



(REVIEW ARTICLE)



FACTORS ASSOCIATED WITH TUBERCULOSIS TRANSMISSION AMONG HOUSEHOLD CONTACTS OF BACTERIOLOGICALLY CONFIRMED PULMONARY TUBERCULOSIS PATIENTS NAKURU COUNTY: A SYSTEMATIC REVIEW

Mwenye Phostine Simiyu, Laura Cherop Chemut, Precious Mwende Kimathi *, Ekitela Rael Ewoi, Omodo Cecilia Labenda, Mocha Clifford Nyakundi and Alice Wangui Ongera

Clinical Medicine and Surgery, Kenya Medical Training College, Bomet, Kenya.

* Corresponding Author; Email: kimathiprecious26@gmail.com

ORCID Details

Mwenye Phostine Simiyu: <https://orcid.org/0009-0008-7729-295X>

Laura Cherop Chemut: <https://orcid.org/0009-0000-2572-9234>

Precious Mwende Kimathi: <https://orcid.org/0009-0006-7098-1010>

Ekitela Rael Ewoi: <https://orcid.org/0009-0005-0991-7821>

Omodo Cecilia Labenda: <https://orcid.org/0009-0008-8978-0862>

Mocha Clifford Nyakundi: <https://orcid.org/0009-0005-9240-5252>

Alice Wangui Ongera: <https://orcid.org/0000-0002-6833-1557>

World Journal of Advanced Research and Reviews, 2026, 32(01), 936–943

Publication history: Received on 03 September 2026; revised on 11 October 2026; accepted on 13 October 2026

Article DOI: <https://doi.org/10.30574/wjarr.2026.32.1.2593>

Copyright © 2026 Author(s) retain the copyright of this article. This article is published under the terms of the Creative Commons Attribution License 4.0

ABSTRACT

Introduction: Tuberculosis (TB) remains an important communicable disease and people living in the same household with a person with bacteriologically confirmed pulmonary TB are at increased risk of TB infection. The World Health Organization recommends systematic screening of household and close contacts and TB preventive treatment for eligible contacts. In 2024, an estimated 14 million household contacts of people who were diagnosed with bacteriologically confirmed pulmonary TB, were reported globally but only a proportion were evaluated and provided with preventive treatment.

Objective: To determine factors associated with tuberculosis transmission among household contact of bacteriologically confirmed pulmonary tuberculosis patients in Nakuru County.

Methods: The proposal will use a quantitative cross-sectional approach among household contacts of bacteriologically confirmed pulmonary TB patients identified in Nakuru County. Eligible contacts will be identified, consented and interviewed using structured questionnaires. TB status and screening information will be obtained from participant assessment and relevant clinical records where available. Data will be coded, entered into Microsoft Excel and analyzed using descriptive analysis.

Results: The findings will provide local evidence that can support targeted household contact screening, health education, infection prevention and TB preventive treatment. No results are presented in this proposal project because data collection has not been completed.

Conclusion: The study will assess household, environmental, clinical, and preventive factors associated with TB transmission among household contacts. Actually, the study may contribute to improved household level TB prevention and support the ongoing efforts to reduce TB transmission and disease in the community.

Keywords: Pulmonary Tuberculosis, Household Contacts, Transmission, Screening, Prevention

1 INTRODUCTION

Tuberculosis is an infectious disease caused mainly by *Mycobacterium tuberculosis*. The disease primarily affects the lungs resulting in pulmonary TB although it can affect other organs and tissue of the body (*World Health Organization (WHO)*, n.d.). Pulmonary TB is the most common form of TB (Turner et al., 2017). Transmission among household contact is influenced by overcrowding, poor ventilation, delayed diagnosis, HIV status, prolonged exposure to an infected TB patient, malnutrition and limited contact screening (Histina, 2025).

Household contacts are an important group for TB prevention for they experience repeated prolonged exposure to an infectious TB household member. The World Health Organization (WHO) advocates for systematic TB screening for household and close contacts of people with TB. WHO also recommends TB preventive treatment for household contacts of people with bacteriologically confirmed pulmonary TB (*BMC Infectious Diseases*, n.d.).

The WHO Global Tuberculosis Report 2025, estimates that approximately 14 million household contacts of people diagnosed with bacteriologically confirmed pulmonary TB existed globally in 2024. Out of 11 million contacts reported, only about 9.3 million were evaluated for TB infection. The overall TB cases among screened household contacts in 124 reporting countries is 1.5% , although the yield varies between countries and programs (3. *TB Prevention & Screening*, n.d.-a)

In Kenya, (Nair et al., 2024) evaluated a program for household contacts of pulmonary TB patients in Kiambu County and found out that 95% of index patients had their household contacts listed within seven days of starting treatment. However, screening outcomes and clinical decisions were not achieved within the intended time for all contacts hence showing that implementation gaps can occur even when contact investigation is established (Nair et al., n.d.,).

In Nairobi(Odera et al., 2020a) conducted a cross-sectional study among adult household contacts of pulmonary TB patients and reported a high prevalence of latent TB infection among the contacts. Factors such as duration of cohabitation, relationship to the index patient and sharing a single room were also explored. The findings therefore supports the need to examine both individual and household risk factors when assessing TB risk among contacts in Kenya (Odera et al., 2020b).

A Kenyan study comparing household contacts of bacteriologically confirmed and non-confirmed TB patients demonstrates the relevance of household contact investigations. Evaluation using symptom assessment and TB infection testing, with clinical and sputum investigations for participants was used (Warria et al., 2020).

Despite implementation of the National Tuberculosis, Leprosy and Lung Disease Program [NTLD-P], transmission among household remain a major challenge. Therefore, the current proposal focuses on household contacts of bacteriologically confirmed pulmonary TB patients in Nakuru County. The study will focus on socio-demographic, environmental, clinical exposure and preventive practice factors associated with TB infection among these contacts.

2 MATERIALS AND METHODS

2.1 Introduction

Tuberculosis is a communicable disease caused by *Mycobacterium tuberculosis*, the disease primarily affects the lungs, resulting in pulmonary tuberculosis [PTB] although it can also affect other organs and tissues of the body(*Global Tuberculosis Report 2022*, 2022). Pulmonary tuberculosis is therefore the most common form of TB and the major form of transmission, because infected individuals release infectious droplets into the air when they cough, sneeze, or spit(*Tuberculosis*, n.d.). Household contacts of individuals with bacteriologically confirmed pulmonary tuberculosis face a highest risk of transmission due to prolonged exposure(2.2.1 *Prioritizing Household Contacts | TB Knowledge Sharing*, n.d.).

In Kenya, contact tracing is the most used way for early detection and administration of tuberculosis preventive therapy [TPT]. However the active the cases and subsequent implementation of the preventive measures are highly influenced by environmental, social demographic and clinical factors (Volkman et al., 2016).

2.2 Identification of the Research Question

The study was guided by the following research questions:

- What is the prevalence of TB among household contacts of bacteriologically confirmed pulmonary TB patients in Nakuru County?
- Which socio-demographic and environmental factors are associated with TB transmission among household contacts?
- Which clinical and household exposure factors are associated with TB transmission among household contacts?

2.3 Search Strategy and Selection Criteria

Boolean operators were used to combine the keywords and phrases to form search strategies (Frankl, n.d.).

Table 1: Boolean Search Operation

Concept	search terms	Boolean operator
Tuberculosis	"Tuberculosis" OR "pulmonary tuberculosis"	OR
Household contacts	"Household contact" OR "family contact" OR "close contact"	OR
Transmission	"Tuberculosis transmission" OR "tuberculosis infection" OR "active tuberculosis"	OR
Factors	"Risk factor" OR "associated factor" OR "socio-demographic factor" OR "environmental factor"	OR
Final combination	("Tuberculosis" OR "pulmonary tuberculosis") AND ("household contact" OR "family contact" OR "close contact") AND ("tuberculosis transmission" OR "tuberculosis infection" OR "active tuberculosis") AND ("risk factor*" OR "associated factor" OR "socio-demographic factor*" OR "environmental factor*")	AND

2.4 Selection criteria

2.4.1 Inclusion

- Household contacts of bacteriologically confirmed pulmonary TB patients.
- Residents of Nakuru County.
- Individuals willing to provide informed consent.
- Individuals available during the data-collection period.

2.4.2 Exclusion

- Non-household contacts.
- Contacts of non- bacteriologically confirmed PTB cases.
- Individuals who are severely ill and unable to respond.
- Participants unwilling to consent.

2.5 Data Extraction Procedure

A structured data – extraction form was used to capture, for each eligible study, the author(s) and year of publication, study design, geographical setting, study population and sample size, data collection method, and key factors or determinants reported in relation to TB transmission among household contacts. Data extraction was performed independently against the reviewed research questions, and extracted data were organized to facilitate thematic synthesis where a study reported statistical measures of association were recorded alongside the corresponding factor. Discrepancies in interpretation were resolved by re-checking the original source against the research questions guiding this review.

2.6 Quality Appraisal

Included studies were appraised for methodological quality using design-appropriate checklists: the (MMAT) Mixed Method Appraisal Tool for mixed- method studies, the (CASP) Critical Appraisal Skill Program checklist for qualitative studies, and the (JBI) Joanna Briggs Institute checklist for analytical cross-sectional studies. Studies were not excluded solely on the basis of methodological limitations, given the relatively limited pool of Nakuru – specific evidence; however, methodological strengths and limitations of the evidence base are considered in the discussion.

2.7 PRISMA Flow Summary

PRISMA flow diagram for study selection

2.7.1 Prisma Flow Summary and image.

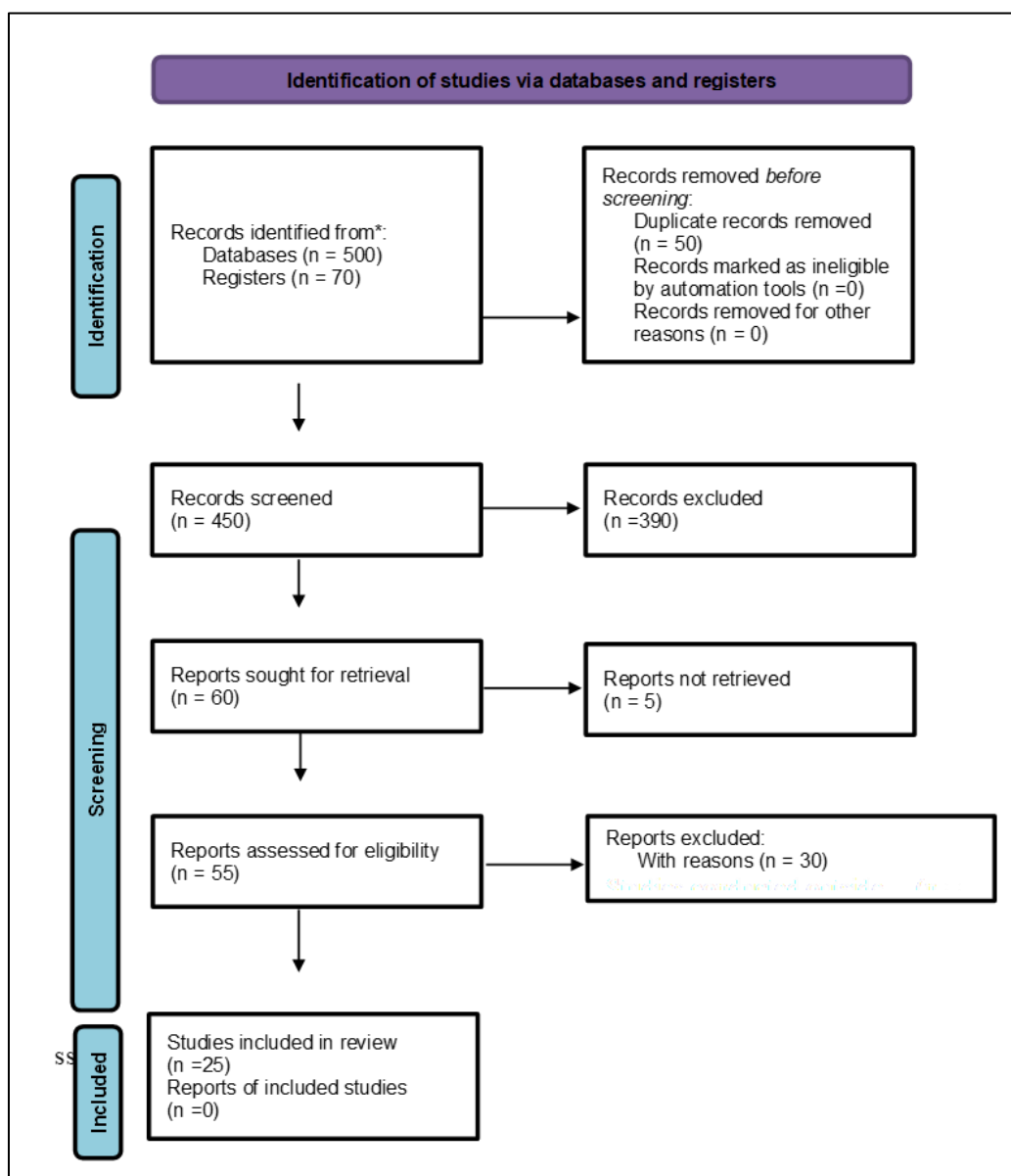


Figure 1: PRISMA 2020 Flow Diagram

3 RESULTS

3.1 Study Selection

The systematic review included 25 studies that met the predefined eligibility criteria. The selection process involved identification of potentially relevant records, screening, full-text assessment, and final inclusion. The available draft did not provide the numerical counts for the records identified, duplicates removed, records screened, or full-text articles excluded; therefore, these values have not been invented. The final number of included studies was 25.

3.2 Characteristics of the Included Evidence

The table below provides the characteristics, factors and interpretation of the included evidence.

Table 2: Characteristics of the included evidence

Characteristics	Factors	Interpretation
Individual	Age, sex and other individual characteristics	Individual characteristics may modify vulnerability to TB infection.
Exposure	Duration and intensity of exposure; relationship to index patient	Prolonged and intensive exposure provides greater risks for transmission.
Household	Crowding and sleeping arrangements	Close and prolonged contact in crowded households may increase risk of exposure.
Environmental	Ventilation and indoor household conditions	Poor ventilation increases persistence and concentration of infectious particles.
Clinical	HIV status, nutritional status and other clinical factors	Clinical and nutritional conditions influence susceptibility and progression of infection.
Preventive practices	Contact screening and preventive treatment	Delayed or incomplete screening may result in missed opportunities for early intervention.

3.3 Factors Associated with Household TB Transmission

The table below shows factors associated with household TB transmission its findings and implementation

Table 3: Factors Associated with Household TB Transmission

Factors	Findings	Implementation
Prolonged exposure	Repeated exposure with the infectious patient increases risk.	Early identification and treatment of index TB patients.
Intense exposure	Close contact with an infectious household member increases exposure risk.	Highly exposed household members should receive timely screening.
Household crowding	Crowded conditions increase close contact among household members and infectious patient.	Household-level infection-prevention measures.
Shared sleeping space	Sharing rooms or sleeping spaces increases prolonged exposure risk.	Sleeping arrangements should be considered during contact assessment.
Poor ventilation	Inadequate ventilation may allow infectious particles to accumulate.	Improve ventilation to reduce exposure.
Delayed diagnosis and treatment	Delays may prolong the infectious period.	Prompt diagnosis and treatment should be encouraged.
Individual and clinical factors	Age, nutrition, HIV status and other clinical factors may increase risk.	Contacts' assessment according to individual vulnerability.
Delayed contact screening	Missed and delayed screening prevents early identification of infection.	Household contacts to be screened promptly and followed up.

4 DISCUSSION

This systematic review shows that TB transmission within households is not explained by a single factor. Instead, risk appears to arise from the interaction between the infectiousness of the index patient, the duration and intensity of exposure, household living conditions, individual characteristics, and the extent to which preventive services are accessed (*TB Prevention & Screening*, n.d.). Sharing rooms or sleeping spaces can further increase opportunities for exposure, particularly where household ventilation is poor (*National Center for Biotechnology Information*, n.d.).

The findings also highlight the importance of early diagnosis and prompt treatment. Delays in identifying infectious pulmonary TB can extend the period during which household contacts are exposed. This supports the value of active household contact investigation and timely assessment of contacts (Yayan et al., 2024).

In environmental conditions, overcrowding and inadequate ventilation may increase the concentration and persistence of infectious particles in indoor spaces. Household-level prevention should therefore consider practical measures that improve ventilation and reduce prolonged close exposure where feasible (*Home / TB Knowledge Sharing*, n.d.).

Contacts need timely screening for TB infection and disease access to appropriate TB preventive treatment. Health education and infection-prevention measures can also help households understand and reduce avoidable exposure.

The current review documentation does not provide the database-specific research yields. Evidence from different settings may not be directly generalized to Nakuru County, so local findings should be interpreted alongside evidence from other settings.

5 CONCLUSION

The systematic review identified 25 eligible studies examining factors associated with TB transmission among household contacts. The evidence points to a combination of exposure-related, household, environmental, clinical, and preventive factors. The findings support continued emphasis on early diagnosis and treatment of infectious pulmonary TB, systematic household contact investigation, timely screening, infection-prevention measures, and TB preventive treatment for eligible contacts. These approaches may help reduce household transmission and contribute to TB control efforts in Nakuru County.

Recommendations

- Strengthen early identification, screening, diagnosis, and prompt treatment of bacteriologically confirmed pulmonary TB cases.
- Provide clear health education on TB symptoms, transmission, ventilation, cough hygiene, and the importance of completing treatment.
- Assess household contacts who may have increased vulnerability because of age, nutritional status, HIV status where relevant and other clinical factors.
- Strengthen routine household contact investigation and follow-up within TB control programs.
- Improve documentation of contact screening, outcomes, and preventive treatment to reduce missed opportunities.
- Promote feasible household measures that improve ventilation and reduce prolonged close exposure during the infectious period.
- Support timely referral and access to TB preventive treatment for contacts who meet eligibility criteria.
- Continue strengthening implementation of household contact investigation within county TB programs.
- Use locally generated evidence to guide TB prevention strategies that are appropriate for households in Nakuru County.
- Conduct additional studies in Nakuru County to quantify the relative contribution of household, environmental, clinical, and exposure-related factors.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

We thank God for the strength and guidance to undertake this work. We are grateful to the supervisors and lectures of the Clinical Medicine Department at Kenya Medical Training College, Bomet Campus, for their academic guidance. We also appreciate the management and staff of Nakuru County for their anticipated cooperation during the study. Finally,

we thank our families, colleagues and all participants who took part in the study for their constant encouragement, patients and moral support during the research period.

Disclosure of conflict of interest

The authors declare that they have no competing interests.

REFERENCES

- [1] *Prioritizing household contacts | TB Knowledge Sharing*. (n.d.). Retrieved September 14, 2026, from <https://tbksp.who.int/en/node/2035>
- [2] *TB prevention & screening*. (n.d.-a). Retrieved September 16, 2026, from <https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2025/tb-prevention-and-screening>
- [3] *TB prevention & screening*. (n.d.-b). Retrieved September 29, 2026, from <https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2025/tb-prevention-and-screening>
- [4] *BMC Infectious Diseases*. (n.d.). SpringerLink. Retrieved September 19, 2026, from <https://link.springer.com/journal/12879>
- [5] *Global Tuberculosis Report 2022* (1st ed). (2022). World Health Organization.
- [6] Histina, H. (2025). Factors Influencing Pulmonary TB Transmission Among Household Contacts of TB Cases: Systematic Review. *Proceeding of International Seminar and Workshop on Public Health Action*, 1(1), 113–119. <https://doi.org/10.60074/iswopha.v1i1.14197>
- [7] *Home | TB Knowledge Sharing*. (n.d.). Retrieved September 29, 2026, from <https://tbksp.who.int/en>
- [8] Nair, D., Thekkur, P., Mbithi, I., Khogali, M., Zachariah, R., Berger, S. D., Satyanarayana, S., Kumar, A. M. V., Kathure, I., Mwangi, J., Bochner, A. F., McClelland, A., Chakaya, J. M., & Harries, A. D. (n.d.). *Timeliness metrics for screening and preventing TB in household contacts of pulmonary TB patients in Kenya*. Retrieved September 19, 2026, from <https://pmc.ncbi.nlm.nih.gov/articles/PMC11189597/>
- [9] *National Center for Biotechnology Information*. (n.d.). Retrieved September 29, 2026, from <https://www.ncbi.nlm.nih.gov/>
- [10] Odera, S., Mureithi, M., Aballa, A., Onyango, N., Anzala, O., & Oyugi, J. (2020a). Latent tuberculosis among household contacts of pulmonary tuberculosis cases in Nairobi, Kenya. *The Pan African Medical Journal*, 37, 87. <https://doi.org/10.11604/pamj.2020.37.87.21102>
- [11] Odera, S., Mureithi, M., Aballa, A., Onyango, N., Anzala, O., & Oyugi, J. (2020b). Latent tuberculosis among household contacts of pulmonary tuberculosis cases in Nairobi, Kenya. *PAMJ Clinical Medicine*, 37(87). <https://doi.org/10.11604/pamj.2020.37.87.21102>
- [12] *Tuberculosis*. (n.d.). Retrieved September 19, 2026, from https://www.who.int/health-topics/tuberculosis#tab=tab_1
- [13] Turner, R. D., Chiu, C., Churchyard, G. J., Esmail, H., Lewinsohn, D. M., Gandhi, N. R., & Fennelly, K. P. (2017). Tuberculosis Infectiousness and Host Susceptibility. *The Journal of Infectious Diseases*, 216(Suppl 6), S636–S643. <https://doi.org/10.1093/infdis/jix361>
- [14] Volkmann, T., Okelloh, D., Agaya, J., Cain, K., Ooko, B., Malika, T., & Burton, D. (2016). Pilot implementation of a contact tracing intervention for tuberculosis case detection in Kisumu County, Kenya. *Public Health Action*, 6(4), 217–219. <https://doi.org/10.5588/pha.16.0032>
- [15] Warri, K., Nyamthimba, P., Chweya, A., Agaya, J., Achola, M., Reichler, M., Cowden, J., Heilig, C. M., Borgdorff, M. W., Cain, K. P., & Yuen, C. M. (2020). Tuberculosis disease and infection among household contacts of bacteriologically confirmed and non-confirmed tuberculosis patients. *Tropical Medicine & International Health: TM & IH*, 25(6), 695–701. <https://doi.org/10.1111/tmi.13392>
- [16] *World Health Organization (WHO)*. (n.d.). Retrieved September 29, 2026, from <https://www.who.int/>
- [17] Yayan, J., Franke, K.-J., Berger, M., Windisch, W., & Rasche, K. (2024). Early detection of tuberculosis: A systematic review. *Pneumonia*, 16(1), 11. <https://doi.org/10.1186/s41479-024-00133-z>
- [18] *Prioritizing household contacts | TB Knowledge Sharing*. (n.d.). Retrieved September 14, 2026, from <https://tbksp.who.int/en/node/2035>

- [19] *TB prevention & screening*. (n.d.-a). Retrieved September 16, 2026, from <https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2025/tb-prevention-and-screening>
- [20] *TB prevention & screening*. (n.d.-b). Retrieved September 29, 2026, from <https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2025/tb-prevention-and-screening>
- [21] *BMC Infectious Diseases*. (n.d.). SpringerLink. Retrieved September 19, 2026, from <https://link.springer.com/journal/12879>
- [22] *Global Tuberculosis Report 2022* (1st ed). (2022). World Health Organization.
- [23] Histina, H. (2025). Factors Influencing Pulmonary TB Transmission Among Household Contacts of TB Cases: Systematic Review. *Proceeding of International Seminar and Workshop on Public Health Action*, 1(1), 113–119. <https://doi.org/10.60074/iswopha.v1i1.14197>
- [24] *Home | TB Knowledge Sharing*. (n.d.). Retrieved September 29, 2026, from <https://tbksp.who.int/en>
- [25] Nair, D., Thekkur, P., Mbithi, I., Khogali, M., Zachariah, R., Berger, S. D., Satyanarayana, S., Kumar, A. M. V., Kathure, I., Mwangi, J., Bochner, A. F., McClelland, A., Chakaya, J. M., & Harries, A. D. (n.d.). *Timeliness metrics for screening and preventing TB in household contacts of pulmonary TB patients in Kenya*. Retrieved September 19, 2026, from <https://pmc.ncbi.nlm.nih.gov/articles/PMC11189597/>
- [26] *National Center for Biotechnology Information*. (n.d.). Retrieved September 29, 2026, from <https://www.ncbi.nlm.nih.gov/>
- [27] Odera, S., Mureithi, M., Aballa, A., Onyango, N., Anzala, O., & Oyugi, J. (2020a). Latent tuberculosis among household contacts of pulmonary tuberculosis cases in Nairobi, Kenya. *The Pan African Medical Journal*, 37, 87. <https://doi.org/10.11604/pamj.2020.37.87.21102>
- [28] Odera, S., Mureithi, M., Aballa, A., Onyango, N., Anzala, O., & Oyugi, J. (2020b). Latent tuberculosis among household contacts of pulmonary tuberculosis cases in Nairobi, Kenya. *PAMJ Clinical Medicine*, 37(87). <https://doi.org/10.11604/pamj.2020.37.87.21102>
- [29] *Tuberculosis*. (n.d.). Retrieved September 19, 2026, from https://www.who.int/health-topics/tuberculosis#tab=tab_1
- [30] Turner, R. D., Chiu, C., Churchyard, G. J., Esmail, H., Lewinsohn, D. M., Gandhi, N. R., & Fennelly, K. P. (2017). Tuberculosis Infectiousness and Host Susceptibility. *The Journal of Infectious Diseases*, 216(Suppl 6), S636–S643. <https://doi.org/10.1093/infdis/jix361>
- [31] Volkmann, T., Okelloh, D., Agaya, J., Cain, K., Ooko, B., Malika, T., & Burton, D. (2016). Pilot implementation of a contact tracing intervention for tuberculosis case detection in Kisumu County, Kenya. *Public Health Action*, 6(4), 217–219. <https://doi.org/10.5588/pha.16.0032>
- [32] Warria, K., Nyamthimba, P., Chweya, A., Agaya, J., Achola, M., Reichler, M., Cowden, J., Heilig, C. M., Borgdorff, M. W., Cain, K. P., & Yuen, C. M. (2020). Tuberculosis disease and infection among household contacts of bacteriologically confirmed and non-confirmed tuberculosis patients. *Tropical Medicine & International Health: TM & IH*, 25(6), 695–701. <https://doi.org/10.1111/tmi.13392>
- [33] *World Health Organization (WHO)*. (n.d.). Retrieved September 29, 2026, from <https://www.who.int/>
- [34] Yayan, J., Franke, K.-J., Berger, M., Windisch, W., & Rasche, K. (2024). Early detection of tuberculosis: A systematic review. *Pneumonia*, 16(1), 11. <https://doi.org/10.1186/s41479-024-00133-z>