Role of informal healthcare providers in tuberculosis care in low- and middle-income countries: A systematic scoping review

5 authors, including:

Poshan Thapa
UNSW Sydney
33 PUBLICATIONS **273** CITATIONS

Nachiket Gudi
The George Institute for Global Health
33 PUBLICATIONS **216** CITATIONS

Kristen Beek
UNSW Sydney
23 PUBLICATIONS **110** CITATIONS

Some of the authors of this publication are also working on these related projects:

Role of Informal Healthcare Providers (IPs) in TB care in LMICs View project

Completeness of reporting in Indian qualitative public health research: a systematic review of 20 years of literature View project

PLOS ONE

Role of informal healthcare providers in tuberculosis care in low- and middle-income countries: A systematic scoping review

Poshan Thapa[1]*, Rohan Jayasuriya[1], John J. Hall[1], Kristen Beek[1], Parthasarathi Mukherjee[2], Nachiket Gudi[3], Padmanesan Narasimhan[1]

1 School of Population Health, University of New South Wales, Sydney, Australia, 2 Liver Foundation, Kolkata, West Bengal, India, 3 The George Institute for Global Health, New Delhi, India

* thapaposhan2009@gmail.com

Abstract

Achieving targets set in the End TB Strategy is still a distant goal for many Low- and Middle-Income Countries (LMICs). The importance of strengthening public-private partnership by engaging all identified providers in Tuberculosis (TB) care has long been advocated in global TB policies and strategies. However, Informal Healthcare Providers (IPs) are not yet prioritised and engaged in National Tuberculosis Programs (NTPs) globally. There exists a substantial body of evidence that confirms an important contribution of IPs in TB care. A systematic understanding of their role is necessary to ascertain their potential in improving TB care in LMICs. The purpose of this review is to scope the role of IPs in TB care. The scoping review was guided by a framework developed by the Joanna Briggs Institute. An electronic search of literature was conducted in MEDLINE, EMBASE, SCOPUS, Global Health, CINAHL, and Web of Science. Of a total 5234 records identified and retrieved, 92 full-text articles were screened, of which 13 were included in the final review. An increasing trend was observed in publication over time, with most published between 2010–2019. In 60% of the articles, NTPs were mentioned as a collaborator in the study. For detection and diagnosis, IPs were primarily involved in identifying and referring patients. Administering DOT (Directly Observed Treatment) to the patient was the major task assigned to IPs for treatment and support. There is a paucity of evidence on prevention, as only one study involved IPs to perform this role. Traditional health providers were the most commonly featured, but there was not much variation in the role by provider type. All studies reported a positive role of IPs in improving TB care outcomes. This review demonstrates that IPs can be successfully engaged in various roles in TB care with appropriate support and training. Their contribution can support countries to achieve their national and global targets if prioritized in National TB Programs.

Introduction

Tuberculosis (TB) was declared a global public health emergency in 1993, and remains one of the leading causes of death worldwide [1, 2]. In 2019, there were an estimated 10 million new cases of TB and 1.2 million deaths among HIV negative people, with an additional 208,000 deaths among HIV positive people [3]. Worldwide TB causes significant loss of productivity, catastrophic health expenditure, and is the 11th leading cause of years of life lost [4, 5]. Between 2015–2019, the global cumulative reduction in incidence and mortality was 9% and 14%, respectively. Despite having a progressive reduction, countries with a high TB burden were far from achieving the 2020 milestone of reducing incidence by 20% and mortality by 35% [3, 6].

Mandatory TB case notification is an integral component of the World Health Organization (WHO) End TB Strategy [7]. There was a noticeable increase in global tuberculosis case notification in 2018, but with a large gap of 3 million missing cases [3]. Seven Low- and Middle-Income Countries (LMICs) with a dominant private health sector account for almost two-thirds of the world's missing TB cases. This gap between estimated and reported cases is due to the under-reporting of detected cases as well as the under-diagnosis of new cases, partially due to the significant private sector presence in health system provision [3, 8]. The significant contribution of the private sector in tuberculosis care is evident from patient pathway analysis [9, 10] and national TB drug sale data [11]. While private sector engagement has been endorsed in global TB strategies since the 1990s, there are ongoing challenges for National Tuberculosis Programs (NTPs) in many countries. Reasons for this include heterogeneity of the private workforce, undocumented size and scope of practice, the lack of legislative frameworks, inadequate health information system, and problems with role clarity [2, 12].

To achieve national and global TB targets, it is essential to engage all health providers, public and private, as well as formal and informal, in line with the WHO Public-Private Mix (PPM) strategy to ensure every case of TB is appropriately detected and receives timely treatment [8, 13]. The Lancet Commission on TB has recommended prioritizing engagement with the private sector in TB programs [2], and this is particularly important for LMICs where the private sector is a predominant provider in health systems [12, 14]. Within the private sector, a large cadre of providers operate outside the formal health system whilst lacking appropriate qualifications for the health services they deliver [15]. In the current literature, commonly used terms to describe this health workforce are Informal Providers and Informal Healthcare Providers (IPs) [16–19]. The term encompasses a wide variety of providers who are broadly distinguished by the nature of their practice and include village doctors, traditional healers, drug compounders, traditional birth attendants, and untrained allopathic practitioners [16, 20]. Although unrecognized and undocumented in many settings, a considerable amount of evidence establishing their contribution to the health system exists. This is especially evident in rural and underserved areas of LMICs, where primary care-seeking from IPs by patients ranges from 65%-90% [16, 19, 21]. The pivotal role of IPs in TB care is increasingly recognized at the global level and evident through multiple patient health-seeking behaviour studies [22–26], as well as through some large scale surveys [27, 28]. However, their prioritization as an important provider in TB care remains the missing piece in NTPs of many LMICs.

Non-engagement of all providers in TB care can potentially limit the success of NTPs. Consequences can include increased community transmission, delayed diagnosis and treatment, drug resistance, catastrophic health expenditure for patients, and impaired tuberculosis monitoring and evaluation systems [8, 23, 29]. The role of different providers varies by qualifications, national regulations, and their practice; however, it is crucial to recognize and engage all providers. The inability to integrate IPs not only represents a missed opportunity but has also limited our understanding of their role in TB care. A substantial body of research suggests that

they are the first point of contact for a significant proportion of TB patients [27, 28], but beyond that point, our understanding of their role in the prevention, diagnosis, and treatment of TB is limited. Studies which have explored the role of IPs in tuberculosis care have found that they create community awareness, assist in the diagnosis of symptomatic cases, and conduct sputum collection [30–32]. However, to our knowledge, their role has not been systematically explored using an evidence synthesis approach. The previous reviews measuring the impact of a PPM model in TB care have primarily focused on the public and formal private systems. Information on IPs is cursory and does not provide clear insight into their role [33, 34]. A discussion paper published in 2011 attempted to explore the potential of engaging IPs in TB care, however, it lacks an appropriate search strategy and has a limited scope [35]. To meaningfully engage IPs in any NTP, the preliminary step must be to understand their current role. Therefore, in this paper, we have undertaken a systematic scoping review of the current literature to identify the role of IPs in TB care in LMICs.

Materials and methods

A scoping review was identified as an appropriate method to achieve the research aim as it is commonly used to clarify working definitions, conceptual boundaries and to map the current status of an object or subject of interest within a particular field [36, 37]. The scoping review approach enables an understanding of the role of IPs in TB care in the available literature. This method is also relevant for disciplines with emerging evidence [38], with research on IPs being an evolving field. This scoping review was conducted using the framework developed by the Joanna Briggs Institute (JBI) based on the work of Arksey and O'Malley (2005) [39]. The framework consists of five sequential stages: 1) identifying the research question, 2) identifying relevant studies, 3) study selection. 4) charting the data, and 5) collating, summarizing, and reporting the results. Each stage is described in detail below. The scoping review is reported following the PRISMA extension for scoping reviews published in 2018, which is made available as a S1 File [40].

Stage 1: Identifying the research question

All authors were involved in the discussion to finalize the research questions for this review. The research questions for the review were:

1. What are the roles of IPs in TB care?

2. What are the various types (classified based on their practice) of IPs engaged in these roles?

3. Which TB related outcomes are influenced by IPs role?

Stage 2: Identifying relevant studies

The Inclusion criteria for the review was developed according to Population-Concept-Context (PCC) framework [39].

Population. As there is no uniform definition for IPs, we referred to previously published papers in this field [16, 17, 20, 21, 41, 42] and developed a summary table to identify the common elements in each definition, available as a S2 File. Hence, in this study, we define IPs as "individuals who are not affiliated or registered to any government body or institution, independently delivering some form of health services, and not possessing a recognized certification for the type of services they offer". The study did not include family or community members, caregivers, or volunteers. Similarly, Community Health Workers (CHWs) who

were formally trained and worked for an established institution (either private or public) were excluded from the review.

Concept. We defined role based on the functions performed by IPs in TB care. We used the WHO People-Centered Model of TB Care to classify functions. It provides a granular classification of TB functions and is best suited for this review to comprehensively outline the distinct role of IPs in TB care [43]. It first broadly divides TB care into three types; 1) prevention, 2) detection and diagnosis, and 3) treatment and support, and then further classifies 17 different functions under these three domains of care. The summary table of the model is available as a S3 File.

Context and design. The World Bank classification by income 2018–2019 was used as a reference to classify LMICs [44]. The review included articles using any study design if they reported any role of IPs in TB care in LMICs. Only studies published in English were included. There was no restriction on date considering the scarcity of evidence in this field. Exclusion criteria included review papers, editorials, commentaries, study protocols, conference abstracts, perspective pieces, or multiple papers from a single study.

Search strategy. A comprehensive search was carried out independently by two authors (PT and NG) in six electronic databases: MEDLINE, EMBASE, SCOPUS, Global Health, CINAHL, and Web of Science, between 15 June to 10 July 2019. The search was updated on 5 September 2020, but no new articles were retrieved. Four key terms were used for the literature search: "Tuberculosis" "Informal Healthcare Provider," Tuberculosis care," and "LMICs". The search strategy was developed in consultation with subject experts, including a qualified research librarian, and also by referring to previously published review studies on TB care and IPs [16, 20, 45]. A manual search of the reference lists of included studies was also undertaken. An example of a complete search strategy performed in MEDLINE (via Ovid) is available as a S4 File.

Stage 3: Study selection

All identified studies from the electronic search were imported into EndNote X8, Clarivate Analytics, US [46]. After removing duplicates, in the first step, two authors (PT and NG) independently reviewed all the titles and abstracts. Any disagreement between these authors was resolved in discussion with a third author (RJ). As a second step, the full text of potential studies was reviewed by two authors (PT and NG). The reasons for excluding the full-text articles at the final stage of screening were recorded and are available as a S5 File. The final articles were discussed among all authors to rule out any disagreement through consensus. The study selection process is reported using the PRISMA-ScR flow diagram (Fig 1).

Methodological quality assessment. The goal of Quality Assessment (QA) is to provide an overview of the methodological rigour of the included studies. The findings from QA did not limit the inclusion of studies in the review. It was done independently by two researchers (PT, RJ), and any disagreement was resolved through discussion and consensus. We used Joanna Briggs Institute (JBI) standard critical appraisal tools for experimental and quasi-experimental studies [47]. Both these tools have a set of questions that help authors determine the methodological rigour of included studies. Each question is scored 'yes', 'no', 'unclear', or 'not applicable', but there is no overall quality score.

Stage 4 & 5: Charting the data and collating, summarising, and reporting the results

Data were extracted using the predeveloped data extraction format in Microsoft Excel, which was tested with four articles and refined before the full extraction. Information retrieved
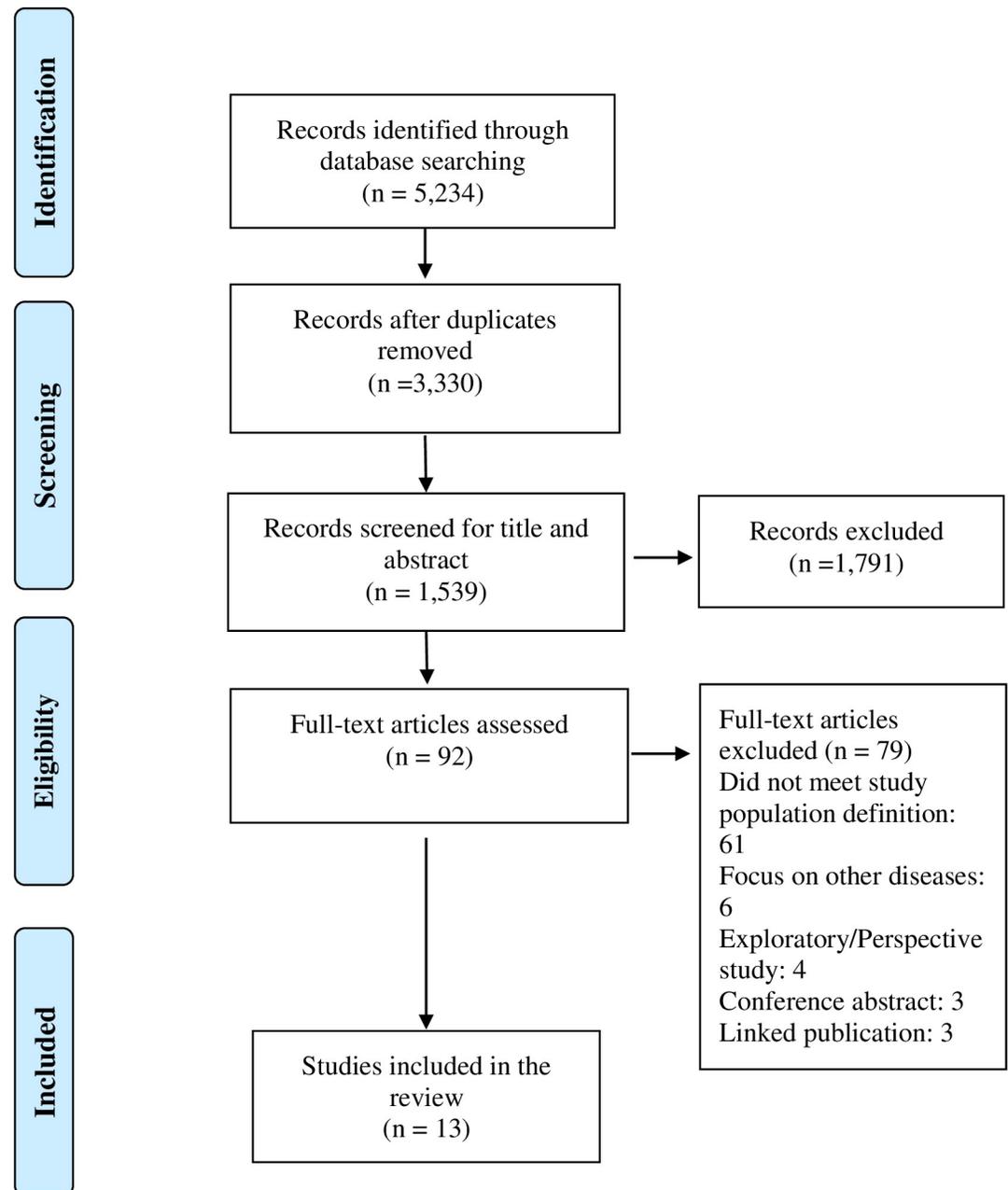
Fig 1. PRISMA-ScR flow diagram of study selection and inclusion process.

included study characteristics (year, objective, site, design, methodology), project characteristics (IP type, training, incentive, use of digital tools), a complete description of the role of IPs, study outcomes, and brief study findings. The goal of the scoping review is to provide an overview of the available literature, so all studies were included regardless of quality assessment outcome [39]. Information, including study objectives, project and IP characteristics, and study outcomes, are summarised descriptively. Data on the role of IPs were synthesized using the content analysis approach [38] based on the WHO People-Centered Model of TB Care.

Results

Characteristics of included articles

We retrieved a total of 5234 studies, of which 92 had their full text assessed.13 studies met the inclusion criteria and were included in the final review. "Incorrect population" was the major reason for excluding articles, meaning the participants did not qualify to be classified as IPs based on our study definition.

We noted an increase of published studies over time, as shown in Fig 2. About 50% (n = 6) of the studies were published between 2010–2019. Eight studies were from Africa and five from Asia. Based on Reichardt classification [48], a majority (n = 10) of the studies were quasi-experimental design (QED), and one study was a cluster randomised trial. We could not determine the design of the two studies as the information was limited [49, 50]. Most of the studies aimed to assess the feasibility, effectiveness, or acceptability of engaging IPs in TB care.

Quality of studies

Out of 10 QED studies, only four studies scored more than 4 out of the 9 criteria listed in the checklist. The overall quality of the included studies was found to be low, especially for criteria 5, 6 and 9, indicating potential bias during measurement of outcomes pre and post [32, 51–57] and lack of appropriate statistical analysis [32, 51, 53–55, 57, 58]. Five studies reported having a control group (Q4), but in 3 studies, the information about the comparison group was not sufficient [54, 55, 57]. One cluster randomised study included in the review was of high quality (10/13) [31]. As it was a cluster randomised design, concealment and blinding of participants was not possible in the study. Future studies should employ standard research methods to address these identified methodological gaps. For detailed QA results, please refer to the S6 File.

Characteristics of the providers and project in included studies

In more than 60% of the studies, NTPs were mentioned as one of the collaborators in the study [51–58]. None of the studies provided background characteristics of IPs, such as
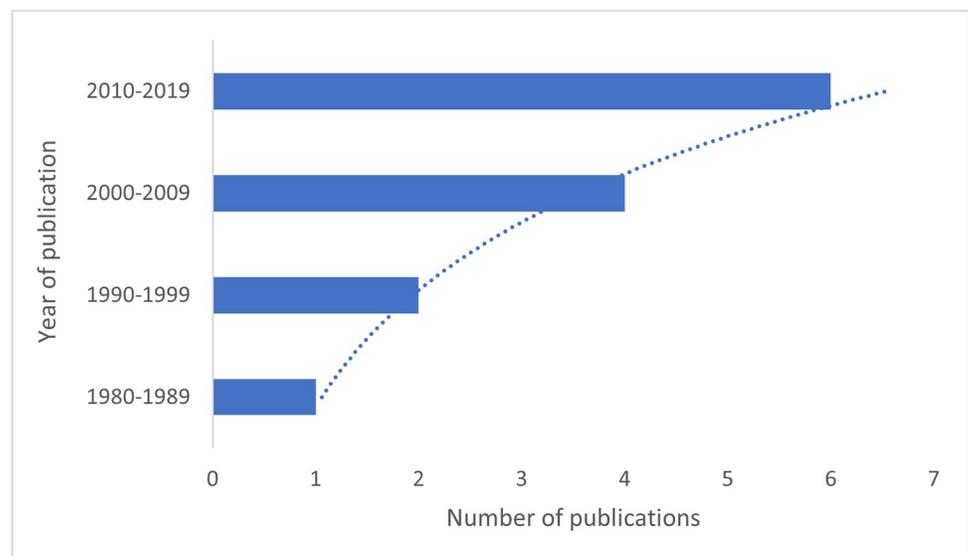

Fig 2. Diagram showing studies based on year of publication.

https://doi.org/10.1371/journal.pone.0256795.g002

education, years of experience, primary training, system of practice etc. In our study, we classified IPs into four major types based on the nature of their practice, as shown in Table 1. The details of providers' classifications are available as a S7 File. The most commonly featured IPs in TB care were Traditional Health Practitioners (THPs) (n = 8) [30–32, 49, 51, 53, 55, 58], followed by traditional birth attendants (TBAs) (n = 3) [50, 56, 57] and drug sellers, storekeepers, and chemists (n = 3) [30, 31, 52]. The least featured IP type were untrained allopathic practitioners (n = 2) [30, 54]. In all studies, IPs were given some training in TB before their involvement, but the duration varied. Not all studies provided the duration of training, but in those that did, it was noted to be between 1–3 days [49, 52, 54–58], and in two studies, between 1–3 weeks [32, 51]. One study [53] provided details of monetary incentives to IPs. For all other studies, monetary incentives were not given for their work or information was not provided in the paper. None of the studies employed any kind of digital tool to support IPs to deliver assigned roles. Based on the nature of the roles assigned, patient referrals were made verbally or using a paper form [30, 32, 49, 51–54, 58] and similarly, information on treatment was documented in a logbook or patient treatment card [50, 54–57].

Roles of IPs in TB care

In the majority of the studies, detection and diagnosis (n = 10) was the most commonly assigned role for IPs [30–32, 49–54, 58], followed by treatment and support (n = 6) [32, 50, 54–57]. In one study, they were assigned a prevention role, combined with detection and

Table 1. Characteristics of included studies (n = 13).

Study	Country	Design	Provider types	Aim
Sima et al. (2019) [51]	Ethiopia	QED–one group posttest	Traditional Health Providers	To assess the role of traditional healers in the detection and referral of active TB cases.
Dutta et al. (2018) [30]	India	QED–prestest-posttest nonequivalent group	Chemist, Traditional Health Providers, Untrained allopathic practitioners	To identify TB patients emerging from under-reached communities through non-formal health providers.
Bello et al. (2017) [31]	Malawi	Cluster randomized trial	Storekeeper, Traditional health practitioners	To investigate the effectiveness of engaging informal providers to promote access in a rural district.
Colvin et al. (2014) [58]	Tanzania	QED–one group pretest-posttest	Traditional health practitioners	To evaluate the community-based project to improve TB case notification.
Kaboru et al. (2013) [53]	Burkina Faso	QED–one group posttest	Traditional health practitioners	To assess the contribution of traditional healthcare providers in TB case finding.
Simwaka et al. (2012) [52]	Malawi	QED–pretest-posttest nonequivalent group	Storekeeper	To determine the effectiveness and acceptability of a storekeeper-based referral system for TB suspects in urban settings.
Salim et al. (2006) [54]	Bangladesh	QED–posttest nonequivalent group	Untrained allopathic practitioners	To assess the feasibility and quality of village doctors' involvement in TB control program.
Harper et al. (2004) [32]	Gambia	QED–one group posttest	Traditional health practitioner	To evaluate the feasibility of involving traditional healers in tuberculosis diagnosis and treatment.
Colvin et al. (2003) [55]	South Africa	QED–posttest non equivalent group	Traditional health practitioner	To assess the acceptability and effectiveness of traditional healers as supervisors of tuberculosis treatment.
Kangangi et al. (2003) [56]	Kenya	QED–one group pretest-posttest	Traditional birth attendant	To evaluate the impact of district TB program performance of decentralizing TB treatment by providing ambulatory care in the hospital and peripheral health units and in the community.
Jagotal et al. (1997) [57]	India	QED–posttest nonequivalent group	Traditional birth attendant	To assess the utility of traditional birth attendants for supervised administration of anti-tuberculosis drugs to patients.
Balasubramanian et al. (1997) [50]	India	Unclear	Traditional birth attendant	To assess the feasibility of involving traditional birth attendants in case finding and door-delivery of drugs to tuberculosis patients.
Oswald et al. (1983) [49]	Nepal	Unclear	Traditional health practitioner	To explores if traditional medical practitioners can be used to reduce the communication gap between health posts and the community.

diagnosis [31]. The details of their roles as classified by the WHO People-Centered Model of TB Care is presented in Table 2.

Prevention. In one study, IPs were assigned the role of conducting community awareness meetings where they provided information about the signs and symptoms of TB and the availability of free services at the local health facility [31].

Detection and diagnosis. Of 10 studies that focused on detection and diagnosis, in 90% of the studies, IPs passively identified patients who visited them at their place of practice and referred them to a nearby health facility if their symptoms resembled that of TB [30–32, 49, 51–54, 58]. In one study, IPs were assigned the role of active case finding. They were given a target population and tasked to identify TB suspects in the community [50]. In two studies, they collected sputum samples from TB suspects either at their place of practice or at the patient's home [30, 31].

Treatment and support. In all the studies with a treatment and support function (n = 6), IPs were assigned the role of administering DOT (Directly Observed Treatment) to confirmed TB patients. DOT was provided either at the IPs place of work or patient's home [32, 50, 54–57]. In none of the studies, IPs self-initiated the treatment of a tuberculosis patient. The TB medication was supplied to IPs by the government health center or NGO/ research institute based on the nature of the collaboration. In one study involving untrained allopathic practitioners, their assigned role was to refer patients to health centers if they had an adverse drug reaction [54].

Roles of IPs in TB care by provider type

There was no major difference in role based on the type of provider (Fig 3). The most commonly featured providers in identified studies were traditional health providers, and they were assigned prevention (n = 1) [31], detection and diagnosis (n = 7) [30–32, 49, 51, 53, 58] and treatment and support (n = 2) [32, 55] roles. Traditional birth attendants were mostly engaged in treatment and support (n = 3) [50, 56, 57], followed by detection and diagnosis (n = 1) [50]. Drug sellers, storekeepers, and chemists were engaged in detection and diagnosis (n = 3) [30, 31, 52] and prevention (n = 1) [31]. Lastly, the untrained allopathic practitioners, the least featured provider type, were engaged in detection and diagnosis (n = 2) [30, 54] and treatment and support (n = 1) [54].

Outcomes measured in the included studies

Outcome measures (Table 3) frequently used in studies identified for this review were treatment outcome (n = 6) [32, 50, 54–57] and referrals made (n = 5) [32, 49, 51, 53, 54] followed by case notification (n = 3) [30, 52, 58], and testing and treatment initiation rate (n = 1) [31]. There was an observed trend in outcomes measured in the studies; older studies have focused on treatment components and more recent studies on case identification and referral. All studies, including those found to provide high-quality evidence [30, 31, 52], have reported a positive role of IPs in improving TB care outcomes.

Discussion

To our knowledge, this is the first review to systematically examine the role of IPs in TB care in LMICs. We identified that IPs were engaged in all three domains of TB care, predominantly in detection and diagnosis of disease, followed by treatment, and least with prevention activities. When we categorised IPs based on their practice, THPs were the most featured providers in TB care, and untrained allopathic practitioners were the least of the three categories. Interestingly, there was no variation in the role by provider type.

Table 2. IPs role classified based on WHO People-Centered Model of TB Care.

Study	Prevention			Detection and Diagnosis				Treatment and support						
	Health promotion and education	Immunization	Latent TB infection services (3 functions)	Active case finding	Passive case finding referral	Clinical evaluation—TB	Lab—Sputum sample collection	Treatment Initiation	Treatment administration and observation	Monitoring treatment progress and response	Prevention and detection of adverse event	Diagnosis and treatment of adverse events	TB Lab monitoring	Counselling and support (2 functions)
Sima (2019)					✓									
Dutta (2018)					✓		✓							
Bello (2017)	✓				✓		✓							
Colvin (2014)					✓									
Kaboru (2013)					✓									
Simwaka (2012)					✓									
Salim (2006)					✓				✓		✓			
Harper (2004)					✓				✓					
Colvin (2003)									✓					
Kangangi (2003)									✓					
Jagotal (1997)									✓					
Balasubramanian (1997)				✓					✓					
Oswald (1983)					✓									
Total	1	0	0	1	9	0	2	0	6	0	1	0	0	0

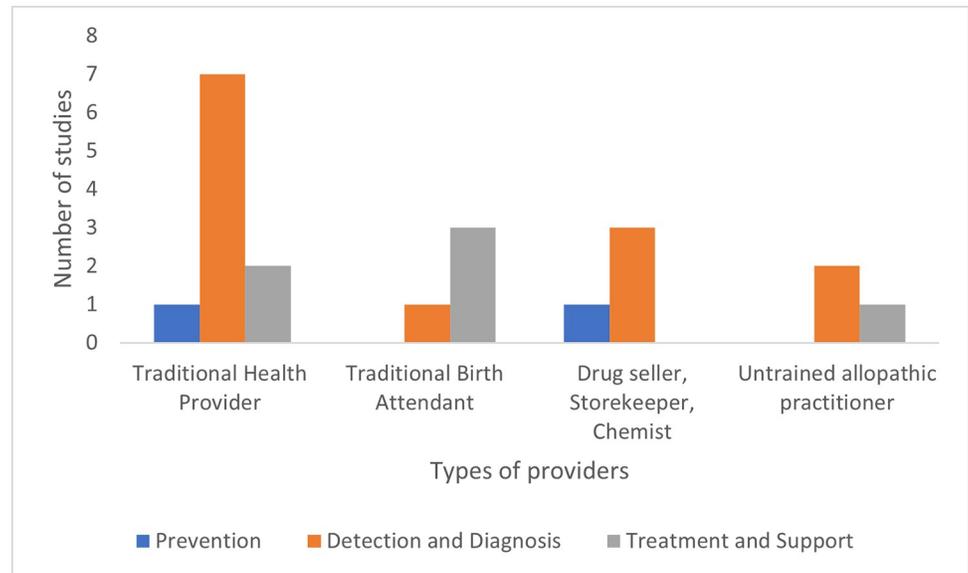https://doi.org/10.1371/journal.pone.0256795.t002

Fig 3. Bar diagram showing the distribution of IPs role by provider type (n = 21[a]). [a] Some studies featured more than one type of provider.

Our review has identified that detection and diagnosis (n = 10) was the most prominent role assigned to IPs in TB care. Engaging IPs in this role would address two major challenges faced by TB care programs in LMICs [2]. First, initial care-seeking from IPs by TB patients has been reported in multiple studies [22, 23, 25, 26, 28], and as demonstrated by the studies included in this review [30, 51, 53, 58], including IPs in the TB care would result in timely and

Table 3. Distribution of outcomes measured in included studies.

Study	Outcomes Measured	Domains	Impact of IP's role in TB care outcomes[a]
Sima et al. (2019)	Referrals made	Diagnosis	Positive
Dutta et al. (2018)	Case notification	Diagnosis	Positive
Bello et al. (2017)	Testing and treatment initiation rate	Diagnosis and treatment	Positive
Colvin et al. (2014)	Case notification	Diagnosis	Positive
Kaboru et al. (2013)	Referrals made	Diagnosis	Positive
Simwaka et al. (2012)	Case notification	Diagnosis	Positive
Salim et al. (2006)	Referrals made and treatment outcome	Diagnosis and treatment	Positive
Harper et al. (2004)	Referrals made and treatment outcome	Diagnosis and treatment	Positive
Colvin et al. (2003)	Treatment outcome	Treatment	Positive
Kangangi et al. (2003)	Treatment outcome	Treatment	Positive
Jagotal et al. (1997)	Treatment outcome	Treatment	Positive
Balasubramanian et al. (1997)	Treatment outcome	Treatment	Positive
Oswald et al. (1983)	Referrals made	Diagnosis	Positive

[a] Positive means that the study has reported improvement in care outcomes like improved referral, increased case notification, higher treatment completion and cure rate.

appropriate referral of TB suspects from the informal to the formal system. A quasi-experimental study by Dutta et al. reports a 30% improvement in TB case notification rate in the intervention arm with the involvement of IPs in case identification [30]. Additionally, Kaboru et al. have noted that assessment of a suspected case by IPs is as effective as when done by a qualified clinician, identifying this as a successful public-private collaboration in TB care [53]. Second, seeking initial care from IPs has been identified as one of the most important factors in diagnostic delay [25, 59, 60]. Therefore, engaging IPs has the potential to promote earlier detection of TB, which is a key TB control and elimination strategy recommended by WHO [61].

Multiple studies included in the review have successfully engaged IPs to administer DOT to patients in the community [32, 50, 54, 56–58]. The positive results observed in these studies are in line with findings from systematic reviews evaluating the impact of similar Community-Based DOT programs [62, 63]. Including IPs as DOT providers capitalises on their flexible working hours, proximity to the community, social and cultural acceptability and trustworthiness [16, 54], all of which can significantly improve TB care outcomes [32, 54, 57]. In Harper et al., all patients successfully completed their six months treatment [32] and similarly, in Jagotal et al., the treatment adherence was reported to be higher in the group whose DOT was administered by IPs [57]. Colvin et al. reported that satisfaction was higher among patients whose treatment was supervised by IPs, primarily because they enquired about the patient's general health and demonstrated a caring, family-like attitude [55]. Loss to follow up during treatment is an important issue in TB care [64] which may be tackled by engaging IPs. A study conducted in Bangladesh found a treatment success rate of 90%, where IPs were assigned the role of administering DOT [54].

In current literature, there is mixed evidence with regards to IPs treating TB patients. One study in India found that 33.8% of IPs treated TB patients with various drug regimens and all lacked correct knowledge of dose, duration and drug combination [65]. A countrywide cluster randomized survey in Bangladesh reported that IPs prescribed drugs in 80–90% of encounters with patients who visited them up to 4 times with symptoms of TB. However, the study lacks detail on the drugs prescribed by IPs [28]. Similarly, a qualitative study found that IPs treated TB patients for 3–4 months before referral [24]. In this review, we did not find any studies where IPs were assigned the role of initiating treatment for TB patients. The included studies might have only evaluated those roles among IPs that are authorized for non-health professionals as per the WHO International Standards for TB care [66]. The evidence on IPs initiating TB treatment is contested but needs to be a research priority, especially among untrained allopathic practitioners who prescribe antibiotics as part of their practice [67].

There is substantial heterogeneity in background characteristics of IPs by their system of practice (traditional versus modern), including education, experience, training, and service modality, but in the current literature, there exists no classification system for IPs. All IPs are assumed to fit into a single category. This was reflected in the studies included in this review, as none of them reported IPs' characteristics even when studies involved multiple provider types. Hence, future research on IPs should follow the standard protocol of reporting research findings by describing the study participants as this impacts the interpretation and generalizability of findings [68]. Additionally, there is a lack of a clear definition for IPs to enable a uniform approach to research. There is a need to undertake a systematic review of definitions, similar to studies conducted for other community-based health workers [69].

It was evident from this review that quality of care is not yet an important component in research pertaining to IPs, as only two studies in this review measured IPs knowledge on TB care [32, 51]. This finding is similar to a systematic review paper by Sudhinaraset et al., where only 24% of 122 studies reported quality outcomes [16]. Studies have found that IPs lack

appropriate knowledge to deliver health care [21], including TB care [70], and IPs knowledge and skills are identified as a crucial factor that influences the quality of care [16]. Hence, future research should employ validated methods, such as standardized patient methods and vignettes, to measure IPs' knowledge and skills in TB care [71, 72].

Further, we found that none of the included studies tested any kind of digital intervention to improve TB care even though the WHO guideline on the digital tool for END TB Strategy recommends promoting the use of ICT (Information and Communication Technology) [73]. With the increasing recognition of the importance of digital technology in TB care activities [74], replicating and evaluating its use in the informal sector needs to be emphasized.

This review highlights an important role of IPs in TB care, which is often not documented or prioritized in global and national TB reports and guidelines. With many LMICs still struggling to achieve the targets set in the End TB Strategy, it is questionable if these are achievable if the informal sector continues to be ignored. Simply acknowledging that they are the first point of contact for a significant proportion of TB patients is not enough; action needs to be taken, policies need to be expanded, and priorities need to be redefined to accommodate the informal sector in NTPs. It is crucial to address the current global gap with regards to IP engagement as the WHO PPM strategy recommends engaging all identified providers in TB care activities. This review broadly identifies the role of IPs in TB care and presents evidence to highlight the contribution they can make in improving TB care outcomes if appropriate training and support are provided. The feasibility of training IPs to provide quality care is already demonstrated by a randomized control trial conducted in India [19]. It is worth noting that 60% of the studies in this review involved NTPs as collaborators. This indicates that there exists a scope and role for IPs in current NTPs. Engaging IPs will complement and strengthen existing TB care services considering their unique role in the care delivery system, especially in countries with high TB burden. This engagement requires recognition, appreciation, and support from the formal health system to maximize the full potential of a large cadre of the informal health workforce which remains underutilized yet highly valued by their communities in many health systems of LMICs.

Limitations

We searched for the literature in six of the main databases, but grey literature was not included due to time and scope constraints, and we may have missed some studies, especially the reports of national and international organizations working in the field of IPs. We only included studies published in English. As there is no uniform definition for IPs and various terms are used in different contexts, there is a possibility that we might have missed studies if they have defined IPs outside of our search strategy.

Conclusions

This review demonstrates the potential of IPs to support prevention, detection, and treatment functions in TB care, leading to improved TB care outcomes. As highlighted by this review, in order to achieve national and global targets, it is essential that NTPs engage with IPs, considering their unique role in TB care. More research is required to answer some of the identified knowledge gaps, and future studies should aim to generate high-quality evidence with methodological rigour. As we progress toward a people-centred model of TB care, and considering the ubiquitous presence of IPs in high burden countries, it is essential to recognise that they can play a valuable role in ensuring acceptable and accessible TB care services are made available to the community. Engaging IPs in TB care would also provide insight on how this large

workforce can be integrated in a health system to strengthen the delivery of primary care, especially in LMICs.

Supporting information

S1 File. PRISMA extension for scoping reviews checklist.
(PDF)

S2 File. Summary table of IPs definitions in published studies.
(PDF)

S3 File. Summary table of WHO People-Centered Model of TB Care.
(PDF)

S4 File. Scoping review search strategy in MEDLINE (via Ovid).
(PDF)

S5 File. Reasons for exclusion of studies.
(PDF)

S6 File. Quality assessment of included studies.
(PDF)

S7 File. Classification system for IPs.
(PDF)

Acknowledgments

Author Contributions

Conceptualization: Poshan Thapa, Rohan Jayasuriya, John J. Hall, Padmanesan Narasimhan.

Data curation: Poshan Thapa, Nachiket Gudi.

Formal analysis: Poshan Thapa, Nachiket Gudi.

Methodology: Poshan Thapa, Rohan Jayasuriya, John J. Hall, Kristen Beek, Parthasarathi Mukherjee, Nachiket Gudi, Padmanesan Narasimhan.

Project administration: Poshan Thapa.

Software: Poshan Thapa.

Supervision: Rohan Jayasuriya, John J. Hall, Kristen Beek, Parthasarathi Mukherjee, Padmanesan Narasimhan.

Visualization: Poshan Thapa, Nachiket Gudi.

Writing – original draft: Poshan Thapa.

Writing – review & editing: Poshan Thapa, Rohan Jayasuriya, John J. Hall, Kristen Beek, Parthasarathi Mukherjee, Nachiket Gudi, Padmanesan Narasimhan.

References

1. World Health Organization. Tuberculosis—Key Facts [Internet] Geneva, Switzerland 2020 [updated Oct 14 2020; cited 2020 Feb 25]. Available from: https://www.who.int/news-room/fact-sheets/detail/tuberculosis.

2. Reid MJ, Arinaminpathy N, Bloom A, Bloom BR, Boehme C, Chaisson R, et al. Building a tuberculosis-free world: The Lancet Commission on tuberculosis. The Lancet. 2019; 393(10178):1331–84.

3. World Health Organization. Global Tuberculosis Report 2020 [Internet]. Geneva, Switzerland 2020 [Available from: https://www.who.int/publications/i/item/9789240013131.

4. Roth GA, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet. 2018; 392(10159):1736–88.

5. Tanimura T, Jaramillo E, Weil D, Raviglione M, Lönnroth K. Financial burden for tuberculosis patients in low-and middle-income countries: a systematic review. European Respiratory Journal. 2014; 43 (6):1763–75.

6. World Health Organization. WHO END TB Strategy [Internet]. Geneva, Switzerland 2015 [Available from: https://www.who.int/tb/post2015_strategy/en/.

7. Uplekar M, Atre S, Wells WA, Weil D, Lopez R, Migliori GB, et al. Mandatory tuberculosis case notification in high tuberculosis-incidence countries: policy and practice. European Respiratory Journal. 2016; 48(6):1571–81.

8. World Health Organization. Public–private mix for TB prevention and care: a roadmap [Internet]. Geneva, Switzerland 2018 [24]. Available from: https://www.who.int/tb/publications/2018/PPMRoadmap/en/.

9. Chin DP, Hanson CL. Finding the missing tuberculosis patients. The Journal of Infectious Diseases. 2017; 216(suppl_7):S675–S8.

10. Hanson C, Osberg M, Brown J, Durham G, Chin DP. Finding the missing patients with tuberculosis: lessons learned from patient-pathway analyses in 5 countries. The Journal of Infectious Diseases. 2017; 216(suppl_7):S686–S95.

11. Arinaminpathy N, Batra D, Khaparde S, Vualnam T, Maheshwari N, Sharma L, et al. The number of privately treated tuberculosis cases in India: an estimation from drug sales data. The Lancet Infectious Diseases. 2016; 16(11):1255–60.

12. World Health Organization. The private sector, universal health coverage and primary health care [Internet]. Geneva, Switzerland 2019 [Available from: https://www.who.int/publications/i/item/WHO-HIS-SDS-2018.53.

13. World Health Organization. DOTS Expansion Working Group strategic plan, 2006–2015 [Internet]. Geneva, Switzerland 2006 [Available from: https://www.who.int/tb/publications/tb-dotsstrategicplan-report/en/.

14. Mackintosh M, Channon A, Karan A, Selvaraj S, Cavagnero E, Zhao H. What is the private sector? Understanding private provision in the health systems of low-income and middle-income countries. The Lancet. 2016; 388(10044):596–605.

15. Sheikh K, Josyula LK, Zhang X, Bigdeli M, Ahmed SM. Governing the mixed health workforce: learning from Asian experiences. BMJ Global Health. 2017;2(2).

16. Sudhinaraset M, Ingram M, Lofthouse HK, Montagu D. What is the role of informal healthcare providers in developing countries? A systematic review. PlOS One. 2013; 8(2):e54978.

17. Sieverding M, Beyeler N. Integrating informal providers into a people-centered health systems approach: qualitative evidence from local health systems in rural Nigeria. BMC Health Services Research. 2016; 16(1):1–12.

18. Gautham M, Shyamprasad K, Singh R, Zachariah A, Singh R, Bloom G. Informal rural healthcare providers in North and South India. Health Policy and Planning. 2014; 29(suppl_1):i20–i9.

19. Das J, Chowdhury A, Hussam R, Banerjee AV. The impact of training informal health care providers in India: A randomized controlled trial. Science. 2016; 354(6308).

20. Shah NM, Brieger WR, Peters DH. Can interventions improve health services from informal private providers in low and middle-income countries? A comprehensive review of the literature. Health Policy and Planning. 2011; 26(4):275–87.

21. Sizear MMI, Nababan HY, Siddique MKB, Islam S, Paul S, Paul AK, et al. Perceptions of appropriate treatment among the informal allopathic providers: insights from a qualitative study in two peri-urban areas in Bangladesh. BMC Health Services Research. 2019; 19(1):424.

22. Mutinda KA, Kabiru EW, Mwaniki PK. Health seeking behavior, practices of TB and access to health care among TB patients in Machakos County, Kenya. A cross-sectional study. Journal of Biology, Agriculture and Healthcare. 2014; 4(14).

23. World Health Organization. Diagnostic and treatment delay in tuberculosis [Internet]. 2006 [Available from: https://apps.who.int/iris/handle/10665/116501.

24. Yellappa V, Lefèvre P, Battaglioli T, Devadasan N, Van der Stuyft P. Patients pathways to tuberculosis diagnosis and treatment in a fragmented health system: a qualitative study from a south Indian district. BMC Public Health. 2017; 17(1):1–10.

25. Huq KE, Moriyama M, Zaman K, Chisti MJ, Long J, Islam A, et al. Health seeking behaviour and delayed management of tuberculosis patients in rural Bangladesh. BMC Infectious Diseases. 2018; 18 (1):515.

26. Kapoor SK, Raman AV, Sachdeva KS, Satyanarayana S. How did the TB patients reach DOTS services in Delhi? A study of patient treatment seeking behavior. PLOS One 2012; 7(8):e42458.

27. Satyanarayana S, Nair SA, Chadha SS, Shivashankar R, Sharma G, Yadav S, et al. From where are tuberculosis patients accessing treatment in India? Results from a cross-sectional community based survey of 30 districts. PLOS One. 2011; 6(9):e24160.

28. Hossain S, Zaman K, Quaiyum A, Banu S, Husain A, Islam A, et al. Care seeking in tuberculosis: results from a countrywide cluster randomised survey in Bangladesh. BMJ Open. 2014; 4(5).

29. Getnet F, Demissie M, Assefa N, Mengistie B, Worku A. Delay in diagnosis of pulmonary tuberculosis in low-and middle-income settings: systematic review and meta-analysis. BMC Pulmonary Medicine. 2017; 17(1):202–.

30. Dutta A, Pattanaik S, Choudhury R, Nanda P, Sahu S, Panigrahi R, et al. Impact of involvement of non-formal health providers on TB case notification among migrant slum-dwelling populations in Odisha, India. PLOS One. 2018; 13(5):e0196067.

31. Bello G, Faragher B, Sanudi L, Namakhoma I, Banda H, Malmborg R, et al. The effect of engaging unpaid informal providers on case detection and treatment initiation rates for TB and HIV in rural Malawi (Triage Plus): A cluster randomised health system intervention trial. PLOS One. 2017; 12(9):e0183312.

32. Harper M, Hill P, Bah A, Manneh K, McAdam K, Lienhardt C. Traditional healers participate in tuberculosis control in The Gambia. The International Journal of Tuberculosis and Lung Disease. 2004; 8 (10):1266–8.

33. Malmborg R, Mann G, Squire SB. A systematic assessment of the concept and practice of public-private mix for tuberculosis care and control. International Journal for Equity in Health. 2011; 10:49–.

34. Lei X, Liu Q, Escobar E, Philogene J, Zhu H, Wang Y, et al. Public-private mix for tuberculosis care and control: a systematic review. International Journal of Infectious Diseases. 2015; 34:20–32.

35. Kaboru BB, Uplekar M, Lönnroth K. Engaging informal providers in TB control: what is the potential in the implementation of the WHO Stop TB Strategy? A discussion paper. World Health & Population. 2011; 12(4):5–13.

36. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. International Journal of Social Research Methodology. 2005; 8(1):19–32.

37. Davis K, Drey N, Gould D. What are scoping studies? A review of the nursing literature. International Journal of Nursing Studies. 2009; 46(10):1386–400.

38. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. Implementation Science. 2010; 5(1):69.

39. Peters MD, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. International Journal of Evidence-Based Healthcare. 2015; 13(3):141–6.

40. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Annals of Internal Medicine. 2018; 169(7):467–73.

41. Ahmed SM, Hossain MA, Chowdhury MR. Informal sector providers in Bangladesh: how equipped are they to provide rational health care? Health Policy and Planning. 2009; 24(6):467–78.

42. Bloom G, Standing H, Lucas H, Bhuiya A, Oladepo O, Peters DH. Making health markets work better for poor people: the case of informal providers. Health Policy and Planning. 2011; 26(suppl_1):i45–i52.

43. World Health Organization. A people-centred model of TB care [Internet]. Geneva, Switzerland 2017 [Available from: https://www.euro.who.int/en/health-topics/communicable-diseases/tuberculosis/publications/2017/a-people-centred-model-of-tb-care-2017#:~:text=It%20aims%20to%20support%20countries,achieving%20better%20health%20outcomes%20in.

44. World Bank. New country classifications by income level: 2018–2019 Washington, USA 2018 [Available from: https://blogs.worldbank.org/opendata/new-country-classifications-income-level-2018-2019.

45. Satyanarayana S, Subbaraman R, Shete P, Gore G, Das J, Cattamanchi A, et al. Quality of tuberculosis care in India: a systematic review. The International Journal of Tuberculosis and Lung Disease. 2015; 19(7):751–63.

46. Clarivate Analytics. EndNote X8 for Windows https://endnote.com/; 2016.

47. Joanna Briggs Institute. Critical Appraisal Tools [cited 2021 13 May]. Available from: https://jbi.global/critical-appraisal-tools.

48. Reichardt CS. Quasi-experimental design. TThe SAGE handbook of quantitative methods in psychology. 2009; 46(71):490–500.

49. Oswald I. Are traditional healers the solution to the failures of primary health care in rural Nepal? Social Science & Medicine. 1983; 17(5):255–7.

50. Balasubramanian R. Feasibility of utiliising traditional birth attendants in DTP. Indian Journal of Tuberculosis. 1997; 44(3):133–5.

51. Sima BT, Belachew T, Bjune G, Abebe F. Traditional healers' role in the detection of active tuberculosis cases in a pastoralist community in Ethiopia: a pilot interventional study. BMC Public Health. 2019; 19 (1):1–7.

52. Simwaka BN, Theobald S, Willets A, Salaniponi FM, Nkhonjera P, Bello G, et al. Acceptability and effectiveness of the storekeeper-based TB referral system for TB suspects in sub-districts of Lilongwe in Malawi. PLOS One. 2012; 7(9):e39746.

53. Kaboru BB. Active referral: an innovative approach to engaging traditional healthcare providers in TB control in Burkina Faso. Healthcare Policy. 2013; 9(2):51.

54. Salim H, Uplekar M, Daru P, Aung M, Declercq E, Lönnroth K. Turning liabilities into resources: informal village doctors and tuberculosis control in Bangladesh. Bulletin of the World Health Organization. 2006; 84:479–84.

55. Colvin M, Gumede L, Grimwade K, Maher D, Wilkinson D. Contribution of traditional healers to a rural tuberculosis control programme in Hlabisa, South Africa. The International Journal of Tuberculosis and Lung Disease. 2003; 7(9):S86–S91.

56. Kangangi J, Kibuga D, Muli J, Maher D, Billo N, NÕgangÕa L, et al. Decentralisation of tuberculosis treatment from the main hospitals to the peripheral health units and in the community within Machakos district, Kenya. The International Journal of Tuberculosis and Lung Disease. 2003; 7(9):S5–S13.

57. Jagota P, Balasangameshwara V, Jayalakshmi M, Islam MM. An alternative method of providing supervised short course chemotherapy in District Tuberculosis Programme. Indian Journal of Tuberculosis. 1997; 44:73–8.

58. Colvin C, Mugyabuso J, Munuo G, Lyimo J, Oren E, Mkomwa Z, et al. Evaluation of community-based interventions to improve TB case detection in a rural district of Tanzania. Global Health: Science and Practice. 2014; 2(2):219–25.

59. Getnet F, Demissie M, Assefa N, Mengistie B, Worku A. Delay in diagnosis of pulmonary tuberculosis in low-and middle-income settings: systematic review and meta-analysis. BMC Pulmonary Medicine. 2017; 17(1):202.

60. Storla DG, Yimer S, Bjune GA. A systematic review of delay in the diagnosis and treatment of tuberculosis. BMC Public Health. 2008; 8(1):15.

61. World Health Organization. Early detection of tuberculosis: an overview of approaches, guidelines and tools [Internet]. Geneva, Switzerland 2011 [Available from: https://apps.who.int/iris/handle/10665/70824.

62. Zhang H, Ehiri J, Yang H, Tang S, Li Y. Impact of community-based DOT on tuberculosis treatment outcomes: a systematic review and meta-analysis. PLOS One. 2016; 11(2):e0147744.

63. Wright CM, Westerkamp L, Korver S, Dobler CC. Community-based directly observed therapy (DOT) versus clinic DOT for tuberculosis: a systematic review and meta-analysis of comparative effectiveness. BMC Infectious Diseases. 2015; 15(1):210.

64. Cherkaoui I, Sabouni R, Kizub D, Billioux AC, Bennani K, Bourkadi JE, et al. Treatment default amongst patients with tuberculosis in urban Morocco: predicting and explaining default and post-default sputum smear and drug susceptibility results. PLOS One. 2014; 9(4):e93574.

65. Anandhi C L, Nagaraj V K, Kumar R. Knowledge and practice pattern of non-allopathic indigenous medical practitioners regarding tuberculosis in a rural area of India. The International Journal of Tuberculosis and Lung Disease. 2002; 6(6):553–5.

66. World Health Organization. International standards for tuberculosis care [Internet]. Geneva, Switzerland 2014 [Available from: https://www.who.int/tb/publications/standards-tb-care-2014/en/.

67. Khare S, Purohit M, Sharma M, Tamhankar AJ, Lundborg CS, Diwan V, et al. Antibiotic prescribing by informal healthcare providers for common illnesses: a repeated cross-sectional study in rural India. Antibiotics. 2019; 8(3):139.

68. Pickering RM. Describing the participants in a study. Age and Ageing. 2017; 46(4):576–81.

69. Olaniran A, Smith H, Unkels R, Bar-Zeev S, van den Broek N. Who is a community health worker?—a systematic review of definitions. Global Health Action. 2017; 10(1):1272223–.

70. Islam QS, Ahmed SM, Islam MA, Chowdhury AS, Siddiquea BN, Husain MA. Informal allopathic provider knowledge and practice regarding control and prevention of TB in rural Bangladesh. International Health. 2014; 6(3):225–31.

71. Sylvia S, Xue H, Zhou C, Shi Y, Yi H, Zhou H, et al. Tuberculosis detection and the challenges of integrated care in rural China: a cross-sectional standardized patient study. PLOS Medicine. 2017; 14(10): e1002405. https://doi.org/10.1371/journal.pmed.1002405

72. Das J, Hammer J. Which doctor? Combining vignettes and item response to measure clinical competence. Journal of Development Economics. 2005; 78(2):348–83.

73. World Health Organization. Digital health for the End TB Strategy—an agenda for action [Internet]. Geneva, Switzerland 2015 [Available from: https://www.who.int/tb/publications/digitalhealth-TB-agenda/en/.

74. Lee Y, Raviglione MC, Flahault A. Use of Digital Technology to Enhance Tuberculosis Control: Scoping Review. Journal of Medical Internet Research. 2020; 22(2):e15727. https://doi.org/10.2196/15727 PMID: 32053111