Tuberculosis and the under reporting of cases that evolved to death: Integrative Literature Review

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Abstract—Objective: This study aims to analyze the trends in scientific production on deaths from tuberculosis and the underreporting of cases, through the analysis of the behavior of notifications from health information systems. MethodIt is an integrative review of the literature by searching the databases, with the time frame between the years 2010 to 2020. For the treatment of the data, the technique of content analysis was used, with categorization of the findings. Eleven complete original articles were selected that answer the central question of the research, which were grouped in tables according to author, title, journal, year of publication, indexation base, objectives, methodologies and evidence. Results: The

analysis of the literature made it possible to elaborate three categories based on relevant points, namely: Category 1- Linkage between health information systems; Surveillance of the Death of Tuberculosis; 2 - Tuberculosis Death Surveillance Actions. Studies indicate that a large part of deaths from tuberculosis are not included in the Notifiable Diseases Information System (SINAN) and Mortality Information System (SIM).Conclusion: This study shows the need to intensify the actions of tuberculosis death surveillance to increase the completeness of information systems, reduce underreporting and the number of unresolved cases, train and supervise the performance of the Primary Health Care health teams and the quality of filling out death certificates and compulsory notification, in addition to intensifying disease control strategies.

Keywords—Death. Notification. Tuberculosis.

I. INTRODUCTION

Tuberculosis (TB) is still a serious and challenging global public health problem. In the world, in 2018, about ten million people became ill from TB and 1.5 million people died as a result of it, with TB being the main cause of death by a single infectious agent. [1]

The Americas contributed 3% of the global TB burden, and Brazil occupied the top position on the continent, with 32% of cases. According to the World Health Organization (WHO), Brazil was the only country in the American continent listed among the 30 countries with a high TB burden that account for 87% of all reported cases and have an estimated incidence rate of 45 cases per 100 thousand inhabitants. In the same year, the Notifiable Diseases Information System (SINAN) of the Department of Diseases of Chronic Conditions and Sexually Transmitted Infections of the Ministry of Health of Brazil (DCCI / MS), registered 75,717 new cases of TB (36.2 cases per 100 thousand inhab.), with 423 cases notified after death. [2]

TB is a compulsory notification disease in Brazil and there is a network of great capillarity for the surveillance and control of the disease, present in all Brazilian municipalities, which implement different strategies and technologies to prevent new cases and reduce the disease burden. However, a portion of the population with TB is not captured by surveillance and health care services.[2]

The failure to detect TB cases is an important challenge to face, as it contributes to the maintenance of the transmission chain, prevents effective treatment and allows to underestimate the magnitude of the problem for Public Health. The post-death notification of a TB case can be considered a "sentinel event" that reports failure in individual care and compromises the effectiveness of the disease control service. [2]

In addition to SINAN, another important system is the Mortality Information System (SIM), responsible for compiling deaths from all causes. The quality of information is fundamental for epidemiological surveillance activities and the complementation or correction of data from a given information system can be carried out based on existing data in other information systems. This process of improving information has been suggested for TB control and has shown good results. [3]

The relationship between information systems has been increasingly used in health research and evaluation, based on the use of databases and computer programs, being a useful strategy for the identification of underreported TB cases and deaths and for improving information on closure of cases. [3]

Thus, this study aimed to analyze the trends in scientific production on deaths from tuberculosis and the underreporting of cases, through the analysis of the behavior of notifications from health information systems.

II. METHOD

The research is an integrative literature review, which has the purpose of gathering and synthesizing research results on a delimited theme, in a systematic and orderly manner, being an instrument for the deepening of knowledge about the investigated theme, allowing the synthesis of multiple published studies and general conclusions about it. [4]

Although there are variations in the conduct of methods for the development of integrative reviews, there are standards to be followed. In carrying out this review, six steps were used: selection of hypotheses or guiding questions for the review; selection of studies that will compose the sample; definition of the characteristics of the studies; categorization of studies; analysis and interpretation of results; and, report of the review. [5]

The guiding question for the elaboration of this integrative review was: What are the scientific productions available on deaths from tuberculosis and the underreporting of cases?

The survey of bibliographic studies took place during the month of November 2020 and five databases were chosen: Latin American and Caribbean Literature in Health Sciences (LILACS), Virtual Health Library (VHL), in Scientific Electronic Library Online (SciELO), Scientific Literature (SCILIT) and Google Scholar.

Following, the validated MESH descriptors were used: "Tuberculosis"; "Notification" and "Death", using the Boolean operators AND, in Portuguese and English, in the last 10 years, published in the period from 2010 to 2020. A total of 7,062 articles were found, which after reading the titles and abstracts, arrived to the number of 11 articles that showed similarities with the object of this study. These were organized in alphanumeric codes, from TB01 to TB11, for better presentation and understanding of the results.

For data collection, it was decided to use the instrument validated by Ursi. The analysis of the selected studies took place in a descriptive manner, in order to enable observance and description of the data, thus, it was possible to gather the synthesized knowledge on the subject in question. Based on that, three empirical categories were elaborated, which will be presented and discussed below, in which Bardin's content analysis method was used to explore the content. To guarantee the success of this study, it was decided to describe and distribute the results in tables, highlighting the main findings of each research. As for the discussion, it was carried out in a descriptive way, in order to achieve the objectives of building an integrative review. [5]

III. RESULTS AND DISCUSSION

Tables 1 and 2 show the characteristics of these studies, in which articles in Portuguese (100%), with a quantitative approach (100%), published in national journals (100%) and indexed in the SciELO database (45,4%). In the present integrative literature review, a total of 11 original scientific articles were analyzed, which strictly met the selection of the sample previously established.

Table 1:Distribution of studies.

Nº	Base	Author. Title. Periodic. Year	Objective	Methodology
TB01	Google Scholar	OLIVEIRA, Gisele Pinto de et al. Linkage entre SIM e SINAN para a melhoria da qualidade dos dados do sistema de informação da tuberculose: a experiência nacional. CAD. SAÚDE COLET., 2010.	Demonstrate how the relationship with the mortality information system can contribute to improving the quality of the closure of cases reported in the TB surveillance system.	3,400 pairs of records were analyzed, resulting from the use of the probabilistic relationship technique between death certificates that presented TB with a basic or associated cause in 2006 and all notifications of tuberculosis in the years 2005 and 2006 in Brazil. Five blocking steps were performed and for the matching of records, the patient's name, mother's name and date of birth were used.
TB02	SciELO	SELIG, Lia. Proposta de vigilância de óbitos por tuberculose em sistemas de informação. Rev Saúde Pública, 2010.	Propose a strategy for surveillance of tuberculosis-related deaths based on the Mortality Information System.	Data on the 55 deaths related to TB, which occurred in two large hospitals in Rio de Janeiro between September 2005 and August 2006, were obtained from SIM. These cases were compared with the records at SINAN. The increase in the number of notifications and data completeness was evaluated, as well as the type of entry and

				outcome in SINAN.
TB03	Google Scholar	OLIVEIRA, Gisele Pinto de. et al. Uso do sistema de informação sobre mortalidade para identificar subnotificação de casos de tuberculose no Brasil. Rev Bras Epidemiol. 2012.	To analyze the underreporting of deaths from TB in Brazil, as well as to verify the impact that these cases would have on the notification rate of new cases and the proportion of deaths from TB in 2006.	The deaths registered in the SIM in 2006 and all TB notifications in the country from 2001 to 2006 were analyzed. The variables used for the relationship were: notification number, municipality and state of residence, name of the patient, date, year of birth, sex, mother's name and address. Six blocking steps were performed. Scores greater than 12.4 were considered even, while those below - 9.7, non-even. At the end of each step, a manual review of doubtful pairs was carried out.
TB04	LILACS	LARROQUE, Mônica Mussolini. et al. Mortalidade por tuberculose: municípios prioritários de Mato Grosso do Sul, 1999-2008. Arq. Ciênc. Saúde UNIPAR, 2013.	To study tuberculosis mortality as a basic or associated cause of death, in the priority municipalities of Mato Grosso do Sul.	SIM and SINAN data were used over a ten-year period. The variables studied were: sex, age group, race / color, education, clinical form and place of death.
TB05	SciELO	BARTHOLOMAY, Patrícia. Melhoria da qualidade das informações sobre tuberculose a partir do relacionamento entre bases de dados. Cad. Saúde Pública, 2014.	To verify the improvement in the quality of information about TB, after linking records and correcting the closure through the probabilistic link of the SINAN with SIM.	For the linking of records, a linkage was made between SINAN do Brazil records, years 2008 and 2009, with the objective of excluding notifications not removed by SINAN routines carried out by states and municipalities. The databases were built according to the outcome of the cases. For the linkage between SINAN and SIM, the database that resulted from linking records and the SIM records that mentioned TB as a basic or associated cause, between 2008 and 2010, was used in Brazil.
TB06	SciELO	ROCHA, Marli Souza. et al. Confiabilidade do desfecho do tratamento usando linkage de bases de dados para a tuberculose. Cad. Saúde Colet., 2015.	Analyze the agreement between the closure of the SINAN and the causes of death in the SIM.	A probabilistic linkage was carried out between SINAN 2006 and SIM from 2006 to 2008. The reliability of the closure was analyzed using the kappa index.
TB07	SciELO	ROCHA, Marli Souza. et al. Do que morrem os pacientes com tuberculose: causas múltiplas de morte de uma	Analyze the multiple causes of death in a cohort of patients notified with TB and present a proposal to	A probabilistic linkage was carried out between SINAN 2006 and SIM, 2006-2008.

		coorte de casos notificados e uma proposta de investigação de causas presumíveis. Cad. Saúde Pública, 2015.	investigate possible causes.	
TB08	LILACS	ROMERO, Renata Olívia Gadelha. Et al. Subnotificação de casos de tuberculose a partir da vigilância do óbito. Rev. Eletr. Enf. 2016.	Analyze the underreporting of tuberculosis cases from the capture of deaths registered in the SIM between 2007 and 2011.	Retrospective study, carried out in a northeastern municipality, which used the probabilistic association technique between the SIM and SINAN records, using the Reclink III software. Odds ratios (OR) were calculated for individuals who died with TB not reported in SINAN, according to sociodemographic characteristics.
TB09	Google Scholar	PERES, Dalila Augusto; FAÇANHA, Monica Cardoso; VIANA JÚNIOR, Antônio Brasil. Incremento de casos e melhoria da informação sobre tuberculose no Estado do Ceará, Brasil, após o relacionamento de bases de dados. Cad. Saúde Colet., 2017.	Measure the increase in tuberculosis cases and the improvement of information about the registration of Acquired Immunodeficiency Syndrome (HIV) infection and closure in SINAN-TB, after its relationship with SIM and SINAN-Aids.	Sectional study based on the relationship of diagnosed TB cases and deaths with TB as a basic or associated cause in persons over 15 years of age, between 2005-2014, living in Ceará.
TB10	Google Scholar	SANTOS, Marcela Lopes. et al. Fatores associados à subnotificação de tuberculose com base no Sinan Aids e Sinan Tuberculose. Rev Bras Epidemiol. 2018.	To estimate the proportion and factors associated with tuberculosis underreporting in Pernambuco, among cases of TB / AIDS co-infection, based on data from the TB and AIDS Notification Diseases Information System.	A cross-sectional study was carried out, based on the records of the TB and AIDS Notification Systems, to identify cases of TB underreporting during the study period, by performing a probabilistic linkage using the RecLink III software.
TB11	SciELO	ARIDJA, Ursila Manga. et al. Casos de tuberculose com notificação após o óbito no Brasil, 2014: um estudo descritivo com base nos dados de vigilância. Epidemiol Serv Saúde. 2020.	Characterize cases with post-death notification of tuberculosis in Brazil in 2014.	Descriptive study of TB cases with post-death notification. The data are the result of linking SINAN with SIM and were described according to the basic cause of death: tuberculosis, AIDS and others.

Source: Research protocol, 2020.

Table 2: Evidence from the studies.

Nº	Evidence
TB01	When comparing the closure of cases before and after the relationship, there was variation in the percentage of deaths in 2006, from 5.6% to 6.4%. Although the changes observed in the other indicators were discreet, the method presents itself as a promising strategy to be explored with a view to improving the quality of information on the closure of TB cases.
TB02	Of the 55 deaths, 28 were reported in SINAN. The relationship of the systems enabled the following corrections: 27 new cases notified, 14 new notifications made by the unit where the death occurred and the closure of ten notifications. This represented an increase of 41 (28%) notifications to the 144 performed by the two hospitals in 2006. Nine cases were reclassified from TB without confirmation to TB with diagnostic confirmation, and five cases were reclassified from TB to AIDS as the basic cause of death.
TB03	SINAN had 547,589 notifications, while SIM had 6,924 records. Of these, 39.4% (n = 2,727) were not found at SINAN in the assessed period. It was observed that 64.5% (2,707) of deaths were reported in 2006 and, when analyzing the proportion of underreported deaths by region and federated units, it was found that the highest percentage was in the North, followed by the Southeast and Northeast. The increase in deaths that were not related to the SINAN database raises the notification rate for new cases by 3.7%. As for the proportion of deaths from TB, this inclusion was responsible for the 60.7% increase in this indicator. The relationship between databases is an important strategy for improving the quality of the TB surveillance system.
TB04	The TB mortality rates fluctuated during the study period in the priority municipalities. Amambai registered the highest coefficient and males represented 72% of the total deaths. The age group from 40 to 59 years old concentrated the highest mortality rate due to TB, 34.8%. According to race / color, the highest percentage (46.1%) were brown. The pulmonary clinical form was present in 89% of the cases and 83% died in hospitals. Only 53% of deaths registered at SIM had notification at SINAN and of these 67% had smear microscopy and 40% received supervised treatment. Of the notified cases, 37% underwent serological examination for infection with the acquired immunodeficiency virus and 10.1% were positive. The joint analysis of the multiple causes of death from TB demonstrates the need for more comprehensive discussions regarding the tendency of the disease to death, points out flaws in the notification process and reveals the importance of reassessing the procedures adopted as control measures in the priority municipalities of Mato Grosso do Sul.
TB05	The linking of records decreased the percentage of new cases with closure by transfer, with a variation of 34.8% in 2008 and 35.5% in 2009. After the link between SINAN and SIM, the percentage of deaths from TB increased, with variation around 15%. The results describe an alert situation with regard to the quality of the TB treatment outcome data at SINAN.
TB06	Of the 417 cases closed by death at SINAN, 88.7% were found at SIM. Of the 82 cases closed as a death from another cause, 42.7% had TB as a basic or associated cause in the SIM, while 41.5% had no mention of TB. The PABAK coefficient (Prevalence and Bias Adjusted Kappa) showed excellent agreement between the outcome of death in the closure field of SINAN and the presence or absence of TB death in SIM. A recommendation for States and municipalities that use the relationship between SINAN and SIM to increase the completeness and consistency of SINAN is to investigate in SIM not only the cases notified without termination, but also those cases terminated by abandonment and transfer.
TB07	There were 825 deaths, of which 23% from TB, 16% from TB and 61% without mention of TB. Two hundred and fifteen (42.7%) deaths occurred before the end of the basic treatment regimen and had no mention of TB, whose profile was different from the standard when TB was one of the associated causes. The high frequency of respiratory diseases, AIDS and ill-defined causes suggest a failure in the quality of information. A proposal was made to correct the associated causes in the SIM and to investigate death based on the list of presumed causes. According to the proposal, 26 deaths could have changed the basic cause. This study highlights the severity of the TB condition and the importance of linkage for TB surveillance and improving SIM and SINAN information.
TB08	Of the total of 147 deaths registered in the SIM, 72.8% had not been reported in the SINAN. Women were more likely than men to not be notified (OR = 2.60), people under the age of 60 (OR = 1.86) and with less than eight

	years of study (OC = 4.42). Strategies must be reframed in order to increase the uptake of respiratory symptoms, timely diagnose cases and avoid failures in filling out records.
TB09	There were an increase of 2,325 (6%) cases after the relationship between SINAN, deaths from TB (basic or associated cause) of the SIM and cases of TB / HIV coinfection in SINAN, as well as improved information regarding the criteria for closure and registration of infection by HIV. The increase was greater in small municipalities. We highlight the importance of investigating deaths from TB, expanding centers for epidemiological surveillance in hospitals and health centers, using data relationships by the municipal coordination to assess underreporting and timely capture of cases by health units.
TB10	There was a 29% proportion of TB underreporting, and the factors associated with underreporting were: having a clinical form of cavitary or unspecified pulmonary TB, or having both types of TB at the same time; and be served outside Recife and in services that are not specialized for human immunodeficiency virus (HIV) / AIDS. The proportion of underreporting found was lower than that observed in other Brazilian studies that took into account underreporting in view of mortality data. The variables associated with TB underreporting refer, for the most part, to the care network, and not to individual characteristics, which points to the need for training health professionals to notify information systems.
TB11	In the 2,703 cases of TB with post-death notification, there was a higher proportion of males (73.5%), over 39 years of age (80.8%), with education <8 years of study (66.5%), race / skin color black and brown (62.8%), who became ill from TB in the pulmonary clinical form (75.2%); notifications by the public service also prevailed (57.6%) and in municipalities with a human development index> 0.7 (66.6%). The described characteristics of the people notified after death and the magnitude of this outcome suggest weaknesses in TB care and surveillance services.

Source: Research protocol, 2020.

The analysis of the literature found made it possible to elaborate three categories based on relevant points, namely: Category 1- Linkage between health information systems, and2-Tuberculosis Death Surveillance Actions, which will be developed below.

Category 1- Linkage between health information systems

The article **TB 01** shows that of TB deaths registered in SIM in 2006, more than 50% had not been reported in SINAN. When analyzing the situation of closure, it was found that, for those notified in 2006, only 71.3% (n = 1,920) presented the closure of the case as death, 3.8% (n = 103) as treatment abandonment and 10.2% (n = 276) had no outcome information. [6]

The percentage of cases with death closure increased from 5.6 to 6.4%. It was found that those who were notified in 2005 had a lower proportion of the death outcome when compared to 2006. This fact suggests that the farther from the year of death the first notification is, the less the chance that the closure will be registered as death , that is, the first notification in the same year of death reflects the late diagnosis of the disease. [6]

Previous abandonment can be considered a risk factor for the occurrence of death. Thus, the need for health

services to create alternatives that guarantee adherence to treatment for these patients is ratified primarily by the use of the Directly Observed Treatment Short-Course (DOTS) strategy, which is recommended worldwide. In addition, one must take into account the fact that the case evolves to death and be classified as abandonment of treatment by the UnityHealth (UH) of origin due to the lack of knowledge about the occurrence of death. [6]

The fact that 10.6%, in 2005 and 5.5%, of the cases in 2006 presented the type of closure as a transfer reinforces the need to follow up these cases to prevent them from getting lost and not reaching the UH for which it was transferred. Thus, it is essential that the UH that performs the transfer monitors the case until the other unit receives the same to continue the treatment. [6]

The cases that evolved to death in 2006 and presented a TB notification in 2005 or 2006 with closure due to cure can be classified as recurrence. However, these cases should be investigated, since the recurrence occurred in a short period of time, suggesting the possibility of an error in completing the closure or medical failure in the case discharge criteria, especially for those notified in the same year of death[6].

The article **TB 02** analyzed 55 deaths and found that only 28 were notified in SINAN, 22 of them with a period between notification and death less than or equal to one

year, with a median of 41 days. These 28 cases generated 43 notifications, which do not represent duplicate records, as the notifications were made by different units or in the course of different treatments. [7]

SIM's relationship with SINAN made it possible to make new notifications, correct new notified cases and complete the closure. In SINAN, it was observed that 58% of notifications were made by hospitals, with a predominance of the type of reentry entry after abandonment and relapse, which indicates the importance of hospital care for a disease that should be primarily conducted in Primary Health Care (PHC), pointing out the delay in diagnosis and possible difficulty in accessing the health network in the area covered by the hospital.[7]

The number of individuals who die of TB after an episode of cure leads to reflection on the criteria for cure and the importance of a post-treatment surveillance system. Furthermore, the relationship of the banks makes it possible to reclassify some cases. [7]

The review of confirmation of pulmonary TB allowed the reclassification of the basic cause of death, from pulmonary TB without mention of bacteriological or histological confirmation (A16.2) to pulmonary TB with confirmation by microscopic examination of the sputum (A15.0). The information on Acquired Human Immunodeficiency Syndrome (AIDS) in SINAN allowed the reclassification of the basic cause of death from TB to AIDS. Patients had chronic comorbidities, other than AIDS, listed in SINAN and not mentioned in the Death Certificate (DC). [7]

The article **TB 03** points out that when analyzing the proportion of underreported deaths stratified by the federated units, a higher percentage was observed for the North, followed by the Southeast and Northeast. The South region had the lowest percentage of underreporting, despite having a total number of deaths from TB higher than the North of the country. This behavior indicates that was heterogeneous, not only between regions, but also among states in the same region, with variations between 16.6% and 54.5%. [8]

The increase in deaths that were not related to the SINAN database would increase the notification rate of new TB cases in 2006 by up to 3.7%, and by 60.7% the proportion of TB cases with death closure, which would increase from 5.6% to 9.0% in the same year. These increases differed between UFs in the country, varying from 1.5% to 7% for the notification rate of new cases and from 18.4% to 130.7% for the cases notified in SINAN with death closure. [8]

Since death is a final outcome for TB cases, the fact that 39.4% of deaths associated with TB are not included in the case register points to an evident mismatch between the LV of TB and assistance, since they are serious cases that were not notified, even at the time of death, which reflects the low coverage of the surveillance system.

TB deaths can be considered as a sentinel event, a concept defined by the occurrence of a preventable disease, disability or death, which can reveal the individual's high fragility due to the low socioeconomic, occupational, environmental or adverse health conditions, as for lack of adequate or timely action by health services. Unemployment, education and income are individual factors that increase vulnerability to TB and, therefore, can also influence access to health services, as well as quality diagnosis. [8]

Considering that, in Brazil, TB is a liability problem of Primary Care (AB) and that the capture of cases in a timely manner does not require highly complex care, there should be no obstacles that prevent access. Another hypothesis for the occurrence of underreporting may be related to the volume of cases notified. The highest proportion of notified TB cases occurs in the Southeast (45%) and Northeast (29%) regions, which appear with the highest rates of underreporting. [8]

The influence of structural and organizational aspects of health services, the flowchart of SINAN and the organization of SUS may explain part of the underreporting of cases to the surveillance system. It was observed that the search for SIM deaths using only the cases registered in the previous two years of SINAN and processing only the first two blocking steps were responsible for a high percentage of case recovery. [8]

The article **TB 04** shows that deaths from pulmonary TB are more significant from an epidemiological point of view than other clinical forms of the disease, because in addition to the lethality being higher in this form, it represents an important route of transmission and spread of the disease. As for the place of occurrence, 83.2% died in hospitals, which reflects the lack of responsibility of AB in the early detection of the disease and suggests difficulty in accessing health services for early diagnosis of cases and may represent a lack of training, commitment and guidance of health professionals.[9]

Of the 345 deaths registered in the SIM of this study, 185 (53.6%) had notification in SINAN. The evolution to death of hospitalized cases that do not have notification suggests that the diagnosis was made in the most severe form of the disease, since hospitalization was necessary for diagnosis and treatment. According to the Ministry of

Health, the SIM has greater coverage than the SINAN indicating that a death from TB may be in the SIM and not have been notified in the SINAN. However, in 2003, WHO classified the SIM as medium quality, estimating a sensitivity ranging from 70% to 90%. [9]

The time elapsed between the date of diagnosis and death was less than one year in 127 (70%) cases, showing the severity of the clinical condition during care in the priority municipalities of Mato Grosso do Sul. In two large hospitals in Rio de Janeiro, it was observed that 79% of deaths had a period of less than one year between the date of notification and the date of death. [9]

The article **TB 05** shows that the linking of records using the linkage between the SINAN-TB databases with SIM brought important corrections for both systems. For Brazil, the percentage of deaths from TB among the newly diagnosed cases increased, with a variation of around 15%, and the percentages of cure, abandonment, transfer and death from other causes decreased in the two years evaluated. [10]

Among the UFs, those with the greatest increases, above 40%, in the percentage of deaths from TB were: Rondônia, Mato Grosso and Distrito Federal in 2008, and Acre, Rondônia, Roraima, Amapá and Minas Gerais in 2009. [10]

About 9,059 reported deaths were found in both systems, 7,939 deaths occurred up to 270 days after the date of TB diagnosis and records were considered related to the same event. In the case of deaths registered with basic TB cause, 63.8% (3,047) were closed in SINAN as death from TB, 24% (1,146) as death from other causes, 3% (145) as cure, 3.2% (154) as abandonment, 3.6% (172) as transference, 0.2% (9) as multidrug-resistant TB and 2.2% (103) were in a closed or ignored situation. The median time between the date of diagnosis and the date of death was 25 days for the period studied and the mode was equal to zero. [10]

Among the 2,144 deaths with TB as an associated cause and HIV as a basic cause, 57.1% (1,225) were terminated in SINAN as death from other causes, 30.1% (645) as death from TB and 12.8% (274) with other closures. Among those with a basic cause of diseases of the respiratory apparatus, 36.5% (54) were terminated at SINAN as death from TB and 50.7% (75) as death from other causes. [10]

The records with basic cause neoplasia or disease of the circulatory system presented the highest percentages of closure in SINAN as death from other causes, 62.3% and 60.2%, respectively. Among the records notified in SIM as death due to other infectious diseases (102), 53.9% (55)

were closed in SINAN as death due to other causes. Other basic causes of death, such as digestive diseases, endocrine and nutritional and metabolic diseases, presented the percentage of closure in SINAN notifications as death from other causes, varying from 40.4% to 54.1%. The kappa index between SINAN and SIM for all SINAN records for 2008 and 2009 was 0.55, considered moderate. [10]

The probabilistic linkage between the data bases contributed to the improvement of the quality of SINAN, with positive effects for information on TB in Brazil. Although the SINAN routines for removing duplication and linking records are widespread in state and municipal PCTs and should be considered a permanent activity by technicians responsible for TB surveillance, the results indicate that they are not yet being implemented carried out properly. [10]

The reduction in duplicate registrations with an indefinite closure or transfer situation was considerable in practically all UFs in the country, generating an increase in the cure rate of around 3% for new cases. This result points to the improvement of the closure information, when compared with the highest percentages obtained after qualification processes carried out in previous years by other authors. However, the cure rates for most UFs are still far from the 85% level suggested by the WHO. [10]

The median of thirty days between the date of diagnosis at SINAN and the date of death at SIM refers to the difficulty in accessing health services for diagnosis and treatment. The high proportion of deaths that occurred shortly after the start of treatment was verified by other authors and reveals the limitations of health services in identifying early and treating a significant portion of TB patients in a timely manner. [10]

The article **TB 06** shows that of the cohort of 6,370 patients notified of TB in 2006 in SINAN, 417 (6.5%) were closed as a result of death, either due to TB or other causes. Of these, 370 (88.7%) were found in the SIM from 2006 to 2008. [11]

In SINAN, 335 (80.3%) of the endings died from TB, 95 (28.4%) of whom had TB as the basic cause in the SIM, 59 (17.6%) as an associated cause, 147 (43.9%) did not have TB as the cause of death and 34 (10.1%) were not found in the SIM. [11]

Of the 82 (19.7%) patients who died as a result of another cause at SINAN, 35 (42.7%) had TB as a basic or associated cause at SIM, 34 (41.5%) did not have TB as a cause of death and 13 (15.8%) were not included in the SIM. [11]

Of the 5,288 patients who closed for a different reason from death at SINAN, that is, closed as cure, abandonment, transfer, multidrug-resistant TB and with a blank / ignored closure situation, 132 (2.5%) presented TB as one of the causes of death and 323 (6.1%) died from other causes.Among the 665 patients with blank / ignored closure, there were 72 (10.8%) deaths, with 20 (27.8%) deaths with TB registered as the basic cause, 12 (16.7%) with TB as an associated cause and 40 (55.5%) were found in the SIM without mention of TB as a cause of death. [11]

The article **TB 07** shows that TB seems to be the main cause of death for patients notified with the disease. Approximately a quarter died of TB in the two years after diagnosis. This points to the magnitude of the problem, although there is effective treatment widely available in the public health system and it is considered a preventable death. [12]

In deaths with basic TB cause, the presence of septicemia, respiratory failure, pneumonia, symptoms and signs related to the respiratory system (hemoptysis, respiratory tract hemorrhage, respiratory arrest) as associated causes reflect the seriousness of the situation due the presence of respiratory conditions and terminal pictures, resulting in hospitalization followed by death.The problems associated with worse outcomes (diabetes, mental disorder and AIDS), which could have contributed directly to death, were less significant. The severity of the cases may be related to other comorbidities, such as circulatory system disease, digestive system diseases and neoplasms, as well as delayed diagnosis and failures in treatment and patient follow-up. [12]

The presence of comorbidities may be underestimated, as this information is based on an optional entry in the notification form. Still, they showed that individuals with two or more comorbidities tend to be older, female and have higher mortality from other causes.Contrary to expectations, a considerable proportion of deaths occurred within the treatment period and TB was not registered at least as an associated cause. Some situations could explain the lack of registration of the disease: patients who started the empirical treatment for TB, but who subsequently had their diagnosis ruled out and the diagnosis was not closed; the ignorance of TB on the part of the doctor who filled out the death certificate; and, finally, the lack of investigation of TB death when there is no laboratory diagnostic confirmation. [12]

The high percentage of deaths from TB points to the deficiency in the uptake and follow-up of cases in AB and to wide communication gaps between the hospital network, the urgency and emergency network and the PNCT. Serious cases, when admitted to emergencies, continue to die, without a timely assessment of the patient's current and previous history or confirmation of the diagnosis. However, smear microscopy is an exam available on the network and, in a municipality with a high incidence of TB, it is important that health professionals are attentive to the occurrence of the disease. [12]

The results suggest that diseases of the circulatory system are related to the early death of the TB patient, given the higher percentage of deaths that mention these causes within the treatment period. This fact can occur due to the possible worsening of diseases of the circulatory system by TB. Although the association between TB and diabetes is recognized, due to the worsening of TB due to this condition or vice versa, there was no relationship in the analysis performed here. [12]

Deaths without mention of TB in OD that occurred during the treatment period, in which the basic cause was septicemia or ill-defined and unknown causes of mortality, possibly were deaths from TB, pointing to the low quality of the information and lack of investigation and, consequently, compromise the quality of death statistics. In order to qualify information on the causes of death in the SIM, the Ministry of Health recommends the mandatory investigation of deaths for specific groups (maternal, child, women of childbearing age and ill-defined causes). Although this strategy is not implemented for specific diseases, its implementation must be strengthened in health services, given the good results achieved in the country. [12]

The article **TB 08** showed that among the cases of deaths reported in the SIM, 72.8% did not have access to TB diagnosis in a timely manner. The correction of the TB incidence coefficient in the analyzed period, from the inclusion of new cases of the disease identified through death surveillance, represented an average increase of 4.88% in this indicator. [13]

The notification allows to retrace the path taken by the patient, in different situations of the disease, allows to identify possible weaknesses in the organization of care for these users and makes it possible to track the opportunity for transmission. [13]

Considering that death and the most critical outcome for TB cases, the lack of awareness of its occurrence by the surveillance sector and underreporting show weaknesses in detecting cases of the disease.Such fragility signals deficiencies in the quality and opportunity for users to access health care, which may be associated with interdependent factors of individual, social and programmatic nature. The individual and social

perspective involves risk perception, level of knowledge of the health and disease process, economic situation, gender and generational relations, cultural values, access to material resources and the ability to receive information, metabolize it and be able to incorporate it practical changes in everyday life. [13]

The lack of knowledge about the disease and its severity, difficulties in access would imply the late search for health services, in hospital diagnosis or at the time of death. [13]

The article **TB 09** shows that between 2005 and 2014, 38,782 TB cases were reported in SINAN. The annual average of cases was 3,844. After the relationship with SIM, there was an increase of 1,955 (5%) TB cases that evolved to death and were not reported in SINAN. 2,816 deaths from TB were observed as a basic or associated cause and only 861 deaths (30%) were registered simultaneously in SINAN and SIM. [3]

After being linked to SINAN Aids, there was an increase of 370 (1%) cases of AIDS / tuberculosis coinfection, corresponding to cases that were not reported in SINAN-TB and, also, were not included in the SIM. In the end, 2,325 (6%) TB cases were added to SINAN. In 2005, the increase was 5.4%, with a reduction in the following years, with 2014 being the lowest in the period: 4.5%. Even with the increase after the relationship, TB cases showed a decreasing trend (p = 0.009). [3]

The number of cases with "tuberculosis death closure" in SINAN-TB was 1,015 to 2,806 after the relationship with SIM and SINAN Aids, an increase of 176.5%. The number of patients who had TB as a cause associated with death went from 1,162 to 2,758 deaths, an increase of 137.3%. The proportion of deaths from TB as a basic or associated cause increased from 5.6% to 13.5% of cases, changing the evolution of cases that had been closed as a cure, abandonment, transfer and even a change in diagnosis, as they had their death registered in SIM and not registered in due time in SINAN-TB, that is, patients registered in SINAN-TB who died of TB as a basic or associated cause registered in SIM and whose records were not updated in SINAN-TB. [3]

Cure was the outcome of 26,908 TB cases (65%); death occurred in 5,564 cases (14%); abandonment in 3,488 cases (8%). Other results that deserve attention are 2,883 (7%) cases that presented "transfer" closure and 1,494 cases (4%) "without information", even after the relationship with SIM and SINAN-AIDS. It should also be noted that some cases of TB / AIDS co-infection had not been reported to SINAN-TB and were recovered after the systems were listed.The record of HIV infection in TB

cases was positive in 2,044 cases (5.3%) and, after the relationship, in 2,623 cases (6.4%), an increase of 28.3% due to improved information, the from AIDS deaths in which TB was an associated cause and from the record of HIV infection in SINAN-AIDS cases. There was no information on HIV infection in 55.8% of TB cases. [3]

The increase in the prevalence of TB was up to 5.6% in half of the municipalities and up to 7.9% in three quarters of the municipalities in Ceará. There was an increase of 8% to 40% in the prevalence of TB, in the period, in 24 small municipalities in Ceará. In 22 (12%) municipalities there was no increase in cases after the relationship. In addition to the lack of registration of 6% of TB cases, it was found that less than half of the deaths were registered in SINAN-TB, a source of information for planning of disease control actions. This under-registration has been maintained in Ceará and Brazil, pointing to the need for reflection on the operational practice of TB surveillance, so that deaths registered in the SIM or cases of TB / AIDS coinfection in SINAN AIDS are investigated and have their registration verified at SINAN-TB and added, if not already notified. [3]

The article **TB 10** shows that the linkage between the 46,642 SINAN-TB records and the 1,307 SINAN-AIDS records showed 926 pairs (71% of AIDS records). These pairs represent individuals who were notified in both systems, from 2001 to 2010, while 381 (29%) existing records at SINAN-Aids with reports of TB coexistence were not found by the probabilistic relationship at SINAN-TB and, therefore, represent TB underreporting. [14]

The studies where the comparison with SIM is present usually present a higher proportion of notification due to the severity of the cases that died and the difficulty of diagnosing TB previously. The linkage between these systems makes it possible to locate patients before they become serious cases and can act to prevent more serious outcomes.Although we find underreporting in several systems, it is known that underreporting occurs mainly due to the lack of knowledge about the diseases that must be notified and due to problems in the notification flow by health professionals. [14]

Regarding the notification of the TB/AIDS association to SINAN, structural and organizational aspects of the SUS health services and the SINAN flowchart may explain part of the underreporting of cases to the surveillance system, however TB in Brazil is an aggravation AB's responsibility. Therefore, there should be no impediment to capturing or reporting cases. Despite this, AB still presents great challenges for TB control, such as the unsatisfactory decentralization program itself, in addition

to structural and human resource deficiencies. Thus, the diagnosis of TB for co-infected persons is still predominant in hospitals and SAEs. [14]

The chance of underreporting for TB was greater among those diagnosed with cavitary or unspecified pulmonary TB and with both forms of the disease (disseminated / extrapulmonary / non-cavitary and cavitary or unspecified pulmonary TB) at the same time. Extrapulmonary TB presents its most complex diagnosis and, once identified, it could be thought that there is a greater concern in the correct notification. Thus, the chance of being underreported when having other forms of TB would be greater compared to the extrapulmonary type. On the other hand, pulmonary TB is responsible for transmission and, therefore, there should be more attention to reporting these cases and starting treatment. These cases are extremely important for TB control, since they can put your contacts at risk and spread the disease. [14]

The article **TB 11**identified that among the main contributing diseases, when TB was the basic cause of death, diseases of the respiratory system (52.7%), mental and behavioral disorders, caused by psychoactive use (10.0%), diseases of the circulatory system (8.9%), malnutrition (6.4%), diseases of the digestive system (5.1%), hypertension (4.4%), diabetes mellitus (4.0%) and diseases of the genitourinary system (3.9%). Among respiratory diseases, chronic diseases of the lower respiratory tract stood out. When TB appeared as an associated cause, malignant neoplasms were among the most common basic causes of death, and, less frequently, as associated causes (2.1%). [2]

Cases attended in the public health service were responsible for about half or more of the post-death TB notifications, for the three groups of basic causes of death (TB; AIDS; others). Finally, more than half of the cases were reported in municipalities with low coverage of the Family Health Strategy (FHS) with 54.2%, although with medium or high coverage of AB, of 42.1% and 35.3% respectively. [2]

TB cases notified after death presented TB and AIDS as the main basic causes of death. Higher proportions of males were observed, aged over 39 years, with eight years or less of study, race / skin color black or brown, with the pulmonary clinical form, and notified by the public health service. Furthermore, their municipalities of residence reported higher MHDI, low poverty rate, large population, low coverage of the Family Health Strategy and high or medium coverage of AB.It is known that men are more affected by TB and die more from this cause, compared to women, which may be related to the fact that they seek

less health services, adhere less to treatment and have more risk factors. [2]

A higher frequency of people aged 60 years or older was identified among the post-death notifications of TB, when compared to that of other age groups. Many studies show that people of working age tend to have a high incidence of TB, pointing out the greater effectiveness of the alert for the detection of cases in this age group. However, the greater biological vulnerability of the elderly, especially related to the presence of other diseases, increases the risk of death from TB at this age, masks symptoms of the disease, reduces the alert for early diagnosis and delays treatment, providing an opportunity for underreporting and notification TB post-death. [2]

Black or brown people contributed more than 60% of all TB post-death notifications, according to this study.In addition to being the ethnic-racial group with the largest population in Brazil, the variable race / skin color black or brown has an important collinearity with schooling and income in the country, and therefore is associated with the pattern of seeking health services. . Black and brown people are thus more exposed to delayed diagnosis and treatment, and timely notification of the disease. The result of the study corroborates this hypothesis and highlights the barriers faced by this contingent in access to quality health care in Brazil, one of the most unequal countries in the world. [2]

The pulmonary clinical form of TB, the most frequent in Brazil, contributed to most of the cases reported after death, as it was verified. People with pulmonary TB and notification only after death are still worrisome, due to their potential for transmission, although accurate diagnostic tests and free effective treatment are available throughout the country to provide a better prognosis than other clinical forms. [2]

However, cases with extrapulmonary TB were more frequent among people co-infected with HIV / AIDS. The strong association between extrapulmonary TB and HIV infection is known. In general, it is more difficult to diagnose this clinical form of TB, even more so in people with HIV, which favors the under-detection of TB in this population. [2]

People seen at public health services at the time of death were responsible for the highest proportion of TB post-death notification (with TB being the basic cause of death or not). This can be explained by the fact that the public service is free and its national coverage, and consequently, covers the majority of the population. In a, people served by these services have, on average, greater

social vulnerability, which may have contributed to the high share of TB notifications only after death.[2]

Cases resident in municipalities with low FHS coverage and low or medium AB coverage contributed to a high proportion of TB post-death notification. This situation may reflect the population exposed to such coverage, since larger municipalities tend to have low coverage for this type of health care, especially for the FHS. Furthermore, these results may reveal territories where the gateway to SUS does not occur, effectively, through PHC, compromising the ordering of care, as well as the adequate management and surveillance of TB. [2]

Category 2- Tuberculosis Death Surveillance Actions

The **TB 02** article points out that the systematization of the procedures allowed the elaboration of a proposal for the surveillance of TB-related deaths based on the SIM in which every case of TB with death outcome must be notified by the unit in which it occurred death, regardless of whether it was previously notified or not. If it is a case previously notified, the notifications must be linked. The notification regarding the previous event must be properly closed after investigation and analysis (cure, abandonment, transfer, bankruptcy or multidrug-resistant TB) [7].

The surveillance of deaths from the SIM produced a substantial increase in the notifications made by the hospitals and a modest increase in the completeness of the data of both information systems, as well as the reclassification of records in the SIM. [7]

The notification records the path taken by the patient, which allows tracking of transmission opportunities. A patient who progresses to death without prior notification is an unknown case of the National Tuberculosis Control Program (PNCT) and, therefore, it is assumed that his contacts have not been evaluated. In this situation, it is recommended that the UH be triggered for a home visit, considering that the risk of illness from contacts is at least 15 times greater than in the general population. It is the role of the Epidemiological Surveillance (ES) to feed back the UH and its professionals with their data, which can encourage professionals to carry out notifications. [7]

The **TB 03** article shows that the adoption of systems relationship strategies is an important tool used by many countries to make estimates of incidence and number of cases. It is recommended, therefore, that the PNCT encourage such a practice, aiming at improving the quality of the TB surveillance system in order to generate reliable indicators to support decision making [8].

The **TB 04** article shows that the objective of the PNCT is based on reducing transmission, morbidity and mortality from the disease in Brazil. Mortality studies are important to analyze the quality and timeliness of treatment and to estimate the number of cases that are not reported. However, it is essential to improve the registration system as well as conduct a study without different geographic regions, especially in those with a high incidence of the disease, such as the municipalities considered to be priorities. Several studies show that current treatment for TB is highly effective and that the death of a case should be a rare event. In Brazil, cases of drug resistance are less frequent and do not represent (for the time being) a risk for the increase in deaths. In this context, TB is recognized as a preventable cause of death [9].

In order to minimize limitations, constant training and improvement of the information system should be carried out throughout the country. The data show that, in some municipalities, the mortality rates are much higher than what is considered satisfactory for the WHO and well above the national data. This suggests that, in these municipalities, a more rigorous monitoring of TB control and notification programs would be essential. Actions such as early diagnosis, seeking respiratory symptoms, reducing dropout and ensuring follow-up until discharge and cure of diagnosed cases, as well as surveillance systems (notification), should be intensified. [9]

The analysis of the causes of deaths from TB considering its multiple associations and the operational problems in the registration and information systems of cases and deaths allowed a more comprehensive notion about the problem, which can assist in the prevention and control of the disease, as well as in the identification of operational problems in the case and death registration and information systems. [9]

The **TB 05** article shows that for health services to use this tool, it is important to invest in the qualification of technicians for handling the database and performing linkage. More than encouraging the use of robust tools, it is essential to develop the ability to analyze the data available in information systems. In municipalities and states where the number of reported cases is low, often only an adaptation of the information flow can minimize or correct existing failures. [10]

The **TB 07** article points out that systematic monitoring and the presence of a highly qualified team, combined with constant fieldwork, make the implementation and maintenance of this activity costly, making adherence more difficult of the local health sector. [12]

The high percentage of deaths that occurred before the end of basic therapeutic treatment without mention of TB in OD refers to the discontinuity of treatment, a serious problem that threatens TB control in the country. The barrier to access to services and treatment had already been overcome, leaving the barrier to continuity of care, which should be considered a priority by services. On the other hand, the delay in diagnosis may have worsened the clinical picture. [12]

The surveillance of TB-related deaths will make it possible to increase the completeness of information systems, increase the proportion of closed cases, correct SINAN and SIM, rescue underreported cases and assess the quality of filling the SIM. All of these measures have the function of improving the sensitivity of the surveillance system and verifying the effectiveness of the treatment. [12]

The article **TB 08** showed that planning and management of actions, responsiveness of the institutions involved, adequate and stable financing facilitate access to health services, as well as quality of care, implementation and implementation of information technologies care that favor the existence of social contexts that favor the adoption of preventive measures. [13]

Therefore, it should be considered that the underreporting of TB cases represents a state of alert to local managers, as it signals delay in diagnosis and treatment, contributing to the inexpressiveness of the promotion and prevention actions in the community. The problem also points to deficiencies in the search for respiratory symptoms, in the identification of suspected cases and in the investigation of contacts. [13]

The lack of response from the AB services can lead to the search for emergency and specialized units. Implementing hospital surveillance centers and evaluating and monitoring notification routines by private services would be possible alternatives to induce the triggering of surveillance actions, especially in the rescue of cases not notified to the health authority. [13]

TB surveillance can be useful to increase the completeness of information systems, rescue and investigate the situation of closing cases, decrease underreporting, increase sensitivity of SINAN and SIM, assess the quality of death certificates, supervise surveillance epidemiology of health establishments and recover the examination of contacts not yet evaluated. [13]

Deficiencies in filling out the notification form, non-compliance with the deadlines for sending and fragility in the flow of information between the notifying units and the ES, may compromise a secure monitoring of the presented

reality. The qualification of the technicians for handling the database and training for the professionals regarding the quality of filling in the notification register of TB cases are some significant actions that can minimize or correct existing failures. [13]

The article **TB 09** shows that the scarcity of cases that evolved to death is worrying due to the failure to register, but mainly due to the possible gap in care and the timely detection of cases, which would have allowed the case of TB to evolve with greater severity each day. Examination of contacts and the active search for respiratory symptoms with a timely diagnosis, in addition to overcoming social inequities historically related to TB and the proper monitoring of cases under treatment can reduce deaths. [3]

The article **TB 10** shows that individuals who were treated in municipalities in the interior or in the metropolitan region were more likely to underreport TB when compared to those treated in the capital. This finding may demonstrate the need for continued training of professionals to report cases in cities in the interior or in the metropolitan region. [14]

AIDS cases reported in units other than SAEs for HIV/AIDS are more likely to underreport TB because the professionals working in these services are potentially more capable of investigating, diagnosing and reporting more correctly for co-infections. [14]

The underreporting of TB represents great damage, since it is a prerequisite to start treatment. The extent to which non-notification is influencing the treatment of TB or whether these individuals, even though they are not registered, are receiving the appropriate treatment, as notification is required for the release of the drug for the treatment of TB. [14]

The article **TB 11** concludes that strengthening AB as a strategy for ordering health care should contribute to addressing the problem and possibly reducing the under-detection and underreporting of TB cases in the municipalities. [2]

IV.   CONCLUSION

From this study it was possible to understand about the magnitude of factors related to the underreporting of deaths from TB, through the observation of the high proportion of cases diagnosed after death or untreated, treated for less than a month, and of those who died soon after hospitalization, in which the difficulties of health services at different levels of care became evident, when they failed to identify and treat cases in a timely manner.

Such characteristics make it possible to classify them as potentially avoidable, and should be given priority in public health interventions. In addition, the predominance of bacilliferous forms and the small number of cases identified in Basic Health Units, as well as those who received home visits, increase the risk of disease transmission between contacts, reducing or neutralizing the impact of activities of control.

Furthermore, tuberculosis death surveillance allows preventive and corrective actions to be implemented in order to increase the completeness of the information systems, reduce underreporting and the number of closed cases, supervise the epidemiological surveillance of the units and the quality of filling out the declarations of death. death, in addition to seeking contacts not evaluated by the health team.

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