Review Article

Impact of healthcare worker training on paediatric tuberculosis detection and reporting: A systematic review

Suryanti Chan[1], Hamzah Hamzah[2], Miftahul Falah[3]

Author Affiliation:

1. Faculty of Medicine, Universitas Dian Nuswantoro, Semarang, Indonesia
2. Faculty of Medicine, Universitas Batam, Batam, Indonesia.
3. Department of Nursing, Faculty of Health Sciences, Universitas Muhammadiyah Tasikmalaya, Indonesia.

Correspondence:
Suryanti Chan
suryanti_83@yahoo.com

Submitted: July 2025
Accepted: August 2025
Published: November 2025

ABSTRACT

Paediatric tuberculosis (TB) is often underdiagnosed in low- and middle-income countries (LMICs) due to limited healthcare worker (HCW) capacity. This review assesses the impact of HCW training on improving paediatric TB detection and notification. A systematic search of international databases from January 2020 to April 2025 identified studies on HCW training related to paediatric TB diagnosis, notification, and HCW knowledge or confidence. Nine studies from LMICs (Kenya, Indonesia, Egypt, China, South Africa) met the criteria. Training formats included workshops and digital platforms, with most improving HCWs' knowledge and confidence. Five studies showed a 35-60% increase in paediatric TB detection, while four showed improved notification, particularly with training, supervision, and TB register use. Barriers included poor internet access, staff turnover, and a lack of mentorship. Digital platforms showed promise but required adaptation. HCW training improves paediatric TB outcomes in LMICs, especially when incorporating interactive content, supervision, and practical tools. Ongoing paediatric TB training should be integrated into national TB programs.

Keywords: paediatric tuberculosis; healthcare workers; training; detection; reporting.

Citation: Chan et al. Impact of healthcare worker training on paediatric tuberculosis detection and reporting: A systematic review. South Sudan Medical Journal, 2025;18(4):218-222 DOI: https://dx.doi.org/10.4314/ssmj.v18i4.12

Introduction

Tuberculosis (TB) is a major global health issue, affecting an estimated 10.6 million people in 2022, including 1.1 million children under 15 years.[1] Paediatric TB represents a significant burden, especially in high-incidence, low- and middle-income countries (LMICs). However, its detection and management lag behind that of adult TB.[2-5]

Diagnosing TB in children is challenging due to non-specific symptoms, paucibacillary disease, and frequent smear-negative results, leading to under-diagnosis, delayed treatment, and preventable morbidity and mortality.[3,4,6-8] Missed cases disrupt surveillance and hinder national TB control efforts.

In LMICs, healthcare workers (HCWs) outside TB programs often lack adequate knowledge and confidence in diagnostic algorithms, contributing to misdiagnosis

and under-reporting.[3,6-9] Better training is needed to improve early detection and reporting of paediatric TB.[2,5]

While traditional training methods like workshops and mentoring are common, digital platforms and blended learning approaches are becoming more popular, helping overcome logistical barriers. For example, Indonesia's Plataran Sehat platform supports ongoing TB management training for primary healthcare workers. Despite these efforts, evidence on their impact is fragmented.[10-16]

Although reviews on general TB detection exist, few focus on healthcare worker training for paediatric TB diagnosis and notification. This review aims to assess the impact of various training interventions (offline, online, or blended) on paediatric TB outcomes and identify key training types, delivery modes, and implementation challenges.

Method

We included studies assessing HCWs training interventions aimed at improving paediatric TB diagnosis and reporting. Participants included general practitioners, nurses, midwives, and community health workers. Eligible interventions involved structured programs (workshops, mentoring, e-learning, or blended formats). We considered RCTs, quasi-experimental designs, cohort studies, and before-and-after studies reporting on outcomes related to diagnosis, notification, or intermediate outcomes (knowledge, confidence, and skills). Only English-language studies published between January 2020 and June 2025 were eligible.

We searched PubMed, Scopus, Web of Science, Embase, and Cochrane Library using keywords related to TB, paediatrics, HCW training, and diagnostic outcomes. Reference lists of relevant studies were screened. Two independent reviewers screened titles and abstracts, followed by a review of the full texts. Disagreements will be resolved by consensus or a third reviewer.

Data extraction focused on study characteristics, training formats, and outcomes (diagnosis, notification, knowledge, confidence, barriers/facilitators). Two reviewers independently extracted data and assessed study quality using Cochrane RoB2 for RCTs and ROBINS-I for non-randomized studies. We grouped studies by intervention type and delivery mode, with thematic analysis of barriers and facilitators.

Results

Out of 121 records identified, 79 remained after removing duplicates. After excluding 27 studies, 9 were included (Figure 1).

The studies, conducted in LMICs (Kenya, Indonesia, Libya, Egypt, South Africa, Brazil), involved quasi-experimental (3), RCTs (2), before-after studies (2), one systematic review, and one qualitative study. Training formats included workshops (5), e-learning (2), and blended (2), with durations from 3 days to several weeks (Table 1).

Seven studies evaluated paediatric TB diagnosis, with five showing a 35%-60% improvement in detection.[11,12,14,15,16] Amare et al. (2023) reported a pooled relative risk of 1.60 (95% CI: 1.53–1.66) following training.[13] Several studies have also shown an increased use of standardized diagnostic algorithms.[6,14]

Six studies assessed the impact of training on TB case notification, with four showing improved paediatric TB reporting to national systems. Key enablers included post-training supervision, TB registers, and mobile tools.[11,13,15,16] In Kenya, training enhanced the use of TBData4Action, leading to improved data-driven responses.[17]

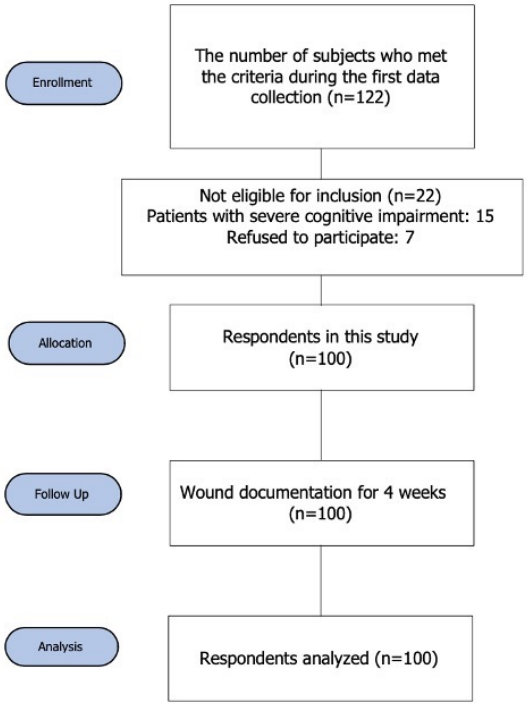

Figure 1. Flow diagram

Table 1. Characteristics of included studies

Author (Year)	Country	Study Design	Participants	Training Type	Key Outcomes
Angala et al. (2022) [16]	Kenya	Quasi-experimental	TB coordinators (n=331)	In-person workshops + field practicals	↑ Notification, ↑ Data use, ↓ Training cost
Elbahloul et al. (2023) [15]	Libya	Quasi-experimental	Nurses (n=100)	Educational module	↑ Knowledge, attitude, practice at 6 months
Madzinga et al. (2022) [14]	South Africa	Qualitative	HCWs (n=24)	TB management training (unspecified)	Barriers to IPC and implementation
Amare et al. (2023) [13]	Multi-country	Systematic review + meta-analysis	Multiple studies	Mixed (varied)	RR = 1.60 for TB case detection
Elgazzar et al. (2023) [12]	Egypt	Quasi-experimental	Nurses (n=36)	Structured educational program	↑ Practice, ↑ Self-efficacy
Sianturi et al. (2023) [10]	Indonesia	Interventional study	TB instructors (n=60)	OCB-based training	↑ Competence (p=0.001)
Russo et al. (2024) [6]	Brazil	Scoping review	Not specified	N/A	Missed diagnosis opportunities in children
Chan et al. (2025) [5]	Indonesia	Qualitative	Physicians (n=15)	No formal training	Barriers to notification (private sector)
Wang et al (2021) [11]	China	Quasi-experimental	N=757	E-learning programs for TB	↑ TB knowledge, key facilitators: content quality, barriers: content difficulty, relevance, and hardware limitations

Six studies reported improvements in HCWs' knowledge and confidence in paediatric TB management post-training.[6,10-14,17] Elbahloul et al. (2023) observed a 40-point knowledge increase, lasting up to six months reported a 40-point knowledge increase, lasting up to six months,[15] while Elgazzar et al. (2023) observed improved self-efficacy in nurses.[12] Long-term retention and behaviour change were inconsistently evaluated.

Five studies identified barriers and facilitators.[10-12,14,16] Barriers included staff turnover, time constraints, poor internet, and lack of post-training support, while facilitators included strong leadership, integration into child health modules, and localized mentorship. Chan et al. (2023) noted gaps in private sector reporting and the need for policy-driven support.[5]

Discussion

This review underscores the importance of HCWs training in improving pediatric TB detection and notification, addressing a significant gap in global TB control. Nine studies showed that training, whether via workshops, blended formats, or digital platforms, consistently improved HCWs' knowledge, confidence, and TB outcomes.[5,6,10-13,15,16]

Our findings align with global evidence that enhancing HCWs competencies is critical for addressing pediatric TB under-diagnosis and underreporting, particularly in resource-limited settings. Notably, several studies reported substantial improvements in TB detection rates after targeted training, with Amare et al. reporting a 60% increase.[12,13,15]

Outcomes varied due to differences in training methods, duration, and local factors like pre-existing skills and available diagnostic tools. However, interventions with post-training mentorship or supervision were more successful in translating knowledge into

practice,[6,10,12,13,15,16] emphasizing the need for ongoing support to sustain improvements.[10,11,13]

Digital and blended training models showed promise, particularly in Indonesia and Kenya,[10,16] but challenges like poor internet access and low digital literacy remain. Success depends on offline support and continuous technical assistance.[10,11,13,16]

While all studies showed immediate improvements in HCW knowledge and confidence, few assessed long-term outcomes. Only Elbahloul et al.[15] evaluated impact beyond six months, highlighting the need for longitudinal research to explore the sustainability of training effects.

For national TB programs, integrating paediatric TB training into continuous professional development and ensuring ongoing supervision are crucial to closing the paediatric TB reporting gap. Monitoring training outputs and case detection rates will help refine programmes.[5,6,15]

This review's strengths include a comprehensive search strategy and robust evaluation, though limitations include study heterogeneity and short-term focus. Future research should compare training models, assess cost-effectiveness, and investigate impacts on treatment outcomes. Qualitative studies, like those by Chan et al.[5] and Madzinga et al,[14] could provide valuable insights into the sustainability of these interventions.

Conclusion

This systematic review highlights the positive impact of healthcare worker training on paediatric tuberculosis detection and notification in low- and middle-income countries. The training methods most effective in improving HCWs' knowledge and clinical practices incorporated interactive content, supervision, and practical tools. Future research should focus on long-term sustainability, cost-effectiveness, and the role of structural and behavioural factors in enhancing training uptake and outcomes.

References

1. WHO. 2024 Global tuberculosis report [Internet]. 25 November 2024. 2024. 1–50 p. Available from: https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2024
2. Basile FW, Nabeta P, Ruhwald M, Song R. Pediatric Tuberculosis Diagnostics: Present and Future. J Pediatric Infect Dis Soc. 2022;11(Suppl 3):S85–93.
3. Linn AR, Dubois MM, Steenhoff AP. Under-Reporting of Tuberculosis Disease among Children and Adolescents in Low and Middle-Income Countries: A Systematic Review. Trop Med Infect Dis. 2023 May;8(6).
4. Mane SS, Shrotriya P. Current Epidemiology of Pediatric Tuberculosis. Indian J Pediatr. 2024 Jul;91(7):711–6.
5. Chan S, Ahmed IA, Hamzah H. Addressing barriers in paediatric tuberculosis reporting: A qualitative study of private healthcare providers' perspectives. South Sudan Med J. 2025;18(1):19–23.
6. Russo DO, Jimenez ALL, Diniz LMO, Cardoso CA, Romanelli RM de C. Missed opportunities in the prevention and diagnosis of pediatric tuberculosis: a scoping review. J Pediatr (Rio J). 2024;100(4):343–9.
7. Tesfaye SH, Mulat Tebeje T, Sisay D, Belete M, Kifle Y, Feleke A, et al. Estimating childhood tuberculosis incidence and under-reporting in Gedeo Zone, Ethiopia: a Bayesian hidden Markov model. IJID. 2025;15:100673. Available from: https://doi.org/10.1016/j.ijregi.2025.100673
8. Moore BK, Graham SM, Nandakumar S, Doyle J, Maloney SA. Pediatric Tuberculosis: A Review of Evidence-Based Best Practices for Clinicians and Health Care Providers. Pathogens. 2024;13(6).
9. UNICEF. Pediatric tuberculosis with a focus on indonesia. Unicef. 2022;1–51.
10. Sianturi E, Situmorang B, Simaremare A. Competency of Tuberculosis Instructor after Training with Citizenship Behavior-Based Organizational Training Management. Open Access Maced J Med Sci. 2023;11(E):5–12.
11. Wang ZY, Zhang LJ, Liu YH, Jiang WX, Jia JY, Tang SL, et al. The effectiveness of E-learning in continuing medical education for tuberculosis health workers: a quasi-experiment from China. Infect Dis Poverty. 2021;10(1):1–11. Available from: https://doi.org/10.1186/s40249-021-00855-y

12. Elgazzar S, Labib Elkashif M, Elbqry M, Elmansy F. Improving nurses' knowledge, practice, and self-efficacy regarding caring patients with tuberculosis: A quasi-experimental design. Iran J Nurs Midwifery Res. 2023;28(3):235–43.

13. Amare D, Getahun FA, Mengesha EW, Dessie G, Shiferaw MB, Dires TA, et al. Effectiveness of healthcare workers and volunteers training on improving tuberculosis case detection: A systematic review and meta-analysis. PLoS One. 2023;18(3):1–13. Available from: http://dx.doi.org/10.1371/journal.pone.0271825

14. Madzinga D, Tshitangano TG, Raliphaswa NS, Razwiedani L. Healthcare Workers' Perception of Measures to Reduce the Risk of New Tuberculosis Infections: A Qualitative Study Report. Nurs Reports. 2022;12(4):873–83.

15. Elbahloul M, Ali K, Alghennai S. Effectiveness of Health Education Intervention in Improving Knowledge, Attitude, and Practices Regarding Tuberculosis Among Nurses Working in Tuberculosis Centers in Libya. Alq J Med App Sci. 2023;6(1):230–9. Available from: https://journal.utripoli.edu.ly/index.php/Alqalam/indexeISSN2707-7179

16. Angala P, Dlodlo RA, Wanjala S, Mamo G, Mugambi-Nyaboga L, Onyango Okoth E, et al. TB training in Kenya: building capacity for care and prevention. Public Heal Action. 2022;12(1):40–7.