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Completeness of tuberculosis data in the Notifiable Diseases Information System: a cross-sectional study

Completude dos dados sobre tuberculose no Sistema de Informação de Agravos de Notificação: estudo transversal

Completitud de los datos sobre tuberculosis en el Sistema de Información de Enfermedades de Declaración Obligatoria: un estudio transversal

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ABSTRACT

Objective: to analyze the completeness and incompleteness of data entered into the Tuberculosis Notifiable Diseases Information System. **Method:** a quantitative, cross-sectional study was conducted with data from 7,658 new tuberculosis cases notified between 2016 and 2020 in the municipality of Belém, Pará, Brazil. Data were collected between June and September 2022 from the Municipal Health Department, considering 11 strategic variables, 14 mandatory variables, and two therapeutic monitoring variables. Descriptive statistical analysis was performed, and the Ministry of Health's classification system was used to assess completeness. Approval was obtained from a Research Ethics Committee. **Results:** in 2019, there were 1616 (21.10%) cases, and in 2017, 1585 (20.70%). The completeness of the variables ranged mainly from good to fair. **Conclusion:** despite the relevance of information for public management, flaws were identified in the completion of some variables, compromising knowledge of the real epidemiological situation and the achievement of goals to control tuberculosis.
Descriptors: Public Health; Tuberculosis; Health Information Systems; Data Analysis; Epidemiological Monitoring.

RESUMO

Objetivo: analisar a completude e a não completude dos dados inseridos no Sistema de Informação de Agravos de Notificação da Tuberculose. **Método:** estudo quantitativo e transversal, realizado com dados de 7.658 casos novos de tuberculose, notificados entre 2016 e 2020 no município de Belém, Pará, Brasil. Dados coletados entre junho e setembro/2022, junto à Secretaria Municipal de Saúde, considerando 11 variáveis estratégicas, 14 obrigatórias e duas de acompanhamento terapêutico. Realizada análise estatística descritiva e utilizada a classificação do Ministério da Saúde para avaliar a qualidade da completude. Obteve-se aprovação por Comitê de Ética em Pesquisa. **Resultados:** Em 2019, ocorreram 1.616 (2110%) casos e, em 2017, 1.585 (20,70%). A completude das variáveis oscilou, principalmente, entre boa e regular. **Conclusão:** apesar da relevância das informações para a gestão pública, identificaram-se falhas no preenchimento de algumas variáveis, comprometendo o conhecimento da real situação epidemiológica e o alcance de metas para controlar a tuberculose.
Descritores: Saúde Pública; Tuberculose; Sistemas de Informação em Saúde; Análise de Dados; Monitoramento Epidemiológico.

RESUMEN

Objetivo: analizar la completitud e incompletitud de los datos ingresados en el Sistema de Información de Enfermedades de Notificación Obligatoria de Tuberculosis. **Método:** se realizó un estudio cuantitativo transversal con datos de 7.658 nuevos casos de tuberculosis notificados entre 2016 y 2020 en el municipio de Belém, Pará, Brasil. Los datos se recopilaron entre junio y septiembre de 2022 en la Secretaría Municipal de Salud, considerando 11 variables estratégicas, 14 variables obligatorias y dos variables de seguimiento terapéutico. Se realizó un análisis estadístico descriptivo, y se utilizó el sistema de clasificación del Ministerio de Salud para evaluar la completitud. Se obtuvo la aprobación de un Comité de Ética en Investigación. **Resultados:** en 2019, se registraron 1.616 casos (2110%) y, en 2017, 1.585 (20,70%). La completitud de las variables varió principalmente entre buena y regular. **Conclusión:** a pesar de la relevancia de la información para la gestión pública, se identificaron deficiencias en la completitud de algunas variables, lo que dificulta el conocimiento de la situación epidemiológica real y el logro de los objetivos de control de la tuberculosis.
Descriptores: Salud Pública; Tuberculosis; Sistemas de Información en Salud; Análise de Datos; Monitoreo Epidemiológico.

INTRODUCTION

Tuberculosis (TB) is a chronic infectious disease transmitted by *Mycobacterium tuberculosis*, which can affect all body systems. Despite being one of humanity's oldest diseases, TB is still considered a serious public health concern worldwide. It can manifest in different clinical forms (pulmonary and extrapulmonary), depending on the affected organs. Pulmonary TB is the most epidemiologically significant form because it is transmissible[1].

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It is estimated that, worldwide, in 2023, 10.8 million people contracted the disease, resulting in 1.25 million deaths, of which 1.09 million occurred among people not infected with the human immunodeficiency virus (HIV). TB is the leading cause of death from a single infectious agent, although, in the health emergency caused by COVID-19, it has become the second leading cause, behind only COVID-19[2]. In 2024, Brazil recorded 84,308 new cases of TB and, in 2023, 6,025 deaths from the disease, with incidence and mortality rates equal to 39.7 cases per 100,000 inhabitants and 2.8 deaths per 100,000 inhabitants[3].

In this context, the epidemiological situation in the state of Pará worsens, with 5,356 new cases registered in 2024 and 320 deaths in 2023, resulting in rates of 61.8 cases per 100,000 inhabitants and 3.7 deaths per 100,000 inhabitants. This exceeds the national rates and ranks fourth among Brazilian states in terms of incidence rate and sixth in terms of mortality rate. In 2023, the cure and treatment discontinuation rates among new laboratory-confirmed pulmonary TB cases in Pará were 67.8% and 13.1%[3], respectively, demonstrating that discontinuation rate was 2.62 times higher than the 5.0% rate considered acceptable by the World Health Organization (WHO) and the Brazilian Ministry of Health[2,4].

In the municipality of Belém, 1,860 new cases and 138 deaths from the disease were notified in 2024 and 2023, with rates of 133.0 cases per 100,000 inhabitants and 9.8 deaths per 100,000 inhabitants, the highest incidence and mortality rates for TB among the country's capitals. In 2023, the cure and treatment discontinuation rates among new laboratory-confirmed pulmonary TB cases in Belém were 62.9% and 16.1%[3], respectively, which is why interruption was 3.22 times higher than the acceptable percentage[2,4], which may be related to the delay in closing cases in the Tuberculosis Notifiable Diseases Information System (In Portuguese, *Sistema de Informação de Agravos de Notificação da Tuberculose* – SINAN-TB)[5].

These data highlight gaps in meeting the End TB Strategy goals, proposed by the WHO in 2015[6], with the aim of eliminating the disease as a public health concern, responding to the global commitments established by the United Nations (UN) to tackle the disease and achieve the Sustainable Development Goals (SDGs)[7]. Based on this strategy, the National Plan to End TB goals are to reduce the incidence rate by 90% and the number of deaths by 95% by 2035, compared to 2015 data. This means that, in Brazil, it is necessary to reduce the incidence to less than 10 cases per 100,000 inhabitants and limit deaths from the disease to less than 230 per year[8].

To this end, TB control policies and plans must consider strategies to strengthen the government's response to the disease, including the organization of Health Care Networks, intersectoral coordination, the promotion of research and innovation activities, the incorporation of new technologies, and social participation, in order to plan actions based on knowledge of the epidemiological situation to advance towards achieving the goals[2,9]. In this regard, TB epidemiological surveillance must provide recommendations and support decision-making, with the responsibilities of investigating suspected cases, notifying confirmed cases and producing data on treatment and monitoring, until the therapeutic closure of the cases[10].

Every case with a confirmed TB diagnosis must be recorded using the SINAN notification/investigation form, which comprises 47 variables divided into four sections: general data, individual notification, residence data, and additional data. The first three sections cover information about the notification unit and the individual, such as personal and housing details. The final section contains information about the case investigation, such as the type of entry into the information system, clinical form of the disease, and test results, among other information[9].

To ensure reliability, an information system must present complete and coherent data. Completeness is understood as the proportion of non-zero values in each record in a system. Fields considered null or incomplete are routinely filled out as "ignored" (information explicitly unknown or rejected, or that was not accepted by the system, despite being filled out) or "blank" (a condition resulting from errors in filling out the data, negligence, or underestimation by the responsible professional)[1112].

The low quality of information compromises adequate knowledge about the epidemiological profile of cases and prevents the assessment of monitoring actions, making it impossible to identify whether the failure to complete the information results from deficiencies in surveillance actions or the low quality of records in the system, as stated in research that assessed TB databases in SINAN, considering specific regions of the country[13]. Furthermore, the Epidemiological Bulletins, published annually by the Ministry of Health and State Departments of Public Health, do not address information on notification form data completeness, nor on the analysis of possible inconsistencies[9]. These aspects hinder analyses of the effectiveness and reliability of the data available in the system, and reinforce the need for studies whose nature allows progress in this context[14].

Given the relevance of the topic, the objective was to analyze the completeness and incompleteness of the data entered into SINAN-TB.

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METHOD

A quantitative, cross-sectional study was chosen, considering its potential for understanding a given phenomenon over a single period, highlighting a snapshot of the reality under investigation[15]. It was conducted using secondary data from SINAN-TB, collected between June and September 2022, with the Belém Municipal Health Department (In Portuguese, *Secretaria Municipal de Saúde de Belém* – SESMA). In compliance with the EQUATOR Network's recommendations on quality and transparency in health research, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were followed[16].

The sample consisted of 7,658 new TB cases diagnosed and registered in the municipality of Belém, state of Pará, Brazil. New cases reported between 2016 and 2020 were included, as the data for this period were already complete and the cases closed. It was decided to exclude duplicate cases, i.e., cases of the same patient, reported in the same treatment, more than once, as a "new case", which did not occur.

Among the fields identified in the notification form, those whose variables were considered strategic for the Brazilian National Tuberculosis Control Program (In Portuguese, *Programa Nacional de Controle da Tuberculose* – PNCT), current General Coordination of Surveillance of Tuberculosis, Endemic Mycoses and Non-Tuberculous Mycobacteria (In Portuguese, *Coordenação-Geral de Vigilância da Tuberculose, Micoses Endêmicas e Micobactérias Não Tuberculosas* – CGTM) of the Department of HIV, AIDS, Tuberculosis, Viral Hepatitis and Sexually Transmitted Infections (In Portuguese, *Departamento de HIV, Aids, Tuberculose, Hepatites Virais e Infecções Sexualmente Transmissíveis* – DATHI), linked to the Department of Health and Environment Surveillance of the Ministry of Health, were selected, totaling 11 variables: age; sex; race/skin color; education; neighborhood; special populations (immigrants, homeless people, people deprived of liberty, and healthcare professionals); beneficiaries of government income transfer programs; associated diseases and conditions (AIDS, alcoholism, diabetes *mellitus*, illicit drug use, smoking, and mental disorders); HIV (testing to detect HIV infection); case detection (smear microscopy for initial diagnosis, rapid molecular testing, and supervised treatment); total number of contacts identified.

Furthermore, the completeness of fields determined as mandatory variables for completion in SINAN-TB was investigated, totaling 14 variables: patient's name; mother's name; notification number; notification date; municipality of residence; municipality of notification; notification unit; date of diagnosis; country (if foreign patient); type of admission; clinical form; sputum culture; date of birth; extrapulmonary location. Two variables related to TB therapeutic monitoring were also investigated: follow-up sputum smear microscopy performed in the 2nd, 4th, and 6th months of treatment; and final status.

The data were stored in digital spreadsheets using Microsoft Office Excel®, version 2016, and Net Tabwin, a SINAN-TB program for local analysis. Data were debugged to identify possible duplications, incompleteness, and inconsistencies, with appropriate adjustments made to standardize the data.

Variable analysis was performed using descriptive statistics to identify absolute and relative numbers, with missing information being considered when the field was filled in as "ignored" or "blank". To assess the quality of system completeness, the classification used by the Ministry of Health was considered, described as: good (when equal to or greater than 75.1%), fair (50.1% to 75.0%), low (25.1% to 50%), and very low (when equal to or less than 25.0%)[9].

In accordance with current resolutions, all ethical aspects were met, and the project was approved in May 2022 by the Research Ethics Committee linked to the proposing institution.

RESULTS

During the analyzed period, 7,658 new cases of TB were diagnosed in the municipality of Belém, distributed as follows: 1522 (19.87%) in 2016, 1585 (20.70%) in 2017, 1,490 (19.46%) in 2018, 1616 (21.10%) in 2019, and 1,445 (18.87%) in 2020. Table 1 presents data completeness for the strategic variables.

Regarding strategic variables, it was found that, of the 21 fields analyzed, 13 had completion rates below 90%, and four, below 75.1%.

No incompleteness was found for the variables "age", "sex", and "HIV". The incompleteness rates for the variables "rapid molecular test" (0.13%), "neighborhood" (1.76%), "smear microscopy for initial diagnosis" (4.95%), and "race/skin color" (8.87%) were the lowest. Table 2 presents data completeness for the mandatory variables.

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Table 1: Completeness of strategic variables in the tuberculosis notification form. Belém, PA, Brazil, 2016-2020.

Variables	2016 (n=1522) n (%)	2017 (n=1585) n (%)	2018 (n=1490) n (%)	2019 (n=1616) n (%)	2020 (n=1445) n (%)	2016-2020 (n=7658) n (%)
Age	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Sex	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Race/skin color	1384 (90.93)	1470 (92.74)	1372 (92.08)	1430 (88.49)	1323 (91.56)	6976 (91.13)
Education	1118 (73.46)	1196 (75.46)	1153 (77.38)	1196 (74.01)	1064 (73.63)	5727 (74.78)
Neighborhood	1498 (98.42)	1554 (98.04)	1472 (98.79)	1575 (97.46)	1424 (98.55)	7523 (98.24)
Special populations						
Immigrant	1315 (86.40)	1332 (84.04)	1238 (83.09)	1474 (91.22)	1350 (93.43)	6709 (87.60)
Homeless population	1328 (87.26)	1349 (85.12)	1267 (85.04)	1485 (91.90)	1350 (93.43)	6779 (88.50)
Deprived of liberty population	1348 (88.60)	1387 (87.50)	1290 (86.60)	1512 (83.56)	1356 (93.84)	6894 (90.02)
Healthcare professional	1327 (87.20)	1340 (84.50)	1254 (84.20)	1479 (91.52)	1352 (93.56)	6752 (88.20)
Beneficiary of a government income transfer program	946 (62.16)	986 (62.21)	975 (65.44)	1162 (71.91)	1099 (76.06)	5168 (67.49)
Associated diseases and conditions						
AIDS	1194 (78.45)	1204 (75.96)	1170 (78.52)	1356 (83.91)	1272 (88.03)	6196 (80.91)
Alcoholism	1301 (85.48)	1247 (84.98)	1264 (84.83)	1415 (87.56)	1311 (90.73)	6638 (86.68)
Diabetes *mellitus*	1323 (86.93)	1366 (86.18)	1296 (86.98)	1450 (89.73)	1329 (91.97)	6764 (88.33)
Illicit drug use	1299 (85.35)	1341 (84.61)	1253 (84.10)	1423 (88.06)	1316 (91.08)	6632 (86.61)
Smoking	1308 (85.94)	1347 (84.98)	1265 (84.90)	1411 (87.31)	1310 (90.66)	6641 (86.72)
Mental disorder	1302 (85.55)	1340 (84.54)	1257 (84.36)	1428 (88.37)	1312 (90.80)	6639 (86.69)
HIV	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Case detection						
Smear microscopy for initial diagnosis	1459 (95.86)	1505 (94.95)	1390 (93.29)	1543 (95.48)	1382 (95.64)	7279 (95.05)
Rapid molecular testing	1520 (99.87)	1584 (99.94)	1489 (99.93)	1.611 (99.69)	1444 (99.93)	7648 (99.87)
Supervised treatment	902 (59.26)	971 (61.26)	951 (63.83)	1144 (70.79)	1056 (73.08)	5.024 (65.60)
Contacts identified	1061 (68.70)	1100 (69.40)	1051 (70.50)	1255 (77.70)	1150 (79.60)	5617 (73.30)

Source: SINAN-TB/SESMA, 2022.

Table 2: Completeness of mandatory variables in the tuberculosis notification form. Belém, PA, Brazil, 2016-2020.

Variables	2016 (n=1522) n (%)	2017 (n=1585) n (%)	2018 (n=1490) n (%)	2019 (n=1616) n (%)	2020 (n=1445) n (%)	2016-2020 (n=7658) n (%)
Patient's name	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Mother's name	1517 (99.67)	1584 (99.94)	1489 (99.93)	1616 (100)	1442 (99.79)	7648 (99.87)
Notification number	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Notification date	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Municipality of residence	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Municipality of notification	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Notification unit	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Date of diagnosis	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Country (if foreign patient)	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Type of entry	1519 (99.83)	1583 (99.90)	1490 (100)	1616 (100)	1445 (100)	7653 (99.95)
Clinical form	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Sputum culture	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Date of birth	1521 (99.93)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)
Extrapulmonary location	1522 (100)	1585 (100)	1490 (100)	1616 (100)	1445 (100)	7658 (100)

Source: SINAN-TB/SESMA, 2022.

Data completeness was 100% for most mandatory variables, except for "mother's name" (99.67% in 2016, 99.94% in 2017, 99.93% in 2018, and 99.79% in 2020), "entry type" (99.83% in 2016 and 99.90% in 2017), and "date of birth" (99.93% in 2016). Regarding the therapeutic monitoring variables, Table 3 described the findings.

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Table 3: Completeness of therapeutic monitoring variables for tuberculosis. Belém, PA, Brazil, 2016-2020.

Variables	2016 (n=1522) n (%)	2017 (n=1585) n (%)	2018 (n=1,490) n (%)	2019 (n=1616) n (%)	2020 (n=1,445) n (%)	2016-2020 (n=7,658) n (%)
Follow-up smear microscopy						
2nd month of treatment	932 (61,24)	900 (57,78)	882 (59,19)	988 (61,14)	953 (65,95)	4.655 (60,79)
4th month of treatment	833 (54,73)	809 (51,04)	826 (55,44)	877 (54,27)	840 (58,13)	4185 (54,65)
6th month of treatment	833 (48,16)	738 (46,56)	755 (50,67)	664 (47,28)	741 (51,28)	3731 (48,72)
Final status	1433 (94,15)	1479 (93,31)	1385 (92,95)	1502 (92,95)	1278 (88,44)	7077 (92,41)

Source: SINAN-TB/SESMA, 2022.

Follow-up smear microscopy tests showed lower completeness percentages than the percentages of the final status, reaching 42.22% incompleteness in the 2nd month of treatment in 2017, 48.96% in the 4th month in 2017 and 53.44% in the 6th month in 2017. Completion of the "final status" variable showed a decreasing trend over the years, reaching 88.44% in 2020.

DISCUSSION

Considering the Ministry of Health's parameters for assessing the quality of the information system's completeness[9], many of the strategic variables presented lower completeness percentages when compared to the mandatory variables. The strategic variables with the lowest completeness, classified as fair, were education level, beneficiary of a government income transfer program, supervised treatment, and identified contacts.

Problems regarding the completion of sociodemographic variables were also found in another study[17]. Considering that socioeconomic conditions, such as low education and low income, are associated with worse outcomes in TB, such as interruption, treatment failure and death, it is essential to have knowledge about these factors to improve case surveillance[11].

Research conducted in northeastern Uganda[18] found that social status and daily living conditions modify several risk factors over time and influence access to resources, leading to the exposure and vulnerability of individuals and groups to disease-causing and/or disease-modifying agents and health problems, resulting in disparities that are particularly important in TB.

Applying this statement to the regional context, the high concentration of cases in Belém can be attributed to the combination of high population density (over 2,000 inhabitants/km^2) and adverse socioeconomic conditions. Densely populated urban areas are consistently identified in global analyses as high-risk zones for TB due to overcrowding, limited ventilation in housing, and poor access to healthcare services. Furthermore, the rapid urbanization of certain regions, such as the Belém Metropolitan Region (BMR), has outpaced infrastructure development capacity, leading to informal settlements in precarious conditions, further perpetuating TB vulnerabilities[19].

Given the lack of specific initiatives to support people undergoing TB treatment, the administrations of Brazil's federative units establish partnerships with official and community bodies to meet their needs[20]. In this context, Resolution 709 of March 16, 2023, published by the Brazilian National Health Council (In Portuguese, *Conselho Nacional de Saúde* – CNS), established guidelines and action proposals for TB surveillance, promotion, prevention, diagnosis, treatment, and rehabilitation within the Brazilian Health System (In Portuguese, *Sistema Único de Saúde* – SUS), aiming to strengthen control strategies in conjunction with other public policies[21]. Therefore, the importance of intersectoral actions and the strengthening of partnerships to expand access to health and social rights is emphasized, especially among the most vulnerable populations[22].

Regarding actions to control TB, it is known that professionals must complete several instruments, from the search for cases to the end of treatment, such as the monitoring report, the clinical record and other documents indicated by the Ministry of Health, whose information is essential for planning care and assessing/monitoring cases as control activities[23]. However, this multiplicity of instruments can generate duplicate data or non-registration, in addition to weaknesses in the use of information to support decision-making processes in the routine of healthcare services[24].

The CGTM recommends that TB control measures be decentralized, including diagnosis and therapeutic monitoring. However, decentralizing these measures, including expanding disease control efforts in Primary Health Care (PHC) units, remains a major challenge in Brazil, where organizational heterogeneity, due to differing regional

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administrative conditions, hinders decentralization processes. Therefore, although official recommendations guide disease control in the country's five regions, timely case management remains difficult[25].

The difference found in completeness between the "AIDS" and "HIV" variables may be related to the guidelines for filling out the forms: filling out the field corresponding to the "HIV" variable is mandatory to register the notification in SINAN-TB[18]. Therefore, it is recommended that the technical documents underlying the classification of mandatory variables in SINAN-TB be reviewed as a strategy to increase the completeness of non-mandatory fields. Hence, TB and HIV/AIDS control programs, at all three levels of management, should implement this strategy to expand healthcare, as the risk of unfavorable outcomes (dropout, relapse, and death) is approximately three times higher in people with TB/HIV coinfection[22].

A study on TB/HIV coinfection and related collaborative activities in Latin America and the Caribbean[26] showed that there were many cases where data were unavailable, highlighting the need to improve information systems as well as joint data collection and analysis processes. One possible solution would be the implementation and expansion of electronic healthcare records, which have been shown to improve the accuracy and speed of general and TB/HIV coinfection-related epidemiological surveillance in all countries.

Regarding the TB therapeutic monitoring fields, smear microscopies from the 2nd, 4th, and 6th months of treatment were considered fair. Despite the good completeness of the "smear microscopy for initial diagnosis" variable, when analyzing the completeness of follow-up smear microscopies, the completion rate decreased. Research on the completeness of data from the TB information system for individuals deprived of liberty in Rio Grande do Sul, Brazil, found that 6-month smear microscopy and the final status were less than 100%, mainly due to the large proportion of notifications with the "unknown", "no information", or "blank"[10] categories, since they are mostly related to the lack of completion of the field and the informant's lack of knowledge[27].

Missing or inaccurate data, regardless of the cause, constitutes poor system quality[12]. This indicates the need for investment in improving healthcare professionals' working conditions as well as in their strategic training. Measures to improve training primarily involve encouraging continuing education and permanent education. The former is understood as a set of specific processes aimed at individual development, as occurs in extension and graduate courses, and the latter as a social practice of teaching and learning in healthcare services, developed dialogically based on collective needs and the problems faced by these services[28,29].

Considering that reliable information is essential for planning actions, it is understood that this will not only contribute to the qualification of human resources and the work processes they develop, but also to the improvement of strategies within health policies and programs.

Furthermore, the lower completeness of follow-up smear microscopies may suggest flaws in the use of the TB case monitoring report. A study conducted with SINAN data in Santa Catarina, Brazil, covering the period from 2007 to 2016, supports this finding by observing lower completeness of follow-up smear microscopies compared to diagnostic ones, with the percentage of completion decreasing over the months of follow-up, reaching 29.5% of non-completion in the 6th month of treatment[11].

It is known that confirmation of TB diagnosis must be performed through bacteriological tests[4,9]. In Brazil, sputum smear microscopy is considered the standard, allowing the identification of 60% to 80% of cases in adults[30]. It is considered important for the monitoring of pulmonary TB cases, with laboratory confirmation, to perform a monthly control smear microscopy, as a guarantee of therapeutic efficacy[31], with smear microscopies in the 2nd, 4th, and 6th months of treatment being essential.

It is recognized that effective disease control requires timely diagnosis, treatment with an appropriate therapeutic regimen, correct doses, timely follow-up and monitoring with follow-up smear microscopies. Therefore, clinical follow-up appointments should be monthly, with the adoption of health education practices and the directly observed treatment (DOT) strategy. To this end, it is essential that healthcare professionals and policies transcend the fragmented and reductionist nature of actions[4,9].

In the BMR, the notification system can be perceived by local professionals and managers as a complex and time-consuming bureaucratic process, with responsibility transferred to the municipal surveillance department to investigate and complete the SINAN database. However, due to the high demand inherent in the number of TB cases occurring in all municipalities in this region, database analysis is sometimes neglected by municipal and state surveillance departments, constituting one of the main factors in the endemic lack of control, as a significant portion of cases remain unresolved and without adequate control[32].

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The weakness of local indicators reflects problems in disease control, consequently increasing the number of new cases and deaths, generating operational difficulties, a greater possibility of drug-resistant TB, higher disease costs, and human suffering. Therefore, the continuous assessment of surveillance indicators, based on specific methods that highlight epidemiological and operational factors, is especially relevant in scenarios that express greater vulnerability, as is the case in several situations in the state of Pará. Furthermore, the assessment of operational indicators, which include more attributes than surveillance quality indicators, demonstrates the capacity of local surveillance to notify, investigate, and ensure the breaking of the chain of transmission and the cure of the disease[32].

It is worth noting that failure to complete certain variables may be related to the perception of some professionals that notification forms represent merely bureaucratic instruments, disregarding the production of qualified data as a necessary action for the management of actions and services[24], a gap that can be resolved through continuing education and permanent education.

A systematic review with meta-analysis[33] found that deficiencies in adequate training of professionals in TB diagnosis and treatment are a common factor in the health system, affecting case detection. Therefore, we suggest conducting studies to identify gaps in professionals' knowledge and skills regarding control and surveillance records, with the aim of supporting educational initiatives needed to improve notification[10].

Continuing education and permanent education are important for healthcare professionals to develop and improve case management skills and improve clinical outcomes. Based on this principle, raising awareness among professionals about the inherent aspects of TB is essential for its control and can be achieved through educational interventions, ensuring the acquisition and updating of knowledge that can be effectively applied to daily healthcare practices[34].

Furthermore, to improve the TB surveillance system, both in case detection and monitoring, it is necessary to strengthen PHC and effectively fulfill its responsibilities in disease control, especially the identification of respiratory symptoms and the active search for absentees, people undergoing treatment and those undergoing follow-up[35].

The Ministry of Health identifies PHC, particularly the Family Health Strategy (FHS), as the primary gateway for people with respiratory symptoms and TB into the healthcare network. PHC's attributes foster stronger connections between users and healthcare professionals, facilitating control activities such as DOT[26].

Therefore, it is recommended to establish municipal goals related to improving the registration and resumption of TB indicators in SUS agreements, with a view to reviewing the financing of the disease surveillance system and monitoring the proportion of respiratory symptoms and contacts examined, in order to assess the quality of the municipal surveillance system for case detection[25].

Among these goals, periodic verification of data completeness should constitute surveillance actions in the municipality, as well as the analysis of inconsistencies and duplications, as recommended by the Ministry of Health[8]. Information systems, such as SINAN-TB, are essential tools for epidemiological surveillance, but data quality issues can occur at every stage of the information production cycle, involving producers, managers, and users. Therefore, epidemiological data analysis and assessment can also occur through SINAN-TB, as the system's technical departments monitor the percentage of completed variables on notification forms, establishing parameters for assessing database completeness[27].

Since it is essential, multidisciplinary teams in healthcare units should complete these forms correctly, as they allow for targeted recommendations and support for decision-making. A study conducted in Serbia reiterates that, if these aspects are not considered, the knowledge generated from the data may not adequately represent reality[36].

In this scenario, notification of nurses and other professionals is essential, as it facilitates the identification of significant information that must be monitored, in order to ensure that the team has access to the data necessary to develop care practices safely and with legal support[37].

During nursing consultations and multidisciplinary monitoring of people with TB, it is important that records are kept clearly, coherently, completely, and reliably, as the data set can support decision-making processes, ensuring continuity of care and maintaining ethical and legal aspects, in addition to contributing to the achievement of the goals proposed by the WHO[38].

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It is worth highlighting the importance of nursing professionals throughout the SUS structure, as well as the historical relevance and leading role of this category in programmatic actions to control TB[39,40], aiming to eliminate the disease as a public health concern in Brazil by 2030. This expertise supports the expansion of their activities, making nursing visible and strengthening it[40].

Study limitations

A limitation is the use of secondary data, which may present data completion issues, potentially leading to flaws in epidemiological investigations. Furthermore, the fact that this study used a sample of cases from a municipality in the state of Pará, which represents a local reality, may limit the generalizability of results to some extent, and the lack of multivariate statistical analysis may limit more robust inferences about factors associated with incompleteness.

Even so, the study presents relevant information for TB surveillance in the municipality, serving as a subsidy for managers and healthcare professionals to make decisions, plan and monitor assessment indicators of disease control actions, seeking to improve the work processes of health teams and qualify the information, contributing to controlling the disease in Pará.

CONCLUSION

This study allowed us to analyze the completeness of TB data for the municipality of Belém, observing that understanding the local reality and the quality of notification records is necessary to support decision-making and develop control actions.

The results demonstrated that the quality of information is crucial for public management, supporting specific strategies and interventions to strengthen control. The surveillance system data were generally considered adequate to guide actions. However, flaws were still identified in the completion of some strategic and mandatory variables on the notification form, as well as in therapeutic monitoring, compromising knowledge of the true epidemiological situation and the achievement of disease control goals.

Therefore, data management is an important responsibility of public healthcare services. Up-to-date, complete, and reliable data improve quality and enable confident decision-making. Identifying factors that interfere with the proper completion of notification forms is essential for monitoring and closing cases, and investing in improving the quality of information.

In order to contribute to solving filling problems and qualifying the data available in information systems, such as SINAN-TB, it is recommended that healthcare professionals, managers and public authorities discuss effective and managerially sustainable measures, such as the creation and implementation of notification flowcharts, encouraging periodic audits in the systems, frequent training and updating of professionals responsible for filling out the forms and the periodic review of databases, in accordance with the Ministry of Health guidelines, depending on the peculiarities of each system.

Based on the role that PHC plays in improving data completeness, it is worth highlighting the importance of this level of care in TB control, which includes epidemiological surveillance as a set of actions inherent to public health.

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Authors' contributions

Conceptualization, F.O.S., A.A.P. and P.S.S.; methodology, F.O.S., A.A.P., P.H., I.L.A.R., E.G.R.A., P.S.S., C.O.E.H. and B.R.S.S.; validation, F.O.S., A.A.P., P.H., I.L.A.R., E.G.R.A., P.S.S., C.O.E.H. and B.R.S.S.; formal analysis, F.O.S., A.A.P., P.H., I.L.A.R., E.G.R.A. and P.S.S.; investigation, F.O.S., A.A.P. and P.S.S.; resources, F.O.S.; data curation, F.O.S., A.A.P. and P.S.S.; manuscript writing, F.O.S., A.A.P. and P.S.S.; review and editing, F.O.S., A.A.P., P.H., I.L.A.R., E.G.R.A., P.S.S., C.O.E.H. and B.R.S.S.; visualization, F.O.S., A.A.P., P.H., I.L.A.R., E.G.R.A., P.S.S., C.O.E.H. and B.R.S.S.; supervision, A.A.P. and P.S.S.; project administration, F.O.S., A.A.P. and P.S.S.All authors read and agreed with the published version of the manuscript.

Use of artificial intelligence tools

The authors declare that no artificial intelligence tools were used in the composition of the manuscript "*Completeness of tuberculosis data in the Notifiable Diseases Information System: a cross-sectional study*".