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BARRIERS TO EARLY DIAGNOSIS AND STRATEGIES FOR EARLY DETECTION OF LEPROSY IN ENDEMIC SETTINGS: A NARRATIVE LITERATURE REVIEW

Revaldo Ezra Dwinata ¹, Medhi Denisa Alinda ^{2,3,*} and Yuri Widia ³

¹ Medical Study Program, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.

² Department of Dermatology and Venereology, Faculty of Medicine, Universitas Airlangga; Dr. Soetomo General Academic Hospital Surabaya, Indonesia.

³ Department of Dermatology and Venereology, Faculty of Medicine, Universitas Airlangga; Universitas Airlangga Hospital, Surabaya, Indonesia.

* Corresponding Author: Medhi Denisa Alinda, Department of Dermatology and Venereology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.

Email: medhidenisaalinda@gmail.com

ORCID Details

Revaldo Ezra Dwinata: <https://orcid.org/0009-0003-0710-5390>

Medhi Denisa Alinda: <https://orcid.org/0000-0001-7400-1629>

Yuri Widia: <https://orcid.org/0000-0002-3598-5714>

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ABSTRACT

Leprosy is a chronic infection of the skin and peripheral nerves, and delayed diagnosis sustains transmission and causes preventable grade 2 disability (G2D) in endemic settings. This review examines which barriers delay the diagnosis of leprosy and which strategies and tools can help detect it earlier, with particular attention to Indonesia. PubMed was searched on 25 September 2026 for English-language records first published online in 2021–2025 (531 records), and ten studies were purposively selected and synthesised narratively. Systematic reviews reported median detection delays of 12–36 months and G2D at diagnosis in 5.6–43.2% of cases. In Tegal, Indonesia, the mean delay was 13.0 months, mostly (9.7 months) before patients reached health services, and was longer with passive detection (16.5 compared with 6.9 months), while misdiagnosis and repeated consultations contributed to delay within health services. In Brazil, 1.3% of notified cases were later found to be misdiagnoses. Point-of-care serology was sensitive in multibacillary disease (0.83–0.92) but not in paucibacillary disease (0.36–0.38), and artificial-intelligence tools remained at an early stage. Contact screening in Cambodia detected 33 new cases among 7,496 contacts, and a cluster-randomised post-exposure prophylaxis (PEP) trial found no significant reduction in incidence in its primary analysis. No included primary study tested whether these strategies shorten detection delay or reduce G2D. Delayed diagnosis arises mainly from patient-level factors such as stigma and care-seeking behaviour, with a contribution from health services. Early detection strategies appear promising, but their effect on delay and G2D is unproven and should be evaluated using these outcomes.

Keywords: Early Diagnosis, Leprosy, Active Case Detection, Endemic Settings, Public Health Strategies, Sustainable Development Goals

1 INTRODUCTION

Leprosy, caused by *Mycobacterium leprae*, affects the skin and peripheral nerves and is classified by the World Health Organization (WHO) as a neglected tropical disease because it remains a cause of preventable disability. Most cases are diagnosed in Brazil, India and Indonesia [1]. One measure of delayed case detection is G2D, defined as visible deformity due to nerve damage. Indonesia has the third-highest number of new cases and of cases with G2D worldwide, after Brazil and India [2]. In Indonesia, 9.2% of new cases in 2023 already presented with G2D, and contacts of patients are reported to have a 5- to 13-fold higher risk of developing G2D [3].

Leprosy is difficult to diagnose early because diagnosis relies mainly on clinical signs. The manifestations are varied, often subtle and resemble other diseases, so the disease is easily recognised late or misdiagnosed [4]. This delay matters because it is clearly correlated with disability [5]. Nerve damage usually becomes irreversible about six months after onset, so diagnosis should ideally be made within six months [2]. The WHO global target is a 70% reduction in annual new cases and a 90% reduction in the rate of new cases with G2D relative to 2020 baseline numbers [2].

Two systematic reviews have summarised the factors behind delayed detection, but none of the studies in either review was conducted in Indonesia [5,6]. Meanwhile, evidence on diagnostic aids, active case finding and post-exposure prophylaxis (PEP) is scattered across designs and settings. PEP means giving a preventive antibiotic, usually a single dose of rifampicin, to people who have been in contact with a leprosy patient so that they are less likely to develop the disease [7,8]. This review therefore aimed to synthesise recent evidence (2021–2025) to answer two questions. First, which barriers to early diagnosis exist at patient, community and health-service level? Second, which diagnostic aids and case-finding strategies can help detect leprosy earlier, with attention to Indonesia?

2 MATERIALS AND METHODS

2.1 Study design

This study is a narrative literature review. It was not registered and followed no formal protocol. Reporting was guided by the Scale for the Assessment of Narrative Review Articles (SANRA), which covers the importance and aims of the review, the literature search, referencing, level of evidence and presentation of key data [9]. No formal risk-of-bias assessment was performed. The two review questions are those stated at the end of the Introduction. Evidence was organised into four themes. Themes 1 and 2 address the first question: (1) patient- and community-level barriers and (2) health-service factors and diagnostic accuracy. Themes 3 and 4 address the second question: (3) diagnostic aids and (4) active case finding and PEP.

2.2 Literature search

PubMed was searched on 25 September 2026 for English-language records first published between 2021 and 2025. The search combined terms for leprosy with terms for early diagnosis, diagnostic delay, misdiagnosis, grade 2 disability, active case finding, contact screening, PEP, point-of-care tests, artificial intelligence, health-seeking behaviour and stigma, using Boolean operators (the full search string is given in Supplementary Table S1). Language and publication-year filters were applied in PubMed. The search retrieved 531 records. No other database was searched.

2.3 Selection of literature

Titles and abstracts, followed by full texts, were screened by one author without independent second screening. Studies were eligible if they (i) were first published online in 2021–2025, (ii) provided leprosy-specific evidence relevant to at least one theme, and (iii) were available in English. Because the aim was narrative synthesis rather than exhaustive coverage, studies were selected purposively. Where several studies addressed the same question, we favoured systematic and scoping reviews, trials and programme evaluations, and primary studies from Indonesia. Ten studies were included (Table 1), and all were retrieved by the search. One study (Handika et al.) was first published online in December 2025 and appeared in a 2026 issue, so it was included under criterion (i). Additional publications cited only in the Discussion were used to give context and were not part of the ten included studies.

2.4 Data extraction and synthesis

For each study, one author extracted the design, setting, sample and main findings into a Google Sheets spreadsheet (Table 1). Full texts were used for nine studies, and for one study only abstract-level information was available (marked * in Table 1). Numerical results were transcribed as reported by the original authors. Findings were synthesised narratively by theme. Meta-analysis was not attempted because of the heterogeneity of designs and outcomes.

3 RESULTS

3.1 Overview of the included studies

Ten studies were included (Table 1): four systematic reviews (one with meta-analysis), one scoping review, two cross-sectional studies from Indonesia, one national surveillance analysis from Brazil, one programme evaluation from Cambodia and one cluster-randomised trial from the Comoros and Madagascar. Five of them were primary studies that collected their own data, and the rest summarised other studies. Neither systematic review on delay included an Indonesian study [5,6].

Table 1: Summary of the ten included studies, ordered by theme

No	Author	Study design	Sample	Main findings
1	Dharmawan et al., 2021[5]	Systematic review	27 studies from 12 countries, none from Indonesia	Median detection delay 12–36 months (mean 11.5–64.1), and 5.6–43.2% of patients already had G2D at diagnosis. In many countries, then, half of the patients were diagnosed only 1 to 3 years after symptoms began. The most frequent causes were care-seeking behaviour (14 of 15 studies that assessed it) and stigma.
2	Dharmawan et al., 2023[2]	Cross-sectional study	126 patients from 171 registered, Tegal Regency	Mean delay 13.0 months (median 5.5). About 9.7 months occurred before patients reached health services and 3.2 months afterwards. Of the patients, 48% waited more than 6 months. Delay was longer in patients under 35 years, men, those detected passively, and those without a family member with leprosy.
3	Handika et al., 2025 *[3]	Cross-sectional study	264 contacts of patients, Gunungkidul District	Only 30.7% of contacts sought care appropriately. They were more likely to do so if they had a favourable view of treatment (aOR 3.60), good access to services (aOR 2.46) and low stigma (aOR 5.74).
4	Dharmawan et al., 2022[6]	Systematic review	20 studies from 10 countries, none from Indonesia	Misdiagnosis was cited in 8 studies. In one study, patients needing 5 or more consultations had a delay 24.4 months longer. A first visit to a general service (aOR 2.10) or a private provider (aOR 2.6) was also linked to longer delay. In Peru, G2D at diagnosis fell from 16.2% to 7.6% after leprosy control was decentralised.
5	Neves et al., 2021[4]	National surveillance analysis	574,181 new cases in Brazil, 2003–2017	Of the cases, 7,477 (1.3%, about 13 per 1,000) were misdiagnoses. Odds were higher in females (OR 1.58), children under 15 years (OR 1.49), the indeterminate form (OR 2.37), cases from mass screening (OR 3.36) and contact examination (OR 2.30), and cases with nerve involvement without skin lesions (OR 2.47).
6	Romero et al., 2022[10]	Systematic review and meta-analysis	12 articles, 16 accuracy studies, 5,395 people	In multibacillary leprosy, sensitivity and specificity were 0.83 and 0.91 for NDO-LID and 0.92 and 0.93 for PGL-I. In paucibacillary leprosy, sensitivity was only 0.38 and 0.36. The tests are thus fairly good for the multibacillary type but often miss the paucibacillary type. Results varied greatly between studies.
7	Fernandes et al., 2024[11]	Systematic review	21 studies from 1,659 records	Mean accuracy was 89.97% for image data and 87.98% for numerical data. However, 57% of the studies classified several skin diseases at once rather than leprosy alone, and 11 studies scored below 40% on quality. AI is therefore still at an early stage and not ready for clinical use.

8	Cavaliero et al., 2021[7]	Programme evaluation	555 index patients and 10,410 listed contacts, 31 districts in Cambodia	Of 7,496 contacts screened (72.0%), 33 new cases were found. The rate was 110 per 10,000 in household contacts and 18 per 10,000 in neighbours. SDR was given to 82.6% of those screened. The proportion with G2D was 6.1% in new cases, lower than in index patients (11.9%), but there was no comparison group.
9	Hasker et al., 2024[8]	Cluster-randomised trial	64 villages in the Comoros and Madagascar, 95,762 participants	New cases tended to be fewer in villages given preventive antibiotics (IRR 0.95, 0.80 and 0.58 in three groups), but the differences were not statistically significant in the primary analysis. After adjustment for baseline prevalence, the group covering household contacts and people within 100 m had an IRR of 0.56 (98.3% CI 0.35–0.89). Risk was 2 to 4 times higher within 75 m of a patient.
10	Brown et al., 2024[1]	Scoping review	23 articles from 11 countries	Six active case-finding methods were identified. The mean detection percentage was 8.23% for identifying household or social contacts in high-endemic regions and 5.07% for rapid village surveys in low-endemic regions. These figures come from different campaigns and should be interpreted cautiously.

*: Abstract-level data only. aOR: adjusted odds ratio. CI: confidence interval. G2D: grade 2 disability. IRR: incidence rate ratio. OR: odds ratio. SDR: single-dose rifampicin.

3.2 Patient- and community-level barriers

The global picture comes from a systematic review of 27 studies in 12 countries. Leprosy was usually diagnosed only after a long time. The median detection delay was 12–36 months, and 5.6–43.2% of patients already had G2D at diagnosis [5]. The factor most often linked to delay was health-service-seeking behaviour (found in 14 of the 15 studies that assessed it), and stigma was the most common social factor. The most common individual factors were older age, male sex, low awareness of symptoms, multibacillary leprosy and lack of knowledge [5].

Evidence from Indonesia comes first from Tegal Regency, where 126 patients were selected from 171 registered patients. The time from first symptoms to diagnosis averaged 13.0 months, with a median of 5.5 months [2]. This time has two parts. Patient delay, from first symptoms to the first visit to a health service, averaged 9.7 months (median 3.0). Health-system delay, from the first visit to diagnosis, averaged 3.2 months (median 0) [2]. Nearly half of the patients (48%) waited more than six months [2]. Longer delay was found in patients aged under 35 years, men, those detected through passive case finding (mean 16.5 months compared with 6.9 months with active detection) and those without a family member with leprosy. Anticipated stigma was also associated with longer patient delay [2].

In Gunungkidul District, researchers looked at the behaviour of people who had been in contact with leprosy patients. Only 30.7% of 264 contacts showed appropriate health-seeking behaviour. Contacts who held a favourable view of treatment (adjusted odds ratio, aOR 3.60), had good access to services (aOR 2.46) and had low stigma (aOR 5.74) were more likely to seek care appropriately [3].

3.3 Health-service barriers

A second systematic review (20 studies, 10 countries) showed that delay can also occur after patients reach a health service. The factors were grouped into structural factors, service factors and intermediate factors such as misdiagnosis, repeated consultations and visits to inappropriate services [6]. Misdiagnosis was cited in eight studies [6]. In one study, patients who needed five or more consultations had a delay 24.4 months longer than those diagnosed at the first consultation. A first visit to a general health service (aOR 2.10) or a private provider (aOR 2.6) was linked to longer delay in separate studies [6]. One study found the shortest delay with a contact survey. A study in Peru linked decentralisation of leprosy control to earlier detection and a fall in G2D at diagnosis from 16.2% to 7.6% [6].

The other side of the problem is visible in national data from Brazil. Of 574,181 new cases recorded in 2003–2017, 7,477 (1.3%) turned out to be misdiagnoses, and their proportion was not correlated with the new case detection rate [4]. The odds of misdiagnosis were higher among females (odds ratio, OR 1.58), children (OR 1.49), the indeterminate clinical form (OR 2.37), cases found during mass screening (OR 3.36) or contact examination (OR 2.30), and cases with nerve involvement but no skin lesions (OR 2.47) [4].

3.4 Diagnostic aids

A meta-analysis of rapid point-of-care serological tests (12 articles, 16 accuracy studies, 5,395 individuals) showed different results by type of leprosy. In multibacillary disease, sensitivity and specificity were 0.83 and 0.91 for NDO-LID and 0.92 and 0.93 for PGL-I. In paucibacillary disease, sensitivity was only 0.38 (NDO-LID) and 0.36 (PGL-I) [10]. Results varied greatly between studies (I^2 up to 98.9%), and patient-selection bias was identified in 11 of 16 studies [10]. In addition, a systematic review of 21 studies on artificial intelligence (AI) for leprosy diagnosis found that 57% of the studies classified several skin diseases at once rather than leprosy alone. Mean accuracy was 89.97% for image data and 87.98% for numerical data. Eleven studies scored below 40% on the quality tool, and the authors concluded that the field was still at an early stage and not mature enough for clinical practice [11].

3.5 Active case finding and post-exposure prophylaxis

In Cambodia, retrospective active case finding combined with single-dose rifampicin (SDR) was carried out in 31 districts between October 2016 and September 2019. Health workers traced 555 index patients and listed 10,410 household and neighbouring contacts, of whom 72.0% (7,496) were screened [7]. This produced 33 new cases, equal to 110 per 10,000 household contacts and 18 per 10,000 neighbour contacts. Of the 33 cases, 23 (69.7%) were household contacts [7]. SDR was given to 6,189 contacts (82.6% of those screened). The proportion with G2D was 6.1% among new cases compared with 11.9% among index patients [7].

In a cluster-randomised trial in 64 villages in the Comoros and Madagascar (95,762 evaluable participants), single double-dose rifampicin (SDDR, 20 mg/kg) PEP was given to household contacts (arm 2), to household contacts and anyone living within 100 m (arm 3), or to those contacts who also tested positive for anti-phenolic glycolipid-I (arm 4), compared with no PEP [8]. Intention-to-treat incidence rate ratios (IRRs) were 0.95, 0.80 and 0.58. These are equal to reductions in new cases of about 5%, 20% and 42%, but none was statistically significant [8]. After controlling for baseline prevalence, arm 3 had an IRR of 0.56 (98.3% CI 0.35–0.89), and the individual-level protective effect of SDDR-PEP was 0.55 [8]. Leprosy risk was two to four times higher within 75 m of an index patient, and household members of patients had more than four times the risk of those living 100 m or further away [8].

A scoping review of 23 articles from 11 countries (15 from high-endemic and 8 from low-endemic regions) identified six active case detection methods. The mean case-detection percentage was 8.23% for identifying household or social contacts in high-endemic regions and 5.07% for rapid village surveys in low-endemic regions [1].

3.6 Effect of strategies on detection delay and G2D

Of the five primary studies, none tested whether a detection strategy shortens detection delay or reduces G2D. The studies in Tegal [2] and Gunungkidul [3] only measured delay and the factors linked to it. The Brazilian study measured misdiagnosis [4]. The Cambodian study reported the cases found without a comparison group [7], and the trial in the Comoros and Madagascar measured new cases rather than delay or G2D [8]. The only hint came from a before-and-after evaluation of decentralisation in Peru, summarised in the 2022 review [6].

4 DISCUSSION

4.1 Summary of findings

In brief, this review found two things. First, delay in diagnosing leprosy occurs mainly before patients reach health services, and partly within health services because of misdiagnosis or repeated consultations. Second, several strategies look promising for finding cases earlier, but there is no direct evidence yet that they actually speed up diagnosis or prevent disability.

4.2 Patient-level barriers

In Tegal, about three quarters of the mean delay (9.7 of 13.0 months) passed before patients reached health services [2]. This agrees with the global finding that care-seeking behaviour and stigma are the most frequently reported factors [5]. The Gunungkidul study shows a similar pattern among contacts of patients, whose decision to seek care was influenced by their view of treatment, access to services and stigma [3].

Two points deserve attention. First, the mean delay in Tegal (13.0 months) was far above the median (5.5 months). This means that half of the patients were diagnosed within 5.5 months or less, but a small group waited very long and pulled the average upward. The median health-system delay was zero, which means that in most patients almost no time was lost after they reached a health service. Even so, 48% of patients still waited more than six months, the threshold linked to a higher risk of permanent nerve damage [2]. Programmes should therefore specifically target patients who are delayed for a very long time. Second, the risk factors were not uniform. Globally, older age was among the most common

factors [5], whereas in Tegal it was age below 35 years that was linked to longer delay [2]. This shows the need for targeting that fits local conditions. All Indonesian data in this review are cross-sectional and come from two districts.

Stigma and low awareness are barriers that programmes can act on. A systematic review of 17 publications found that several types of intervention reduced leprosy-related stigma, but the evidence came only from Nepal, India and Indonesia and information on cost was rarely available [12]. In Indonesia, a questionnaire to measure community awareness of the early detection of common skin diseases, including leprosy, has been developed and tested in Pamekasan District (680 participants in the field test), and health programmes could use it to assess public awareness of early detection [13].

4.3 Health-service barriers

The 2022 systematic review concluded that delay is mainly due to misdiagnosis, but misdiagnosis was cited as a factor in only eight of 20 studies [6], so this conclusion should be read with care. The Brazilian data show another side of the problem. Recorded misdiagnoses were more frequent among cases found through mass screening or contact examination [4]. This does not mean that active case finding should be avoided. It does mean that screening needs trained examiners and referral for confirmation. The authors also noted that false-negative diagnoses, which may sustain transmission, could not be counted, and they stressed continuous training of health workers [4].

Evidence from other countries shows that this training need is real and that training can help. In primary healthcare clinics in Pahang, Malaysia, 150 health workers had a mean leprosy knowledge score of 11.10 out of 25 and a median skills score of 12 out of 70, which the authors described as inadequate [14]. In a leprosy hotspot district in Ethiopia, a five-day training for frontline health workers was followed by an active case detection campaign. In pre- and post-training surveys, the proportion with good knowledge rose from 61.2% to 77.3% and the proportion with good skills from 51.7% to 75.0%. The campaign that followed screened 3,780 contacts and found 17 new leprosy cases [15].

4.4 Diagnostic aids

Rapid serological tests worked well in multibacillary disease but poorly in paucibacillary disease [10], which usually has fewer signs. The authors stated that such tests could inform implementation in primary care, but they called the results inconclusive because of heterogeneity and risk of bias [10]. AI-based tools are also at an early stage, because most studies classified many skin diseases and many were of low quality [11]. In our view, the most realistic route to earlier diagnosis at present is stronger clinical recognition by primary-care workers, with laboratory and digital tools as adjuncts.

Recent reviews support this view. A 2026 practical guide concluded that early diagnosis remains primarily clinical and that no single laboratory test confirms early leprosy on its own [16]. The same guide reported that PCR improves diagnosis in paucibacillary disease with a sensitivity of 34–80%, and that anti-PGL-I serology has a sensitivity below 30% in tuberculoid forms, although seropositive contacts have a 3.5-fold higher risk of developing disease [16]. Another review also noted that laboratory tests are less useful in early diagnosis when symptoms are not clearly defined, for example in some paucibacillary cases [17].

4.5 Active case finding and PEP

In Cambodia, new cases were concentrated among household contacts (23 of 33 cases), although these made up only 27.9% of those screened [7]. This supports the idea that case finding should start with the people closest to the patient. The lower proportion of G2D among new cases (6.1% compared with 11.9%) is compatible with earlier detection, but it rests on two cases and has no comparison group. National new diagnoses fell from 154 in 2016 to 127 in 2019, but the authors could not attribute this to the programme [7].

The randomised PEP trial gives a more cautious picture. Protection was weaker than anticipated. The primary analyses were not significant, the significant estimate in arm 3 depended on adjustment for baseline prevalence that differed between arms, and the planned sample size of 144,000 was not reached [8]. Even so, leprosy risk was strongly clustered around index patients. The authors interpreted this as support for targeted door-to-door screening around index patients combined with blanket PEP [8]. Detection percentages in the scoping review differ by method and level of endemicity, so they should be interpreted cautiously [1].

PEP was first tested in a large trial in Bangladesh, which included 21,711 close contacts and found that a single dose of rifampicin reduced the incidence of leprosy by 57% (95% CI 33% to 72%) over the first two years [18]. On this basis, WHO recommends single-dose rifampicin for adults and children who are in regular contact with leprosy patients, and it advises caution because of stigma, particularly for contacts outside the patient's family [19]. In routine programmes, the LPEP feasibility programme in seven countries, including Indonesia, traced and screened 174,782 contacts (97.2% of those listed) and gave single-dose rifampicin to 151,928 of them (86.9%), and it found PEP to be safe and generally

well accepted [20]. These studies show that PEP can be delivered in routine programmes, while the trial in the Comoros and Madagascar found smaller and non-significant effects in its primary analysis, so more evidence is needed from different settings [8].

Observational evidence is consistent with a benefit of active detection on delay. Passive detection was associated with longer delay in Tegal [2], and a contact survey gave the shortest delay in one study in the 2022 review [6].

4.6 Gaps in the evidence

Apart from a single before-and-after evaluation of decentralisation in Peru summarised in the 2022 review [6], none of the included studies tested whether a detection strategy reduces detection delay or G2D. This is the main gap that future research needs to address.

4.7 Implications for practice

(1) Combine community education and stigma reduction with better access to care, focusing on groups with the longest delays. (2) Strengthen primary-care training, particularly on paucibacillary and neural presentations. (3) Integrate contact screening, including neighbours, with PEP, with referral for confirmation to limit false-positive diagnoses. (4) Use serology only as an adjunct for suspected multibacillary disease. (5) Monitor detection delay and the proportion of G2D as programme indicators. These steps are in line with the WHO Global Leprosy Strategy 2021–2030, which includes integrated active case detection alongside prevention and combating stigma among its four pillars, and which aims to contribute to the Sustainable Development Goals [21].

4.8 Limitations of the study

This review searched a single database (PubMed), selected studies purposively, had no registered protocol and did not formally appraise study quality, so selection bias is possible. Screening and data extraction were done by one author without independent verification. The two systematic reviews on delay covered the same period and are likely to overlap. One study was assessed at abstract level only. Only English-language studies were considered. The only national surveillance analysis is from Brazil, and no primary study from India was included. Evidence on delay in Indonesia comes from two districts.

5 CONCLUSION

Regarding barriers, in the Indonesian studies reviewed, delayed diagnosis of leprosy was driven mainly by patient-level factors such as stigma and care-seeking behaviour. The health-service component was smaller and was linked globally to misdiagnosis and repeated consultations. Regarding strategies, available diagnostic aids do not reliably detect paucibacillary disease, and AI tools are not ready for clinical use. Active case finding with PEP is promising, but its effect on detection delay and disability remains unproven. Future studies, particularly in Indonesia, should evaluate integrated strategies using detection delay and G2D as primary outcomes.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

The authors declare that no conflict of interest exists.

Supplementary materials

The following supporting information can be downloaded at:
<https://docs.google.com/document/d/1XzdurKqjiLN4sVeyaGHeBhI-OP5plds67fRedqTorrw/edit?usp=sharing>

REFERENCES

- [1] Brown H, Fastenau A, Penna S, Saunderson P, Klabbers G. Exploring active case detection approaches for leprosy diagnosis in varied endemic settings: a comprehensive scoping review. *Life* (Basel). 2024;14(8):937. doi:10.3390/life14080937.
- [2] Dharmawan Y, Korfage IJ, Abqari U, Widjanarko B, Richardus JH. Measuring leprosy case detection delay and associated factors in Indonesia: a community-based study. *BMC Infect Dis*. 2023;23:555. doi:10.1186/s12879-023-08552-x.

- [3] Handika DO, Siswati AS, Sukoco SH, Ahmad RA. Determinants of health-seeking behaviour for leprosy among high-risk populations in Gunungkidul District, Indonesia: a community-based cross-sectional study. *Trop Med Int Health*. 2026;31(3):336–344. doi:10.1111/tmi.70073.
- [4] Neves KVRN, Nobre ML, Machado LMG, Steinmann P, Ignotti E. Misdiagnosis of leprosy in Brazil in the period 2003–2017: spatial pattern and associated factors. *Acta Trop*. 2021;215:105791. doi:10.1016/j.actatropica.2020.105791.
- [5] Dharmawan Y, Fuady A, Korfage I, Richardus JH. Individual and community factors determining delayed leprosy case detection: a systematic review. *PLoS Negl Trop Dis*. 2021;15(8):e0009651. doi:10.1371/journal.pntd.0009651.
- [6] Dharmawan Y, Fuady A, Korfage IJ, Richardus JH. Delayed detection of leprosy cases: a systematic review of healthcare-related factors. *PLoS Negl Trop Dis*. 2022;16(9):e0010756. doi:10.1371/journal.pntd.0010756.
- [7] Cavaliero A, Ay SS, Aerts A, Lay S, So V, Robijn J, et al. Preventing leprosy with retrospective active case finding combined with single-dose rifampicin for contacts in a low endemic setting: results of the Leprosy Post-Exposure Prophylaxis program in Cambodia. *Acta Trop*. 2021;224:106138. doi:10.1016/j.actatropica.2021.106138.
- [8] Hasker E, Assoumani Y, Randrianantoandro A, Ramboarina S, Braet SM, Cauchoix B, et al. Post-exposure prophylaxis in leprosy (PEOPLE): a cluster randomised trial. *Lancet Glob Health*. 2024;12:e1017–e1026. doi:10.1016/S2214-109X(24)00062-7.
- [9] Baethge C, Goldbeck-Wood S, Mertens S. SANRA—a scale for the quality assessment of narrative review articles. *Res Integr Peer Rev*. 2019;4:5. doi:10.1186/s41073-019-0064-8.
- [10] Romero CP, Castro R, do Brasil PEA, Pereira DR, Pinheiro RO, Toscano CM, et al. Accuracy of rapid point-of-care serological tests for leprosy diagnosis: a systematic review and meta-analysis. *Mem Inst Oswaldo Cruz*. 2022;117:e220317. doi:10.1590/0074-02760220317.
- [11] Fernandes JRN, Teles AS, Fernandes TRS, Lima LDB, Balhara S, Gupta N, et al. Artificial intelligence on diagnostic aid of leprosy: a systematic literature review. *J Clin Med*. 2024;13(1):180. doi:10.3390/jcm13010180.
- [12] Willis M, Fastenau A, Penna S, Klabbers G, Spinicci M. Interventions to reduce leprosy related stigma: a systematic review. *PLOS Glob Public Health*. 2024;4:e0003440. doi:10.1371/journal.pgph.0003440.
- [13] Abqari U, Isfandiari MA, Dharmawan Y, Beladina N, Matani J, Ibad M, et al. Early detection of common skin diseases, including leprosy: development and validation of an awareness questionnaire. *Int J Public Health*. 2025;70:1607938. doi:10.3389/ijph.2025.1607938.
- [14] Zafirah TN, Ahmad Zaki R, Lim SH, Baharudin R, Nur Aiza Z. Knowledge and skills of leprosy among healthcare workers and its associated factors in primary healthcare. *INQUIRY*. 2025;62. doi:10.1177/00469580241312059.
- [15] Mamo E, Tsehay D, Hassen S, Getahun S, Mengiste A, Tadesse B, et al. Training and active case detection to prevent leprosy: effect on knowledge, attitude and skills of health workers on early diagnosis of leprosy in a leprosy hotspot district in Ethiopia. *Trop Med Infect Dis*. 2024;9(3):51. doi:10.3390/tropicalmed9030051.
- [16] Fróes Júnior LAR, Sotto MN, Avancini J, Garbino JA, Trindade MAB. Laboratory and functional tests in leprosy diagnosis: a practical guide for clinical decision-making. *An Bras Dermatol*. 2026;101(2):501297. doi:10.1016/j.abd.2026.501297.
- [17] Sharma M, Singh P. Advances in the diagnosis of leprosy. *Front Trop Dis*. 2022;3:893653. doi:10.3389/fitd.2022.893653.
- [18] Moet FJ, Pahan D, Oskam L, Richardus JH; COLEP Study Group. Effectiveness of single dose rifampicin in preventing leprosy in close contacts of patients with newly diagnosed leprosy: cluster randomised controlled trial. *BMJ*. 2008;336(7647):761–764. doi:10.1136/bmj.39500.885752.BE.
- [19] World Health Organization. Guidelines for the diagnosis, treatment and prevention of leprosy. New Delhi: WHO Regional Office for South-East Asia; 2018. Available from: <https://www.who.int/publications/i/item/9789290226383>.
- [20] Richardus JH, Tiwari A, Barth-Jaeggi T, Arif MA, Banstola NL, Baskota R, et al. Leprosy post-exposure prophylaxis with single-dose rifampicin (LPEP): an international feasibility programme. *Lancet Glob Health*. 2021;9(1):e81–e90. doi:10.1016/S2214-109X(20)30396-X.
- [21] World Health Organization. Towards zero leprosy: global leprosy (Hansen's disease) strategy 2021–2030. New Delhi: WHO Regional Office for South-East Asia; 2021. Available from: <https://www.who.int/publications/i/item/9789290228509>.