

Scaling up evidence-based approaches to tuberculosis screening in prisons

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People deprived of liberty have among the highest rates of tuberculosis globally. The incidence of tuberculosis is ten times greater than the incidence of tuberculosis in the general population. In 2021, WHO updated its guidance to strongly recommend systematic screening for tuberculosis in prisons and penitentiary systems. Which case-finding strategies should be adopted, and how to effectively implement these strategies in these settings, will be crucial questions facing ministries of health and justice. In this Viewpoint, we review the evidence base for tuberculosis screening and diagnostic strategies in prisons, highlighting promising approaches and knowledge gaps. Drawing upon past experiences of implementing active case-finding and care programmes in settings with a high tuberculosis burden, we discuss challenges and opportunities for improving the tuberculosis diagnosis and treatment cascade in these settings. We argue that improved transparency in reporting of tuberculosis notifications and outcomes in prisons and renewed focus and resourcing from WHO and other stakeholders will be crucial for building the commitment and investments needed from countries to address the continued crisis of tuberculosis in prisons.

Introduction

Globally, the estimated 11·5 million people deprived of liberty are at exceedingly high risk of tuberculosis.^{1,2} People deprived of liberty refers to anyone held in prisons, penitentiaries, correctional facilities, jails, detention centres, or similar facilities. Incarceration of people who are already at high risk from the community combined with overcrowding; inadequate ventilation; poor nutrition; high prevalence of smoking, alcohol, and drug use; and delays in tuberculosis diagnosis due to poor access to medical care have all been recognised as determinants of excess risk among people deprived of liberty.³ A 2021 meta-analysis of 159 studies found that the incidence of tuberculosis was, on average, ten times greater in people deprived of liberty than in the general population.⁴ Disparities vary by region, with the highest incidence ratio (26·9) observed in South America, where tuberculosis notifications in prisons and penitentiary institutions (collectively referred to throughout as prisons) have increased by more than 250% since 2000, an increase that is largely driven by increasing incarceration rates.⁵ Prisons have also been implicated in outbreaks of multidrug-resistant and extensively drug-resistant tuberculosis in multiple countries.^{6,7}

High rates of tuberculosis transmission in prisons also threaten to undermine efforts to eliminate tuberculosis in the general population. People deprived of liberty have an elevated risk of acquiring tuberculosis after release from prisons,⁸ and genomic epidemiology studies from multiple countries have documented evidence that *Mycobacterium tuberculosis* strains circulating in prisons spill over into surrounding communities, which means that prisons act as institutional amplifiers or epidemiological pumps for continued transmission in communities.⁹ Prisons have amplified community outbreaks of drug-resistant tuberculosis, and evidence is emerging that these high-risk environments might select

for bacterial strains with increased fitness that are more capable of spreading in the broader population.⁷ At a national level, rising incarceration rates have been found to drive the incidence of tuberculosis and multidrug-resistant tuberculosis, reversing earlier gains in the control of these diseases.¹⁰

Several obstacles hinder attempts to reduce the burden of tuberculosis in prisons in low-income and middle-income countries (LMICs) in particular, including insufficient human resources for health-care programmes, underuse of prevention strategies including preventive therapy, inadequate funding, and insufficient focused policies for addressing tuberculosis in prisons. Among the most glaring deficiencies, however, is the insufficient implementation of effective screening and diagnostic tools, which constitute the backbone of tuberculosis control. Although studies from the past two decades have consistently shown that active case-finding for tuberculosis in prisons is effective and cost-effective,^{11,12} national policies and practices for tuberculosis screening in prisons have been insufficient. Active tuberculosis case-finding, which is sometimes used synonymously with systematic screening, involves provider-initiated screening and testing, typically occurring outside of health-care facilities and not dependent on individuals presenting with symptoms for medical care. Most LMICs with a high burden of tuberculosis do not consistently perform active tuberculosis case-finding or other dedicated tuberculosis case-finding activities in prisons. In 2021, WHO released new guidelines, which for the first time strongly recommended systematic screening for tuberculosis in prisons.¹³ Systematic screening for tuberculosis, which is used interchangeably with the term active tuberculosis case-finding, involves the systematic identification of people at risk for tuberculosis disease, in a predetermined target group, by assessing symptoms and using tests, examinations, or other procedures that can be applied

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rapidly. For those who screen positive, the diagnosis needs to be established by diagnostic tests and additional clinical assessments. However, specific guidance on implementation, which is crucial for formulating national policies and strategies, was minimal in WHO's recommendation. Here, we aim to provide practical guidance for programmes to complement the WHO recommendations, using existing evidence to inform how systematic screening can be effectively implemented in prisons as the first step in building a comprehensive strategy for tuberculosis control, and to highlight areas requiring further investigation.

Evidence base for tuberculosis case-finding interventions in prisons

The high prevalence of undiagnosed tuberculosis among people deprived of liberty justifies enhanced active (tuberculosis) case-finding interventions to improve health outcomes and reduce transmission. A 2021 systematic review, which synthesised data published between 1980 and 2020, assessed the effects of tuberculosis screening on populations and individuals.¹⁴ Eight studies assessed the effect of screening in prisons on tuberculosis case notification rates, prevalence, and smear positivity. The screening strategies used in these studies varied, and included peer educators, prison personnel, and dedicated implementation teams to screen existing residents and new entrants. Screening approaches included education and screening with symptoms, and chest x-ray or sputum microscopy for all. We distinguish here between active case-finding, which encompasses approaches to systematic tuberculosis screening initiated by health programmes, and passive case-finding, whereby health programmes rely on individuals presenting for medical care with symptoms compatible with tuberculosis.

One cluster randomised trial found a higher estimated case detection rate in prisons using a peer-led active (tuberculosis) case-finding programme than in controls in facilities with passive case detection (79·8% screened vs 26·9% in control prisons; mean difference 52·9%, $p=0\cdot010$).¹⁵ In four quasi-experimental studies, prisons employing active (tuberculosis) case-finding consistently had higher tuberculosis case notification rates, but effect on tuberculosis prevalence in two studies was mixed.¹⁴ One study found smear positivity among culture-confirmed cases was lower among people deprived of liberty who were actively screened (10·0%) compared with cases identified by passive case-finding (50·9%; $p<0\cdot01$), suggesting that systematic screening resulted in earlier tuberculosis detection, with the potential to interrupt transmission.¹⁶ Thus, evidence supports that active (tuberculosis) case-finding is associated with increased case detection when compared with passive case-finding, which can be further optimised as more sensitive screening tools are deployed such as rapid diagnostic tests.

When should active case-finding be implemented?

Despite WHO recommending systematic screening for tuberculosis in prisons, no guidance was provided in relation to the timing for active (tuberculosis) case-finding, resulting in programmes implementing a variety of strategies. Some national and regional guidelines recommend screening people deprived of liberty for tuberculosis upon entry into prisons, to prevent introduction of infectious cases (panel).^{17,18} Other models, however, support active (tuberculosis) case-finding when people exit prisons to be beneficial for reducing community transmission in settings with low tuberculosis incidence in the community and high transmission in prisons.⁸ Screening at both entry and exit provides an opportunity to detect tuberculosis at the first and last point of contact in the prison system, protecting the health of the individual, other people deprived of liberty, and the community outside of the prison.

Another highly effective strategy to identify prevalent cases is periodic mass screening, regardless of entry and exit screening. To be effective, it should be undertaken at least once per year. However, in settings with high transmission rates or less robust access to clinical diagnostics, modelling suggests that annual screening would have only a moderate effect on tuberculosis transmission, resulting in incidence that is still extremely elevated.^{8,11} Screening for tuberculosis twice a year, or even more frequent screening, would probably be required to bring incidence rates down to rates similar to those found in the general population.¹⁹ Future studies or model-based analyses could investigate the requisite frequency of mass screening needed to contain tuberculosis according to the underlying transmission conditions.²⁰ For now, it is reasonable to recommend active (tuberculosis) case-finding at entry and exit in all settings, with mass screening performed at least annually in settings with high tuberculosis incidence rates in prisons.

In prisons with lower tuberculosis burden, contact tracing might be an effective method for case-finding, although the evidence for its effectiveness in prisons is generally poor.²¹ For contacts of individuals with multidrug-resistant tuberculosis or extensively drug-resistant tuberculosis, systematic screening with rapid diagnostic tests that detect rifampicin resistance should be performed, given risks of onward transmission and poor treatment outcomes when therapy is delayed. However, in prisons with high tuberculosis incidence and overcrowding, the marginal benefits of targeted contact investigations above and beyond universal mass screening could be limited.

How should active case-finding be performed?

WHO guidance documents recommend that health-care workers should conduct screening on the basis of history

of former tuberculosis disease and clinical symptoms (eg, coughing for more than 2 weeks, sputum production, fever, night sweats, loss of weight and appetite, haemoptysis, chest pain, and low BMI).¹⁹ Multiple studies, however, have found that up to half of people deprived of liberty with microbiologically confirmed tuberculosis do not have symptoms;^{22,23} symptom-based screening misses early detection and results in clinical deterioration and transmission to others. In settings where smoking is allowed, however, cough is common among people deprived of liberty, and it markedly reduces the specificity for tuberculosis. This diminishes the potential efficiency gains that can be achieved by utilising a symptom screen to target downstream diagnostics. In view of these studies, we believe that systematic screening should be done irrespective of symptoms.

Among the most transformational technologies for tuberculosis diagnosis are molecular rapid diagnostics, which are endorsed by WHO for systematic screening and are widely available in LMICs. Several studies have evaluated the implementation of molecular rapid diagnostics in the context of active case-finding in prisons, generally finding that molecular rapid diagnostics improved case-finding compared with smear microscopy.^{24,25} Studies have found that mass screening with molecular rapid diagnostics on sputum samples would be cost-effective and could reduce the incidence of tuberculosis.^{11,12} Pooling sputum samples, with testing by molecular rapid diagnostics, could further reduce costs with very modest loss of sensitivity.²⁶ In 2017, this approach was piloted in Brazilian prisons and found to yield considerable cost savings.²⁷ Providing on-site access to molecular rapid diagnostics in prisons, potentially combined with pooled sputum testing, could reduce the diagnostic gap. Furthermore, the use of molecular rapid diagnostics that detect rifampicin resistance, or those that detect resistance to second-line drugs, could be crucial for containing multidrug-resistant and extensively drug-resistant tuberculosis transmission in prisons.

Chest radiography is a sensitive screening tool for adults at high risk of tuberculosis. A systematic review published in 2021 showed high sensitivity (94%) and specificity (89%) of chest radiography for the presence of any abnormality.¹³ However, this review included few studies that measured the accuracy of chest radiography among people deprived of liberty, for whom smoking and prior tuberculosis are common, which might influence the image interpretation.²⁸ Nevertheless, mass screening using chest radiographies, followed by sputum smear microscopy and culture for those with abnormal x-rays, and treatment where appropriate led to marked decreases in tuberculosis incidence in prisons in Hong Kong and Rio de Janeiro.^{29,30} One obstacle to implementing chest radiography is the need for trained personnel to interpret them. Computer-aided detection software showed promising results for addressing this

Panel: Key recommendations and illustrative action steps for advancing tuberculosis screening and diagnosis in prisons

High-level political acknowledgment and will for operationalising WHO guidelines in prison systems

- Inclusion of an explicit focus on people deprived of liberty in national strategic plans for HIV and tuberculosis
- Collaboration and coordination between ministries of health and justice and prison authorities
- Provision of health-care workers to prisons and assurance of sustained access
- Transparency in reporting tuberculosis case notifications among people deprived of liberty
- Investments in tuberculosis prevention, screening, diagnosis, treatment, and care infrastructure
- Patient-centred care; health education to people deprived of liberty, prison staff, and visitors; and counselling, social support, and psychological support

Systematic screening irrespective of symptoms

- Routine screening at entry and exit, with periodic mass screening
- Use of chest radiography and rapid diagnostic tests

Transitional care at community re-entry

- Supporting linkage to tuberculosis care among people leaving prisons

Research to identify effective, scalable strategies for addressing tuberculosis in prisons

- Systematic evaluations and comparisons of screening and diagnostic algorithms
- Implementation science studies of approaches to operationalising screening and integrating it within programmes for common comorbid diseases
- Modelling to evaluate optimal frequency of mass screening across epidemiological contexts
- New technologies, such as ultra-portable chest x-rays, tongue swabs, and urine tests

Person-centred approaches grounded in human rights

- Educational programmes to destigmatise tuberculosis that include people deprived of liberty as peer educators
- Respectful engagement of people deprived of liberty as participants and partners in tuberculosis screening rather than as subjects of disease control programmes
- Maintenance of confidentiality of medical information throughout screening and treatment
- Assurance that medical isolation during treatment, if implemented, does not harm mental health or social wellbeing, or deprive individuals of their possessions

barrier, exceeding WHO benchmarks for a screening test (90% sensitivity, 70% specificity).^{31,32} However, many prisons in LMICs do not have functioning x-ray equipment, and maintenance is often neglected. New technologies, such as ultraportable chest radiographies,

could improve access.³³ Increased investments in radiography equipment and personnel are needed in many countries to leverage these technological innovations and make them accessible in prisons.

An additional challenge to active case-finding is the reliance on sputum for confirmatory testing, which many individuals, particularly those in the earlier stages of tuberculosis, are unable to produce in sufficient volume. Because a key goal of active case-finding is identification of early tuberculosis cases, there is a crucial need for diagnostics that are not dependent on sputum production. Several emerging technologies have shown promise for non-sputum-based tuberculosis screening, leveraging sampling of exhaled breath, blood, urine, and oral membranes.³⁴ In addition, bidirectional tuberculosis and COVID-19 diagnostic tools could have a role in prisons.³⁵ Apart from urine lipoarabinomannan testing, which is primarily useful in tuberculosis screening for people living with HIV, none of these approaches are yet endorsed and commercialised.

Translating evidence-based tuberculosis screening interventions from guidelines into practice can be done by using implementation strategies targeting operational challenges specific to prison settings. For example, task shifting of tuberculosis screening activities from professional health workers to peer educators who work with people deprived of liberty has been trialled in several settings to overcome entrenched shortages of human resources for health in prison health systems.¹⁵ When properly trained, mentored, and supervised, these peer educators can facilitate systematic symptom screening and sputum sample collection for tuberculosis screening done at entry, exit, and during incarceration, and can provide psychosocial support to promote medication adherence, care engagement, and monitoring for treatment side-effects. Changing service delivery sites and incorporating new technologies, such as those we have mentioned, can facilitate high-throughput screening. Linking screening to treatment of tuberculosis will have a profound effect on transmission. Engaging key opinion leaders within formal and informal prison structures and people deprived of liberty leadership structures is essential to ensure political commitment and support for systematic screening and sustained access to the incarcerated population. Furthermore, optimal screening and implementation strategies could vary according to local epidemiology (eg, prevalence of HIV and multidrug-resistant tuberculosis) and prison characteristics and should, therefore, be tailored when possible to local or regional evidence and knowledge.

Structural challenges to tuberculosis control in prisons

To achieve tuberculosis control in prisons we ultimately need to address structural barriers that impede systematic tuberculosis screening. Firstly, in many countries, there is a need to address policies driving rising incarceration

rates, which often disproportionately expose marginalised and vulnerable populations to overcrowded prison settings with increasingly overstretched health systems.⁵ Reducing incarceration rates and overcrowding of prisons might be crucial to addressing tuberculosis in these settings.³⁶ Secondly, upgrading prison infrastructure to meet international standards for ventilation and cell occupancy would not only improve detention conditions, but could also reduce tuberculosis transmission risk based on mathematical modelling data.^{37,38} Thirdly, tuberculosis screening, prevention, treatment, and care should be embedded within a functioning prison health system sufficiently resourced to provide good-quality primary health care to all people deprived of liberty. Integrated specialty care for common comorbid illnesses including HIV, viral hepatitis, mental health disorders, and opioid use disorders should also be embedded within these health systems. However, prison health systems often do not have the human resources, equipment, medications, and diagnostic consumables needed to provide high-quality diagnosis and treatment for these conditions. Additional domestic and international investments are needed to enact the strategies recommended here for enhanced screening and care for tuberculosis and related diseases.

The re-entry transition from prisons to the community is a vulnerable period, during which studies have documented a high risk of interruption in care for tuberculosis and HIV.^{39,40} Transitional care programmes for people living with HIV suggest that linkage and retention in care can be improved.⁴¹ Such transitional care interventions, however, require human resources and can be affected by geography. Care continuity for tuberculosis and other health conditions should be prioritised through the offering of discharge planning, peer navigation, and transitional care services (including temporary medication supply) that meaningfully articulate prison and community health systems, including electronic record systems where possible.

A final obstacle to addressing the burden of tuberculosis in people deprived of liberty is the paucity of publicly available data. Most countries do not publicly report case notifications among incarcerated individuals, and WHO does not routinely collect these data. Moreover, given the high turnover rate in many prison systems, notification rates probably underestimate true incidence attributable to prisons, because many cases occur following release and are not reported as being related to incarceration.^{8,42} In its annual Global Tuberculosis Report, WHO now reports estimated numbers of tuberculosis cases attributable to five key risk factors (alcohol use, diabetes, HIV, smoking, and undernourishment), but does not provide estimates for incarceration, which has a population attributable fraction that is similar to these other risk factors in many countries.^{5,43} Indeed, in WHO's 2022 Global Tuberculosis Report, prisons, and any synonym for prisons, were not mentioned.⁴³ Specific

Search strategy and selection criteria

We searched PubMed using the terms (tuberculosis OR TB) AND (screening OR diagnos*) AND (prison* OR jail* OR correctional OR carcer OR incarcer*) for papers published from inception up to April 28, 2022. We included articles published in English, Spanish, or Portuguese. We additionally reviewed articles that were included in three meta-analyses published in 2021. The final reference list was determined by relevance to tuberculosis screening in prisons.

disaggregation of data for prisons in national and global reports is crucial for achieving progress in addressing the burden of tuberculosis in prisons.

Conclusions

The extraordinarily high incidence of tuberculosis in prisons worldwide is not only a persistent injustice, but also a growing threat to national and global tuberculosis control objectives. Systematic, active case-finding through routine mass screening and screening at entry and exit, irrespective of symptoms, should be implemented in all prisons, and the tools for doing so (eg, chest radiography and rapid diagnostic tests) are available now. The evidence for the need, feasibility, and methods for addressing tuberculosis in prisons is robust; what has been insufficient is high-level political will to confront this epidemic. COVID-19 showed what can be achieved when political will is elevated and our collective efforts are focused on a common cause. The commitment and coordination of ministries of health and justice, with concomitant investment of resources, are needed to address the crisis of tuberculosis among people deprived of liberty. Given the growing concentration of tuberculosis in prisons, such investments will probably have a marked effect on this vulnerable population and their surrounding communities.

Contributors

JRA and SC were involved in conceptualising the manuscript, writing the first draft, and revising the manuscript critically for intellectual content. All other authors contributed to the first draft and revised the manuscript and approved the final version of the manuscript.

Declaration of interests

We declare no competing interests.

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