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Review Article

Tuberculosis in People Experiencing Homelessness During the COVID-19 Era: A Narrative Review of Primary Observational Evidence

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ABSTRACT

Background: Tuberculosis (TB) remains a significant global public health problem, disproportionately affecting people experiencing homelessness (PEH). During the COVID-19 pandemic, healthcare resources were redirected, potentially disrupting TB monitoring and care for this already vulnerable population.
Methods: This review of primary observational studies was conducted using PubMed, LILACS, SciELO, Cochrane Library, CAPES Periódicos, and ScienceDirect. Searches used the terms [(Tuberculosis) AND (homeless people) AND (COVID)] and [(Tuberculosis) AND (unhoused) AND (COVID)], covering publications from 2020 to November 2025. Secondary reviews identified during the search were excluded from the primary evidence set and used solely for background contextualization.
Results: The studies documented high rates of unfavorable TB outcomes among PEH — including treatment discontinuation, prolonged hospitalization, and elevated mortality — across multiple settings and healthcare contexts. Each study employed a distinct operational definition of homelessness, limiting direct cross-study comparisons. Where PEH-specific denominators were available, outcomes were substantially worse than general population comparators. Evidence on TB–COVID coinfection specifically within PEH remains scarce; most relevant estimates come from broader vulnerable or mixed populations and are considered indirect evidence.
Conclusion: Structural vulnerabilities — including inadequate housing, barriers to healthcare access, and high comorbidity burden — are the primary drivers of poor TB outcomes in PEH. Pandemic-era care disruptions were associated with worsened TB indicators in the general population; among PEH, outcomes remained persistently high across periods, suggesting a pre-existing ceiling of vulnerability. The descriptive nature of the available primary evidence constrains causal attribution.

1. Introduction

Tuberculosis is a neglected tropical disease caused primarily by Mycobacterium tuberculosis, the most epidemiologically significant species within the genus Mycobacterium, and it affects individuals of all ages but disproportionately impacts adults in low- and middle-income countries due to socioeconomic vulnerabilities that heighten exposure and hinder access to care [1, 2]. Transmission occurs mainly through the inhalation of bacilli released into the air when individuals with active pulmonary tuberculosis cough, speak, or sneeze, while ingestion of milk contaminated with M. bovis represents a less common gastrointestinal transmission route [1, 3]. Infectivity persists as long as bacilli are present in sputum, typically declining after approximately 15 days of appropriate treatment. However, ongoing risks persist in communities burdened by overcrowding, limited ventilation, and poor living conditions, all of which amplify the potential for transmission. Furthermore, the disease's lengthy and complex treatment regimen often results in low adherence, which compromises therapeutic success, prolongs infectiousness, and perpetuates transmission cycles, particularly among populations experiencing social inequality and restricted access to healthcare services.

Tuberculosis remains a significant public health problem. In Brazil, more than 85,000 new cases were reported in 2024, representing a significant increase over previous years, even relative to the pre-pandemic period, when annual totals did not exceed 80,000 cases (including new and retreatment cases). Among new cases of confirmed pulmonary tuberculosis, 36.2% were closed due to abandonment – a proportion 2.6 times the WHO-established 5% threshold – during the 2020 – 2022 period. This increase appears to be related to disruptions in health services and systems caused by the COVID-19 pandemic [4–7].

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), responsible for COVID-19, has infected more than 35.5 million Brazilians since 2020, causing an infectious respiratory disease transmitted through small liquid particles and often characterized by a severe inflammatory response that disrupts immune function [8, 9]. Both pulmonary tuberculosis and COVID-19 affect the respiratory system, potentially causing permanent alterations that compromise lung parenchyma and pulmonary function [10–12].

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During the COVID-19 pandemic, priority public health care was concentrated on SARS-CoV-2 containment, which significantly affected the monitoring and treatment of other diseases, including TB – reflected in reductions in case notifications and likely increases in undiagnosed patients [10, 13–16].

People experiencing homelessness (PEH) form a heterogeneous and vulnerable population surviving in conditions of extreme material deprivation – including lack of stable shelter, basic sanitary conditions, and economic resources – which renders them susceptible to infectious diseases, treatment barriers, and adverse health outcomes. During the SARS-CoV-2 pandemic, the homeless population grew in several settings at a rate disproportionate to general population growth [17, 18].

Despite growing literature on TB and COVID-19, evidence specifically addressing PEH remains fragmented, heterogeneous, and methodologically limited. Most available studies employ divergent operational definitions of homelessness, and PEH-specific denominators are often not reported separately from broader vulnerable-population data. Understanding the TB burden and care disruptions experienced by PEH during the COVID-19 era – and distinguishing direct from indirect evidence – is essential for informing targeted public health responses.

The objective of this narrative review was to describe TB-related outcomes and care disruptions among people experiencing homelessness (PEH) during the COVID-19 era (2020 – 2025) using primary observational evidence.

2. Methods

This narrative review was designed to synthesize primary observational evidence on TB-related outcomes among PEH during the COVID-19 era. A narrative approach was selected given the substantial heterogeneity of the available evidence across study designs, population definitions, and outcome measures, which precluded a formal meta-analytic synthesis. No formal protocol was pre-registered; this methodological limitation is acknowledged.

Primary studies were prioritized to anchor the main findings. Secondary reviews (Laycock et al., 2021; Zhu et al., 2023) identified during the search were excluded from the primary evidence set and are used solely to contextualize background information, mechanisms, or service-delivery dynamics [19, 20]. These secondary sources are clearly distinguished from primary study findings throughout the manuscript.

2.1. Search Strategy

Searches were conducted in six databases: PubMed (MEDLINE), LILACS (Virtual Health Library), SciELO (Scientific Electronic Library Online), Cochrane Library, CAPES Periódicos, and Elsevier/ScienceDirect. Searches were performed between October and November 2025, covering publications from 1 January 2020 to 30 November 2025. Language limits: English, Portuguese, and Spanish.

The core search combined the following term sets: [(Tuberculosis) AND (homeless people) AND (COVID)] and [(Tuberculosis) AND (unhoused) AND (COVID)]. In PubMed, MeSH terms were used: ("Tuberculosis"[MeSH Terms] OR "Tuberculosis"[Title/Abstract]) AND ("Ill-Housed Persons"[MeSH Terms] OR "homeless people"[Title/Abstract] OR "unhoused"[Title/Abstract] OR "people experiencing homelessness"[Title/Abstract]) AND ("COVID-19"[MeSH Terms] OR "SARS-CoV-2"[Title/Abstract] OR "COVID"[Title/Abstract]). Equivalent DeCS-based terms were applied in LILACS and SciELO; adapted free-text strategies were used in the remaining databases as described in Supplementary Table S1.

2.2. Eligibility Criteria

The review question was structured using a PECO framework: Population (P) – people experiencing homelessness; Exposure (E) – the COVID-19 pandemic era (2020 onward); Comparator (C) – pre-pandemic period and/or general population, where applicable; Outcomes (O) – TB-related indicators including incidence, treatment interruption, hospitalization, mortality, and TB – COVID coinfection.

Inclusion criteria required that studies: (1) were published between 2020 and 2025; (2) reported outcomes for a population that explicitly included PEH or a clearly separable PEH subgroup; and (3) addressed at least one TB-related outcome. Qualitative and quantitative studies published in Portuguese, English, or Spanish were eligible.

Studies were excluded if they were duplicate records; focused exclusively on sheltered populations, preventing comparison with unsheltered individuals; did not address the specified TB-related outcomes; were case reports; or were secondary reviews (which were retained only for contextual use). Given the Brazilian context – where a substantial proportion of the homeless population is unsheltered and exposed to conditions of extreme street vulnerability – studies focusing exclusively on sheltered populations were not prioritized.

Secondary reviews identified through the search were not counted among the included primary studies and were not formally appraised for quality. Their use is restricted to contextualizing background and mechanistic information.

2.3. Study Selection and Data Extraction

A total of 306 records were identified across all databases. After removal of 20 duplicates, 286 records remained for title and abstract screening. Of these, 259 were excluded at the screening stage for the following reasons: population not addressing PEH (n=98); no TB-related outcome reported (n=87); study did not address the COVID-19 period or context (n=52); publication outside the eligible period (n=22). Twenty-seven full-text articles were assessed for eligibility. Eighteen were excluded at full-text review: secondary reviews repositioned as contextual references (n=2); case reports (n=3); PEH subgroup not separable from broader population (n=6); outcomes not meeting inclusion criteria (n=4); duplicate data source (n=2); language not covered by the review (n=1). Seven primary studies were included in the final qualitative synthesis, plus two contextual secondary reviews supported the writing of this review **(Figure 1)**.

Study selection was conducted in two sequential stages by two independent reviewers, with discrepancies resolved by consensus or consultation with a third reviewer. Data were extracted independently by both reviewers using a standardized extraction form.

2.4. Data Synthesis

Given the heterogeneity of included studies, a narrative synthesis approach was adopted. Studies were organized into three thematic domains: (1) TB-related clinical outcomes among PEH; (2) TB diagnosis and treatment continuity during the COVID-19 era; and (3) TB – COVID coinfection. An explicit evidence hierarchy was applied: PEH-specific quantitative studies (retrospective and prospective cohorts, case-control studies) anchor the main findings; descriptive and surveillance analyses provide supporting context; qualitative evidence illuminates mechanisms, barriers, and service-delivery dynamics. Findings across domains are reported with

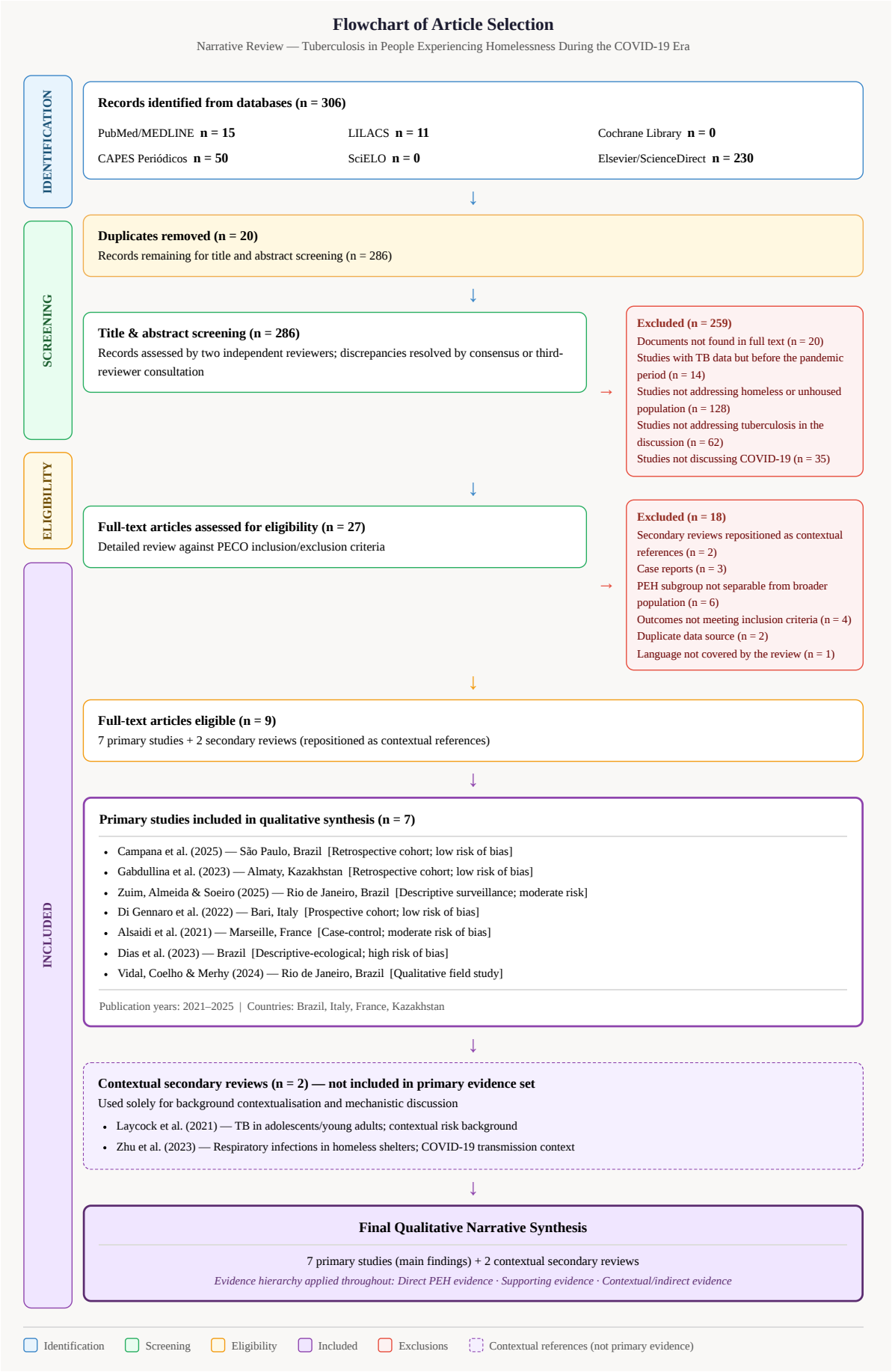

Figure 1: Flowchart of Article Selection.

explicit identification of study designs and PEH-specificity of the data.

2.5. Risk of Bias Assessment

Design-specific appraisal tools were applied as follows: the Newcastle – Ottawa Scale (NOS) was used for observational cohort and case-control studies (Di Gennaro et al., Gabdullina et al., Campana et al., Alsaidi et al.)[21–24]; the CASP Qualitative Checklist was used for the qualitative field study (Vidal et al.)[25]; and the Joanna Briggs Institute (JBI) Prevalence Checklist was applied to descriptive and surveillance-based studies (Dias et al., Zuim et al.)[26, 27]. Secondary reviews (Laycock et al., Zhu et al.) were not formally appraised, as they were excluded from the primary evidence set [19, 20]. Individual quality ratings are reported in Supplementary Table S2 and inform interpretation but do not function as formal inclusion thresholds.

3. Results

The seven included primary studies were conducted across multiple countries and settings, including Brazil, Italy, France, and Kazakhstan. Study designs included retrospective cohorts (Gabdullina et al., Campana et al., Di Gennaro et al.)[22–24], a case-control study (Alsaidi et al.)[21], prospective observational analyses (Di Gennaro et al.)[23], and descriptive surveillance analyses (Dias et al., Zuim et al., Vidal et al.)[25–27]. Publication years ranged from 2021 to 2025. **(Table 1)** summarises key characteristics, including the operational definition of homelessness used in each study and the degree to which PEH-specific data are separable from broader populations.

The risk-of-bias assessment revealed substantial variability in methodological quality. Three studies with robust designs and appropriate adjustment for confounding (Di Gennaro et al., Gabdullina et al., Campana et al.)[22–24] were classified as low risk, and the study by Alsaidi et al. was classified as moderate risk due to limited comparability or partial representativeness of PEH [21]. The remaining studies were at high risk of bias due to indirect populations, descriptive designs, or a lack of control for confounding. Full ratings are provided in Supplementary Table S2.

In interpreting these findings, readers should note that the included studies employ heterogeneous operational definitions of homelessness – ranging from formally street-dwelling adults to shelter residents, shared dormitory occupants, and administrative or socially vulnerable classifications. These differences limit direct cross-study comparability, and findings from studies with indirect or partial PEH definitions are explicitly labeled as such throughout this section.

Evidence hierarchy note: *The following results are presented according to an explicit evidence hierarchy. PEH-specific quantitative studies drive the primary findings (labeled 'Direct PEH evidence'). Descriptive and surveillance analyses provide supporting context (labeled 'Supporting evidence'). Qualitative and contextual literature are used to explain mechanisms and barriers (labeled 'Contextual/indirect evidence').*

Direct PEH evidence – Campana et al. (2025; São Paulo, Brazil; retrospective cohort; low risk of bias): In São Paulo, between 2017 and 2022, more than 39,000 TB cases were reported. Among PEH specifically, the proportion of unfavorable outcomes remained persistently high and statistically stable across the pre-pandemic and pandemic periods (57.8% pre-pandemic vs. 59.5% pandemic; no significant period-associated risk). Dropout rates were approximately 50%, and TB mortality exceeded 8% throughout. In contrast, unfavorable outcomes in the general population increased significantly during the pandemic period (from 21.8% pre-pandemic to 28.9% during the pandemic; HR 1.45; 95% CI: 1.37 – 1.55). These PEH-specific figures represent the most methodologically robust estimates of pandemic-era changes in TB outcomes in this population available in the reviewed literature [22].

Direct PEH evidence – Gabdullina et al. (2023; Almaty, Kazakhstan; retrospective cohort; low risk of bias): A retrospective study of TB treatment outcomes among socially vulnerable populations from 2018 to 2021 found that unfavorable outcomes increased markedly during the pandemic period compared with the pre-pandemic period (20% vs. 11%). Mortality rose (9% vs. 6%). After adjustment for age, sex, HIV status, and alcohol use, homelessness was independently associated with unfavorable outcomes (aRR approximately 2.7 – 2.9). These PEH-specific adjusted estimates are among the strongest quantitative evidence available for homelessness as a risk factor for poor TB outcomes [24].

Direct PEH evidence – Zuim, Almeida & Soeiro (2025; Rio de Janeiro, Brazil; descriptive surveillance; moderate risk of bias): A descriptive analysis of Rio de Janeiro surveillance data from 2016 to 2021 documented 2,965 TB cases among the homeless population – 1,708 (57.6%) new cases and 1,257 (42.4%) retreatment cases. Treatment interruption rates were high: 50.3% in new cases and 61.1% in retreatment cases. Proportions of deaths were 10.1% and 6.5%, respectively. The authors noted that COVID-19 worsened pre-existing inequalities and TB indicators in this population [27].

Direct PEH evidence – Di Gennaro et al. (2022; Bari, Italy; prospective cohort; low risk of bias): Among 206 TB-diagnosed patients admitted from 2013 to 2021, 17 (8.3%) were identified as experiencing homelessness. Overall treatment success was 57%; TB-attributable mortality was 1% (n=4). Social vulnerability – including homelessness and prolonged street residence – was associated with longer hospitalization duration, particularly among patients under 65 years of age (43 vs. 24 days). This study provides direct PEH-specific clinical outcome data within a broader cohort, though the PEH subgroup is small [23].

Supporting evidence – Dias et al. (2023; Brazil; descriptive-ecological; high risk of bias): A national descriptive analysis of pulmonary TB in Brazil from 2019 to 2021 estimated that PEH accounted for 4.2% of all pulmonary TB diagnoses nationally, with the Southern Region showing the highest proportional representation. Structural barriers – including underreporting, insufficient primary care coverage, and limited community health agent outreach – were identified as persistent drivers of diagnostic delay and treatment dropout. These findings provide national surveillance context but do not enable PEH-specific outcome calculations independent of broader population data [26].

Contextual/indirect evidence – Alsaidi et al. (2021; Marseille, France; case-control; moderate risk of bias): In a case-control study of 64 participants from a mixed vulnerable population – including immigrants and individuals experiencing homelessness, supported by a social assistance organization – conducted during March – May 2020, 23.4% were hospitalized. Risk factors for COVID-19 infection included shared dormitory residence, poor social distancing adherence, and prior TB history or multiple comorbidities. This study provides contextual evidence regarding COVID-19 risk in mixed vulnerable populations that included PEH, but PEH-specific outcomes are not separable from the broader study population [21].

Contextual/indirect evidence – Vidal, Coelho & Merhy (2024; Rio de Janeiro, Brazil; qualitative field study; CASP appraisal): A qualitative study conducted between May and December 2021,

Table 1: Literature compilation relating to cases of tuberculosis in people experiencing homelessness (PEH) during the COVID-19 pandemic.

Reference	Country	Design	Study duration	Homelessness Definition	TB / COVID Variables	Outcomes	Main Results
Laycock et al.	Not specified (multi-context)	Narrative review	2016–2021	Vulnerable youth including those in homelessness (implicit, not formally defined)	TB progression risk; age-related immunological susceptibility; vulnerability factors	TB infection and progression risk	TB progression increases with age (due to puberty-related immunological changes). Homeless and marginalized youth have higher TB risk due to healthcare access barriers and congregate living.
Alsaidi et al.	France (Marseille)	Observational study	March 2020 to May 2020	Individuals in vulnerable housing, including homelessness and shared dormitories (AAJT-supported population)	COVID-19 infection; TB history; comorbidities; living conditions	COVID-19 infection; hospitalization	23.4% hospitalized. COVID-19 risk associated with shared dormitories, poor social distancing, prior TB, and comorbidities.
Di Gennaro et al.	Bari (Italy)	Prospective cohort	From January 13, 2013, to December 15, 2021	Individuals identified as homeless within TB patient cohort (no formal definition provided)	TB diagnosis delay; hospitalization; treatment outcomes	Treatment success; mortality; hospitalization duration	8% homeless. Younger patients (< 65) had longer diagnostic delay and hospitalization. Overall treatment success 57%; mortality 1%. Social vulnerability influenced longer hospitalization.
Dias et al.	Brazil	Observational analysis	2019–2021	People living on the streets (structural/social definition)	Pulmonary TB incidence; social determinants; healthcare access	TB diagnosis, treatment adherence, transmission	Homeless represented 4.2% of TB cases. Structural barriers (underreporting, weak primary care) contribute to delayed diagnosis, treatment dropout, and ongoing transmission.
Zuim, Almeida & Soeiro	Rio de Janeiro (Brazil)	Observational (surveillance-based)	2016–2021	Homeless population (administrative classification)	TB incidence; treatment adherence; COVID-19 context	Treatment interruption; mortality	2,965 TB cases among the homeless. High dropout (50–61%) and mortality (6.5–10.1%). COVID-19 worsened inequalities and TB indicators.
Vidal, Coelho & Merhy	Rio de Janeiro (Brazil)	Observational (surveillance-based)	Between May and December 2021	Homeless population (a conceptual approach within the SUS)	Social determinants; access to healthcare (not necessarily specific to TB or COVID)	Access, care, vulnerability of professionals from the "street clinic" linked to a basic health unit	They highlight structural barriers to care for the homeless population, including fragmented care, difficulties in accessing services, and the need for strategies such as mobile clinics.
Gabdullina et al.	Almaty (Kazakhstan)	Retrospective cohort	2018–2021	Socially vulnerable populations including homelessness (not formally defined)	TB treatment outcomes; COVID-19 period comparison	Unfavorable outcomes; mortality	Unfavorable outcomes increased during COVID-19 (20% vs. 11%); mortality rose (9% vs. 6%). Homelessness independently associated with poor outcomes (aRR ~2.7–2.9).
da Silva Campana et al.	São Paulo (Brazil)	Retrospective cohort	2017–2022	Homeless subgroup within TB registry (not formally defined)	TB outcomes; COVID-19 period; diagnostic use	Unfavorable outcomes; dropout; mortality	Unfavorable outcomes increased in general population (21.8%→28.9%). Among homeless: persistently high unfavorable outcomes (~58–60%), dropout ~50%, mortality > 8%. No significant pandemic effect in this subgroup.
Zhu et al.	Multi-country	Systematic review	2020–2021	Shelter users vs. non-sheltered homeless	COVID-19 prevalence; TB infection risk	Infection prevalence; asymptomatic cases	Up to 86% asymptomatic COVID-19 in shelters. Higher SARS-CoV-2 prevalence in shelters vs. unsheltered. Frequent shelter use linked to higher TB infection risk due to prolonged exposure.

TB, tuberculosis; COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; AAJT, Association d'Aide aux Jeunes Travailleurs; SUS, Sistema Único de Saúde; aRR, adjusted relative risk.

from the perspective of healthcare professionals linked to street clinics, documented structural barriers to TB care for PEH: fragmented service delivery, difficulties in maintaining continuity of care, and reliance on mobile outreach units as a compensatory strategy. These findings are used to explain mechanisms and service-delivery context rather than to quantify outcomes [25].

Supporting evidence – Laycock et al. (2021; narrative review; repositioned as contextual reference): As a secondary review, this work is not included in the primary evidence set. It is noted here for contextual purposes: focusing on TB in adolescents and young adults aged 10 – 24 years from 2016 to 2021, the review documented that TB progression risk increases with puberty-related immunological changes, and that homeless and marginalized youth face elevated TB risk due to congregate living and healthcare access barriers. This provides background to understand age-specific TB vulnerability [19].

Contextual reference – Zhu et al. (2023; systematic review; repositioned as contextual reference): As a secondary review, this work is not included in the primary evidence set. For context: this systematic review of 21 articles documented that mass testing in shelter settings identified high proportions of asymptomatic COVID-19 cases (up to 86% in one study) and that shelter users had higher SARS-CoV-2 prevalence than unsheltered PEH. Prolonged shared environments were the main transmission factor identified for TB in this setting [20, 28].

4. Discussion

This narrative review synthesized primary observational evidence from seven studies to describe TB-related outcomes and care disruptions among PEH during the COVID-19 era. The evidence hierarchy applied throughout this synthesis distinguishes between PEH-specific quantitative studies – which anchor the primary conclusions – and descriptive, qualitative, or contextual sources, which are used to explain mechanisms and service-delivery dynamics. Collectively, findings indicate a severe and disproportionate TB burden in this population, characterized by persistently high rates of treatment interruption, prolonged hospitalizations, and elevated mortality [29]. These patterns predate the COVID-19 era; available evidence suggests that the pandemic in PEH did not uniformly worsen them, though disruptions in the broader population are well documented.

4.1. Structural Drivers of Poor TB Outcomes in PEH

Across the primary studies reviewed, PEH consistently showed substantially worse TB outcomes than general-population comparators when such data were available [29, 30]. The most methodologically robust evidence – from Campana et al. (2025) and Gabdullina et al. (2023) – confirms that unfavorable TB outcomes (treatment discontinuation, mortality, loss to follow-up) are far more prevalent among PEH than in the general population, and that homelessness is independently associated with poor outcomes even after adjustment for major confounders (aRR 2.7 – 2.9) [22, 24, 30].

The structural drivers of these outcomes are consistent across settings, despite differences in healthcare systems and geographic contexts compound these vulnerabilities [28, 29, 31]: (i) at the individual level, impaired self-care capacity, mental health conditions, and substance use disorders interfere with treatment adherence; (ii) at the social level, stigma, overcrowding, poor ventilation, and food insecurity facilitate TB transmission and disease progression; (iii) and programmatic factors, limited access to primary healthcare, fragmented service delivery, and treatment interruptions [29]. The qualitative evidence from Vidal et al. (2024) contextualizes these mechanisms from the perspective of healthcare providers working in street outreach settings, illustrating the operational challenges of maintaining continuity of care for this population [25].

Brazilian national surveillance data consistently document high dropout rates (50 – 61%) and substantial mortality (6.5 – 10.1%) among PEH with TB [26, 27]. While these studies have methodological limitations, including reliance on administrative definitions of homelessness and the absence of adjustment for confounding, their consistency across different Brazilian settings reinforces the pattern documented in more robust study designs.

4.2. TB Outcomes During the COVID-19 Era Among PEH

The relationship between the COVID-19 era and TB outcomes among PEH is best characterized as amplifying pre-existing structural vulnerabilities rather than as a uniformly causal effect of the pandemic. The available evidence does not consistently demonstrate a statistically significant pandemic-associated deterioration in PEH-specific TB outcomes, but it documents persistently severe baseline conditions.

The São Paulo registry analysis, the most methodologically robust study available for this question, used time-stratified comparisons and proportional hazard models to demonstrate a clear pandemic-associated increase in unfavorable outcomes among the general population (HR 1.45; 95% CI: 1.37 – 1.55) [22]. Among PEH, however, unfavorable outcomes remained statistically stable and persistently high across periods (57.8% pre-pandemic vs. 59.5% pandemic). This pattern could reflect a ceiling effect – outcomes were already so severe among PEH that pandemic-related disruptions produced no measurable marginal increase – or a protective effect of specialized, PEH-targeted services that maintained some continuity of care. The Kazakhstan cohort, from a different healthcare system, documented a different pattern: unfavorable outcomes increased during the pandemic period (from 11% to 20%), with elevated mortality, and identified homelessness as an independent predictor of these outcomes [24].

Declines in TB notification rates and service disruptions during the pandemic are well documented in broader population analyses [32]. Still, these estimates are not PEH-specific and are treated as contextual evidence rather than direct support for PEH-specific conclusions. Pandemic-related disruptions are biologically and epidemiologically plausible in PEH, given limited access to hygiene, healthcare, and stable housing; however, the extent to which these dynamics specifically affected PEH TB outcomes – beyond the already severe baseline – remains insufficiently quantified in the current primary evidence base.

4.3. TB – COVID Coinfection: Evidence and Limitations

Evidence on TB – COVID coinfection specifically within PEH is scarce. Most available estimates of coinfection outcomes are derived from broader population meta-analyses, which document higher fatality rates among coinfected individuals than among COVID-19-only cases [33–35]. These estimates are biologically plausible in PEH given the high prevalence of active TB and immunosuppressive comorbidities in this group. Still, they cannot be attributed to PEH specifically and are presented as contextual background [36].

The only included primary study addressing TB history and COVID-19 outcomes in a partially PEH population identified prior TB as a risk factor for COVID-19 infection in a mixed vulnerable population [21]. However, PEH-specific outcomes stratified by TB status were not reported, and this study is characterized as indirect evidence. The Zhu et al. systematic review (repositioned as a contextual reference)

documented higher SARS-CoV-2 prevalence among shelter users and asymptomatic transmission dynamics relevant to understanding infection risk [20]. Still, it did not specifically address TB – COVID coinfection outcomes.

Accordingly, any conclusions regarding TB – COVID coinfection in PEH must be treated as speculative, supported only by biological plausibility and indirect epidemiological evidence. This represents a critical gap in the literature requiring prospective, PEH-specific studies.

4.4. Health System Disruptions and Programmatic Fragility

Programmatic challenges were consistently identified as key contributors to poor TB outcomes among PEH, particularly in the context of the COVID-19 era. Primary studies consistently documented disruptions to TB diagnosis, follow-up, and treatment continuity in PEH-relevant settings, including reductions in service availability, reallocation of resources to the COVID-19 response, and decreased access to primary care [37].

The qualitative evidence from Vidal et al. (2024) contextualizes these systemic challenges from a street-clinic operational perspective: fragmented care pathways, professional burnout, and logistical constraints of mobile outreach highlight the operational fragility of PEH-targeted services even before and during the pandemic [25]. Surveillance data from Rio de Janeiro and the São Paulo cohort both document diagnostic and follow-up disruptions affecting TB management in PEH contexts [22, 27].

5. Limitations

Several limitations should be considered when interpreting these findings. First, the heterogeneity of operational definitions of homelessness across included studies prevents direct cross-study comparisons. Studies range from those explicitly focusing on street-dwelling adults to those using administrative, sheltered, or mixed vulnerable-population classifications; the latter are clearly characterized as indirect evidence throughout this review, but their inclusion introduces imprecision into the overall synthesis of evidence.

Second, a significant proportion of included studies were at moderate to high risk of bias, particularly due to the use of administrative population definitions, limited control for confounding, and small PEH subgroup sizes. Findings from high-risk studies, while consistent with the overall pattern, should be interpreted with caution.

Third, formal quality appraisal tools were applied only to primary studies; the two secondary reviews were repositioned as contextual references and were not formally appraised. This is methodologically appropriate but limits the ability to assess the quality of the contextual literature drawn upon in the Discussion.

Fourth, the restriction to six databases and three languages may have introduced selection bias, potentially missing relevant evidence published in other languages or in grey literature. No protocol was pre-registered, which is acknowledged as a methodological limitation consistent with the narrative design.

Finally, the predominantly descriptive nature of the available primary evidence precludes rigorous causal inference about the pandemic's effects on PEH TB outcomes. What can be concluded is that unfavorable TB outcomes remain unacceptably high among PEH across the reviewed period, and that pandemic-era disruptions likely affected an already critical situation – the magnitude and direction of any marginal pandemic effect in PEH specifically cannot be robustly estimated from this evidence base.

6. Conclusion

This narrative review described TB-related outcomes and care disruptions among PEH during the COVID-19 era (2020 – 2025). The most methodologically robust evidence confirms that PEH are disproportionately affected by unfavorable TB outcomes – including high rates of treatment interruption, prolonged hospitalization, and elevated mortality – driven by structural vulnerabilities operating across individual, social, and programmatic dimensions.

Pandemic-era disruptions were associated with increased unfavorable TB outcomes in the general population in multiple settings. Among PEH, outcomes remained persistently high across pre-pandemic and pandemic periods in the most robust study available, suggesting a pre-existing ceiling of vulnerability; in another high-quality study from a different setting, pandemic-era worsening was documented. This inter-study heterogeneity underscores the importance of context-specific, PEH-targeted surveillance and service delivery.

Evidence on TB – COVID coinfection in PEH specifically remains sparse, heterogeneous, and indirect. Future research should prioritize well-designed prospective studies with explicit PEH definitions, separable PEH-specific outcome denominators, and appropriate comparator designs to better characterize the epidemiological dynamics of TB and TB – COVID coinfection in this population.

Conflicts of Interest

The authors declare no conflicts of interest.

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Institutional Review Board (IRB)

This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

Large Language Model

The authors declare that generative artificial intelligence (AI) tools were used to assist in language refinement and grammar checking during the preparation of this manuscript. The authors reviewed and verified all content, and they take full responsibility for the integrity and accuracy of the manuscript.

Author Contributions

SKS contributed to conceptualization, methodology, investigation, literature search, study selection, data extraction, data analysis, writing the original draft, preparation of figures and tables, and writing review and editing. JKR contributed to investigation, literature search, study selection, data extraction, data analysis, writing the original draft, and writing review and editing. LNC contributed to conceptualization, supervision, methodology, critical review of

the manuscript, and writing review and editing. SMS contributed to conceptualization, supervision, methodology, critical review of the manuscript, and writing review and editing. All authors read and approved the final manuscript.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

References

1. Ministério da Saúde. Manual de recomendações para o controle da tuberculose no Brasil. Brasília; 2019. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/manual_recomendacoes_controle_tuberculose_brasil_2_ed.pdf.
2. Savacool JW. Philadelphia and the White Plague. Trans Stud Coll Physicians Phila. 1986;8(3):147-81. [PMID: 3532445].
3. Centers for Disease Control and Prevention. Tuberculosis (TB): Basic TB Facts. Atlanta; 2019. Available from: https://www.cdc.gov/tb/topic/basics/default.htm.
4. Maia CMF, Martelli DRB, Silveira D, Oliveira EA, Martelli Junior H. Tuberculosis in Brazil: the impact of the COVID-19 pandemic. J Bras Pneumol. 2022;48(2):e20220082. [PMID: 35475872, PMCID: PMC9064638, https://doi.org/10.36416/1806-3756/e20220082].
5. Nascimento CPA, Bezerra e Silva SY, Ferreira AGL, da Silva SB, Lira ALBdC, Pinto ESG. Vulnerabilidade De Pessoas Em SituaÇÃo De Rua Que Vivem Com Tuberculose: AnÁlise De Conceito. Revista Enfermagem Atual In Derme. 2023;97(3). [https://doi.org/10.31011/reaid-2023-v.97-n.3-art.1908].
6. Ministério da Saúde. Boletim Epidemiológico de Tuberculose - número especial. Brasília; 2024. Available from: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/boletins/epidemiologicos/especiais/2024/boletim-epidemiologico-de-tuberculose-numero-especial-mar-2024.pdf.
7. Silva DR, Mello FCQ, D'Ambrosio L, Centis R, Dalcolmo MP, Migliori GB. Tuberculosis and COVID-19, the new cursed duet: what differs between Brazil and Europe? J Bras Pneumol. 2021;47(2):e20210044. [PMID: 33950095, PMCID: PMC8332832, https://doi.org/10.36416/1806-3756/e20210044].
8. Pan American Health Organization. Histórico da pandemia de COVID-19. Washington;. Available from: https://www.paho.org/pt/covid19/historico-da-pandemia-covid-19.
9. World Health Organization. Origin of SARS-CoV-2. Geneva; 2020. Available from: https://apps.who.int/iris/bitstream/handle/10665/332197/WHO-2019-nCoV-FAQ-Virus_origin-2020.1-eng.pdf.
10. Aggarwal AN, Agarwal R, Dhooria S, Prasad KT, Sehgal IS, Muthu V. Active pulmonary tuberculosis and coronavirus disease 2019: A systematic review and meta-analysis. PLoS One. 2021;16(10):e0259006. [PMID: 34673822, PMCID: PMC8530351, https://doi.org/10.1371/journal.pone.0259006].
11. Baratella E, Crivelli P, Marrocchio C, Bozzato AM, Vito A, Madeddu G, et al. Severity of lung involvement on chest X-rays in SARS-coronavirus-2 infected patients as a possible tool to predict clinical progression: an observational retrospective analysis of the relationship between radiological, clinical, and laboratory data. J Bras Pneumol. 2020;46(5):e20200226. [PMID: 32965310, PMCID: PMC7572267, https://doi.org/10.36416/1806-3756/e20200226].
12. Fan H, Wu F, Liu J, Zeng W, Zheng S, Tian H, et al. Pulmonary tuberculosis as a risk factor for chronic obstructive pulmonary disease: a systematic review and meta-analysis. Ann Transl Med. 2021;9(5):390. [PMID: 33842611, PMCID: PMC8033376, https://doi.org/10.21037/atm-20-4576].
13. Fei H, Yinyin X, Hui C, Ni W, Xin D, Wei C, et al. The impact of the COVID-19 epidemic on tuberculosis control in China. Lancet Reg Health West Pac. 2020;3:100032. [PMID: 34173601, PMCID: PMC7511841, https://doi.org/10.1016/j.lanwpc.2020.100032].
14. Fukunaga R, Glaziou P, Harris JB, Date A, Floyd K, Kasaeva T. Epidemiology of Tuberculosis and Progress Toward Meeting Global Targets - Worldwide, 2019. MMWR Morb Mortal Wkly Rep. 2021;70(12):427-30. [PMID: 33764960, PMCID: PMC7993552, https://doi.org/10.15585/mmwr.mm7012a4].
15. McQuaid CF, Vassall A, Cohen T, Fiekert K, White RG. The impact of COVID-19 on TB: a review of the data. Int J Tuberc Lung Dis. 2021;25(6):436-46. [PMID: 34049605, PMCID: PMC8171247, https://doi.org/10.5588/ijtld.21.0148].
16. Ortiz-Martínez Y, Rodríguez-Morales AJ, Henao-Martínez AF. Decreased notification of TB cases during the COVID-19 pandemic. Int J Tuberc Lung Dis. 2022;26(2):177-8. [PMID: 35086633, https://doi.org/10.5588/ijtld.21.0651].
17. Brito C, Silva L, Xavier C, Antunes V, Costa M, Filgueiras S. The way of life of the unhoused people as an enhance for COVID-19 care. Revista Brasileira de Enfermagem. 2021;74. [https://doi.org/10.1590/0034-7167-2020-0832].
18. Sousa IV, Brasil CCP, Silva RMD, Vasconcelos DPE, Silva KA, Bezerra IN, et al. Participatory diagnosis to identify health problems in a socially vulnerable community. Cien Saude Colet. 2017;22(12):3945-54. [PMID: 29267711, https://doi.org/10.1590/1413-812320172212.25012017].
19. Laycock KM, Enane LA, Steenhoff AP. Tuberculosis in Adolescents and Young Adults: Emerging Data on TB Transmission and Prevention among Vulnerable Young People. Trop Med Infect Dis. 2021;6(3). [PMID: 34449722, PMCID: PMC8396328, https://doi.org/10.3390/tropicalmed6030148].
20. Zhu A, Bruketa E, Svoboda T, Patel J, Elmi N, El-Khechen Richandi G, et al. Respiratory infectious disease outbreaks among people experiencing homelessness: a systematic review of prevention and mitigation strategies. Ann Epidemiol. 2023;77:127-35. [PMID: 35342013, https://doi.org/10.1016/j.annepidem.2022.03.004].
21. Alsaïdi I, De Sousa Santos F, Plard B, Janvier E, Tinland A, Hafni A, et al. Factors associated with SARS-CoV2 infection and care pathways among the most vulnerable populations living in Marseille: a case control study. BMC Public Health. 2021;21(1):1704. [PMID: 34538240, PMCID: PMC8449995, https://doi.org/10.1186/s12889-021-11716-6].
22. da Silva Campana P, da Silva ATC, Klautau GB, Rujula MJP, Salles MJ, de Castro MC. Impact of the COVID-19 pandemic on unfavorable tuberculosis outcomes: a comparative analysis of unhoused and general populations. BMC Public Health. 2025;25(1):2260. [PMID: 40604738, PMCID: PMC12219442, https://doi.org/10.1186/s12889-025-23491-9].
23. Di Gennaro F, Lattanzio R, Guido G, Ricciardi A, Novara R, Patti G, et al. Predictors for Pulmonary Tuberculosis Outcome and Adverse Events in an Italian Referral Hospital: A Nine-Year Retrospective Study (2013-2021). Ann Glob Health. 2022;88(1):26. [PMID: 35582409, PMCID: PMC9053535, https://doi.org/10.5334/aogh.3677].
24. Gabdullina M, Maes EF, Horth RZ, Dzhazybekova P, Amanova GN, Zikriyarova S, et al. COVID-19 pandemic and other factors associated with unfavorable tuberculosis treatment outcomes-Almaty, Kazakhstan, 2018-2021. Front Public Health. 2023;11:1247661. [PMID: 37808989, PMCID: PMC10552263, https://doi.org/10.3389/fpubh.2023.1247661].
25. Vidal AA, Coelho KSC, Merhy EE. [The street as a space for care production: the singular therapeutic project and tuberculosis management in people experiencing homelessness during the Covid-19 pandemic in the city of Rio de Janeiro]. Salud Colect. 2024;20:e4774. [PMID: 38457779, PMCID: PMC11822893, https://doi.org/10.18294/sc.2024.4774].
26. de Medeiros MM, Dias ALM, Figueira PB. Analysis of the proportion of homeless individuals diagnosed with pulmonary tuberculosis among the total cases, by Brazilian region, in the period from 2019 to 2021. 2023. Available from http://educapes.capes.gov.br/handle/capes/737291.
27. Zuim RCB, de Almeida JR, Soeiro I. Casos de tuberculose, cura e interrupção de tratamento na População em Situação de Rua, no estado do Rio de Janeiro, de 2016 a 2021: um estudo descritivo com base nos dados de vigilância. REPIS (Revista Educação, Pesquisa e Informação em Saúde). 2025. [https://doi.org/10.71209/repis.2025.3.e.0356].
28. Mohsenpour A, Bozorgmehr K, Rohleder S, Stratil J, Costa D. SARS-Cov-2 prevalence, transmission, health-related outcomes and control strategies in homeless shelters: Systematic review and meta-analysis. EClinicalMedicine. 2021;38:101032. [PMID: 34316550, PMCID: PMC8298932, https://doi.org/10.1016/j.eclinm.2021.101032].

29. Pavinati G, Lima LV, Ferreira MRL, Zanatta STP, Magnabosco GT. Trends and clusters of tuberculosis treatment interruption among people experiencing homelessness in Brazil: influence of individual, social and programmatic factors. Rev Bras Epidemiol. 2025;28:e250041. [PMID: 40802343, PMCID: PMC12333893, https://doi.org/10.1590/1980-549720250041].
30. Santos A, Brunfentrinker C, Pena LDS, Saraiva SDS, Boing AF. Analysis and comparison of tuberculosis treatment outcomes in the homeless population and in the general population of Brazil. J Bras Pneumol. 2021;47(2):e20200178. [PMID: 33656159, PMCID: PMC8332848, https://doi.org/10.36416/1806-3756/e20200178].
31. Gioseffi JR, Batista R, Brignol SM. Tuberculosis, vulnerabilities, and HIV in homeless persons: a systematic review. Rev Saude Publica. 2022;56:43. [PMID: 35649090, PMCID: PMC9126575, https://doi.org/10.11606/s1518-8787.2022056003964].
32. Berra TZ, Ramos ACV, Alves YM, Tavares RBV, Tartaro AF, Nascimento MCD, et al. Impact of COVID-19 on Tuberculosis Indicators in Brazil: A Time Series and Spatial Analysis Study. Trop Med Infect Dis. 2022;7(9). [PMID: 36136658, PMCID: PMC9500936, https://doi.org/10.3390/tropicalmed7090247].
33. Gao Y, Liu M, Chen Y, Shi S, Geng J, Tian J. Association between tuberculosis and COVID-19 severity and mortality: A rapid systematic review and meta-analysis. J Med Virol. 2021;93(1):194-6. [PMID: 32687228, PMCID: PMC7405273, https://doi.org/10.1002/jmv.26311].
34. Irfani TH, Siburian R, Nabila R, Umar TP. Tuberculosis and Coronavirus Disease 2019 (COVID-19) from A Clinical Perspective: A Systematic Review. Medeni Med J. 2020;35(4):338-43. [PMID: 33717627, PMCID: PMC7945727, https://doi.org/10.5222/MMJ.2020.36775].
35. Wang Q, Guo S, Wei X, Dong Q, Xu N, Li H, et al. Global prevalence, treatment and outcome of tuberculosis and COVID-19 coinfection: a systematic review and meta-analysis (from November 2019 to March 2021). BMJ Open. 2022;12(6):e059396. [PMID: 35725250, PMCID: PMC9213780, https://doi.org/10.1136/bmjopen-2021-059396].
36. Flores-Lovon K, Ortiz-Saavedra B, Cueva-Chicana LA, Aperrigue-Lira S, Montes-Madariaga ES, Soriano-Moreno DR, et al. Immune responses in COVID-19 and tuberculosis coinfection: A scoping review. Front Immunol. 2022;13:992743. [PMID: 36090983, PMCID: PMC9459402, https://doi.org/10.3389/fimmu.2022.992743].
37. Aoki L, de Carvalho Rodrigues J, Bertollini Lamy I, da Veiga GL, Alves BdCA, Pereira EC, et al. Impact of COVID-19 on Social, Economic, and Health Interventions for Tuberculosis and Leprosy. Hygiene. 2025;5(4). [https://doi.org/10.3390/hygiene5040053].