive for universal health coverage, some middle-income countries, such as Malaysia and Indonesia, have made good progress towards the provision of free public healthcare particularly for low-income households, and it is the better off who choose to use PPs.[11 12] However, in many low-income countries, particularly in sub-Saharan Africa and South Asia, the private sector, characterised by limited regulation and widely available over-the-counter anti-TB drugs, tends to be the most common first point of contact for people with TB.[13 14] This combination of high vulnerability to TB and easy access to PPs for treatment underlines the need for city governments and national TB programmes (NTPs) to find ways of harnessing the private sector to provide effective TB diagnosis and care in urban areas in LMICs.

PPM models are a well-recognised and recommended mechanism to address these challenges and improve TB treatment outcomes; previous reviews have concluded the overall improvements in TB service outcomes, especially in resource-limited areas.[15–17] However, the reviews did not explicitly focus on urban contexts, which is key to address, given the rapid urbanisation and proliferation of PPs in urban areas and the need for policymakers to understand how to design PPMs for urban contexts.[18] We, therefore, aimed to describe and investigate the impact of existing PPM models for TB diagnosis and treatment on health, process and system outcomes in urban health systems in LMICs.

METHODS

This review was developed as a part of the Community-led Responsive and Effective Urban Health Systems (CHORUS) Research Programme Consortium, which aims to develop and test ways to improve the health of the poorest urban residents and build research capacity in LMICs. This is a collaborative study developed by representatives from the CHORUS partner organisations in the UK, Nepal, Bangladesh, Ghana and Nigeria. This review is a part of a broader synthesis on Public-Private Partnership (PPP) models in LMICs, which has been submitted as a separate manuscript.

Our report follows the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines[19] (online supplemental table 1). The review protocol was registered on PROSPERO (CRD42021289509)[20] and published.[21]

Search strategy

We searched the following ten electronic databases and research repositories, covering published and grey literature on 20 June 2024: EMBASE, MEDLINE, Health Management Information Consortium, Social Sciences Citation Index, Science Citation Index, Emerging Sources Citation Index, CENTRAL, Database of Disability and Inclusion Information Resources, WHO Library Database and 3ie. The search strategy consisted of two main facets, namely, PPM models and the countries or regions of interest (see online supplemental table S2 for details). No language or date restrictions were applied. In addition, reference lists of relevant systematic reviews were checked to identify any additional research, alongside screening of references and forward citations of included studies. Retrieved records were deduplicated in EndNote and uploaded to COVIDENCE (www.covidence.org) for further evaluation.

Inclusion criteria and study selection

We included all primary studies examining PPM models delivering TB services in urban health sectors of the 2021 World Bank-defined[22] least-developed, low-income and lower–middle-income countries and territories. PPM models were defined as long-term (not one-off events), formal or informal arrangements between the public and private sectors, while the term 'urban' referred to all semi-urban, peri-urban, suburban and urban slum and non-slum areas in eligible countries. Protocol papers were included to allow a comprehensive understanding of types of PPM models being developed. Unless subsequent results were published, no further information on study outcomes relating to these models could be included in the synthesis. Studies that included urban and rural areas were eligible only if urban-specific results were separately reported (see online supplemental table S3 for detailed

eligibility criteria). A total of 17 reviewers were involved in the study selection process. Sets of two reviewers independently screened the studies, first by title and abstract, then by full texts; discrepancies were resolved through discussion with a third reviewer.

Data extraction and synthesis

17 reviewers were involved in data extraction and used a prepiloted template specifically developed for this review and uploaded to COVIDENCE. All extractions were completed by a single reviewer and checked by a second reviewer. Quality appraisals were carried out using the mixed-methods appraisal tool (MMAT).[23] The screening questions were applied to all study designs (S1. Are there clear research questions? and S2. Do the collected data allow us to address the research questions?), followed by a separate set of five questions on the methodological quality criteria tailored for each study design: qualitative, quantitative randomised trial, quantitative non-randomised studies (eg, cohort and case–control), quantitative descriptive (eg, surveys and case series) and mixed-methods studies. No sensitivity analysis was conducted based on the quality assessment. However, as recommended by MMAT, we presented the final rates for each study. Extraction items included publication details, PPM partners, their roles as previously defined[24] (stewardship/support/service provision/monitoring/financing), study characteristics and sample size, TB interventions provided by the PPM, reported outcomes related to health (TB treatment outcomes), process (indicators of access, coverage, utilisation, cost, etc.) and WHO-defined[25] system-building blocks (leadership and governance, service delivery, health system financing, health workforce, products/technologies and information systems). The authors of the included studies were not contacted for additional data. During the extraction and coding of the six system-building blocks, the team found findings pertaining to the attitudes and behaviours of those involved in the PPM and the social and organisational context. Hence, two additional themes were added.

Narrative synthesis was carried out by tabulating and summarising studies according to PPM models (ie, whether the partnership between the public and private sectors was direct or managed through an interface agency) and reported in line with the synthesis without meta-analysis guidelines (online supplemental table S4).[26] We also assessed the performance of different PPM models on TB health, process (including cost-effectiveness) and system outcomes.

For health outcomes, we used the percentages and CIs to build forest plots (without meta-analysis) grouped by PPM models; CIs not reported in the studies were calculated using SD and sample sizes. Quantitative results relating to process and system outcomes were tabulated in similar groups and summarised. For studies reporting cost and cost-effectiveness, we first summarised the study perspectives (ie, patient, provider, public sector and societal) and outcomes (ie, treatment success and disability-adjusted life years (DALYs) averted) reported. All costs were reported in International Dollars (I$) at 2022 prices to ensure comparability across the studies. We first inflated costs reported in local currencies to 2022 prices using the annual inflation rates provided by the International Monetary Fund. Costs reported in US Dollars were converted to local currencies using the exchange rates specified in each study, then inflated to 2022 prices. To convert costs to I$, we divided the inflated costs by the World Bank's annual purchasing power parity conversion factor for each country, using 2022 values. Afterwards, we plotted the results on a cost-effectiveness diagram. We adopted WHO-CHOICE and country-specific thresholds to report the incremental cost-effectiveness ratio (ICER) per DALY averted when available. Due to the variability in costs and cost-effectiveness outcomes, we were unable to run sensitivity analyses.

All extracted qualitative findings were coded and grouped under the qualitative themes using Nvivo 1.7.[27] An inductive reasoning approach was adopted, with three reviewers independently coding the qualitative findings. Disagreements or discrepancies were resolved by discussion. The synthesised qualitative findings were combined with quantitative findings and reported against each building block. Finally, we conducted results-based convergent synthesis to explore how the PPM models affect their outcomes.

Amendments to the protocol

Our original review covered all health conditions.[21] However, given the large number of studies on TB control and the comparability of outcomes reported, we amended our protocol (updated on PROSPERO) to carry out additional synthesis specifically on those papers reporting urban TB PPM models. The screening criteria originally excluded tertiary healthcare settings, but was amended to remove this clause after piloting for 25 studies. Finally, we did not use RE-AIM[28] for qualitative analysis as originally planned, as the framework did not adequately capture the outcomes reported in the included studies.

Patient and public involvement

No patients or members of the public were involved in the conception, development or analysis of the review. No patients were asked to advise on the interpretation or writing up of results.

RESULTS

Our searches identified 8207 records, from which 57 eligible studies on TB (reported in 65 publications) were included[29–93] (figure 1). For eight studies,[29 30 35 36 50 51 59 60 62 63 72 73 82 86 87 89 90] the research was reported across two publications each, which were merged and extracted as one study (online supplemental table S5 and online supplemental table S6). Most studies were from the WHO Southeast Asia region (n=37, 64.9%), followed by eastern Mediterranean (n=7, 12.3%), western

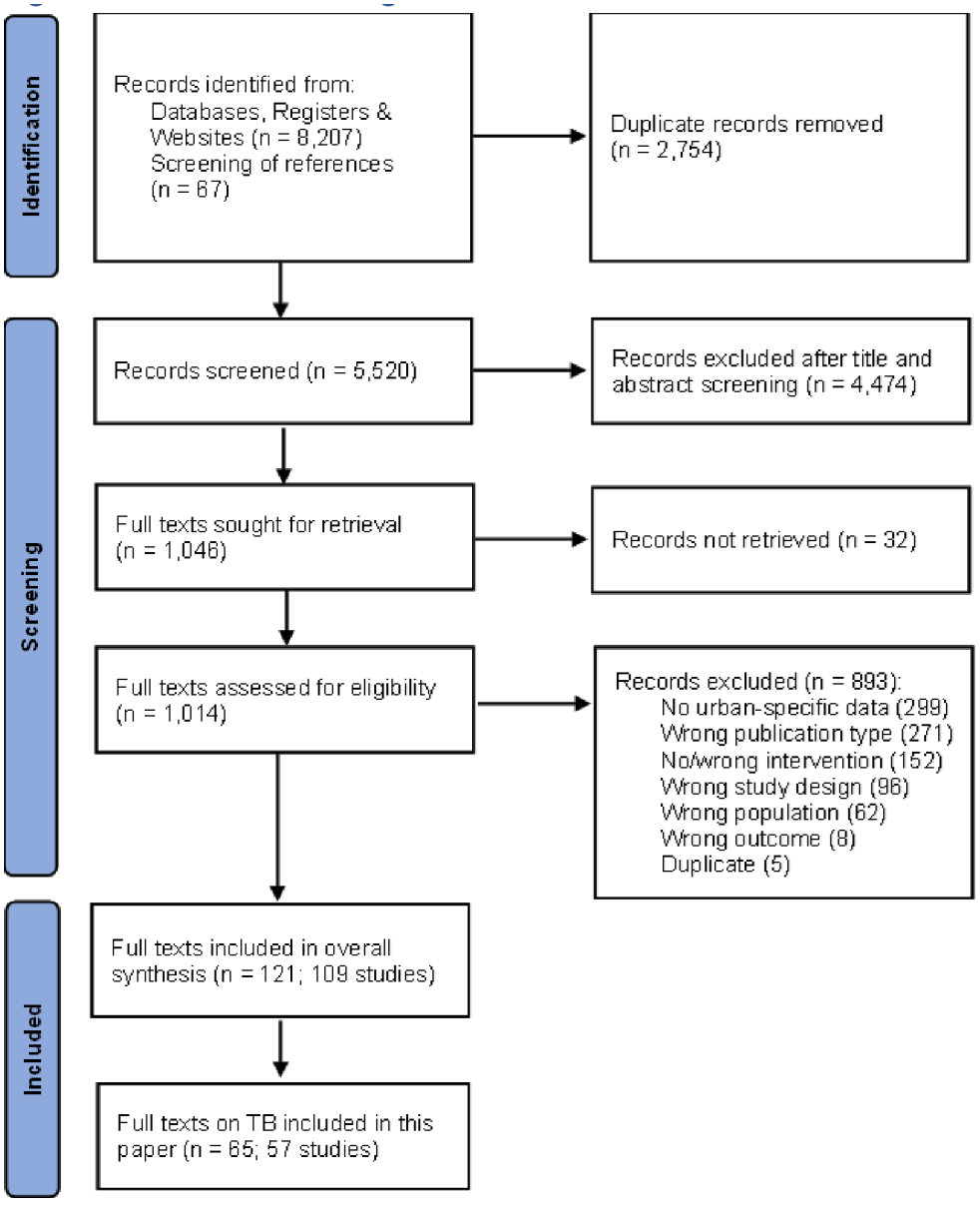


Figure 1 PRISMA flow diagram. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analysis.

Pacific (n=6, 10.5%), African (n=5, 8.8%) and American (n=1, 1.7%) regions. One study reported models from across three different countries and regions (online supplemental table S5).

We included quantitative (Randomised Controlled Trial (RCT) protocol 1, RCT 1, non-randomised intervention studies with comparison 9, without comparison 19, observational 4, and cost and cost-effectiveness 7), qualitative (n=6) and mixed-methods (n=10) studies. Few studies (mostly qualitative) met all the design-specific quality appraisal criteria (n=7, 12.3%), while scores for the remaining studies were distributed as follows: scores 4/5=9 (15.8%) studies, 3/5=19 (33.3%) studies, 2/5=8 (14.0%) studies and 1/5=2 (3.5%) studies (online supplemental table S5). In the mixed-methods studies (n=10), we found no clear integration between the different study components, but the majority scored 3/5 or greater in the separate qualitative and quantitative parts. Finally, quality scores could not be assessed for one protocol[50] and another study, which did not provide the necessary methodological details[31] (online supplemental table S5).

Characteristics of PPM models included in the review

We found two types of PPM models (online supplemental table S5 and S6)—those in which the public-sector TB programme formed a direct partnership with the private sector (direct models, n=24), and those in which there was an interface agency linking the public and private partners within the model (interface models, n=37). The interface agencies themselves varied, but were frequently NGOs, private hospitals, medical or pharmacy associations or research organisations who were also involved in the evaluations of the models. In only one study, which included participants from multiple PPM models, the description of each model was not clearly provided.[92]

In both the interface and direct models, the roles of stewardship, monitoring and support (as defined by Tabrizi *et al*[24]) were mainly provided by the public sector, most commonly through the NTP. The extent of involvement of the NTP in the interface models varied, with some taking on monitoring and support directly, while in other models, the NTP would only provide a stewardship role. Information regarding financing was not reported in many papers, but when it was reported, the public partner was reported as providing funding most frequently, often supported by The Global Fund. Both public and private partners were involved in delivering services in both the interface and direct models (online supplemental table S6). Regarding the interventions provided, while some models focused on increasing case detection, the majority also aimed to decentralise TB treatment to increase coverage and reach growing urban populations. A mix of health, process and systems outcomes was reported in most studies, while some only reported results relating to one outcome category. For the RCT protocol that was included,[50 51] only details of the PPM model were extracted.

Health outcomes

Health outcomes for urban-specific populations were reported in 31 studies, comprising treatment success (n=29), unfavourable treatment outcomes, such as default, failure, mortality (n=19), sputum conversion (n=3) and TB incidence (n=1).

Of the 29 studies reporting treatment success,[29 31 33 36–39 43 45–47 53–56 58 59 62 64 67 68 70 75 77 79 80 83 85 91] 17 (60.7%) reported rates>=85%. Figure 2 plots the estimates from 21/28 studies (for which 95% CIs were reported or could be estimated), according to PPM model type and quality appraisal scores. The interface models achieved a treatment success rate close to 90% more consistently than the direct models, particularly among studies with a quality score of 4/5, although given the heterogeneity of the studies, it was not possible to draw conclusions. Ten studies compared favourable and/or unfavourable treatment outcomes (treatment success, default, failure and mortality) for PPM directly observed treatment short course (DOTS) provision with public DOTS/private non-DOTS during the study period.[29 31 33 39 46 64 67 70 80 94] The majority (8/10) reported comparable or better outcomes

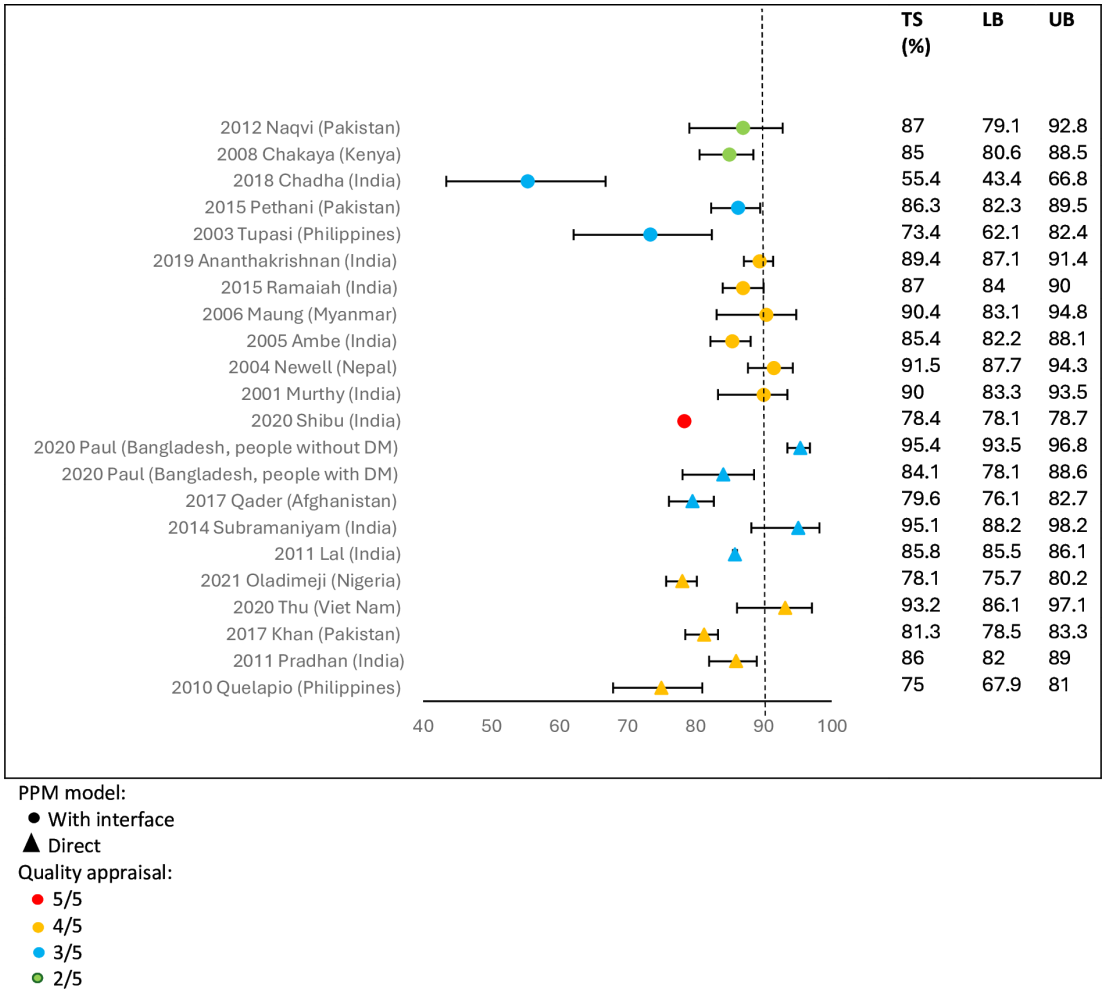


Figure 2 Forest plot (without meta-analysis) of studies reporting TB treatment success according to PPM model type. LB, lower bound; PPM, public–private mix; TB, tuberculosis; TS, treatment success; UB, upper bound.

- 10 studies compare TB treatment outcomes of PPM DOTS with public DOTS/private non-DOTS, but CI not reported/could not be calculated in five studies; only studies with CIs have been plotted in the figure below:

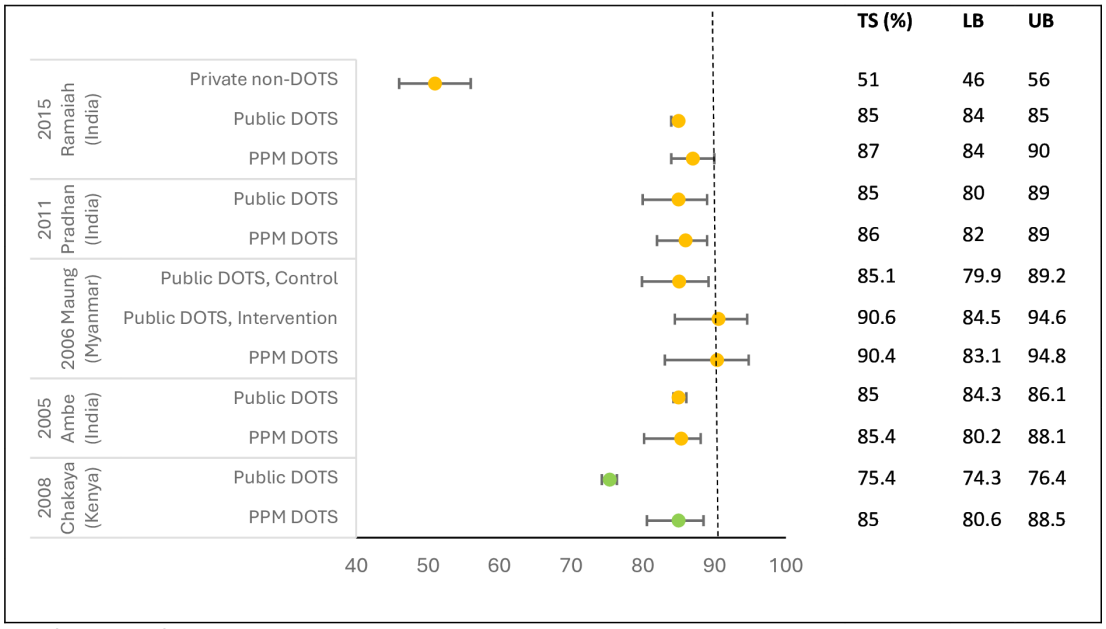


Figure 3 Forest plot (without meta-analysis) of studies reporting TB treatment success comparing PPM DOTS with public DOTS/private non-DOTS. DOTS, directly observed treatment short course; LB, lower bound; PPM, public–private mix; TB, tuberculosis; TS, treatment success; UB, upper bound.

with the implementation of PPM models (online supplemental tables S5 and S6 and figure 3). Regarding sputum conversion, all three studies reported increases after PPM implementation.[57 58 67] One modelling study estimated that with 75% PPM with interface coverage, the cumulative incidence of TB would reduce by 8.5% (95% CI 4.2 to 15.6) over 10 years.[86]

Process outcomes

Process outcomes were reported in a total of 46 studies, including access (n=10), coverage (case detection/notification) (n=23), utilisation (n=4), awareness/behaviour change (n=9) and improved efficiency (n=8). Further, we found studies that reported cost (n=4), cost-effectiveness (n=4) and both cost and cost-effectiveness (n=1).

Results showed an increase in access to TB diagnostic services (including GeneXpert testing)[72 84 88] and DOTS[39 42 58 62 67 77 95] with PPM implementation. Almost all studies reporting coverage (in both direct and interface models) reported an increase in case detection/notification (up to 40%[64] with PPM implementation, or they found higher rates in PPM compared with control settings).[49 61 67 74] In only one study, no increase in case detection was found,[57] while in another, it was only reported as being close to national targets.[39] On the other hand, we found less favourable results relating to the utilisation of TB diagnostic and treatment services within the context of PPMs. TB testing based on GeneXpert,[48] as well as TB-HIV testing and treatment,[41 70] appeared to be poorer in PPM compared with public settings. In one PPM model-providing workplace DOTS, only 24.2% of those diagnosed with TB undertook treatment at the workplace.[77]

Awareness and behaviour change among PPs (including pharmacies) was mainly reported in interface models and positively influenced by PPMs. These included greater use of sputum testing, decreased reliance on chest X-rays and adoption of DOTS among PPs.[62 71 82 84 89] In private pharmacies, reduction in stocking and selling of anti-TB drugs and greater referral to NTP services were noted.[62 65] Among the direct models, one cross-sectional study found that a considerable number of PPs still lacked access to DOTS guidelines (42.3%) and continued to treat TB on clinical suspicion (47.1%).[40] Nonetheless, an increase in TB knowledge[34] and greater referrals to NTP services were also found among PPs after implementation of two direct PPM models.[49]

Regarding the outcome 'improved efficiency', high TB treatment initiation was consistently reported across both model types.[43 54 55 83] Studies also reported lower loss to follow-up before treatment initiation among PPM PPs compared with non-PPM PPs.[45] The use of a mobile-health application in one small Ugandan study identified increased efficiency in case notification and clinical decision-making due to the use of the app.[92] In another

interface model, which included both formal and informal PPs, consulting an informal PP first was associated with delay in diagnosis (absolute increase 22.8 days, 95% CI 6.2 to 39.5) and increased risk of long delays (adjusted risk ratio (aRR) 2.4, 95% CI 1.3 to 4.4).[81]

Cost and cost-effectiveness studies

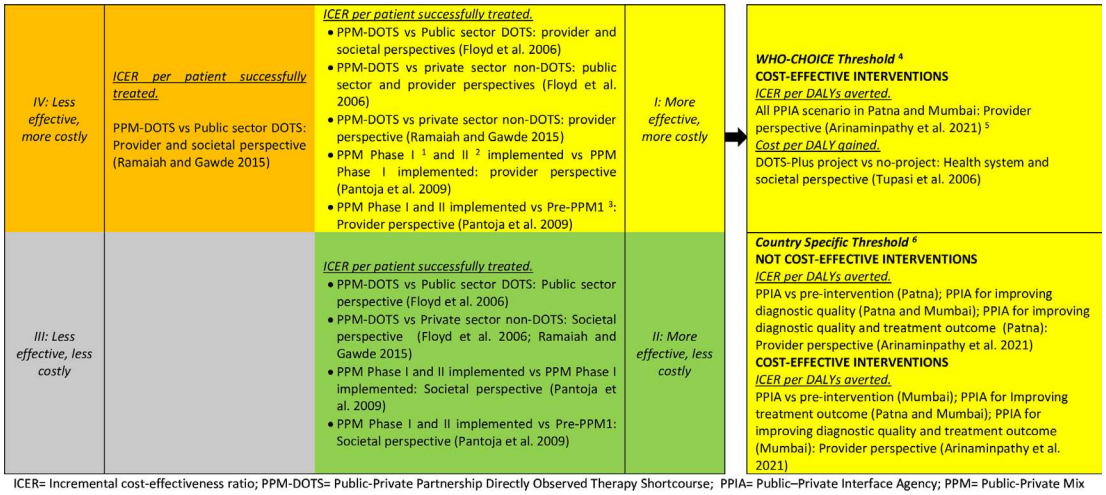
Among the studies reporting cost and cost-effectiveness, only one (reporting both outcomes) was based on a direct model,[35] while all remaining studies evaluated interface models.[56 60 66 69 80 87 88] The cost studies looked at out-of-pocket expenses, time and income loss incurred by patients (n=2), as well as costs incurred by the PPM providers to implement the intervention (n=3). Most cost-effectiveness studies (n=4) adopted the societal perspective.

One costing study in Hyderabad, India (interface model) found lower out-of-pocket expenditures (eg, fees, transport, diagnostic investigations and medications) and income loss (months' lost wages) for patients treated under PPM-DOTS compared with public-sector DOTS (treatment costs: I$7.56 vs I$83.16 and months' lost wages: 1.4 vs 2.8).[56] Another before and after costing study from India found lower out-of-pocket expenditures for patients after implementing a direct PPM model to aim to ensure good quality TB diagnosis and treatment (I$130.03 vs I$897.80).[35] From the health system perspective (all interface models), the total cost (start-up plus 1-year recurrent costs) of implementing PPM-TB varied substantially from I$14 227 for an intervention aiming to increase TB case detection, diagnosis and treatment in Bandung City, Indonesia[82] to I$299 224 for an intervention aiming to improve the quality and coverage of TB diagnosis and treatment in Latipur City, Nepal.[69] The cost to PPM providers per TB case detected was calculated to be I$424.42 in Patna, India[86] and I$836.91 in Bandung, Indonesia[88] (online supplemental table S7).

Among the cost-effectiveness studies, one reported the ICER per DALY averted,[87] one the cost per DALY gained[60] and all others ICER per patient successfully treated.[35 66 80] The ICER varied according to the intervention, perspective (eg, societal, health system and patient), cost-effectiveness threshold (ie, WHO-CHOICE based on the Gross National Income and country-specific threshold) and comparator, falling in different quadrants of the cost-effectiveness diagram (figure 4). Two studies with the interface model indicated that, compared with separate public- and private-sector DOTS, PPM-DOTS was cost-saving (more effective and less expensive) from a societal perspective.[66 80] Another cost-saving intervention from a societal standpoint was the scale-up and intensification of a direct PPM in 14 large cities in India.[35] Using the WHO-CHOICE threshold, the DOTS-Plus project targeting MDR-TB was also cost-effective from a societal perspective in the Philippines.[60] From the provider perspective, an interface model aiming to provide high-quality TB diagnostic tests and maximise treatment completion presented mixed results in India. The intervention was cost-effective for all coverages in both Patna and Mumbai when adopting the WHO-CHOICE threshold. However, when adopting a country-specific threshold, the intervention was cost-effective in Patna only when focused on improving treatment outcomes[87] (online supplemental table S7 and figure 4).

System outcomes

Results pertaining to system outcomes covered leadership and governance (n=5), service delivery (n=12), health workforce (n=27), information systems (n=3) as well as the two additional qualitative themes, namely attitudes and



ICER= Incremental cost-effectiveness ratio; PPM-DOTS= Public-Private Partnership Directly Observed Therapy Shortcourse; PPIA= Public–Private Interface Agency; PPM= Public-Private Mix for tuberculosis care and control

[1] PPM Phase I: RNTCP started to engage with public and private medical colleges, and increased collaboration with NGOs as well as public sector entities not previously involved in the RNTCP; [2] PPM Phase II: scale up and intensify PPM in 14 large cities; [3] Pre-PPM phase: DOTS implemented almost exclusively in the facilities of the Ministry of Health; [4] Per capita Gross National Income; [5] PPIA scenarios: PPIA vs pre-intervention, PPIA for improving treatment outcome; PPIA for improving diagnostic quality; PPIA for improving diagnostic quality and treatment outcome; [6] Based on willingness to pay studies in India

Figure 4 Cost-effectiveness plan for PPM TB. DALYs, disability-adjusted life years; NGO, non-governmental organisations; PPM, public–private mix; RNTCP, Revised National Tuberculosis Control Programme; TB, tuberculosis.

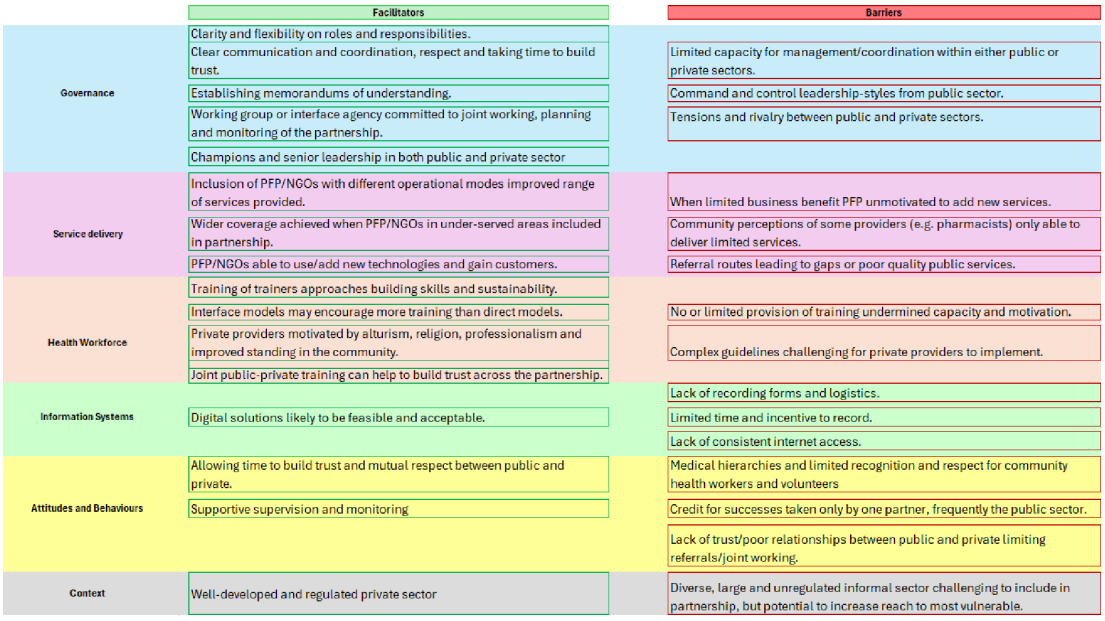


Figure 5 Summary of facilitators and barriers to implementation of public–private partnerships identified in the included studies. NGOs, non-governmental organisations; PFP, private for-profit.

behaviours within the system (n=7), and context (n=4). The facilitators and barriers to successful implementation of the partnerships identified within the studies under these health system domains are summarised in figure 5.

Leadership and governance

The leadership and governance findings were multifaceted and complex. Understanding clear roles and responsibilities of partners was essential, noting that individual roles could change and develop throughout the partnership. Joint working and communication were identified as important factors for TB PPMs, and time and trust were required for this to happen effectively. However, 'deep-rooted tensions, rivalry and suspicion',[78] particularly between the public and private sector, have been a feature of PPMs. These factors, along with a lack of confidence in partners' capabilities, have resulted in a requirement to 'build relations (and) trust'[57] through 'sustained interactions',[39] based on clear commitments to the NTP and championing of the PPM. Building relations was fundamental, given that PPM governance often required 'changes in standards'[78] to promote and maintain the quality of services (including laboratory diagnosis, care and drugs), necessitating control mechanisms in an environment of little previous trust or confidence in other stakeholders within the partnership. PPM stakeholders also required sufficient capacity (including the NTP) to contribute meaningfully and sustainably. This capacity could be strengthened through progressive, flexible learning programmes, such as 'Cambodia's learning-by-doing philosophy, its readiness to review and adapt policy'[73] or giving partners the opportunity to gain additional experience in management that ultimately was 'relevant not only to TB control but other public health issues'.[73]

Where leadership and governance were housed within NGOs or other interface organisations, the qualitative findings reported that this feature was crucial to success: 'a key component of the PPP was the provision of an interface between the various partners. In our case, this interface was a working group serviced by a liaison officer. The working group was a forum for potential partners to meet and plan the PPP. The commitment of the liaison officer proved key to the successful implementation of the PPP' (2005 Newell, pg. 1014).[63]

Qualitative participants in one study in India[78] explored differences between direct government-led models and an interface model led by a private hospital. They found that where government leadership was seen as too strong with rigid reporting systems and supervision, and little respect for PP's decisions, the PPM models were problematic. Conversely, interface organisations, often under the leadership of a TB 'champion',[63 78] ensured open communication and respect between public and private sectors and were more effective.

Service delivery

All relevant studies (covering study designs and both model types) reported increases in the number of DOTS-providing centres following PPM implementation.[37 41 46 47 70 85] The inclusion of a variety of private and NGO providers within the models allowed adaptations to the standard public TB services offered. For example, in PPMs where NGOs were involved, home visits were also included to increase follow-up and conduct contact tracing, thus strengthening service provision.[42] However, in one study, when a new HIV testing service was added on to the existing service provision of TB services, the private-sector providers were less likely to implement the new service than the public sector, the authors do identify,

however, that this may have been due to limited reporting from the PPs.[40] In many models, the way services were delivered also changed with increased emphasis on counselling and advising patients to seek diagnosis and complete their treatment. This was particularly identified by PPM pharmacy owners as a key part of the services provided, although some felt that community perceptions of pharmacies as only providers of drugs undermined this role.[72]

Where a PPM provided a new service, it ensured buy-in from PPs, for example, in McDowell *et al*[84] and Daftary *et al*,[88] where the inclusion of GeneXpert diagnostics and free chest X-rays, respectively, provided care seekers with a tangible new service. However, when there were gaps in vital services provided by the public sector, such as microscopy, the coordinated provision of services within the PPM would break down.[57] While referral systems were a key mechanism for improving service delivery, several studies identified challenges, such as limited feedback from the public to the private system,[57 76] or poor relationships between the private and public providers, undermining referrals to public services when needed.[41] Only one study found that PPs were concerned about providing TB services due to fears of infection control.[72]

Health workforce

Several studies (both quantitative and qualitative) indicated positive outcomes in improving the knowledge and skills of the TB health workforce and their active engagement.[32 34 37 68] Among the quantitative studies, one study reported using a 'training of trainers' approach to improve sustainability and follow-on training for the health workforce.[37] The proportion of PPs receiving training ranged from 17.6%[52] to 82.8%[32] in direct models and 62.9%[82] to 100%[56] in interface models.

Findings from the qualitative studies (all but two based on interface models) presented insights from PPs on the value of training in increasing their confidence to counsel and motivate patients to take up their referrals while also ensuring their client flow and status in society.[72] Nonetheless, public- and private-sector providers both had concerns about the TB treatment knowledge and quality of care that the other sector provided. Even after training and dissemination of guidelines, some studies[57 78 84] found it a challenge to ensure care according to the government TB programme standards: 'the government has a programme. The private practitioners have patients' (TB consultant quoted in 2014 Engel, pg. 922).[78] Yet, training was identified as one part of the process to build trust between the two sectors,[62 76] in addition to reassuring PPs that they would not lose clients through mechanisms, such as the public-sector issuing patients with back-referral letters.[44 78]

Where a training programme for PPs within the PPM did not exist, as was the case in Pokhara (Nepal),[93] both public and private sector providers felt it undermined the approach. However, the sheer number of pharmacies and private clinics, particularly in urban contexts, was also seen as too many to feasibly train and update on TB guidance. Further, training only the pharmacy owners might not be sufficient as the day-to-day staffing likely comprised other, sometimes unregistered, staff. These factors led to calls from policymakers to ban the sale of TB medications in private facilities.[93]

Motivation of PPs was another recurring theme within the health workforce domain. Several mechanisms that motivated PPs were identified, including altruism and religion,[72] improving public health,[72 88] financial compensation and feedback,[88] professionalism[82] and increased legitimacy and standing in the community.[42 62] Standing in the community was particularly enhanced when the increased knowledge and improved practice of the PPs led to treatment success.

'When patients get better, they are thankful. They have trust in our pharmacies and let their friends and relatives know. So that helps build our customer base. That's one benefit for our business'. (Focus group with pharmacists in Cambodia, 2012 Bell, pg. 1089).[72]

Information systems

Regarding the role of information systems in PPMs, Baral *et al*[93] and Hurtig *et al*[57] found considerable challenges, with lack of availability of reporting forms, and private hospitals and pharmacies not having the time to complete patient reports. Hurtig *et al*[57] also reported that the potential to use records to collect tax or payments undermined the willingness of PPs to complete any patient records. A more recent study assessed the feasibility of a mobile-health application to facilitate referrals between private clinics and public hospitals for TB diagnosis and treatment.[92] While only a small pilot intervention in three private and one public hospital, users of the app from all facilities reported that it was feasible to use and reminded patients to attend appointments, although it depended on health professionals having a smartphone and internet access.[92]

Attitudes and behaviours within the system

Qualitative findings emphasised tensions in attitudes between public and private sectors. Where studies reported the evolution of PPMs over time, there were interesting reflections on the changing nature of these attitudes, moving from distrust and suspicion particularly in relation to quality and motivation to a greater understanding and respect.[57 62] However, building relationships took time, and this was identified as a significant barrier when PPMs followed the direct model and leadership and coordination fell to the NTP: 'the NTP lacks the time, and to a lesser extent the credibility, to do this, and it will, therefore, usually be necessary to find someone else to act'. (2002 Hurtig, Pg. 84).[57]

Medical hierarchies were also identified as undermining the effectiveness of PPM models, with TB healthcare workers and volunteers working directly with patients and household contacts expressing their frustration at the lack of respect, calling for a shift towards recognising their

pivotal role and addressing power dynamics.[42 44] In one study, NGO health workers of the same professional level as NTP supervisors reported being treated as inferior due to their non-public-sector position, and this was despite an interface model where the NGO coordinated the PPM.[78] Positive monitoring and support mechanisms were also emphasised for PPM success and scale-up.[76 77] Where all credits for improvements in programme outcomes were seen as being taken solely by the government, this undermined the smooth running of the programme.[44]

Context

The private sector demonstrated considerable heterogeneity, including informal providers, non-allopathic professionals and a highly accessible, developed and regulated pharmacy network. However, PPM policies tended to '(categorise) all types of private practitioners (irrespective of system of practice) under one broad group', seeing them 'through the same lens of financial incentive' (2016 Salve, Pg. 631).[44] While different categories of providers had different motivators for contributing to a PPM, they were not solely financial. Further, given that 'unqualified practitioners predominate in poorer areas' (2014 Engel, Pg. 922),[78] policymakers may feel uneasy about working with providers that legally do not exist but recognise that not doing so may result in lost opportunities. This did not go unrecognised by some practitioners who felt that '(PPM) policy has ignored the potential of alternative systems of medicine and the contribution they can bring to TB control efforts' (2016 Salve, Pg. 631).[44] The role of external donors was explored in one study where qualitative participants highlighted the role of the leading global stakeholder in supporting programme implementation, knowledge transfer and capacity building.[73] However, it was also noted that, in the long term, this proved unsustainable.[57 73]

DISCUSSION

Principal findings of the review

In this systematic review, we summarise the impact of PPM models for TB diagnosis and treatment specifically within urban health systems in least-developed, low-income and lower–middle-income countries and territories. Overall, we found a positive impact on health outcomes (treatment success and sputum conversion), access to healthcare and coverage (TB diagnostic services and case detection) and value for money (cost-saving interventions and reduced patient costs). We also found that PPM models are linked with improved TB health workers' skills and service delivery. Any differences in impact based on PPM model type (direct or interface) were less clear though. The interface models were more commonly linked with higher treatment success (close to 90%), reduced TB incidence (by 8.5%), improved awareness and behaviour change among PPs, effective communication and mutual respect between the public and private sectors. On the other hand, we could not find any pattern of PPM models linked to costs and cost-effectiveness, as just one of the ten studies on this outcome was based on a direct model.

Despite the overall positive impact of PPM TB in the urban scenario, our review also pointed out areas of improvement, particularly in the process and system outcomes. GeneXpert testing and TB/HIV coinfection testing were poorer under PPMs compared with the public sector. Qualitative findings reported inconsistencies in the implementation of NTP guidelines, uncoordinated referrals, lack of confidence in the capabilities of partners, inappropriate power dynamics and inefficiency of direct models when they adopted strict report systems and supervision. With the growing number and diversity of PPs in urban areas, the challenges of conducting sufficient training and keeping providers up to date with NTP guidelines were highlighted particularly in the more recent studies. While we have summarised the facilitators and barriers to the successful implementation of PPM models in urban contexts in figure 5, this should not be seen as an exhaustive list of potential facilitators and barriers. Many studies did not systematically assess or report facilitators and barriers to implementation, and it is very likely that additional factors will influence implementation, and that with rapid changes in the mix of providers, services available, information systems and the context of urban areas, these factors will also be dynamic rather than static.

Interpretation of findings

The WHO recommends PPM models for TB care where there is high utilisation of the private sector, poor quality of care, low case detection, poor treatment outcomes and increased costs to affected families.[96] In the context of LMICs, rapid urbanisation has exacerbated these problems, and our review findings indicate the contribution of PPMs in ameliorating them. Our findings are also supported by previous reviews on the topic,[16 17] although their inclusion criteria covered rural contexts as well. Similar to Lei *et al*,[17] our included studies were largely from Asia, followed by the African and American regions. In contrast, while they classified the PPM collaborative characteristics as support, contract and multipartner groups, we categorised them as direct and interface models and within both model types, listed the roles for public- and private-sector partners (stewardship/support/service provision/monitoring/financing), as defined by Tabrizi *et al*.[24] Based on their classification, Lei *et al*[17] recommend multiple collaboration mechanisms, including multipartner groups to ensure positive PPM performance. Although our findings similarly lean towards interface models with multiple partners, this must be interpreted with caution due to the heterogeneity of PPM schemes in terms of coverage, services provided and outcome measures evaluated.

An earlier review by Malmborg *et al*[16] assesses the degree to which the STOP TB Partnership's[97] global objectives of engaging all care providers are met through existing PPM interventions and find inclusive evidence

on reducing patient costs. Our updated searches identified ten studies reporting cost and/or cost-effectiveness of PPM models, and findings indicate lower out-of-pocket payments and cost-saving interventions from the societal perspective, possibly due to the influence of lower patient costs despite high implementation costs. However, we found substantial differences in outcomes evaluated, types of costs included and methodological approaches (eg, cost-effectiveness thresholds) (online supplemental table S8), which likely influenced the high degree of variation in implementation costs and whether a model was cost-effective when other study perspectives were adopted. Another 2006 review by Malmborg *et al* focuses on the range of PPs included in TB PPMs and concludes that the existing models do not adequately cover providers who may be best suited to meet the needs of the poor and vulnerable.[98] This is unfortunately still true; few studies mentioned non-allopathic PPs,[32 56 64 91] and even fewer reported on informal providers,[44 81] despite the existing evidence that all providers can be successfully engaged in TB care with appropriate support and training.[99]

Regarding system outcomes, findings from the present review somewhat align with the current evidence. The role of training in improving skills and service delivery within TB PPMs is well documented,[17 100] and challenges related to funding discontinuation and lack of regulatory mechanisms have been noted in non-TB PPMs as well.[24 101] Some recent studies have explored solutions to the system challenges identified, such as inconsistent implementation of NTP guidelines, uncoordinated referrals and lack of trust among partners. A study from Nigeria has recommended making less bulky and more precise NTP guidelines available at all levels of care, as well as training intensification for PPs to improve adherence.[102] In another study, a Hub and Spoke model improved the referral system and uptake of GeneXpert testing after a coordinated engagement of private laboratories.[103] In India, recognition of PPs as key stakeholders and equal partners, and formalisation of partnerships enhanced transparency and trust between partners and a sense of accountability within PPM models.[104] With increasing use of mobile-health technologies, there is potential for these data systems to support PPMs and further research in this area would be beneficial.[105]

Strengths and limitations

Our review analyses the impact of PPM models for TB diagnosis and treatment, focusing on urban settings in LMICs, to provide decision makers with systematically synthesised evidence that is specific to these contexts. We excluded upper–middle-income countries, given the differences in TB prevalence and trends of urbanisation compared with other LMIC groups.[106] Our searches covered a large number of databases and grey literature resources, with no restrictions on outcome, publication date or language. Finally, we adopted a collaborative approach within the review team, which fostered cross learning among different disciplines, such as urban and public health, epidemiology, statistics and health economics. However, the following are some limitations to consider. First, more than half the studies (65%) were from Southeast Asia, with other WHO regions being less represented. So, the extrapolation of our findings may be limited, particularly for South American countries with only one included study. Second, most studies reached a low-quality score (3 or lower), likely reflecting on the accuracy of the information provided. Third, we could not establish a clear pathway of impact according to the PPM model types (direct or interface) due to the heterogeneity of the studies. The lack of detailed descriptions of the models and, particularly, the roles of the different organisations within the PPMs limited our ability to draw firm conclusions on which the characteristics of the models could be clearly associated with the facilitators or barriers to success. Our inclusion of qualitative findings provided valuable insights on these facilitators and barriers; however, drawing any definitive conclusions is a limitation of the study. Fourth, we excluded grey literature due to its variable quality and lack of peer review. Finally, we found limited evidence on informal providers, who play an essential role in the TB cascade of care in urban LMIC contexts.

Implications of findings

Although PPM models have the ability to improve access to TB screening, diagnosis and treatment outcomes in urban contexts, careful consideration is needed in their design due to considerable levels of mistrust between public and private sectors in most contexts. Factors such as excess control and top-down approaches from government agencies, can undermine the strong partnership between public and private sector providers. Instead, where regular communication built on the principles of equal partnership is implemented, PPM models appear to be more successful. There is also some evidence that this may be more achievable when an interface organisation manages the partnership.

Based on ten included studies, PPM interventions appear cost-saving, with lower out-of-pocket payments. Nonetheless, more comparative research is needed to understand which PPM models are most cost-effective, particularly to guide the decision-making process and indicate the sustainability of interventions in resource-constrained scenarios.[103] Further, Adepoju *et al*[102] point out the difficulties in evaluating TB-PPM performances, given the variations in risk profiles, as well as access to providers and services across the public and private sectors in different urban contexts. In addition, we found poor methodological and reporting quality of existing studies. Following from these points, we support the need for clearer and more standard reporting of PPM models and their performances, with particular attention to the involvement of diverse PPs, including informal providers.

CONCLUSIONS

Taken together, our findings support the implementation of PPM models for TB care in urban LMIC contexts. Providing decision makers with evidence of the best design of PPM models to deliver these positive outcomes is, however, less straightforward. Very few studies included informal providers, which is a major gap in urban LMIC contexts.

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