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Identifying gaps in the quality of latent tuberculosis infection care

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ABSTRACT

Latent tuberculosis infection (LTBI) occurs after transmission and acquisition of infection, when the tuberculosis (TB) bacteria lie dormant in a person. Nearly one-quarter of the world's population is estimated to have LTBI, yet few studies have been published assessing the quality of LTBI services globally. This paper reviews issues to providing patient-centered LTBI services and offers an example framework to formally assess the quality of LTBI patient care. By applying the LTBI cascade of care model, TB programmes can evaluate the gaps and barriers to high-quality care and develop locally-driven solutions to improve LTBI services. Quality care for LTBI must address some of the key challenges to services including: (1) low prioritization of LTBI; (2) gaps in healthcare provider knowledge about testing and treatment; and (3) patient concerns about side effects of preventive treatment regimens. TB programmes need to ensure that these issues are addressed in a patient-centered manner, with clear communication and ongoing evaluation of the quality of LTBI services. Quality LTBI care must be a central focus, particularly identifying and engaging more household contacts in preventive treatment, in order to halt the progression to active disease thereby stopping TB transmission globally.

1. Introduction

It is estimated that nearly one-quarter of the world's population has latent tuberculosis infection (LTBI) [1]. Of the nearly 1.7 billion individuals with LTBI, approximately 10%, or almost 170 million people, will progress from LTBI to active TB disease [2]. The World Health Organization's (WHO) End TB Strategy has called for patient-centered care and increased provision of preventive treatment for LTBI to reduce the reservoir of individuals who are latently infected [3]. To meet the target of a 90% reduction in TB incidence (i.e., incidence of less than 10/100,000) expanded LTBI services and preventive treatment will be required globally [2,4].

In 2018, the United Nations convened the first High Level Meeting on TB (UNHLM-TB), after which a declaration was announced with a commitment to end TB by 2035. To achieve this goal, the target of providing 30 million people with preventive treatment for LTBI by 2022 was established including: 4 million children under 5 years of age, 6 million HIV-infected individuals along with 20 million household contacts older than 5 [1,5]. In 2018, it was estimated that 49% of people newly enrolled in HIV care were started on preventive treatment and 27% of the 1.3 million estimated eligible children aged under 5 years were on treatment. Yet in the same year, less than 2% of the eligible contacts over 5 years of age were on preventive treatment globally, representing an important gap in preventive services [1].

Both the WHO and UNHLM declaration affirm the *Lancet Global Health* Commission on High Quality Health Systems (HQSS) focus on providing person-centered, high-quality TB care [1,5,6]. The Lancet's Commission called for a radical change to approaches to healthcare delivery in low- and middle-income countries (LMICs) by quantifying and measuring the quality of services, which was previously primarily a focus in high-income countries (i.e., Canada and USA) [6]. However, there is insufficient local- and national-level data available on the quality of health systems across the continuum of care [6]. The call for improved healthcare delivery and research on current practices is particularly relevant for LTBI program scale-up. There is a dearth of data on quality of LTBI care and human resource needs to achieve the target of reaching 30 million people with preventive treatment worldwide by 2022.

2. Framework to assess gaps

2.1. LTBI cascade of care framework

In order to provide quality care for persons with LTBI, it is necessary

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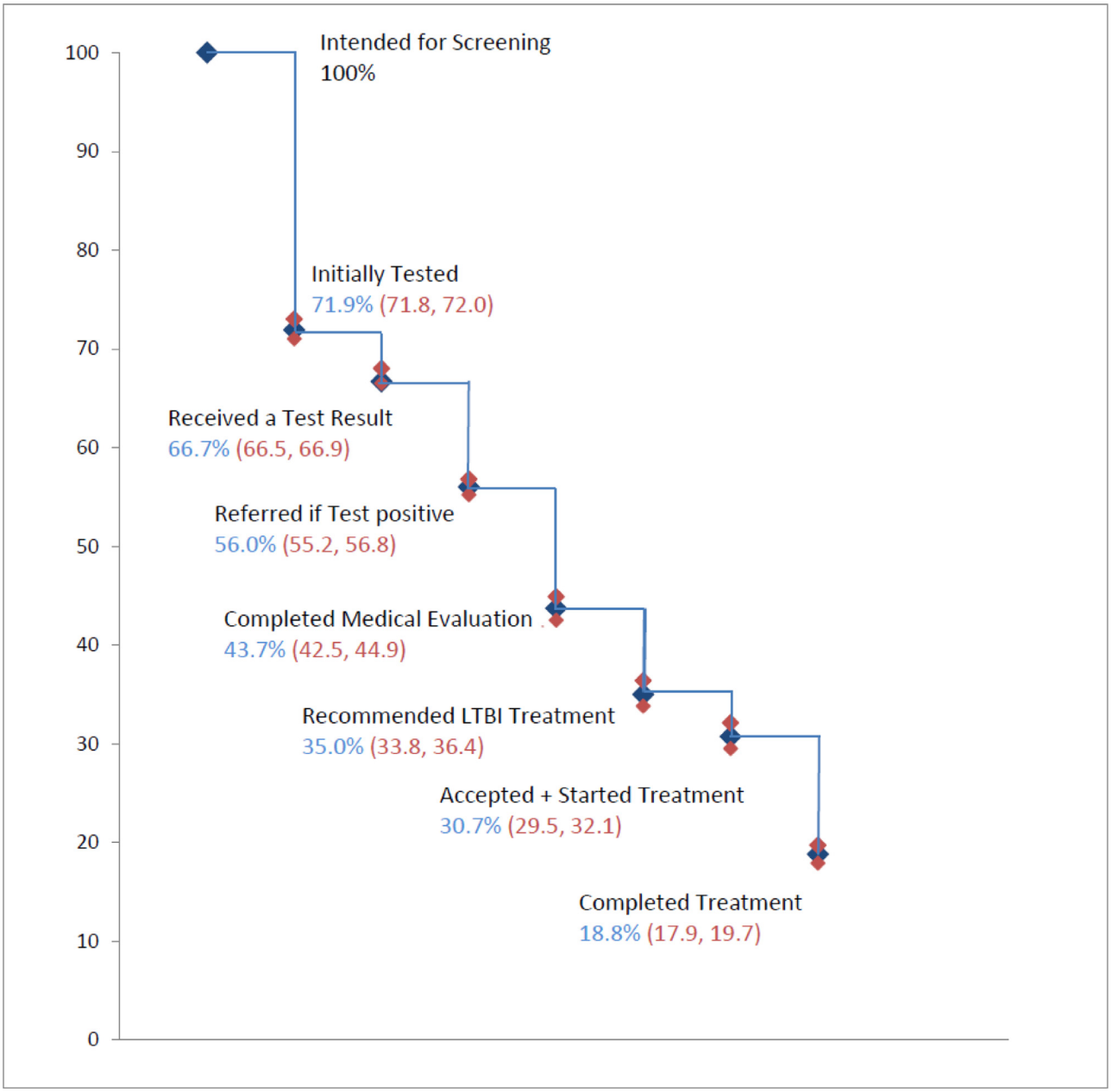
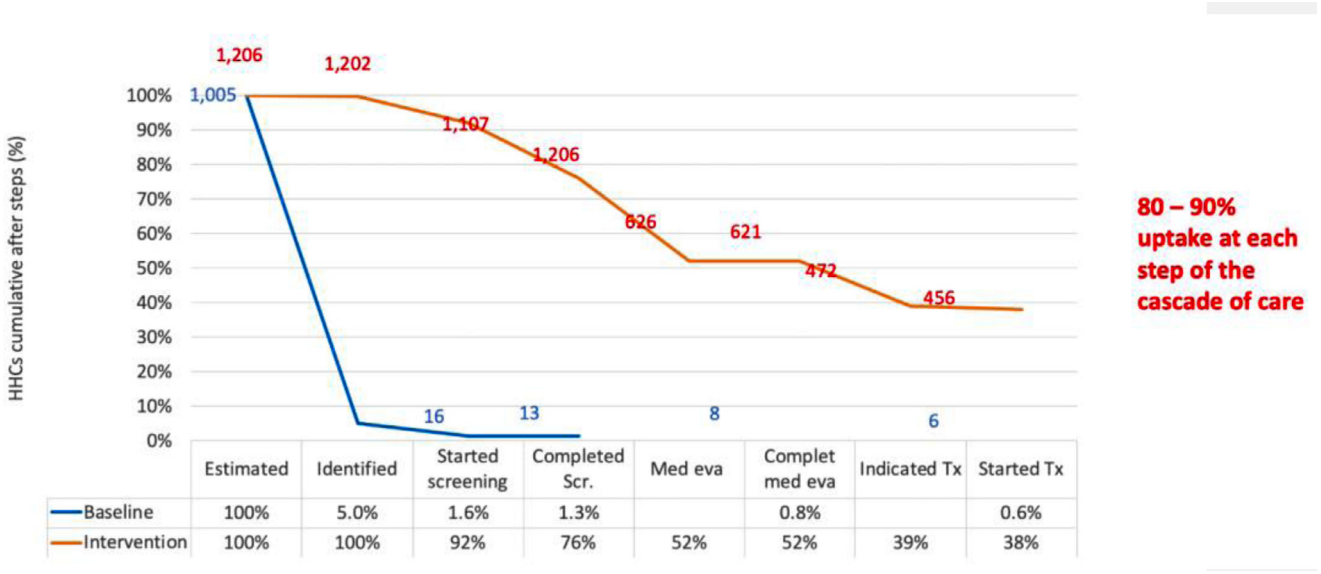


Fig. 1. Losses and drop-outs at each stage of the cascade of care in latent tuberculosis infection (LTBI). Numbers in parentheses are 95% confidence intervals. The value for each level is calculated as the product of the valude from the preceding step, multiplied by the pooled estimate for that step (from fixed-effects analysis). Source: Alsdurf H et al. Lancet Infect Dis 2016 [7] (reproduced with permission).

to understand the complex, multi-staged patient journey known as the LTBI cascade of care. A recent systematic review and meta-analysis identified gaps along the LTBI cascade of care including the following steps: (1) identification of household contacts; (2) initial screening of contacts by placing a tuberculin skin test (TST); (3) reading a TST; (4) conducting a medical evaluation; (5) recommending and initiating LTBI treatment for eligible contacts; and (6) monitoring and completion of LTBI treatment [7]. This systematic review demonstrated that less than 20% of all eligible contacts completed LTBI treatment, however it was also shown that there are losses at all other steps along the cascade (see Fig. 1) [7]. While this review highlighted the importance of addressing the losses of patients along all steps in the cascade, to date the majority of research has focused on the completion of treatment in patient care among those who began treatment, including compliance and adherence research or RCTs of shorter regimens [8].

Although the relative loss is highest at the last step in the LTBI cascade of care (i.e., completing treatment), almost 70% of household contacts do not even start preventive treatment [7]. Public health solutions targeting the steps upstream from treatment initiation, the points in the patient journey where people do not engage with the health facility (i.e., are not identified or screened or do not complete a medical evaluation), are the main drivers of poor treatment outcomes. Gaps in provider knowledge and understanding about the importance of improved contact investigation efforts [9], ease of TST for screening [10], and effectiveness of shortened [11] regimens must be addressed. Only by confronting these misconceptions and enahncing training will TB programmes be able to increase the numbers of contacts who complete initial steps in the LTBI cascade and initiate preventive treatment.

In response to the gaps identified at each stage in the LTBI cascade of care, a pragmatic, cluster-randomized controlled trial entitled “Enhancing the public health impact of latent TB infection diagnosis



	Estimated	Identified	Started screening	Completed Scr.	Med eva	Complet med eva	Indicated Tx	Started Tx
Baseline	100%	5.0%	1.6%	1.3%		0.8%		0.6%
Intervention	100%	100%	92%	76%	52%	52%	39%	38%

Fig. 2. Cumulative proportion completing each step along the LTBI cascade of care (Vietnam) before (blue line) and after (red line) the ACT4 intervention to evaluate and strengthen LTBI services. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

and treatment 'ACT4'" was conducted in five countries: Benin, Canada, Ghana, Indonesia and Vietnam. The aim of the ACT4 trial was to evaluate and strengthen the LTBI cascade of care through locally-developed solutions [12]. The primary objective of the trial was to estimate the increase in the number of household contacts initiating LTBI treatment per newly diagnosed active TB patient (index case) within three months of diagnosis [12]. Initial research findings from this trial are not yet published but a country-specific cascade of care identifying the steps with major losses and local solutions to improve outcomes in Vietnam was presented at the 50th Annual World Lung Conference (see Fig. 2). These study results provide an example of how interventions to address local losses of patients along the cascade could be used by TB programmes in other settings to improve outcomes for LTBI patients.

2.2. Improving quality of LTBI care

As highlighted by the Lancet's Commission, a key to providing quality LTBI patient care is to define, measure and then monitor services [6,13]. The LTBI cascade of care provides a clear, practical framework for evaluation of each step to equip TB programmes with data on where gaps in care occur at the local level. Care cascades offer two key benefits for TB programmes: (1) an approach to measuring TB outcomes and (2) a conceptual framework for assessing quality of healthcare services across the patient journey [14]. The cascade analysis can be presented in various formats, such as a simple graph (see Fig. 2) or as part of dashboards or other tracking systems as a way to engage HCW by presenting results in a timely manner. TB programmes can use cascade analyses for long-term monitoring and evaluation on a local- and national-level, which can then be used to leverage political commitment and financial support for TB care and services [15].

2.3. Applying quality improvement (QI) methods

Quality improvement (QI) in TB programmes was identified by the Lancet Commission as a key approach for improving quality healthcare [6]. QI focuses on improving the quality across all six dimensions of healthcare: safety, effectiveness, patient-centeredness, timeliness, efficiency and equitability [16]. A recent review highlighted that a QI approach will be a necessary strategy to improve outcomes and ensure patient-centered care along the LTBI cascade [17]. In order to provide quality LTBI services, local data should be used in order to maximize the number of household contacts identified, screened and placed on treatment [17]. Applying a QI approach to LTBI program expansion will enable interventions to adapt and target different steps along the LTBI cascade in an iterative manner to measure progress in quality of patient care [17].

3. Key steps to improving LTBI services

3.1. Improved identification of household contacts and screening services

Contact investigations are performed when people who have close contact (i.e., spend over 5 h per week) with active TB patients are systematically investigated for TB infection or active disease [18]. A key challenge to improving LTBI services is identifying all household contacts who are eligible for preventive treatment. In most LMICs, although contact investigations are technically included in national TB control policies, contact tracing is inconsistently performed due to resource limitations, as well as poor standards, lack of clear definitions of index cases or procedures for contact investigation [18]. A proactive approach to contact screening is necessary to ensure everyone that has been in contact with the patient with active TB disease, including high-risk individuals (i.e., HIV positive patients), is properly screened and tested for LTBI.

In low-incidence countries, such as Canada, LTBI screening for recent immigrants at the time of entry based on demographic factors has been shown to be the most effective, albeit resource-intensive approach [19]. Lonnroth et al. outlined priority areas for global TB strategy in low-incidence countries which includes five priorities related to LTBI patient care directly: (1) providing political commitment, funding and planning for high-quality services; (2) screening for active TB and LTBI in TB contacts and providing appropriate treatment; (3) ensuring continued surveillance, program monitoring and evaluation and data management; (4) investing in research and new tools; and (5) supporting global TB prevention, care and control efforts [20]. But key challenges in this setting include inadequate political commitment to TB elimination, reduced awareness of TB in the general public and diminished clinical expertise [21,22].

3.2. Healthcare workforce training for TB testing

One barrier to proper testing of patients for LTBI is the lack of

knowledge by health providers on how to use simple tools to test for latent tuberculosis, such as a tuberculin skin test (TST). Yet testing is key to determining if someone has active or latent TB. Incorrect administration of TST is a problem, particularly in LMICs. Although international guidelines recommend either TST or interferon-gamma release assays (IGRAs) may be used to test for LTBI, the TST remains the most widely used test in LMICs due to its low cost and ease of use [23]. TST is a relatively simple test but it requires careful training and supervision to establish HCW proficiency to administer and read the TST [10]. To address the lack of simple TST training tools available online, a study tested the accuracy and reproducibility of an mhealth approach for mobile TST (mTST) to train HCWs how to measure the size of swelling directly following injection (TST injection bleb) and 48–72 h (TST induration) [10]. Results showed that the mTST approach was reliable for assessments of injections, and for detecting indurations 15 mm or larger [10]. This study highlights how innovative approaches, such as the use of mobile health technologies, can provide simple, affordable solutions to increase screening and testing for LTBI, particularly in LMICs.

3.3. Comprehensive medical evaluations

Alsdurf et al. identified a key loss along the LTBI cascade at the point of patients completing medical evaluation [7]. Chest radiography (CXR) is a highly sensitive test to detect pulmonary TB, and is used in medical evaluations to rule-out active TB disease before providing preventive treatment [18,24]. But the lack of skilled readers, high cost of equipment as well as the need for expertise to interpret chest x-rays in resource limited settings, poses a challenge to ensuring medical evaluations are completed properly [24,25]. Computer-aided detection (CAD) uses software programmes to interpret digital radiographs and detect radiographic abnormalities consistent with possible active TB [24,25]. Findings from a systematic review of five studies on CAD for TB demonstrated that CAD software was capable of achieving similar accuracy as non-expert clinicians [24]. And a recent study in high-burden TB countries, found that CAD had the potential to be used for TB screening [25]. While additional research is needed on CAD technologies, this is an exciting potential solution for the longstanding barrier of diagnostic delays for LTBI patients.

3.4. Shorter and safer LTBI treatment regimens

LTBI preventive therapy has been available for over 60 years to prevent the progression to active TB disease, which is an important public health benefit [11,26]. As with any preventive health service, however, it can be difficult to treat people with LTBI who are asymptomatic and feel otherwise healthy [11]. Like many chronic diseases, it can be emotionally draining and confusing for patients who do not feel sick to take medication for long periods of time [27], and thus many patients fail to complete preventive treatment. Yet the consequence of progressing to active TB disease are serious and thus preventive treatment for LTBI should be prioritized. This will require high-quality, patient-centered care approaches to educate and discuss treatment options with household contacts to ensure they understand and agree to treatment [11].

There are currently four available treatment regimens for LTBI that have evidence to support their use: (1) isoniazid for 6–9 months, (2) rifampin daily for 4 months (4R), (3) isoniazid and rifapentine weekly for 3 months (3HP), or (4) isoniazid and rifampin daily for 3–4 months (3–4HR) [9,28]. Based on results from two recently published randomized controlled trials 4R was non-inferior to 9H among high-risk groups, and treatment completion rates were significantly higher in the 4R group [29,30]. Concerns about safety of preventive treatment has historic significance, particularly given the hepato-toxicity that has been a serious concern for isoniazid preventive therapy (IPT) [31]. Preventive treatment regimens with 4R and 3HP have been shown to be safer than isoniazid in trials and observational studies [29,30,32–35] a notable improvement to the patient treatment experience. Providing patients in LMICs with shortened treatment regimens that are easier to complete and less toxic would enable more people to get on treatment, thereby closing the gap in the last step of the LTBI cascade [11]. Furthermore, a reduction in time on treatment will have an enormous impact on the quality of life for patients [11], by alleviating the psychological stress and fatigue from taking medication daily over such a long time period.

4. Shifting to prioritize quality LTBI care

There is more than sufficient evidence that preventive treatment of LTBI should be part of a comprehensive and epidemiologically sound strategy for TB elimination [11]. The joint push from the WHO and UNHLM-TB has provided clear justification and strong support for expanded LTBI services globally [1,5]. Recent emphasis on the need to improve the quality of healthcare in global health [6,36,37], has increased the attention on providing comprehensive LTBI services.

Patient-centered care should be driven by continuous input from the intended beneficiaries (i.e., LTBI patients) [15]. TB programmes looking to expand LTBI services must work hard to better identify all eligible contacts and seek patient input to determine local solutions to keep patients engaged in their care journey. It is also critical to consider how expanded health services for better LTBI patient-centered care will impact the workload of HCWs, particularly in high-burden TB settings. Initial results from the ACT4 trial showed a statistically significant increase of 11% in the proportion of HCW time spent on LTBI activities following the intervention to evaluate and strengthen LTBI services (data submitted for publication). Importantly, these increases in HCW time resulted in LTBI services that were signficantly improved following the ACT4 intervention. As seen in sites such as Vietnam, less than 5% of eligible contacts completed all steps along the LTBI cascade at baseline (see Fig. 2, blue line) compared to over 80% completing each step following the intervention (see Fig. 2, red line). These results demonstrate that extensive planning and resource allocation will be needed to ensure there is well-trained and sufficient staffing of TB programmes. HCWs must have adequate time throughout their workday devoted to LTBI services in order to be able to provide patient-centered care and expanded LTBI services without negative impacts to care for other patients (i.e., active TB).

However this will require significant financial commitments which are currently not available for LTBI services globally. The 2019 WHO Global TB Report estimates show that US$10.1 billion was required for TB prevention, diagnosis and treatment, yet there was a gap of almost US$3.3 billion. And of the estimated total, US$0.3 billion was for TB prevention services thus accounting for less than 3% of the total TB funding globally [1].To achieve the End TB Strategy goals, it will be particularly important that political and financial commitments to TB services not only continue but also support the expansion of LTBI patient care activities.

5. Conclusion

The Lancet Commission's HQSS framework has emphasized the importance of strengthening the healthcare workforce to improve patient-centered care. The numerous steps along the LTBI cascade of care pose challenges, but also opportunities to engage patients to ensure services meet their needs. TB programmes can improve the quality of latent TB services by implementing regular and standardized evaluations of the LTBI cascade of care with implementation of interventions to resolve gaps in care. This will lead to improvements in identification, diagnosis, treatment and retention in care of persons with latent TB. Ultimately, this will reduce the numbers of persons developing active TB disease thereby bringing an end to TB globally.

CRediT authorship contribution statement

Alsdurf Hannah: Conceptualization, Writing - original draft, Writing - review & editing. **Menzies Dick:** Supervision, Conceptualization, Writing - review & editing.

Declaration of Competing Interest

Neither of the authors of this manuscript have any conflicts of interest to declare.

References

[1] Organization WH. Global tuberculosis report. Geneva: World Health Organization; 2019. WHO/CDS/TB/2019.15.
[2] Houben RM, Dodd PJ. The global burden of latent tuberculosis infection: a *re*-estimation using mathematical modelling. PLoS Med 2016;13(10):e1002152.
[3] World Health Organization. The end TB strategy: global strategy and targets for tuberculosis prevention, care and control after 2015. Geneva: World Health Organization; 2014.
[4] Dye C, Glaziou P, Floyd K, Raviglione M. Prospects for tuberculosis elimination. Annu Rev Public Health 2013;34:271–86.
[5] United Nations General Assembly. Political declaration of the un high level meeting on the fight against tuberculosis. New York City: United Nations; 2018. Resolution A/RES/73/3.
[6] Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, et al. High-quality health systems in the sustainable development goals era: time for a revolution. Lancet Glob Health 2018;6(11):e1196–252.
[7] Alsdurf H, Hill PC, Matteelli A, Getahun H, Menzies D. The cascade of care in diagnosis and treatment of latent tuberculosis infection: a systematic review and meta-analysis. Lancet Infect Dis 2016;16(11):1269–78.
[8] Hirsch-Moverman Y, Daftary A, Franks J, Colson PW. Adherence to treatment for latent tuberculosis infection: systematic review of studies in the US and Canada. Int J Tuberc Lung Dis 2008;12(11):1235–54.
[9] Sharma SK, Mohanan S, Sharma A. Relevance of latent TB infection in areas of high TB prevalence. Chest 2012;142(3):761–73.
[10] Moayedi-Nia S, Barss L, Oxlade O, Valiquette C, Ly MX, Campbell JR, et al. The mTST - an mHealth approach for training and quality assurance of tuberculin skin test administration and reading. PLoS One 2019;14(4):e0215240.
[11] Rangaka MX, Cavalcante SC, Marais BJ, Thim S, Martinson NA, Swaminathan S, et al. Controlling the seedbeds of tuberculosis: diagnosis and treatment of tuberculosis infection. Lancet 2015;386(10010):2344–53.
[12] Oxlade O, Trajman A, Benedetti A, Adjobimey M, Cook VJ, Fisher D, et al. Enhancing the public health impact of latent tuberculosis infection diagnosis and treatment (ACT4): protocol for a cluster randomised trial. BMJ Open 2019;9(3):e025831.
[13] Arsenault C, Roder-DeWan S, Kruk ME. Measuring and improving the quality of tuberculosis care: a framework and implications from the lancet global health commission. J Clin Tuberc Other Mycobact Dis 2019;16:100112.
[14] Subbaraman R, Nathavitharana RR, Mayer KH, Satyanarayana S, Chadha VK, Arinaminpathy N, et al. Constructing care cascades for active tuberculosis: a strategy for program monitoring and identifying gaps in quality of care. PLoS Med 2019;16(2):e1002754.
[15] Agins BD, Ikeda DJ, Reid MJA, Goosby E, Pai M, Cattamanchi D. Improving the cascade of global tuberculosis care: moving from the “what” to the “how” of quality improvement. Lancet Infect Dis 2019;19(12):e437–43. https://doi.org/10.1016/S1473-3099(19)30420-7.
[16] Crossing the quality chasm: a new health system for the 21st century. Institute of Medicine (US) Committee on Quality of Health Care in America. Washington (DC): National Academies Press (US); 2001.
[17] Barss L, Menzies D. Using a quality improvement approach to improve care for latent tuberculosis infection. Expert Rev Anti Infect Ther 2018;16(10):737–47.
[18] Latent tuberculosis infection: updated and consolidated guidelines for programmatic management. WHO/CDS/TB/2018.4 Geneva: World Health Organization; 2018.
[19] Ronald LA, Campbell JR, Rose C, Balshaw R, Romanowski K, Roth DZ, et al. Estimated impact of world health organization latent tuberculosis screening guidelines in a region with a low tuberculosis incidence: retrospective cohort study. Clin Infect Dis 2019;69(12):2101–8.
[20] Lonnroth K, Migliori GB, Abubakar I, D’Ambrosio L, de Vries G, Diel R, et al. Towards tuberculosis elimination: an action framework for low-incidence countries. Eur Respir J 2015;45(4):928–52.
[21] LoBue PA, Mermin JH. Latent tuberculosis infection: the final frontier of tuberculosis elimination in the USA. Lancet Infect Dis 2017;17(10):e327–33.
[22] Milinkovic DA, Birch S, Scott F, Newbold KB, Hopkins J, Saffie M, et al. Low prioritization of latent tuberculosis infection-A systemic barrier to tuberculosis control: a qualitative study in Ontario, Canada. Int J Health Plann Manag 2019;34(1):384–95.
[23] Fox GJ, Dobler CC, Marais BJ, Denholm JT. Preventive therapy for latent tuberculosis infection-the promise and the challenges. Int J Infect Dis 2017;56:68–76.
[24] Pande T, Cohen C, Pai M, Ahmad Khan F. Computer-aided detection of pulmonary tuberculosis on digital chest radiographs: a systematic review. Int J Tuberc Lung Dis 2016;20(9):1226–30.
[25] Melendez J, Hogeweg L, Sanchez CI, Philipsen RHHM, Aldridge RW, Hayward AC, et al. Accuracy of an automated system for tuberculosis detection on chest radiographs in high-risk screening. Int J Tuberc Lung Dis 2018;22(5):567–71.
[26] Bibbins-Domingo K, Grossman DC, Curry SJ, Bauman L, Davidson KW, Epling JWJ, et al. Screening for latent tuberculosis infection in adults: US preventive services task force recommendation statement. JAMA 2016;316(9):962–9.
[27] Blumberg HM, Ernst JD. The challenge of latent TB infection. JAMA 2016;316(9):931–3.
[28] Zenner D, Beer N, Harris RJ, Lipman MC, Stagg HR, van der Werf MJ. Treatment of latent tuberculosis infection: an updated network meta-analysis. Ann Intern Med 2017;167(4):248–55.
[29] Diallo T, Adjobimey M, Ruslami R, Trajman A, Sow O, Obeng Baah J, et al. Safety and side effects of rifampin versus isoniazid in children. N Engl J Med 2018;379(5):454–63.
[30] Menzies D, Adjobimey M, Ruslami R, Trajman A, Sow O, Kim H, et al. Four months of rifampin or nine months of isoniazid for latent tuberculosis in adults. N Engl J Med 2018;379(5):440–53.
[31] Kabbara WK, Sarkis AT, Saroufim PG. Acute and Fatal Isoniazid-induced hepatotoxicity: a case report and review of the literature. Case Rep Infect Dis 2016;2016:3617408.
[32] Lardizabal A, Passannante M, Kojakali F, Hayden C, Reichman LB. Enhancement of treatment completion for latent tuberculosis infection with 4 months of rifampin. Chest 2006;130(6):1712–7.
[33] Page KR, Sifakis F, Montes de Oca R, Cronin WA, Doherty MC, Federline L, et al. Improved adherence and less toxicity with rifampin vs isoniazid for treatment of latent tuberculosis: a retrospective study. Arch Intern Med 2006;166(17):1863–70.
[34] Stagg HR, Zenner D, Harris RJ, Munoz L, Lipman MC, Abubakar I. Treatment of latent tuberculosis infection: a network meta-analysis. Ann Intern Med 2014;161(6):419–28.
[35] Sterling TR, Villarino ME, Borisov AS, Shang N, Gordin F, Bliven-Sizemore E, et al. Three months of rifapentine and isoniazid for latent tuberculosis infection. N Engl J Med 2011;365(23):2155–66.
[36] Das J, Woskie L, Rajbhandari R, Abbasi K, Jha A. Rethinking assumptions about delivery of healthcare: implications for universal health coverage. BMJ 2018;361:k1716.
[37] Pai M, Temesgen Z. Quality: the missing ingredient in TB care and control. J Clin Tuberc Other Mycobact Dis 2019;14:12–3.