Original Article

THE INDONESIAN JOURNAL OF INFECTIOUS DISEASES

p-ISSN: 2354-6077), e-ISSN: 2599-1698

Detection of Tuberculosis Cases Among Correctional Facility Inmates in Indonesia

Amelia Yuri Karlinda[1], Syahrizal Syarif[2]

[1]Master of Epidemiology Program, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia
[2]Department of Epidemiology, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia

ARTICLE INFO

Received: 6 March 2025
Reviewed: 27 April 2025
Accepted: 6 May 2025

Keywords:
Tuberculosis, Correctional facility inmates, Systematic screening, *Chest X-ray (CXR)*

*Corresponding author:
Amelia Yuri Karlinda
Email: ameliayuri.18@gmail.com

ABSTRACT

Background: *Tuberculosis (TB) remains a major health burden in correctional facilities, with incidence rates significantly higher than in the general population due to confined and overcrowded environments. Systematic screening is an essential approach to detecting TB cases early; however, national data on the effectiveness of systematic screening in Indonesian correctional facilities remains limited.*
Methods: *This cross-sectional study utilized data from TB screening of 206,337 inmates across 376 correctional facilities in Indonesia conducted between July and December 2023. Screening included symptom assessment and chest X-ray (CXR) examination, followed by rapid molecular testing (TCM) for suspected cases. Analysis was performed to evaluate the proportion of TB case detection and the association between screening results and TB diagnosis.*
Results: *A total of 4,881 TB cases were identified, with a detection proportion of 2.37% and a prevalence rate of 2,369 per 100,000 inmates. Systematic use of CXR successfully identified TB cases, including among asymptomatic inmates, with 25.99% of inmates showing abnormal CXR findings confirmed to have TB. There was a statistically significant association between CXR results and TB case detection ($p < 0.001$).*
Conclusion: *Systematic screening combining symptom assessment, CXR, and TCM is effective in enhancing early TB case detection in correctional facilities. These findings reinforce the need for widespread implementation of comprehensive screening strategies, strengthening of healthcare services, and infection control measures to reduce the TB burden in Indonesian correctional settings.*

INTRODUCTION

Tuberculosis (TB) remains a global health challenge, with an estimated 10.8 million people falling ill with TB and 1.1 million deaths attributed to the disease in 2023 [1,2]. This burden disproportionately affects vulnerable populations—those at high risk of infection and with limited access to healthcare services, such as people experiencing homelessness, incarcerated

individuals, refugees, Indigenous populations, people who use drugs, sex workers, and sexual and gender minorities [1]. The TB burden among incarcerated individuals is estimated to be ten times higher than in the general population, ranging from 2,371 to 2,790 cases per 100,000 population [1,3]. A systematic review also found substantial differences in the annual TB incidence rates in correctional facilities between high-income countries (237.6 per 100,000 population) and low- and middle-income countries (1,942.8 per 100,000 population) [4].

Indonesia is classified as a high TB burden country, with an estimated incidence rate of 387 cases per 100,000 population. In 2023, a total of 821,200 TB cases were detected out of an estimated 1,090,000 cases [2]. The Vice Minister of Health emphasized that the transmission rate of tuberculosis in correctional facilities in Indonesia is significantly higher than in open community settings [5]. This is evidenced by the detection of 6,039 TB cases in correctional facilities in 2023 which is 112% of the estimated number of cases. This figure also represents a substantial increase compared to 2022, which only 2,713 TB cases were identified in correctional facilities [6–8].

In 2023, Indonesia had a total of 517 correctional technical units, comprising 324 prisons, 161 detention centers, and 32 special juvenile correctional institutions [9]. Inmates are at high risk of tuberculosis due to the enclosed environment, which facilitates prolonged close contact. The imbalance between the number of inmates and the facilities' capacity further exacerbates the situation [8]. In 2023, the total housing capacity was 137,246, while the actual number of detainees and prisoners reached 267,149, resulting in overcrowding of 95% [9]. Additionally, the limited number of healthcare workers in correctional facilities, along with their uneven distribution, poses further challenges and contributes to the increased risk of TB transmission [8].

Several high TB burden countries such as India, Nigeria, Bangladesh, and Indonesia have reported findings on TB case detection in correctional facilities using various screening methods. In India, Bhatnagar et al. (2019) reported a TB prevalence of 1.9% in Aizawl correctional facilities through intensive screening at entry, mass screening, and exit screening, using a combination of symptom assessment, digital chest X-ray, sputum microscopy, CBNAAT, and HIV testing [10]. In Nigeria, Adesokan et al. (2015) found a TB prevalence of 1.2% in Ibadan prisons through sputum screening using simple random sampling and questionnaire-based interviews, focusing on subclinical TB infection [11]. Meanwhile, Banu et al. (2010) in Bangladesh reported a TB prevalence of 2.23% from active screening conducted over two years in Dhaka prisons, using sputum microscopy, culture, and drug susceptibility testing [12]. In Indonesia, Aurelia et al. (2024) reported a TB prevalence of 2.5% in correctional facilities in Central Papua through periodic symptom-based screening, followed by sputum examination for inmates exhibiting symptoms such as cough, fever, weight loss, or night sweats [13]. Although the reported

prevalence varies across settings, the findings consistently underscore that correctional facilities are high-risk environments for TB transmission.

WHO recommends the implementation of systematic TB screening using symptom assessment, chest X-ray (CXR), or WHO-recommended rapid molecular diagnostic tests, either individually or in combination, as a case-finding strategy in prisons and detention centers. CXR has been shown to be a sensitive screening tool, although its specificity is insufficient for confirming a TB diagnosis. Therefore, CXR plays an important role in early detection of TB cases, and when combined with early treatment, it can help reduce the overall burden of the disease [14].

The provision of quality healthcare services is essential in correctional facilities, particularly for TB case detection. Although WHO has recommended the implementation of systematic TB screening in correctional settings as a key strategy for early detection, national data on the actual outcomes of such screening activities in Indonesian prisons and detention centers remain limited. Therefore, this study aims to describe the results of TB case detection efforts conducted in 376 correctional technical units (UPT) across Indonesia in 2023, and to assess the extent to which screening methods, such as symptom assessment and chest X-ray (CXR), contribute to the detection of TB cases.

METHODS

This was a cross-sectional study aimed at evaluating the outcomes of systematic TB screening activities conducted among inmates (WBP) across 376 correctional facilities (UPT Pemasyarakatan) in Indonesia. The study was carried out from February to March 2025. This study participants included all inmates who participated in the TB screening, were recorded in the Individual TB Screening Result Report, and met the inclusion criteria. The inclusion criteria were inmates who had both symptom screening results and chest X-ray (CXR) screening results. Eligible samples with incomplete or invalid data were excluded from the analysis (Figure 1).

Participant characteristics were presented as proportions for categorical variables, and as medians with interquartile ranges (IQR) for continuous variables. The TB case detection outcome was calculated based on the proportion of individuals confirmed to have TB out of the total number screened. Subgroup analyses were conducted to evaluate the association between TB case detection and chest X-ray (CXR) findings among inmates who presented with any TB-related symptoms, as well as among those who were asymptomatic, using the chi-square (χ^2) test. The use of data for this study was approved by the National Tuberculosis Program (NTP) of the Ministry of Health of the Republic of Indonesia (Approval Letter No. IR.03.01/C.III/519/2025).

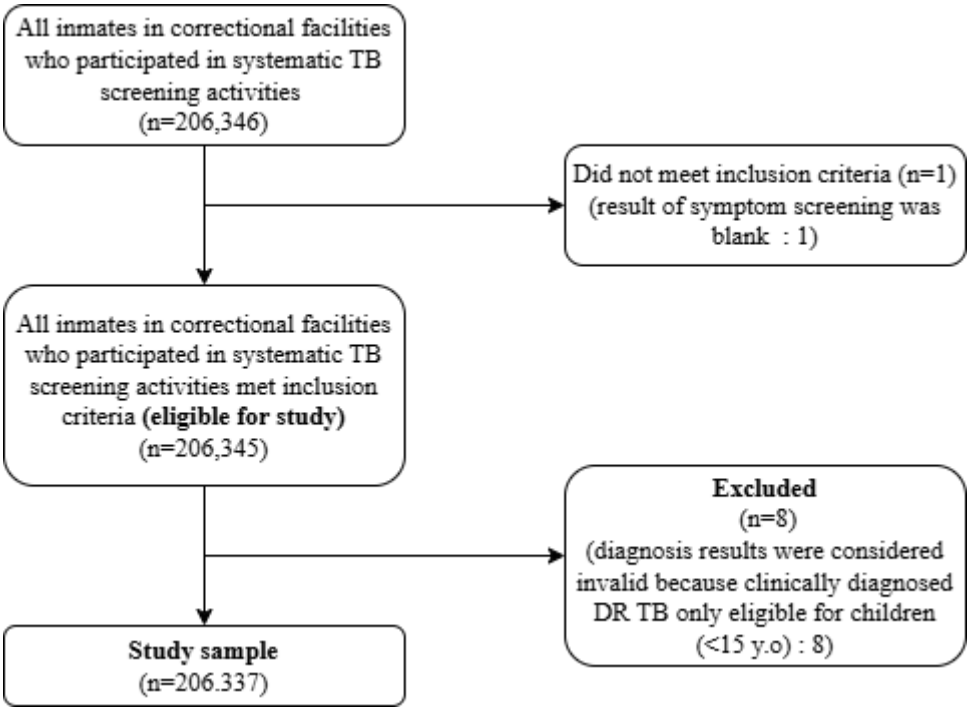

Figure 1. Flowchart of Study Sample Selection

RESULTS

Of the 206,337 inmates eligible to participate in the study, the vast majority were male (96%). The median age of screening participants was 34 years, with an interquartile range (IQR) of 27 to 42 years. Half of the inmates had a normal body mass index (BMI 18.5–22.9 kg/m^2), while only 11% were underweight (BMI <18.5 kg/m^2). Almost all inmates who underwent screening were smokers (93%), and only a small proportion were people living with HIV (PLHIV) (0.48%). Based on symptom screening, only a small proportion of inmates presented with symptoms suggestive of TB (14%), while abnormalities indicative of TB was observed in just 9% of chest X-ray (CXR) results. A total of 21% of inmates met the criteria for presumptive TB, and 20% underwent molecular testing using the Xpert MTB/RIF assay (Table 1).

Table 1. Characteristics of Inmates Participating in the TB Case Detection Activity

Characteristic	2023	
	N	%
Sex		
Male	197,116	95.53
Female	9,221	4.47
Age, Years, Median (IQR)	34 (27-42)	
Body Mass Index (kg/m^2)		
<18,5: Underweight	21,689	10.51
18,5 – 22,9: Normal Weight	100,760	48.83
23 – 24,9: Overweight	38,728	18.77

Characteristic	2023	
	N	%
25 – 29,9: Obese	36,837	17.85
≥30: Obese II	8,323	4.03
Smoking status		
Yes	191,098	92.61
No	15,236	7.38
Unknown	3	00.01
HIV status		
Positive	982	0.48
Negative	189,522	91.85
Unknown	15,833	7.67
Presence of TB symptoms		
Yes	28,091	13.61
No	178,246	86.39
CXR examination performed		
Yes	206,337	100
No	-	-
CXR examination results		
Abnormal	17,630	8.54
Normal	188,707	91.46
Presumptive TB		
Yes	42,552	20.62
No	163,785	79.38
Xpert MTB/RIF test performed		
Yes	40,297	19.53
No	166,040	80.47
TB classification		
Drug-sensitive TB (DS-TB)	4,810	11.24
Drug-resistant TB (DR-TB)	71	0.17
Not TB	37,925	88.60
Total	206,337	100

The case-finding activities conducted in correctional facilities identified 4,881 TB cases, the vast majority of which were drug-sensitive TB (DS-TB) (99%), with the remaining 1% classified as drug-resistant TB (DR-TB). Of these, 2,729 DS-TB cases were bacteriologically confirmed, 2,081 were clinically diagnosed, and 71 DR-TB cases were bacteriologically confirmed (Table 2).

The overall proportion of TB cases identified was 2.37% (4,881/206,337). Among inmates presenting with TB symptoms, 4.75% were confirmed as TB cases, while 95.25% were not. In contrast, among those without TB symptoms, a higher proportion (21.46%) were confirmed TB cases, with 78.54% not having TB. A statistically significant association was observed between the presence of symptoms and TB case detection (p-value < 0.001) (Table 3).

Table 2. Types of Tuberculosis by Diagnostic Category

Type of TB	Type of Diagnosis		Total n (%)
	Bacteriologically Confirmed n (%)	Clinically Diagnosed n (%)	
DS-TB	2,729 (97)	2,081 (100)	4,810 (99)
DR-TB	71 (3)	-	71 (1)
Total	2,800 (100)	2,081 (100)	4,881 (100)

Table 3. Association Between TB Case Detection and Presence of TB Symptoms

Case Detection Outcome	Presence of TB Symptoms		P Value
	Present n (%)	Absent n (%)	
TB Case	1,223 (4.75)	3,658 (21.46)	<0.001
Not TB	24,536 (95.25)	13,389 (78.54)	
Total	25,759 (100)	17,047 (100)	

Among inmates with TB symptoms and abnormal CXR findings, 33.24% were confirmed as TB cases, while the remaining 66.76% were not. In contrast, among those with TB symptoms but normal CXR results, only 0.92% were confirmed to have TB, and 99.08% did not have TB. A statistically significant association was observed between CXR findings and TB case detection among symptomatic inmates (p-value < 0.001) (Table 4).

Table 4. Association Between TB Case Findings and CXR Results in Inmates with TB Symptoms

Activity Result	CXR Result		P Value
	Abnormality (Signs of TB Present) n (%)	Normal n (%)	
TB Case	1,014 (33.24)	209 (0.92)	<0.001*
Not TB	2,037 (66.76)	22,499 (99.08)	
Total (n)	3,051 (100)	22,708 (100)	

* Chi-Square Test (x^2)

While among inmates without TB symptoms but with abnormal CXR findings, 25.99% were confirmed as TB cases. In contrast, among asymptomatic inmates with normal CXR results, only 0.17% were confirmed to have TB. A statistically significant association was observed between CXR findings and TB case detection among asymptomatic inmates (p-value < 0.001) (Table 5).

Table 5. Association Between TB Case Findings and CXR Results in Inmates Without TB Symptoms

Activity Result	CXR Result		P Value
	Abnormality (Signs of TB Present) n (%)	Normal n (%)	
TB Case	3,653 (25.99)	5 (0.17)	<0.001
Not TB	10,401 (74.01)	2,988 (99.83)	
Total (n)	14,054 (100)	2,993 (100)	

* Chi-Square Test (x^2)

DISCUSSION

This study examined the results of TB case detection in prisons/detention centers in Indonesia in 2023. With screening coverage of 206,337 inmates, the proportion of TB case detection was 2.37%, with a prevalence rate of 2,369 per 100,000 inmates. This figure far exceeds the national TB burden in the general population, which stands at 387 per 100,000 population [2]. Compared to the global TB burden in prison populations (1,148/100,000; 95% CI: 860–1517) and in the Southeast Asia region (1,419/100,000; 95% CI: 794–2313) [16], the TB burden in Indonesian prisons is also notably higher. This confirms that prisons are high-risk environments and should be a top priority for TB control interventions. The high detection rate may also reflect the effectiveness of the systematic screening strategy implemented, while highlighting the importance of strengthening TB prevention, diagnosis, and treatment efforts in correctional facilities.

Compared to findings from other countries, the proportion of TB case detection in Indonesia is higher than that in Tajikistan (0.43%) [17], India (1.9%) [10], Nigeria (1.2%) [11], and Bangladesh (2.23%) [12]. However, these results are slightly lower than those reported in several studies from Brazil (2.8–6%) [18,19] and Mozambique (3.34%) [20]. These studies emphasize the importance of systematic screening coverage in increasing TB case detection, especially when conducted using a combination of symptom screening, chest X-ray (CXR), and Xpert MTB/RIF (TCM) testing.

The high rate of TB case detection in Indonesia is most likely driven by a systematic screening strategy based on symptom assessment and 100% chest X-ray (CXR) screening for all participants [21]. The WHO has recommended this combination as a strategy to enhance screening sensitivity [14]. Other studies have also demonstrated that the use of CXR especially when combined with Computer-Aided Detection (CAD) can significantly improve TB case detection compared to symptom-based screening alone [20,22,23].

An important finding in this study is the high proportion of TB cases among asymptomatic inmates with abnormal chest X-ray (CXR) results (25.99%) (Table 5). This figure indicates that one in four inmates without reported symptoms may still have active TB if abnormalities are detected through CXR. A similar finding was reported by Soares et al. (2023), who demonstrated that the use of CXR-based algorithms could identify TB cases that would have been missed by symptom screening alone [23]. Therefore, a mass screening approach using CXR is essential for detecting latent and subclinical TB cases that may potentially serve as sources of transmission in correctional facilities.

Overcrowding of up to 95% and poor ventilation in correctional facilities are major contributing factors to the high risk of TB transmission. With a housing capacity of only 137,246 individuals but occupied by 267,149 inmates, there is nearly double the intended occupancy,

creating ideal conditions for the spread of infectious diseases [9]. Studies in various countries have also shown a positive correlation between housing density and increased TB incidence in closed settings such as prisons [12,18]. In addition, the lack of isolation rooms, high inter-cell mobility, and insufficient natural ventilation further exacerbate the situation. These factors significantly increase the TB burden in correctional facilities [14].

This study has several limitations, including the potential for selection bias due to screening being conducted on inmates during a specific time period, and the possibility of information bias resulting from inconsistencies in recording TB symptoms and screening results in the field. The large sample size is a strength of the study; however, the uneven distribution of characteristics and variations in screening implementation quality across different correctional facilities may affect the generalizability of the findings. Future studies should consider a longitudinal design, validation of screening results through culture testing, the use of information systems with automated data validation for screening result recording, and the analysis of additional risk factors such as HIV status, history of previous TB treatment, nutritional status, history of drug abuse, history of close contact with TB patients, and BCG vaccination status [11,12,20,24].

The findings of this study reinforce the need to strengthen systematic screening policies based on a combination of symptom assessment, chest X-ray (CXR) examination, and the use of Truenat/CBNAAT (TCM) across all correctional facilities in Indonesia. Additionally, expanding the use of artificial intelligence-based technologies such as Computer-Aided Detection (CAD) for interpreting CXRs and increasing access to TCM as the standard for rapid molecular diagnosis is essential to improve early detection of TB cases. Studies conducted in Mozambique and South Africa have shown that the integration of these technologies accelerates diagnosis and increases the proportion of TB case detection [20,22].

The integration of routine TB screening as part of standard health protocols in all correctional facilities is crucial in clinical practice. In the context of public health interventions, a coordinated approach between healthcare services and the correctional system must be developed to accelerate diagnosis and initiate treatment promptly. Improving access to basic healthcare services, strengthening laboratory capacity, and implementing effective infection control measures should also be top priorities to sustainably reduce the TB burden within prisons and detention centers. By consistently implementing these strategies, the TB burden in correctional facilities can be reduced, thereby contributing to the achievement of national TB elimination targets.

CONCLUSION

This study demonstrates that the rate of tuberculosis (TB) case detection in correctional facilities (prisons/detention centers) in Indonesia in 2023 remains very high, with a proportion

of 2.37% and a prevalence rate of 2,369 per 100,000 inmates significantly exceeding the TB burden in the general national population. Systematic screening using a combination of symptom assessment and chest X-ray (CXR) examination has effectively increased detection coverage, including identifying a substantial number of active TB cases among asymptomatic inmates. These findings reinforce the importance of optimizing TB screening in correctional settings through the use of a combined clinical, radiological, and molecular (TCM) algorithm, as well as strengthening access to healthcare services and infection control systems. The sustainable implementation of this systematic screening strategy is key to reducing the TB burden in correctional facilities and supporting the achievement of national TB elimination targets.

DECLARATIONS

Ethics approval

This study was approved by Ethical approval obtained from the Research and Community Service Ethics Committee, Faculty of Public Health, Universitas Indonesia (No. Ket-291/UN2.F10. D11/PPM.00.02/2025).

Conflict of interest.

The authors declare no conflict of interest.

Funding

This research did not receive any specific grants from funding agencies in the public, commercial, or not for profit sectors.

Acknowledgments

The authors gratefully acknowledge the National Tuberculosis Program for granting permission to conduct the study and collect the data.

REFERENCES

1. Litvinjenko S, Magwood O, Wu S, Wei X. Burden of tuberculosis among vulnerable populations worldwide: an overview of systematic reviews. Lancet Infect Dis. 2023 Dec;23(12):1395–407.
2. WHO. Global Tuberculosis Report 2024. 1st ed. Geneva: World Health Organization; 2024.
3. WHO. Global Tuberculosis Report 2023. 1st ed. Geneva: World Health Organization; 2023.
4. Baussano I, Williams BG, Nunn P, Beggiato M, Fedeli U, Scano F. Tuberculosis Incidence in Prisons: A Systematic Review. Menzies D, editor. PLoS Med. 2010 Dec 21;7(12):e1000381.
5. Kemenkes RI. Tingkat Penularan TBC di Lapas Sangat Tinggi, Wamenkes Tinjau Langsung Proses Skrining [Internet]. 2025 [cited 2025 Apr 20]. Available from: https://kemkes.go.id/id/tingkat-penularan-tbc-di-lapas-sangat-tinggi-wamenkes-tinjau-langsung-proses-skrining
6. Kemenkes RI. Laporan Program Penanggulangan Tuberkulosis Tahun 2022. Kementerian Kesehatan RI; 2023.
7. Kemenkes RI. Laporan Program Penanggulangan Tuberkulosis Tahun 2023. Kementerian Kesehatan RI; 2024.

8. Kemenhukham, Kemenkes RI. Rencana Aksi Nasional Pencegahan dan Pengendalian Tuberkulosis di Unit Pelaksana Teknis Pemasyarakatan Tahun 2020-2024. 2019.
9. Direktorat Jenderal Pemasyarakatan. Jumlah Penghuni Lembaga Pemasyarakatan (Lapas), Rumah Tahanan Negara (Rutan), Lembaga Pembinaan Khusus Anak (LPKA), Lembaga Pemasyarakatan Perempuan (LPP) [Internet]. SDP Publik. [cited 2025 Feb 12]. Available from: https://sdppublik.ditjenpas.go.id/analisa/jumlah-penghuni
10. Bhatnagar T, Ralte M, Ralte L, Chawnglungmuana, Sundaramoorthy L, Chhakchhuak L. Intensified tuberculosis and HIV surveillance in a prison in Northeast India: Implementation research. Torpey K, editor. PLOS ONE. 2019 Jul 29;14(7):e0219988.
11. Adesokan H, Cadmus E, Adeyemi W, Lawal O, Ogunlade CO, Osman E, et al. Prevalence of previously undetected tuberculosis and underlying risk factors for transmission in a prison setting in Ibadan, south-western Nigeria. 2015;
12. Banu S, Hossain A, Uddin MKM, Uddin MR, Ahmed T, Khatun R, et al. Pulmonary Tuberculosis and Drug Resistance in Dhaka Central Jail, the Largest Prison in Bangladesh. Hill PC, editor. PLoS ONE. 2010 May 21;5(5):e10759.
13. Aurelia, Kamaludin, Muslimin C, Balik Y, Lestari T, Hafidz F, et al. Comprehensive Tuberculosis Screening and Treatment at a Prison in Central Papua Province, Indonesia. Trop Med Infect Dis. 2024 Oct 12;9(10):241.
14. WHO. WHO Consolidated Guidelines on Tuberculosis. Module 2: Screening - Systematic Screening for Tuberculosis Disease. 1st ed. Geneva: World Health Organization; 2021. 1 p.
15. Kementerian Kesehatan RI. Klasifikasi Obesitas setelah pengukuran IMT [Internet]. Penyakit Tidak Menular Indonesia. 2018 [cited 2025 Feb 15]. Available from: https://p2ptm.kemkes.go.id/infographic-p2ptm/obesitas/klasifikasi-obesitas-setelah-pengukuran-imt
16. Global, regional, and national estimates of tuberculosis incidence and case detection among incarcerated individuals from 2000 to 2019: a systematic analysis - The Lancet Public Health [Internet]. [cited 2025 Mar 6]. Available from: https://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(23)00097-X/fulltext
17. Moe S, Asozoda M, Aung A, Dusmatova Z, Akintore F, Nshimiyimana E, et al. Yield of TB screening in prisons in Tajikistan. IJTLD OPEN. 2024 Aug 1;1(8):344–8.
18. Sanchez A, Massari V, Gerhardt G, Espinola AB, Siriwardana M, Camacho LAB, et al. X ray screening at entry and systematic screening for the control of tuberculosis in a highly endemic prison. BMC Public Health. 2013 Dec;13(1):983.
19. Santos ADS, De Oliveira RD, Lemos EF, Lima F, Cohen T, Cords O, et al. Yield, Efficiency, and Costs of Mass Screening Algorithms for Tuberculosis in Brazilian Prisons. Clin Infect Dis. 2021 Mar 1;72(5):771–7.
20. Olotu AA, Chiramal JA, Boehm RA, Nair AM, Chawla S, Vicente MA, et al. Accelerating Tuberculosis Diagnosis in Mozambican Prisons Using Digital Chest X-rays with Computer Aided Detection: Preliminary Results from a Longitudinal, Comprehensive Health Intervention [Internet]. Public and Global Health; 2024 [cited 2025 Mar 6]. Available from: http://medrxiv.org/lookup/doi/10.1101/2024.12.01.24318070
21. Kemenhukham, Kemenkes RI. LAPORAN KEGIATAN SKRINING TBC LAPAS, RUTAN, LPKA 2023. 2023.
22. Velen K, Sathar F, Hoffmann CJ, Hausler H, Fononda A, Govender S, et al. Digital Chest X-Ray with Computer-aided Detection for Tuberculosis Screening within Correctional Facilities. Ann Am Thorac Soc. 2022 Aug;19(8):1313–9.
23. Soares TR, Oliveira RDD, Liu YE, Santos ADS, Santos PCPD, Monte LRS, et al. Evaluation of chest X-ray with automated interpretation algorithms for mass tuberculosis screening in prisons: a cross-sectional study. Lancet Reg Health - Am. 2023 Jan;17:100388.
24. Thuffi R, Herdayati M, . B. Risk of Tuberculosis among Prisoners: A Case Control Study in Narcotics Prison Class II A Jakarta. KnE Life Sci. 2018 Jan 11;4(1):55.