

Coding pulmonary sepsis and mortality statistics in Rio de Janeiro, RJ

Codificação da sepse pulmonar e o perfil de mortalidade no Rio de Janeiro, RJ

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ABSTRACT: Objectives: This study aimed to describe “pulmonary sepsis” reported as a cause of death, measure its association to pneumonia, and the significance of the coding rules in mortality statistics, including the diagnosis of pneumonia on death certificates (DC) with the mention of pulmonary sepsis in Rio de Janeiro, Brazil, in 2011. **Methods:** DC with mention of pulmonary sepsis was identified, regardless of the underlying cause of death. Medical records related to the certificates with reference to “pulmonary sepsis” were reviewed and physicians were interviewed to measure the association between pulmonary sepsis and pneumonia. A simulation was performed in the mortality data by inserting the International Classification of Diseases (ICD-10) code for pneumonia in the certificates with pulmonary sepsis. **Results:** “Pulmonary sepsis” constituted 30.9% of reported sepsis and pneumonia was not reported in 51.3% of these DC. Pneumonia was registered in 82.8% of the sample of the medical records. Among physicians interviewed, 93.3% declared pneumonia as the most common cause of “pulmonary sepsis.” The simulation of the coding process resulted in a different underlying cause of death for 7.8% of the deaths with sepsis reported and 2.4% of all deaths, regardless the original cause. **Conclusion:** The conclusion is that “pulmonary sepsis” is frequently associated to pneumonia and that the addition of the ICD-10 code for pneumonia in DC could affect the mortality statistics, highlighting the need to improve mortality coding rules.

Keywords: Information systems. ICD. Death certificates. Mortality registries. Underlying cause of death. Sepsis.

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RESUMO: *Objetivo:* Descrever os óbitos com menção de sepse pulmonar, medir a associação entre sepse pulmonar e pneumonia, assim como avaliar o impacto da regra de codificação no perfil de mortalidade, com a inclusão simulada do diagnóstico de pneumonia, nas declarações de óbito (DO) com menção de sepse pulmonar, no Rio de Janeiro, em 2011. *Métodos:* Foram identificados os óbitos com menção de sepse pulmonar independentemente da causa básica. Aos médicos atestantes, aplicou-se questionário medindo a associação entre sepse pulmonar e pneumonia. O registro de pneumonia nos prontuários dos óbitos com menção de sepse pulmonar e sem menção de pneumonia na DO foi investigado. Foi descrito o perfil de mortalidade após a inclusão simulada do código de pneumonia nas declarações com sepse pulmonar. *Resultados:* Sepse pulmonar correspondeu a 30,9% das menções de sepse e a menção de pneumonia estava ausente em 51,3% dessas declarações. Pneumonia constava em 82,8% da amostra de prontuários investigados. Dos médicos entrevistados, 93,3% relataram pneumonia como a mais frequente causa de sepse pulmonar. A simulação revelou que a inclusão da pneumonia alterou a causa básica de 7,8% dos óbitos com menção de sepse e 2,4% de todos os óbitos, independentemente da causa original. *Conclusão:* Sepse pulmonar está associada à pneumonia e a simples inclusão do código de pneumonia nas declarações de óbito com menção de sepse pulmonar impactaria o perfil de mortalidade, apontando necessidade de aprimoramento das regras de codificação na Classificação Internacional de Doenças (CID-10).

Palavras-chave: Sistemas de informação. CID. Declaração de óbito. Registros de mortalidade. Causa básica de morte. Sepse.

INTRODUCTION

The longevity arising from demographic and epidemiological transitions favors the coexistence of different disease processes and a greater complexity of the mechanisms involved in death. Consequently, a greater number of diagnoses is recorded on the death certificate (DC), making it difficult to determine the underlying cause of death (UC)¹. The increase in the declaration of sepsis as the UC occurs, in part, due to this process.

The proportional mortality rate for infectious and parasitic diseases (IPD) in Brazil corresponded, in 1979, to 10.3% of total deaths. In 30 years, it was significantly reduced, accounting for 4.3% of deaths in 2010. Sepsis, however, shows a different behavior. Between 1996 and 2010, there was an increase of 19.1% in the absolute number of deaths with sepsis declared as the UC. In Rio de Janeiro, in 2010, sepsis appeared as the most frequent UC of deaths by IPD with 41.6%^{2,3}. Particularly in the most developed region with the oldest population in the municipality — Planning Area 2.1 (PA 2.1)^{4,5} —, the proportional mortality by IPD has been slightly but systematically higher than that of the municipality. In 2010, in PA 2.1, sepsis accounted for 58.7% of the causes of deaths by IPD. If we consider the age group of 80 years or more, sepsis was responsible for 86.0% of deaths by IPD and 4.2% of all deaths³.

The DCs often show terms such as “abdominal sepsis,” “skin sepsis,” “pulmonary sepsis,” or “urinary sepsis.” According to the “Rules and guidelines for mortality and morbidity coding” of the 10th Revision of the International Classification of Diseases and Health-related

Problems (ICD-10), these terms, when cited in DCs, must be encoded with categories A40 — “streptococcal septicemia” or A41 — “other septicemia.” There is no location-specific coding, with the exception of urinary sepsis. Possible specifications in other cases are related to the infectious agent. The terms “pulmonary sepsis” or “pulmonary septic shock” are characterized by their high frequency, although there is no formal definition or specific codes for them in ICD-10.

Pneumonia is the diagnosis most commonly associated with pulmonary sepsis, as with sepsis in general. In the city of Rio de Janeiro, in 2010, pneumonia was cited in 40.5% of the DCs that mentioned sepsis, regardless of other reported causes, and was the UC in 16.5% of these deaths³. The association between pneumonia and sepsis generally reinforces the idea that the term “pulmonary sepsis” refers to a sepsis originating from a pulmonary infection — as seems obvious — and which is usually used as routine in clinical practice⁶⁻⁸. Thus, when the term “pulmonary sepsis” is cited as in a DC, but is not related to its previous infectious cause, the mere adoption of the A40 and A41 coding categories could mean loss of information as to the origin of the infection. In these cases, the declared adjective “pulmonary” is not useful for the qualification of sepsis and of the UC. The coding rule used by the Mortality Information System (SIM) conditions the loss of information to the origin of sepsis, contained implicitly in the DC.

This study aimed to describe the deaths with pulmonary sepsis declared among the causes of death, to measure the association between pulmonary sepsis and pneumonia, and to assess the impact of the coding rules of ICD-10 on the UC, through the inclusion of the diagnosis of pneumonia in DCs citing pulmonary sepsis in PA 2.1 of the municipality of Rio de Janeiro in 2011.

METHODS

This is a descriptive study based on secondary data from the SIM, hospital records, and primary data obtained by questionnaires given to the doctors that reported the DCs. The database and images of the DCs were provided by the Municipal Health Secretariat of Rio de Janeiro.

The city of Rio de Janeiro consists of ten PAs. The population of PA 2.1 is the one with the highest proportion of elderly, 23.1%. With 10.1% of the local population, in PA 2.1 is 22.0% of the population aged 80 or more⁴. It is a region with good development indicators, and 8 of its districts are among the 10 with the highest Human Development Index (HDI)⁵. The study population is composed of non-stillbirth deaths registered in PA 2.1 in 2011.

Figure 1 shows the five stages of the study. The first stage was to identify the DCs that mentioned sepsis in any part of the certificate. Records were selected from the SIM database, to which were assigned coding categories A40 (Streptococcal septicemia), A41 (Other septicemia), T79 (Some early complications of trauma), and the interval between T80 and T88 (complications of medical and surgical care, NCOP) of ICD-10. The DCs

selected were analyzed according to age, sex, race/color, education, place of residence, and UC. In the second stage, each DC selected was reviewed to identify the terms to which the above codes are assigned. Terms selected were those related to pulmonary sepsis, considering the variations “sepsis,” “septicemia,” “septic shock,” “bloodstream infection,” “generalized infection,” and “systemic inflammatory response syndrome,” which were accompanied by the terms “pulmonary,” “lung,” “with a pulmonary focus,” “of pulmonary origin,” or “respiratory.” The presence of pneumonia mention and doctors who used the term pulmonary sepsis or its variations was also identified. The third stage consisted of consulting the records of hospitalizations that resulted in the hospital deaths selected in the second stage, in whose DCs there was no mention of pneumonia. The presence of the reporting of pneumonia was investigated. No clinical or radiographic criteria were considered. Length of stay, admission diagnosis, date of the first and last reports of pneumonia and sepsis, the mention of pulmonary sepsis, and the use of mechanical ventilation and its duration were also recorded. The application of

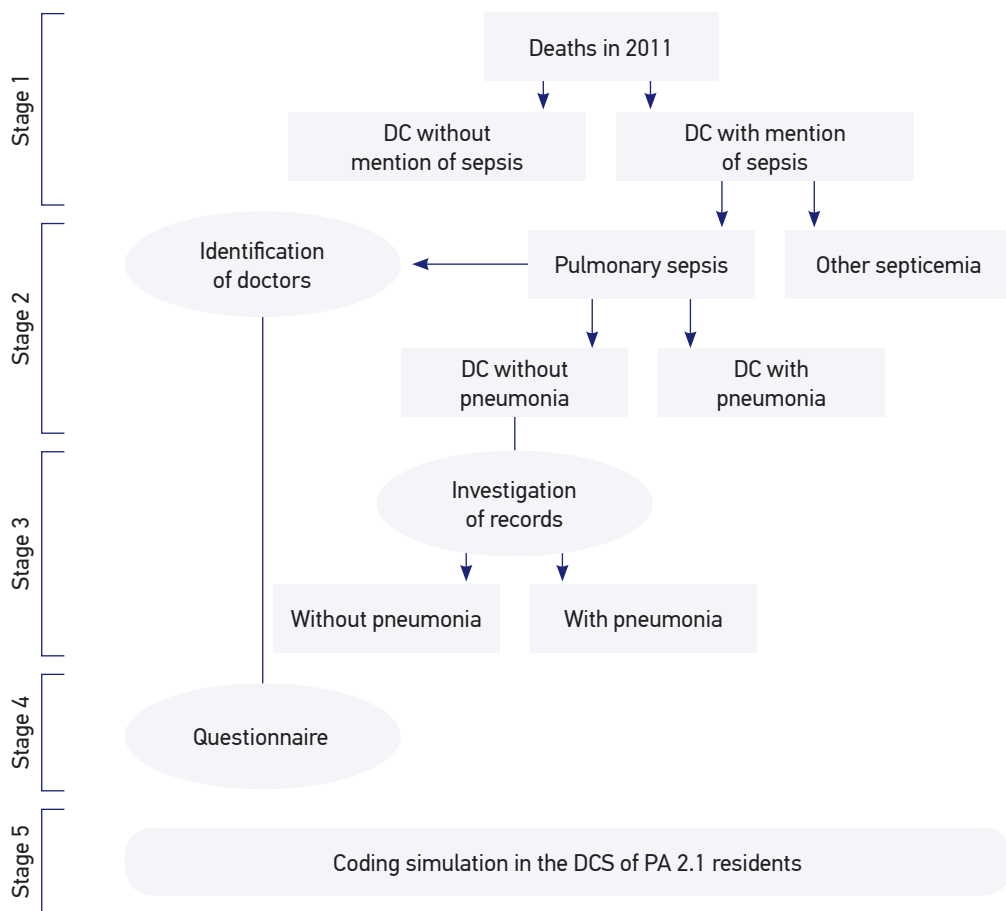


Figure 1. Stages of the investigation of deaths with mention of pulmonary sepsis.

a questionnaire to the reporting doctors in the DCs that mentioned pulmonary sepsis was the fourth stage of the study. The questionnaire contained questions about the year of graduation — for the calculation of time of professional practice — and the medical specialty, with the main question being: “When you use the term ‘pulmonary sepsis’ in a Death Certificate, what is the frequency of pneumonia as the precedent infection?,” which had five possible answers ranging from 0 to 100%, categorized into five ranges of 20 points. The fifth step was the simulation of the coding of the term “pulmonary sepsis,” with the adoption of code A41.9 (unspecified septicemia) associated with the code J18.9 (unspecified pneumonia) and subsequent selection of new UCs for the deaths of the PA 2.1 residents in 2011. The code J18.9 was inserted in the same line of Block V, to the right of the code related to pulmonary sepsis. The proportional mortality due to the underlying cause, before and after, the simulation was compared to measure the impact of the new encoding. The McNemar test was conducted to investigate the difference between the proportion of deaths due to the underlying cause, according to the chapters of ICD, before and after the simulation.

This study was approved by Institutional Review Board of the Institute of Public Health Studies, UFRJ, case number 206.498 of 02/06/2013. There is no conflict of interest from the authors (CAAE: 07904012.0.0000.5286).

RESULTS

In 2011, there were 7,530 non-stillbirth deaths in PA 2.1. The coding categories A40 (streptococcal septicemia), A41 (other septicemia), and sepsis-related codes from category T79 (some early complications of trauma) and the interval from T80 to T88 (complications of surgical and medical care, NCOP) were assigned to 2,292 DCs (30.4%). In 2,181 DCs (95.1%), the code used was A41.9 (unspecified septicemia). Six DCs were excluded from the study because of error in assigning the codes cited to terms different from sepsis.

Total deaths and deaths with mention of sepsis in the DC were more frequent in the age groups with elderly people, occurring in 58.9 and 68.4% of cases in people aged 70 or more, and only in 15.3 and 9.7%, respectively, in the age group under 50 years. Regarding the variables place of residence, sex, race/color, and education, no important differences were observed between the two groups. As for proportional mortality from the UC according to the chapters of ICD, the differences are obvious. The respiratory diseases (RD) were the most frequent among deaths with mention of sepsis (22.0%), followed by deaths by cancer (19.9%), cardiovascular diseases (14.2%), and IPD (14.0%). In total deaths, these frequencies were 11.7% (RD), 22.2% (cancer), 26.6% (cardiovascular), and 5.9% (IPD), respectively.

The second stage showed a great diversity of terms for which the codes related to sepsis were assigned. Initially, 74 different terms and variations were identified for the four categories used in ICD-10. By grouping related terms, such as “sepsis” and “septicemia,” as well as “lung”, “of pulmonary origin” and “with a pulmonary focus,” or yet “indeterminate,”

“unknown,” and “unspecified,” 32 categories were considered (Table 1). In cases where there were terms that qualified location, the etiologic agent, or different clinical classification, there was no aggregation. The most common terms were “septic shock” (34.4%) and “pulmonary sepsis” (29.2%) (Table 1).

A total of 708 deaths (30.9%) were considered as mention of pulmonary sepsis, classified in the “pulmonary sepsis,” “pulmonary septic shock,” and “respiratory sepsis” categories (Table 1). In this group, more than half (57.2%) occurred in the age group of 80 years or more, and only 3.9% in the group under 50 years. About 78% of deaths were in the range

Table 1. Frequency of terms identified on death certificates with sepsis-related codes, Planning Area 2.1, Rio de Janeiro, RJ, Brazil, in 2011.

Term	n	%
Septic shock	787	34.43
Pulmonary sepsis	668	29.22
Sepsis	593	25.94
Abdominal sepsis	85	3.72
Pulmonary septic shock	30	1.31
Skin sepsis	20	0.87
Urinary sepsis	18	0.79
Systemic inflammatory response syndrome	16	0.70
Sepsis with undetermined focus	15	0.66
Respiratory sepsis	10	0.44
Generalized infection	6	0.26
Mixed sepsis	5	0.22
Bloodstream infection	4	0.17
Biliary sepsis	4	0.17
Staphylococcal sepsis	4	0.17
Abdominal septic shock	3	0.13
Peritoneal sepsis	2	0.09
Catheter-related sepsis	2	0.09
Others*	14	0.56
Total	2,286	100.00

*Biliary septic shock, gastrointestinal septic shock, septic emboli, multiple sepsis, soft tissue sepsis, bloodstream sepsis, disseminated sepsis, streptococcal sepsis, fungal sepsis, pneumocardial sepsis, pneumococcal sepsis, bedsore-related sepsis, Gram negative-related (*E. coli*) sepsis, upper respiratory tract (sinuses) sepsis – terms mentioned only once.

of 70 or more. The DCs with mention of pulmonary sepsis were reported by 354 physicians (1–16 DCs per doctor). Only eight deaths occurred outside health facilities, and the rest were spread over 30 hospitals. The report of pneumonia was found in 345 DCs (48.7%).

The groups with and without mention of pneumonia in the DC differed sharply regarding the UC according to the chapters of the ICD. In the group with mention of pulmonary sepsis and mention of pneumonia, RDs predominated (50.1%), following the pattern of deaths from sepsis in general and pulmonary sepsis. In this group, the percentage of IPDs was very low (1.4%). In the group with mention of pulmonary sepsis, but without mention of pneumonia, the IPDs predominated (35.8%) and the percentage of RDs was small (6.9%) (Figure 2). The most frequent ICD categories reported as UC were “other septicemia” (A41), with 122 deaths (33.6%) in the group without mention of pneumonia, and “pneumonia, unspecified” (J18), with 129 deaths (36.5 %) in the group with the mention of pneumonia.

In the third stage, the analysis of 186 medical records of deaths with mention of pulmonary sepsis and without mention of pneumonia (51.5% of selected deaths) of 16 hospitals (57.1% of hospitals with the occurrence of selected deaths) was conducted. The frequency of medical records analyzed was due to the authorization and timely provision by hospitals for the study.

Among the medical records evaluated, there was a higher frequency of low education, especially in the category of 1 – 3 years of study (20.4%) compared to the total number of selected deaths (16.1%). There were no important differences in the characteristics of age, sex, race/color and UC, and the IPDs, cancers and cardiovascular diseases accounted for

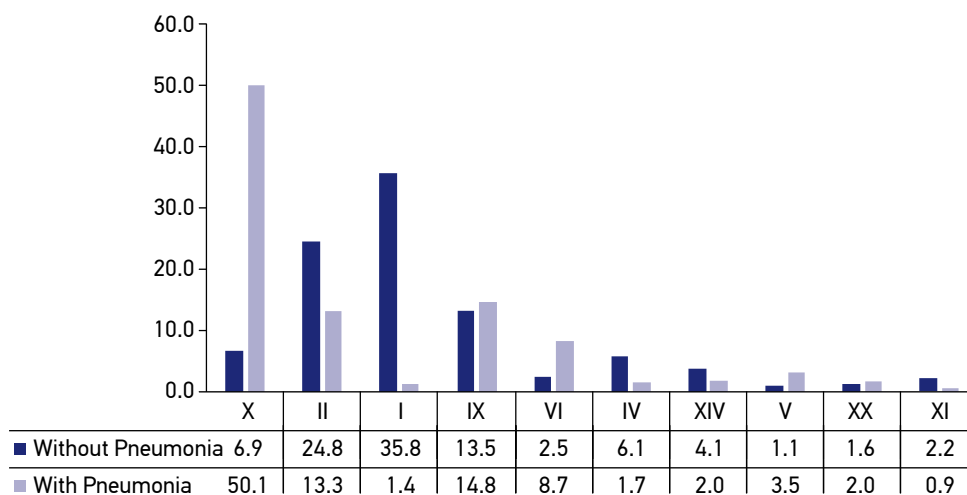


Figure 2. Proportional mortality by cause by ICD chapter in deaths with mention of pulmonary sepsis, with and without mention of pneumonia, in the Planning Area 2.1, Rio de Janeiro, RJ, Brazil, in 2011.

about 75% of deaths. In only 32 (17.2%) of the 186 records analyzed, there was no record of pneumonia during hospitalization, and in 45 records (24.2%), pneumonia was reported as a reason for hospitalization.

The median age of death in the analyzed medical records was 79 years (ranging from 12 to 99 years), and the age distribution of deaths with and without pneumonia was similar. Females prevailed both in the total (54.8%) and in the group of records with report of pneumonia (57.1%), whereas in the group without the report of pneumonia, males were most frequent (56.3%).

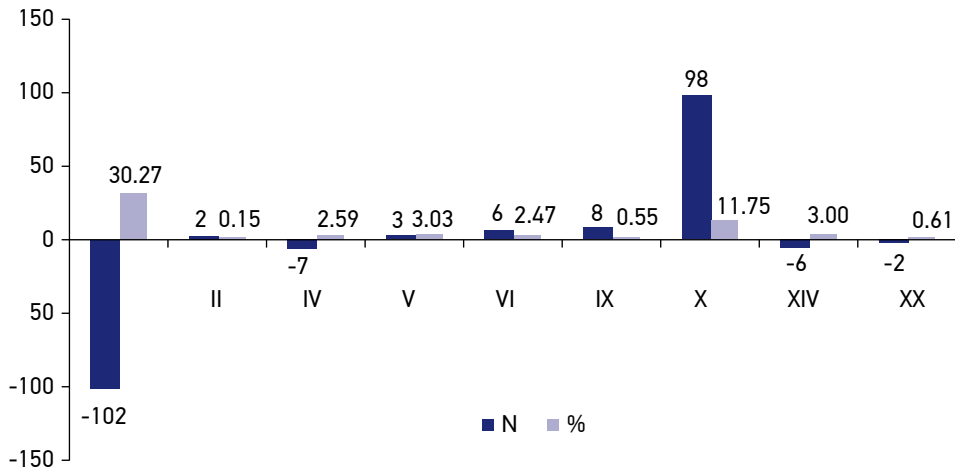
The median hospitalization time was 16 days (ranging from 1 to 606 days), with no important differences between deaths with and without report of pneumonia. The record of sepsis diagnosis was present in 137 (73.9%) of the 186 records. The use of mechanical ventilation was reported in 144 records (77.4%) and the time of use ranged from 1 to 64 days, with an average of 7.5, eight in the group with pneumonia and two in the group without pneumonia.

A total of 354 doctors who issued the 708 DCs with mention of pulmonary sepsis were identified, and 75 (21.2%) of those responded to the questionnaire. The 708 DCs came from 30 health units. The respondent doctors issued 129 (18.2%) of these DCs from 24 units (80.0%). The time of professional exercise varied widely between 2 and 38 years. Doctors who graduated between 2001 and 2010 formed the largest group, with 51 professionals (68.0%). Twenty-four specialties were reported, predominantly general practitioners (28%). As for the relationship between pulmonary sepsis and pneumonia, 82.7% reported the option of “81 – 100%,” 10.7% reported “61 – 80%,” and 4.0% reported “41 – 60%.” The options “21 – 40%” and “0 – 20%” had only one response.

In the fifth stage, the DCs of PA 2.1 residents, recorded in Rio de Janeiro, in 2011, which contained the mention of pulmonary sepsis were recoded, adding the code J18.9. After the new encoding, the reselection and evaluation of the new causes was performed. Of the total 5,651 DCs, there was a change of the UC in 138 cases (2.4% of all deaths and 7.8% of all deaths with mention of sepsis). In 119 cases (86.3%), the new UC was classified in a different ICD chapter than the original cause. There were 13 changes of the cause to other categories within the same chapter and to other codes in the same category, there were six cases. The chapters of ICD-10 in which there was the greatest number of changes were Chapters I and X. In Chapter I (IPD), there was a reduction of 102 deaths, 30.3% of the deaths in the chapter. In Chapter X (RD), there was an increase of 11.7% — 98 deaths (Figure 3). There was a change in the total deaths in nine chapters of ICD-10, of which six chapters (I, IV, VI, IX, X, and XIV) showed a statistically significant difference between the proportion of deaths before and after the simulation ($p < 0.05$).

In the analysis of proportional mortality by UC according to the chapters of ICD-10, Chapter I suffered the greatest change after recoding and reselection of UC: originally, the IPDs were the fourth most frequent cause of death (5.9%), going to the eighth position (4.1%). Among the 138 deaths of PA 2.1 residents that suffered changes in the UC, 98 deaths (71.0%) occurred in the age group of 80 years or more. In this range, the inclusion

of the code for pneumonia in the DC brings a stronger impact. Deaths from IPD, previously the fifth most common chapter (5.7%), moved to the ninth position (3.1%) (Figure 4). In this group, 130 deaths had sepsis as the declared UC and, of these, 74 (56.9%) had mention of pulmonary sepsis. The proportion of deaths before and after the simulation in the age group of 80 years or more showed statistically significant differences for the same chapters of the ICD than total deaths.



Note: I. Some infectious and parasitic diseases; II. Cancers; IV. Nutritional and metabolic endocrine disorders; V. Mental and behavioral disorders; VI. Nervous system disorders; IX. Cardiovascular diseases; X. Respiratory diseases; XI. Digestive diseases; XIV. Diseases of the genitourinary system; XX. External causes of morbidity and mortality.

Figure 3. Total and proportion of basic causes modified with the introduction of the code J18.9 (unspecified pneumonia) by ICD chapter, Planning Area 2.1, Rio de Janeiro, RJ, Brazil, in 2011.

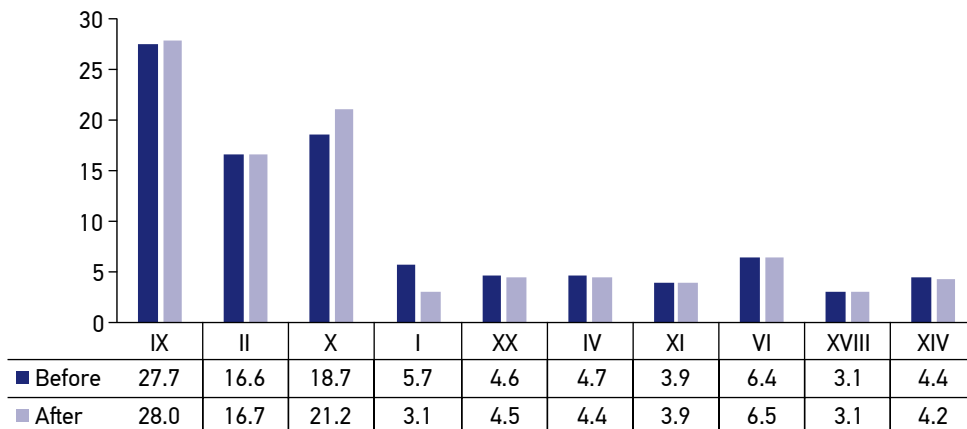


Figure 4. Proportional mortality by cause in the age group of 80 years or more, before and after recoding, Planning Area 2.1, Rio de Janeiro, RJ, Brazil, in 2011.

DISCUSSION

The analysis of DCs revealed a concentration of deaths with mention of sepsis in older age groups. This characteristic is even more striking when the DCs with mention of pulmonary sepsis are assessed. Of these, 57.2% were aged 80 years or more. Chapter X (RD) is the most frequent among deaths with mention of sepsis and pulmonary sepsis. The data reinforce the relevance of the study on sepsis and RDs in the process of sickness and death, especially in the elderly population, as pointed out by Lima-Costa, Peixoto, and Giatti (2004)⁹.

We identified 32 different groups of terms for which the sepsis-related codes were assigned. However, this diversity is not expressed in the SIM database, as they receive the same code. The A41 category (other septicemia) was used in 95% of cases. The use of a single category of ICD for such a wide variety of terminology might mean loss of relevant information for the more accurate identification of the UC.

DCs with mention of pulmonary sepsis, classified in groups with and without mention of pneumonia, were very similar regarding the demographic and educational characteristics. The two groups differed on the UC. In the group without mention of pneumonia, "other septicemia" (A41) was the most frequent UC, with 33.6% of deaths. In the group with mention of pneumonia, "other septicemia" (A41) cannot be the UC, as the "Rules and guidelines for mortality and morbidity coding" of ICD-10 establish that sepsis should be considered a direct result of pneumonia, and the latter, when present in the DC, should be selected as the UC according to the Selection Rule 3 (SR3)¹⁰. This huge variation, therefore, cannot be due to a real difference between UCs, as there is the mention of "pulmonary" sepsis in both groups. The death certification process, which inevitably have a subjective component, as well as the coding and UC selection rules of ICD-10 may have contributed to the magnitude of the difference. Laurenti et al. (2009)¹¹ point out the effectiveness of the selection rules when the UC is present in the DC, but there are few studies that assess other implications of the UC selection rules.

The results in this study that support the hypothesis of association between pulmonary sepsis and pneumonia were the high frequency of diagnosis of pneumonia (82.8%) in the records evaluated and the responses of doctors on the frequency of pneumonia preceding pulmonary sepsis. The low response rate (21.2% of doctors), the type of question that did not allow reference to other possible precedent for sepsis, different from pneumonia, and not including the control group (DCs with report of pneumonia) in the investigation of the records are, however, limitations to this study. It should be noted that the decision to consider only the explicit reports of pneumonia, not clinical criteria, decreased sensitivity and increased the specificity of the inclusion criteria.

The changes in the UC observed after the simulation coding are mostly related to the UC declared as sepsis (77.2%). These causes migrated, also mostly, to pneumonia due to the absence of other diagnoses in Part I of the certificate. Improper death certification justifies this result because sepsis, in concept, should not be UC, since there is always a

preceding infection. The change in the UC declared as sepsis was expected due to what was exposed on the SR3 and is consistent with findings from other studies that investigated medical records¹²⁻¹³.

The analysis of the mortality data of the PA 2.1 population, with the assumption that pneumonia is the preceding infection to pulmonary sepsis, showed that the coding simulation modifies the total deaths in nine chapters of the ICD. Chapter X (RD) receives the highest number of deaths with modified causes; however, because it already has a high percentage of deaths, it remains the third most common chapter. Pneumonias are overestimated as the UC, being an incomplete diagnosis¹⁴ in some cases, and it is certain that the simulation conducted further adds to the number of deaths due to pneumonia as the UC. In some cases, they are probably intermediate causes, which could not be considered an important gain. Some authors¹², however, do not consider pneumonia as an incomplete diagnosis for children under 1 year and adults over 60 years of age. There is, however, undeniable gain. Of the total deaths in the PA 2.1 population with sepsis as the UC (194), 52.6% were due to pulmonary sepsis. Of these, 24.5% migrated to well-defined causes from Chapters V, VI, IX, XX, and categories other than pneumonia from Chapter X. What determines the quality gain on the UC in the simulation proposed is, in large part, the application of the SR3. Sepsis is considered by the SR3 a direct result of pneumonia, but is not considered a direct result of other conditions such as cerebrovascular disease or dementia, as pneumonia is. If we consider the frequency of association between unspecified sepsis and pneumonia, be it on SIM or on what the data on the literature point out to¹⁵⁻¹⁶, perhaps the relationship of these diagnoses, among themselves and with others, with respect to SR3, deserve be discussed as suggested in the "Annual Meeting of the WHO-FIC Network", in 2009¹⁷.

The impact of the coding simulation for pulmonary sepsis is higher in the population aged 80 years or more. In this group, the deaths with UCs in Chapter I have significantly decreased, losing more than 45% of the total. The great contribution to Chapter I, of all deaths with the UC declared as sepsis, may induce a distortion of the real magnitude of mortality from IPD, since sepsis should not be the UC.

CONCLUSION

In this study, we conclude that the simulation of a new coding for the term pulmonary sepsis, with the simple inclusion of the diagnosis of pneumonia in the DCs, modify the proportional mortality profile by group of causes, especially in deaths from IPDs in the elderly. Investment in the quality of information entered in the DCs on SIM must necessarily be multidimensional. The training of professionals in the system concepts, especially in the process of filling the DCs, is the initial and key step. The promotion of studies and constant improvement of the coding and the selection of UCs rules from ICD-10, can help with simple, standardized, low-cost, and far-reaching measures in the process of qualification of mortality data.

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