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TUBERCULOSIS CASE DETECTION AND GLOBAL HEALTH SECURITY IMPLICATIONS

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ABSTRACT
Tuberculosis (TB) remains a major global health problem, and effective case detection is essential for strengthening the Global Health Security (GHS) Detection Pillar, particularly in high-burden countries such as Indonesia. To retrospectively analyse tuberculosis (TB) case detection data from a single referral hospital in Mataram, Indonesia (2022–2024), and assess its implications for the Global Health Security (GHS) Detection Pillar. This study employed a descriptive retrospective design using Secondary Data extracted from the hospital tuberculosis (TB) register. All recorded TB cases registered between January 2022 and December 2024 were included in the analysis (total sampling) Annual case counts were tabulated and descriptively analysed. Findings were qualitatively mapped to three components of the GHS Detection Pillar: surveillance system strengthening, laboratory capacity, and frontline health worker empowerment. A total of 315 TB cases were identified over the three-year period. Annual case counts increased substantially from 33 cases in 2022 to 140 cases in 2023 and slightly to 142 cases in 2024. Although the upward trend may indicate improved institutional detection capacity, the absence of denominator data limits interpretation, as true case detection rates could not be calculated. The hospital's activities demonstrated alignment with all three assessed components of the GHS Detection Pillar. Hospital-based TB detection efforts may contribute to strengthening components of global health security. However, interpretation of increased case detection should be made cautiously in the absence of data on testing coverage and linkage with broader surveillance or laboratory systems.

Keywords: case detection; global health security; hospital data; surveillance; tuberculosis

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INTRODUCTION

Tuberculosis (TB) remains one of the major infectious diseases contributing substantially to global morbidity and mortality. The World Health Organization (WHO) reported that, in 2023, the incidence of TB reached 10.8 million cases, representing a 0.9% increase compared with 10.7 million cases in 2022. (Yang et al., 2024) The burden of this disease is unevenly distributed, with 30 low- and middle-income countries accounting for approximately 87% of the total global burden.(Aisyah et al., 2020) Indonesia is among the five countries with the highest TB burden in the world, alongside India, China, the Philippines, and Pakistan, which collectively contribute 56% of the global burden. More specifically, Indonesia ranks second after India, with an estimated 1,060,000 cases and approximately 93,000 deaths annually (Chakaya et al., 2021)

As the country with the second-highest TB burden globally, Indonesia faces major challenges in achieving the target of TB elimination by 2030. (Magdalena et al., 2025) Strengthening the health system and improving the capacity for rapid and accurate case detection are fundamental prerequisites for attaining this goal. (Karlinda & Syarif, 2025) . Indonesia still has a large gap between estimated TB incidence and notified cases, with "46.2% who have not been notified; both unreached, undetected and unreported(Saimi et al., 2024) Low detection is seen locally, e.g. Jambi province detection only 19% and 53% at one health center Undetected and untreated TB "can

spread the disease to others" and impose large family and national economic burdens (Health et al., n.d 2021.) Delays or failures in case detection (missing cases) may serve as ongoing sources of transmission within communities and exacerbate the risk of antimicrobial resistance (AMR), which is now recognized as one of the major threats to global health.

During COVID-19, TB notifications in Indonesia dropped by nearly 45% versus 2019, mainly from limited facility access, fear of infection, and lockdowns, leading to "underdiagnosis and untreated TB cases that continued to transmit the disease within communities"(Eriansyah et al., 2025). Disrupted treatment increased risks of failure, relapse, and drug resistanc Referral hospitals carry a dual responsibility:(Chakaya et al., 2021) providing optimal clinical services while also serving as sentinels within the infectious disease surveillance system. a significant burden in diagnosing and reporting TB cases, particularly in the post-COVID-19 pandemic period, during which catch-up efforts for case detection have become increasingly urgent.(Eriansyah et al., 2025)

The phenomenon of TB case detection is highly relevant within the framework of Global Health Security (GHS). One of the core pillars of GHS is the Detection Pillar, which assesses a country's capacity to conduct effective surveillance, perform reliable laboratory diagnosis, and ensure real-time reporting mechanisms for health threats. TB detection performance at the micro level (hospital level) directly reflects either the vulnerabilities or the strengths of the health system in meeting the indicators of the GHS Detection Pillar (Dall, 2024; Lee, Kim, Kim, & Park, 2025). Therefore, a comprehensive evaluation of detection performance in referral health facilities is essential for assessing subnational contributions to strengthening global health security.

Previous studies on tuberculosis (TB) in Indonesia have generally focused on treatment effectiveness, patient adherence, and epidemiological aspects at the community level (Lemaire et al., 2024) Although routine case data are available, there remains a scientific gap in studies that explicitly link the operational performance of TB case detection in specific referral facilities with the evaluation framework of the Global Health Security (GHS) Detection Pillar. (Hansun et al., 2025) Existing analyses have generally been descriptive in nature and have not connected their findings to broader global health security standards (Chukwu et al., 2024)

Specifically, to date there has been no comprehensive study analyzing: The trends and quality of TB case detection at Hospital during the 2022–2024 period; and the empirical interpretation of such performance within the context of the indicators of the GHS Detection Pillar. This analysis will provide critical insights into the effectiveness of current TB detection strategies and their alignment with global health standards.(Rahman et al., 2025) The findings will also help identify gaps in the existing detection methodologies and inform future improvements in TB screening practices.To enhance TB case detection, it is essential to adopt innovative screening methods and ensure their implementation aligns with the goals set by global health initiatives.(Gasmi et al., 2026) Innovative approaches, such as community engagement and advanced diagnostic technologies, are crucial for improving TB case detection and achieving better health outcomes globally.These strategies can significantly contribute to reducing the incidence of tuberculosis, especially in high-burden regions, aligning with global health objectives for TB control(Sharath et al., 2025)

Research Gap. Previous studies on tuberculosis (TB) in Indonesia have generally focused on treatment effectiveness, patient adherence, and epidemiological aspects at the community level. (Aisyah et al., 2020) Although routine case data are available, there is still a scientific gap in studies that explicitly examine the operational performance of TB case detection in specific referral facilities in relation to the evaluation framework of the Global Health Security (GHS) Detection Pillar. Existing analyses have largely been descriptive and have not linked their findings to broader global health security standards.(Nurmalisa, 2023). The operational performance of tuberculosis (TB) case detection in referral facilities is critical for enhancing treatment effectiveness and patient

adherence, particularly within the framework of the Global Health Security (GHS) Detection Pillar. Despite the availability of routine case data, there remains a significant gap in studies that connect these findings to global health security standards. The following sections outline key aspects of TB case detection and its implications.(Pratiwi et al., 2025). More specifically, to date no comprehensive study has analyzed: The trends and quality of TB case detection at hospital Mataram during the 2022–2024 period; and The empirical interpretation of this performance within the context of the indicators of the GHS Detection Pillar. To retrospectively analyse tuberculosis (TB) case detection data from a single referral hospital in Mataram, Indonesia (2022–2024), and assess its implications for the Global Health Security (GHS) Detection Pillar.

METHOD

This study employed a descriptive retrospective design to examine tuberculosis (TB) case detection within a single referral hospital setting. The design was selected to enable an in-depth analysis of routinely collected data and to describe temporal trends without introducing intervention or hypothesis testing. The study focused on understanding patterns of case detection and situating these findings within the broader framework of global health security. The research was conducted at Rumah Sakit Islam Siti Hajar Mataram, a referral hospital located in West Nusa Tenggara, Indonesia. This facility provides diagnostic and treatment services for tuberculosis and contributes to national reporting through the Tuberculosis Information System (Sistem Informasi Tuberkulosis, SITB). The study period covered three consecutive years, from January 1, 2022, to December 31, 2024.

The study population comprised all tuberculosis cases diagnosed and reported by the hospital during the specified timeframe. The analysis was based on aggregate institutional data rather than individual patient-level records. As such, no recruitment procedures, follow-up processes, or longitudinal tracking were undertaken. Eligibility criteria included all TB cases recorded in the hospital's TB register and reported to the national system, encompassing both pulmonary and extrapulmonary forms, as well as drug-sensitive and drug-resistant cases. No exclusion criteria were applied, as the study utilised complete enumeration of all reported cases within the institution. No sampling strategy or participant selection algorithm was required because the study relied on total population data at the institutional level. Individual identifiers were not accessed, and the dataset consisted exclusively of aggregated counts. Therefore, the study does not correspond to cohort, case–control, or experimental designs.

The primary variable of interest was the annual number of detected TB cases, treated as a discrete quantitative variable. No exposure variables, predictors, or confounding factors were specified, given the descriptive nature of the study. Diagnostic classification followed national tuberculosis guidelines aligned with World Health Organization standards, including both bacteriological and clinical diagnoses. Data were obtained from two main sources: the hospital TB register and the national SITB reporting system. The hospital register, maintained by the TB unit, provided primary documentation of diagnosed cases, while SITB served as the official reporting platform for aggregated monthly and annual data. Annual totals for each year were extracted and used as the basis for analysis. Given the use of routine data, potential sources of bias were considered. Reporting bias may have occurred if diagnosed cases were not fully captured in the reporting system. Selection bias was not applicable, as the study did not involve sampling. Information bias could not be assessed due to the absence of individual-level data. To enhance data reliability, cross-verification between hospital records and SITB reports was undertaken where feasible.

No formal sample size calculation was conducted, as the study analysed the complete set of cases reported over the defined period. The study size was therefore determined by the total number of recorded TB cases. The analysis did not involve subgroup stratification or data transformation. Statistical analysis was limited to descriptive methods. Annual case counts were summarised using

frequencies and percentages, and trends were presented to illustrate changes over time. No inferential statistical tests or modelling techniques were applied. Missing data at the aggregate level were not identified; however, the possibility of underreporting was acknowledged. Sensitivity analyses were not performed due to the absence of modelling assumptions and the purely descriptive scope of the study.

RESULT

The study population comprised all tuberculosis cases diagnosed and reported by Rumah Sakit Islam Siti Hajar Mataram between January 1, 2022, and December 31, 2024. No individual-level filtering, eligibility screening, or exclusion criteria were applied at any stage of participant selection. This was because the investigators only had access to pre-aggregated totals derived from the hospital's TB register and the SITB; individual patient records were neither provided nor accessible. Therefore, the study did not involve any sampling, matching, or restriction based on demographic characteristics, clinical features, diagnostic confirmation status, or completeness of records. In effect, the study population was defined as the complete enumeration of all TB cases reported by the hospital during the specified timeframe, with no exclusions.

Flow of Data

The flow of data from the original source to the final analytic dataset is summarized narratively below and visualized in Figure 1. A total of 315 TB cases were recorded in the hospital's TB register over the three-year study period, distributed as follows: 33 cases in 2022, 140 cases in 2023, and 142 cases in 2024. These 315 cases represented the complete set of records identified from the source database. No records were excluded from analysis, as no exclusion criteria were applied at the aggregate level. Furthermore, no records were identified as having potential data quality issues—such as inconsistent dates, missing monthly totals, or arithmetic inconsistencies between monthly and annual sums—that would warrant exclusion from the descriptive analysis. Consequently, the final number of cases analyzed was 315, which corresponds to 100% of the reported cases recorded in the hospital register and verified against SITB submissions.

Table 1.
Number of Tuberculosis (TB) Cases Detected

Year	Month												Total
	Jan	Feb	Mrch	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
2022	2	0	2	5	2	6	1	6	2	3	3	1	33
2023	1	16	20	11	10	10	7	18	13	13	12	9	140
2024	8	16	6	8	10	13	12	15	17	15	11	11	142

Trend in Case Detection

Temporal Trends at the Study Site

Over the three-year study period from 2022 to 2024, a total of 315 tuberculosis cases were detected and reported at Rumah Sakit Islam Siti Hajar Mataram. The annual case counts showed a marked increase between 2022 and 2023, followed by relative stabilization in 2024. Specifically, 33 cases were recorded in 2022, 140 cases in 2023, and 142 cases in 2024. The year-over-year changes were as follows. From 2022 to 2023, the number of detected cases increased by 107 cases, representing a growth of 324.24%. From 2023 to 2024, the increase was substantially smaller, with only 2 additional cases detected, corresponding to a growth of 1.43%. When viewed as proportions of the three-year total, 2022 accounted for 10.48% (95% CI: 7.46% – 14.33%) of all detected cases, while 2023 accounted for 44.44% (95% CI: 38.97% – 50.03%), and 2024 accounted for 45.08% (95% CI: 39.60% – 50.64%).

Interpretation of the observed trend: The sharp increase between 2022 and 2023 requires careful interpretation. Several non-mutually-exclusive explanations are possible. First, the increase may reflect a genuine strengthening of detection capacity at the hospital, including improved diagnostic services, enhanced case-finding efforts, or post-COVID-19 pandemic catch-up activities. Second, the very low baseline of 33 cases in 2022 may have been artificially depressed due to residual disruptions from the COVID-19 pandemic, making the subsequent increase appear larger than it would have been relative to a normal operating year. Third, the near-stability between 2023 and 2024 (from 140 to 142 cases) may suggest that detection capacity reached a plateau, or that the hospital is now detecting a relatively stable annual number of cases from its catchment area. It is important to note that without denominator data (e.g., total number of presumptive TB cases examined, population size of the catchment area, or expected incidence rates), the observed trend cannot be definitively attributed to improved detection alone, nor can it be distinguished from a true increase in disease incidence.

Comparison with Global, National, and Regional Data

To contextualize the local trend, Table 2 presents available data from global, national, and provincial sources. However, several important caveats must be noted before making direct comparisons. First, the data sources and reporting periods differ substantially across levels. Global estimates from the World Health Organization (WHO) represent modeled annual incidence (10.7 million cases in 2022 and 10.8 million cases in 2023), whereas the hospital data represent actual reported (notified) cases from a single facility. Second, national case notification data for Indonesia are incomplete in this table, with only partial data available for 2022 (503,712 cases reported up to October 2022) and no data presented for 2023 or 2024. Third, the provincial data for West Nusa Tenggara (NTB) are particularly mismatched: the 2022 figure (5,430 cases) is from 2020, not 2022, and the 2024 figure (4,429 cases) is reported only up to May 2025, which falls outside the study period. Fourth, the hospital's case counts (33, 140, 142) represent a small fraction of provincial totals, which is expected for a single facility. Therefore, Table 2 is presented for illustrative and contextual purposes only. Direct numerical comparisons between the hospital's case counts and global, national, or provincial figures should be avoided due to the substantial mismatches in time periods, data definitions (incidence vs. notifications), and completeness of reporting.

Table 2.
Comparison of TB Case Detection at the Global, National, and Local Levels, 2022–2024

Parameter	2022	2023	2024
Global Number of Cases (WHO)	10,7 million	10,8 million	Data not yet available
National Case Notifications (Indonesia)	503.712 (until Oct. 2022)	Data not yet available	Data not yet available
Number of Cases in West Nusa Tenggara (NTB)	5.430 (2020)	Data not yet available	4.429 (until May 2025)
Number of Cases at RSI Siti Hajar Mataram	33	140	142

DISCUSSION

This study had four specific objectives.

First, to describe the trend of TB case detection at Rumah Sakit Islam Siti Hajar Mataram from 2022 to 2024 using routinely collected hospital register data. The results demonstrated a substantial increase from 33 cases in 2022 to 140 cases in 2023 (a 324.24% increase), followed by relative stabilization at 142 cases in 2024 (a 1.43% increase).

The study identified a sharp increase in tuberculosis (TB) case detection at Rumah Sakit Islam Siti Hajar Mataram from 33 cases in 2022 to 140 cases in 2023, followed by stabilisation at 142 cases in 2024. This pattern strongly suggests a post-disruption recovery effect rather than a simple linear improvement in detection performance. During the COVID-19 pandemic, TB services globally experienced significant interruptions, including reduced diagnostic access and delayed care-seeking, which led to underreporting of cases (World Health Organization, 2023). As health systems

recovered, many settings reported a rebound in TB notifications due to delayed diagnoses being captured in subsequent periods (Cilloni et al., 2023). Therefore, the low baseline in 2022 likely reflects under-detection, while the surge in 2023 represents a compensatory increase rather than a true epidemiological spike. (Dheda et al., 2020)

Beyond recovery dynamics, the observed increase may also reflect strengthening of institutional diagnostic and reporting capacity. The adoption and scaling of rapid molecular diagnostics, such as GeneXpert, have been consistently associated with higher case detection rates and improved identification of previously missed cases (Albert et al., 2021; Kik et al., 2020). In parallel, improvements in digital surveillance systems, including Indonesia's Tuberculosis Information System (SITB), may enhance completeness and timeliness of reporting, thereby increasing recorded case counts (Ministry of Health Indonesia, 2023). However, without disaggregated data on testing volume, diagnostic methods, and case classification, it remains unclear to what extent the observed increase reflects true improvements in detection versus changes in reporting practices.(Jeong & Min, 2023)

The stabilisation of case numbers between 2023 and 2024 suggests that the hospital may have reached a temporary equilibrium in its detection capacity, but this interpretation remains limited by the absence of denominator data. Without information on the number of individuals screened or tested, it is not possible to calculate case detection rates or assess detection efficiency (Glaziou, 2020). From a global health security perspective, while the hospital demonstrates functional alignment with the Detection Pillar through surveillance reporting and diagnostic activity, increases in case counts alone are insufficient to infer strengthened system performance (Katz et al., 2018; Uplekar et al., 2021). Robust evaluation requires integration of additional indicators, including testing coverage, diagnostic accuracy, and timeliness of reporting, to determine whether observed trends translate into meaningful improvements in public health response capacity.(Glaziou, 2020)

Second, to assess the quality of case detection by evaluating completeness and consistency of reported data. At the aggregate level, monthly and annual totals were consistent between the hospital register and SITB submissions, with the exception of February 2022 (zero cases, confirmed as accurate due to temporary laboratory disruption).
The second objective of this study was to assess the quality of tuberculosis (TB) case detection by examining the completeness and consistency of reported data. At the aggregate level, the findings indicate a high degree of consistency between the hospital TB register and the national reporting system (SITB), as monthly and annual totals were fully aligned across the study period. This consistency suggests that the reporting mechanism at the institutional level is functioning reliably, particularly in terms of data aggregation and transmission. Data consistency across reporting platforms is a key indicator of surveillance system performance and is essential for ensuring the validity of epidemiological monitoring and decision-making processes (Woodruff et al., 2015)

However, the identification of a zero-case report in February 2022 highlights the importance of contextual validation in interpreting surveillance data. The absence of reported cases during that month was confirmed as accurate and attributed to a temporary disruption in laboratory services, including the unavailability of diagnostic testing. Such service interruptions have been documented in various settings and can significantly affect case detection outputs, independent of true disease incidence. This finding underscores that even complete and internally consistent data may still be influenced by operational constraints, which must be considered when evaluating surveillance quality.(Peter et al., 2024)

Despite the overall consistency observed, the assessment of data quality remains limited by the use of aggregate-level data. While completeness in reporting totals can be verified, it does not capture other critical dimensions of data quality, such as accuracy, timeliness, and diagnostic validity (Katz

et al., 2018). Previous studies have emphasised that high-quality TB surveillance systems require not only complete reporting but also detailed individual-level data to detect misclassification, duplication, and reporting delays (Uplekar et al., 2021). Therefore, although the findings suggest strong reporting consistency, further evaluation using more granular data is necessary to comprehensively assess the quality of case detection and its implications for health system performance.

Third, to map institutional case detection performance onto the three core components of the GHS Detection Pillar: surveillance system strengthening, laboratory diagnostic capacity, and frontline health worker empowerment. The hospital's consistent reporting into SITB, use of diagnostic technologies, and active role of personnel align with all three components.

The third objective of this study was to map institutional case detection performance onto the three core components of the Global Health Security (GHS) Detection Pillar: surveillance system strengthening, laboratory diagnostic capacity, and frontline health worker empowerment. The findings indicate that the hospital demonstrates functional alignment with these components. Consistent reporting into Indonesia's national Tuberculosis Information System (SITB) reflects an operational surveillance mechanism that supports routine data flow and contributes to national-level monitoring. Strong surveillance systems are a cornerstone of global health security, as they enable timely detection and reporting of infectious diseases (World Health Organization, 2023; Katz et al., 2018).

In terms of laboratory diagnostic capacity, the hospital's use of established TB diagnostic approaches, including bacteriological and clinical methods, indicates the presence of essential diagnostic infrastructure. The availability and utilisation of rapid diagnostic technologies, such as molecular testing, are critical for improving detection accuracy and reducing diagnostic delays, particularly in high-burden settings (Albert et al., 2021; Kik et al., 2020). Strengthening laboratory systems has been widely recognised as a key strategy in enhancing the Detection Pillar, as it directly influences the sensitivity and reliability of case identification (Uplekar et al., 2021).

Furthermore, the active role of healthcare personnel in diagnosing, recording, and reporting TB cases reflects the contribution of frontline health worker empowerment. Competent and engaged health workers are essential for translating surveillance and diagnostic capacity into effective case detection and reporting practices (Centers for Disease Control and Prevention, 2022). However, while structural alignment with the three GHS Detection components is evident, the present study does not assess the quality, timeliness, or effectiveness of these processes. Therefore, although the hospital demonstrates alignment at an operational level, further evaluation is required to determine the extent to which this alignment translates into measurable improvements in global health security outcomes.

Fourth, to generate empirical evidence that can inform subnational contributions to global health security governance.

The fourth objective of this study was to generate empirical evidence that can inform subnational contributions to global health security governance. The findings demonstrate that hospital-level tuberculosis (TB) detection data can provide valuable insights into how local health systems contribute to broader surveillance and detection capacities. As frontline service providers, referral hospitals play a critical role in identifying, diagnosing, and reporting infectious diseases, thereby acting as key nodes within national and global surveillance networks (World Health Organization, 2023). Evidence generated at this level is essential for understanding how global health security frameworks are operationalised in real-world settings.

At the subnational level, the use of routinely collected data—such as hospital TB registers and national reporting systems like SITB—offers a practical approach to monitoring health system performance and identifying gaps in detection capacity. Previous studies have emphasised that strengthening global health security requires integration of data from local health facilities, as these represent the first point of contact for most patients and the primary source of surveillance data (Katz et al., 2018; Centers for Disease Control and Prevention, 2022). The present findings suggest that consistent reporting and observable detection trends can serve as indirect indicators of system functionality, even in the absence of more complex epidemiological metrics.

However, the contribution of subnational data to global health security governance remains constrained by limitations in data completeness, integration, and standardisation. Without linkage to population-level denominators, laboratory networks, and real-time surveillance systems, the ability to translate local findings into actionable global insights is limited (Uplekar et al., 2021). Therefore, while this study provides initial empirical evidence of institutional contributions, future efforts should focus on strengthening data integration across multiple levels of the health system to enhance the reliability and utility of subnational evidence in informing global health security strategies. The findings suggest that local referral facilities can contribute meaningfully to detection capacity, although the magnitude of this contribution cannot be quantified without denominator data or linkage to population-based surveillance.

CONCLUSION

This study demonstrates that tuberculosis (TB) case detection at Rumah Sakit Islam Siti Hajar Mataram showed a substantial increase between 2022 and 2023, followed by stabilisation in 2024. This trend highlights the dynamic nature of case detection in the post-pandemic period, where previously disrupted health services begin to recover and re-establish routine diagnostic and reporting functions. However, the observed increase should be interpreted cautiously, as it may reflect a combination of improved detection and delayed case identification rather than a true rise in TB incidence (World Health Organization, 2023; Cilloni et al., 2023).

In terms of data quality, the study found strong consistency between the hospital TB register and the national reporting system (SITB), indicating reliable aggregate-level reporting practices. This consistency is an important component of surveillance system performance and supports the credibility of the reported trends. Nevertheless, reliance on aggregate data limits the ability to assess other dimensions of data quality, such as accuracy, timeliness, and completeness at the individual level, which are critical for robust epidemiological analysis (Katz et al., 2018; Uplekar et al., 2021). The findings also suggest that the hospital demonstrates operational alignment with the three core components of the Global Health Security (GHS) Detection Pillar: surveillance system strengthening, laboratory diagnostic capacity, and frontline health worker engagement. Consistent reporting into SITB, the use of diagnostic technologies, and the active involvement of healthcare personnel collectively indicate that institutional-level activities contribute to the broader detection framework. Such alignment is essential for early identification and response to infectious disease threats within the context of global health security (Centers for Disease Control and Prevention, 2022; World Health Organization, 2023).

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