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RISK FACTORS FOR SURGICAL SITE INFECTION IN CARDIAC SURGICAL PROCEDURES

FATORES DE RISCO PARA INFECÇÃO DE SÍTIO CIRÚRGICO EM PROCEDIMENTOS CIRÚRGICOS CARDÍACOS

FACTORES DE RIESGO PARA INFECCIÓN DE SITIO QUIRÚRGICO EN PROCEDIMIENTOS QUIRÚRGICOS CARDÍACOS

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Objective: describe the risk factors for surgical site infection in patients submitted to cardiac surgical procedures. Method: retrospective and descriptive case-control study. The participants were the patients submitted to cardiac surgical procedures between 2011 and 2013 who developed and who did not develop an infection. The data were collected from the Hospital Infection Control Committee and in the patient histories between May and December 2014. Results: fifty patients were studied, being 19 cases and 31 controls. Infection occurred more frequently in male elderly patients. Both groups showed similarities in the prevalence of the following risk factors: length of preoperative hospitalization longer than 24 hours, classified under physical status classification system level III. The patients suffered from hypertension and diabetes and the antibiotic prophylaxis was discontinued. Conclusion: the risk factors for surgical site infection in patients submitted to cardiac surgeries demand greater control from the professionals involved in the process with a view to reducing the rates of these complications.

Descriptors: Surgical wound infection. Risk factors. Thoracic surgery. Nursing.

Objetivo: descrever os fatores de risco para infecção de sítio cirúrgico presentes em pacientes submetidos a procedimentos cirúrgicos cardíacos. Método: estudo de caso-controle, retrospectivo e descritivo. Participaram os pacientes submetidos a procedimentos cirúrgicos cardíacos entre 2011 e 2013 que desenvolveram e não desenvolveram infecção. Os dados foram coletados na Comissão de Controle de Infeção Hospitalar e nos prontuários, entre maio e dezembro de 2014. Resultados: foram estudados 50 pacientes, 19 casos e 31 controles. A ocorrência de infecção foi mais frequente em idosos do sexo masculino. Ambos os grupos apresentaram semelhanças na prevalência dos fatores de riscos: tempo de internação pré-operatório superior a 24 horas, classificados no nível III*, pelo* physical status classification system*, eram portadores de hipertensão e de diabetes e houve descontinuidade da antibioticoprofilaxia. Conclusão:*

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os fatores de risco para infecção de sítio cirúrgico em pacientes submetidos a cirurgias cardíacas requerem dos profissionais envolvidos no processo maior controle para reduzir os índices dessas complicações.

Descritores: Infecção da ferida cirúrgica. Fatores de risco. Cirurgia torácica. Enfermagem.

Objetivo: describir los factores de riesgo para infección de sitio quirúrgico en pacientes sometidos a procedimientos quirúrgicos cardíacos. Método: estudio de caso-control, retrospectivo y descriptivo. Participaron pacientes sometidos a procedimientos quirúrgicos cardíacos entre 2011 y 2013 que desarrollaron y no desarrollaron infección. Datos recolectados en la Comisión de Control de Infección Hospitalaria y en registros médicos, entre mayo y diciembre de 2014. Resultados: se estudiaron 50 pacientes, 19 casos y 31 controles. Incidencia de infección más frecuente en ancianos varones. Ambos los grupos presentaron semejanzas en la prevalencia de los factores de riesgo: tiempo de internación preoperatorio superior a 24 horas; clasificados en el nivel III*, por el* physical status classification system*; portadores de hipertensión y diabetes; y en discontinuidad de la antibioticoprofilaxis. Conclusión: los factores de riesgo para infección de sitio quirúrgico en pacientes sometidos a cirugías cardíacas requieren de los profesionales involucrados en el proceso mayor control para reducir los índices de esas complicaciones.*

Descriptores: Infección de la herida quirúrgica. Factores de riesgo. Cirugía torácica. Enfermería.

Introduction

Among hospital-acquired infections, surgical site infection (SSI) ranks among the leading Health Care-Associated Infections (HAI), accounting for 17%. It is estimated that 240,000 cases per year occur in the United States of America[1]. In Brazil, SSI ranks third among all HAI and corresponds to 14% to 16% of HAI in hospitalized patients[2].

According to a survey carried out at the Department of Information Technology at the Service of SUS (DATASUS), between 2010 and 2014, 372,250 cardiac surgeries were performed in Brazil, with 23,382 deaths. In Bahia, more than 15,000 cardiac surgeries were performed, with a total of 634 deaths. In Salvador, 11,910 surgeries were performed, with approximately 500 (4.2%) deaths recorded after the surgical procedure[3]. Considering the SSI rate described for Brazil, approximately 1,667 (14%) to 1,905 (16%) of these patients could have developed SSI and, in addition, between 70 (14%) and 80 (16%) deaths could have occurred due to SSI and/or its consequences[3].

SSIs occur within the first 30 days after surgery or up to one year in case prostheses are used[4]. They are classified as superficial incisional when involving skin and subcutaneous tissue; deep incisional, when involving deep soft tissues, such as fascia and/or muscles; and organs/cavity when involving any organ or cavity, called mediastinitis, in cardiac surgery[4-5].

The risk factors associated with the development of SSI in cardiac surgery are related to the patient in the preoperative period, such as advanced age, poorly controlled diabetes mellitus, obesity, tobacco use, use of immunosuppressive medications and long hospital stay in the preoperative period; and to the procedure or in the perioperative period, which include the length of surgery, trichotomy, hypoxia and hypothermia[6-7].

In the literature, patients exposed to long hospitalization prior to cardiac surgery had a higher prevalence of postoperative infectious complications[7]. A study of 19,333 patients undergoing cardiac surgery in the period from 1995 to 2012 in Canada found that 2,726 (14%) contracted at least one infection. The risk factors related to the development of this process were advanced age, female gender, low ejection fraction, peripheral vascular disease and cerebral vascular disease, renal failure, diabetes, congestive heart failure, reoperations, combined cardiac procedures, chronic obstructive pulmonary disease and emergency procedures[6].

Studies on risk factors that contribute to the occurrence of SSI may provide support for the

planning and adoption of strategies to prevent, control and monitor SSI, aiming to minimize its occurrence and to ensure the principles of surgical patient safety.

In this sense, we ask: What are the risk factors for SSI present in patients submitted to cardiac surgery in a University Hospital?

The objective of the study was to describe the risk factors for SSI present in patients submitted to cardiac surgical procedures.

Method

This is a retrospective and descriptive epidemiological case-control study of SSI in patients submitted to cardiac surgical procedures at a large, federal, public, general University Hospital that is part of a Hospital and Outpatient Complex located in the state of Bahia, in the Northeast of Brazil, from 2011 to 2013.

A convenience sample was used. Initially, the population included all patients submitted to cardiac surgical procedures in the surgical center of the University Hospital, who had a diagnosis of infection defined in the postoperative period and who were treated while in hospital. These cases presented a confirmatory registry of SSI by the Hospital Infection Control Committee (HICC) of the hospital and were monitored during the period of interest. Then, to select the patients of the control group, the defined matching criteria were applied: patients who underwent the same surgery, of the same sex, with an age variation of ± 5 years.

The diagnosis of SSI is based on defined criteria[1]: confirmation of the infection by the attending physician; use of surveillance indicators, such as antibiotic therapy; results of examinations and cultures; in addition to the medical and nursing records available in patients' histories.

Data collection was carried out from May to December 2014, using the databases of the HICC services and the physical and electronic records of the Medical and Statistical Archive Service (MSAS), considering the research variables.

The groups of variables selected to characterize the patients' profile were particularly related to the risk factors acknowledged in the literature for the development of SSI. Hence, sociodemographic variables were collected: age, sex, color/race, origin, employment situation; background clinical characteristics: systemic arterial hypertension (SAH), diabetes mellitus (DM), cardiac conditions, respiratory disease, malnutrition/low weight, immunological diseases, chronic renal failure (CRF); and characteristics of the surgical process (hospitalization and surgery): length of preoperative hospitalization, classification of surgery (emergency), length of surgery, ASA physical status classification system and antibiotic prophylaxis.

This study received approval from the Hospital's Research Ethics Committee (REC) under Opinion 573.351 and complied with the guidelines of National Health Council Resolution 466/12 for research involving human beings.

The collected data were typed into a database created for that purpose, using the Data Analysis and Statistical Software (STATA), version 13. For the data analysis, descriptive statistics were used.

Results

According to the Annual Reports of the Hospital's HICC, there were 1,056 cases of hospital-acquired infections (HIs) in the research period. Of these, 114 (10.8%) were SSIs, 19 (16.7%) of which patients developed after cardiac surgical procedures. In 2011, there were 4 cases; in 2012 there were 10 cases; and in 2013, 5 cases. According to the proposed method, 38 controls should be analyzed, respecting the 1: 2 ratio. Thirty-one patients were analyzed though, obtaining a ratio of 1:1.63 due to the application of the matching criteria and the exclusion of cases of patients who presented an infectious process before the surgical procedure, thus totaling 50 patients studied.

Table 1 shows that, of the patients who developed SSI, 64.7% were male, and the most frequent age group was over 60 years (63.2%). Most of them self-declared mulatto, from the

interior of the state, were retired or practiced other activities, such as teacher, painter, baker, veterinarian, tourist guide, administrative technician, farmer, cook, merchant, and driver. The data also evidenced the high rates of patients with hypertension (78.9% and 83.9%) and DM (42.1% and 48.4%) among the cases and controls, respectively. Malnutrition, respiratory disease, immune disease, and CRF were less prevalent comorbidities among the patients studied.

Table 1 – Sociodemographic and clinical characteristics of patients submitted to cardiac surgery at a University Hospital. Salvador, Bahia, Brazil – 2015 (N=50)

Sociodemographic Characteristics	Patients with Surgical Site Infection CASE (n=19)	Patients without Surgical Site Infection CONTROL (n=31)
Age group		
30 to 60 years	7 (36.8%)	14 (45.2%)
Over 60 years	12 (63.2%)	17 (54.8%)
Sex		
Female	8 (42.1%)	14 (45.2%)
Male	11 (64.7%)	17 (54.8%)
Color/Race		
White	5 (26.3%)	5 (16.1%)
Black	6 (31.6%)	8 (25.8%)
Mulatto	8 (42.1%)	18 (58.1%)
Origin		
Capital	9 (47.4%)	14 (45.2%)
Interior	10 (52.6%)	17 (54.8%)
Occupation		
Retired	7 (36.8%)	14 (45.2%)
Housewife/domestic servant	4 (21.1%)	3 (9.7%)
Other activities	6 (31.6%)	13 (41.9%)
Unemployed	2 (10.5%)	-
Clinical/comorbidities		
Systemic arterial hypertension	15 (78.9%)	26 (83.9%)
Diabetes mellitus	8 (42.1%)	15 (48.4%)
Respiratory disease	2 (10.5%)	-
Malnutrition/Low weight	5 (26.3%)	3 (9.7%)
Immunological disease	1 (5.3%)	-
Chronic renal failure	1 (5.3%)	1 (3.2%)

Source: Created by the authors.

Note: Conventional signal used:
- Numerical data equal to zero not resulting from rounding.

In Table 2, we can observe that all patients – cases and control – were hospitalized more than 24 hours before the surgery. The most frequent surgical procedure was elective coronary artery bypass grafting, which took between four and eight hours. Most patients were classified as ASA III (with severe systemic disease, with functional limitation, but not disabling). The use of antibiotic prophylaxis prevailed in both groups. Most participants, including all patients in the control group, continued with the antibiotic prophylaxis for 24 hours after the surgery. Antibiotics therapy (more than 24 hours) was used in most of these patients after the procedures, including all patients in the case group.

Table 2 – Characteristics of surgical process of cardiac surgery patients at a University Hospital. Salvador, Bahia, Brazil – 2015 (N=50)

Characteristics of surgical process	Patients with Surgical Site Infection CASE (n=19)	Patients without Surgical Site Infection CONTROL (n=31)
Length of preoperative hospitalization		
More than 24 hours	19 (100%)	31 (100%)
Surgical procedure		
Coronary artery bypass grafting	13 (68.4%)	24 (77.4%)
Change/Implantation of valve or mitral prosthesis	5 (26.3%)	5 (19.1%)
Implantation of pacemaker	1 (5.3%)	-
Mitral/aortic valvuloplasty	-	2 (6.45%)
Emergency		
Yes	2 (10.5%)	-
No	17 (89.5%)	31 (100%)
Length of surgery		
Up to 2 hours	1 (5.3%)	-
2 to 4 hours	8 (42.1%)	11 (35.5%)
More than 4 until 6 hours	8 (42.1%)	18 (58%)
More than 6 hours	2 (10.5%)	2 (6.45%)
ASA*		
II	6 (31.6%)	1 (3.2%)
III	12 (63.1%)	25 (80.6%)
IV	1 (5.3%)	5 (16.1%)
Antibiotics Use		
Antibiotic prophylaxis	18 (94.3%)	30 (96.8%)
Continuation of antibiotic up to 24 hours	12 (63.2%)	31 (100%)
Antibiotics therapy for more than 24 hours	19 (100%)	21 (67.7%)

Source: Created by the authors.

Note: Conventional signal used:
- Numerical data equal to zero not resulting from rounding.

*ASA physical status classification system, adapted from American Society of Anesthesiologists[8].
ASA I: healthy, normal patient.
ASA II: patient with a mild systemic disease, without important functional limitations.
ASA III: patient with one or more moderate or severe systemic diseases, with important functional limitation.
ASA IV: patient with a severe systemic disease that is a constant threat to life.
ASA V: moribund patient who is not expected to survive without the operation.
ASA VI: a declared brain-dead patient whose organs are being removed for donor purposes.

Discussion

Considering the sociodemographic characteristics, the presence of SSI stood out in male elderly patients over 60 years of age. A study carried out in the Brazilian Southeast, involving 82 patients submitted to cardiac surgeries in the year 2015, found that SSI predominantly affected male and elderly patients, with 75.60% and 51.21%, respectively[9], corroborating the findings of this study. In that age group, many individuals are retired, which can also be evidenced in the patients studied.

In contrast, in a study conducted in Japan with data from patients submitted to cardiac surgery between 2008 and 2010, no statistical significance was found for the association of SSI with age ($p = 0.73$) and sex ($p = 0.13$)[10].

As for race/color, mulatto prevailed, self-declared by the patients, which is very typical of each region. Bahia ranks among the Brazilian states with the highest concentration of black and mestizo populations. Moreover, a large part of this population lives in unfavorable socioeconomic conditions, with greater difficulties in accessing

social opportunities and, consequently, greater limitations in health care[11].

Differences in the patients' origin were found in the literature. In this study, most patients lived in the interior of Bahia while, in a study conducted in another Brazilian state, 66.6% of the patients who developed SSI after cardiac surgery lived in the capital[12]. This divergence can be justified by the absence of services of the same or similar complexity to the research hospital beyond the limits of large urban centers, a reality common in the Northeastern states of Brazil. Thus, the constitution of regional hierarchical care networks for cardiac surgeries is an important strategy to reduce inequalities in access to health among Brazilian regions, to guarantee the quality of care and to optimize resources and costs in this area[13].

The most prevalent co-morbidities in the groups studied were hypertension and DM, particularly the former, with high rates in both patients who developed and did not develop SSI. This data is reaffirmed in a study based on the analysis of 896 medical records of patients submitted to cardiac surgery, in which SAH was present in 80.9% and DM in 42.8%[12]. Elderly patients present a greater number of problems related to chronic noncommunicable diseases. Among the problems related to the cardiovascular system, hypertension is common in this group of people.

The background diagnosis of hypertension is also the most common medical condition for the postponement or suspension of a surgery because important hemodynamic changes may occur during a surgical procedure and are more pronounced in hypertensive patients. This reality has been progressively reconsidered as the growing knowledge about the pathophysiology of hypertension, antihypertensive therapy and the development of new anesthetics and muscle relaxants with minimal hemodynamic effects, as well as postoperative pain control protocols, have contributed to reducing complications related to the perioperative period of hypertensive patients[14].

A study carried out in 16 centers specialized in cardiothoracic surgery in the Netherlands found that, among the risk factors for the development of SSI, diabetes was considered one of the most relevant comorbidities due to the pathophysiological complications that occur and hamper the healing process[14]. A meta-analysis on diabetes and risk for SSI, considering studies from 1985 to 2015, showed an association between diabetes and SSI with odds ratio (OR) equal to 1.53. The association of these factors with cardiac surgery (OR = 2.03) was also higher when compared to other types of surgeries ($p = 0.001$). Thus, these results support the consideration of diabetes as an independent risk factor for SSI and affirm that continuous efforts are needed to improve surgical outcomes for diabetic patients[15].

The clinical history observed in a recent Brazilian study with patients submitted to cardiac surgery, during a one-year period, showed a higher prevalence of hypertension (93.90%), DM (41.46%), dyslipidemia (30.48%) and smoking (23.17%)[9].

This study did not find relevance in the indices related to nutrition. In a recent Brazilian study, however, SSI was identified as the main cause of readmission in 87.5% of patients undergoing coronary artery bypass grafting and in 12.5% of those submitted to valve prosthesis implantations ($p<0.001$), being associated with obesity and dyslipidemia[16]. In contrast, in a meta-analysis that associated the Body Mass Index (BMI) - which reflects the patients' nutritional status - with SSI stated that they did not find any significant results[15].

All patients in this study, both cases and control, were hospitalized for more than 24 hours before the surgery. In a study involving 32,707 patients submitted to cardiac surgery, 40% hospitalized before the data of the surgery and 60% admitted on the same day, found that 6.7% of the infection cases occurred in patients admitted on the same day, against 8.7% in patients hospitalized earlier ($p<0.001$), and intrahospital mortality corresponded to 1.5% versus 2.8% ($p<0.001$), respectively[17]. Thus, the relationship between exposure, length of hospitalization and SSI was statistically proven. Hospitalization before the day of surgery was related to a 1.9-fold increase in the risk of infection, which is greater than that

of other comorbidities, including diabetes. In the same study, it was verified that emergency surgery and intraoperative blood transfusion were the only variables with a higher or similar risk of infection when compared to the length of hospitalization prior to the day of the procedure.

Emergency surgeries constitute a risk factor for the occurrence of SSI, as patients often present unstable clinical conditions and even death risk. In addition, the reduced time to perform the anesthetic-surgical procedure can often interfere in the preoperative preparation, such as in skin antisepsis and antibiotic prophylaxis, as well as in the alteration of the surgical technique adopted, since it requires fast organization in order to match priorities. Conditions such as shock, hypoxemia, hypothermia, blood transfusions and improper antibiotic prophylaxis, which are commonly present in emergency situations, are factors predisposing to infection[18].

In this study, in the case group, 10.5% of the patients needed emergency surgery, while all surgeries in the control group were elective. Based on these results, it could be inferred that emergency surgeries were directly related to the development of SSI in these patients undergoing cardiac surgery.

In this study, the low percentage of patients who underwent emergency surgery is due to the fact that the hospital where the study was developed does not have an emergency service as the entrance door, and patients are admitted through bed regulation, other services or the outpatient clinic.

Cardiac surgical procedures, due to the need to manipulate noble and delicate organs, require longer preparation, surgery, and hospitalization. These aspects increase the risk for postoperative complications, including the occurrence of SSI. There are many factors that may influence the increased risk of SSI directly related to the patient, the environment, the technique and the care provided[19]. These complications, in addition to extending the patient's hospital stay, generate high costs for institutions that are increasingly adopting institutional protocols for safe surgery[20].

For both the case and control groups, similar lengths of surgery were found, so that it cannot be inferred that this factor was relevant for the occurrence of SSI. Not many studies have been identified that address the relationship of these factors. In a study with Japanese patients undergoing cardiac surgery, however, a significant ($p < 0.0001$) association was found[10].

The ASA classification ranges from I to V, from the best to the worst clinical condition, respectively, while VI classifies the brain-dead patient[8]. It is the most used method for preoperative clinical patient assessment and represents a risk factor for the occurrence of SSI, that is, the more severe the patient's clinical condition, the higher the occurrence of infections, including SSI[21]. In a study carried out with Japanese patients undergoing cardiac surgery, it was observed that the duration of the surgery and a high ASA score were significant predictors of SSI risk[10]. In this study, the ASA classification that prevailed between the case and control groups of patients undergoing cardiac surgery was ASA III, in which the patient has one or more moderate or severe systemic diseases with important functional limitation, such as badly controlled DM or SAH, chronic obstructive pulmonary disease, morbid obesity, active hepatitis, alcohol addiction, presence of cardiac pacemaker, moderate reduction in ejection fraction, CKD in regular dialysis, premature birth, history of acute myocardial infarction more than three months earlier, stroke, transient cerebral ischemia or coronary stents[8].

Regarding the prophylaxis and treatment of SSI, there is a consensus on the administration of antimicrobials. Taking into account studies and instruction manuals[4,19] on the use of prophylactic antibiotics in surgeries in the different medical specialties, many health services elaborate their protocols, adapting the use to their characteristics and needs.

Overall, these guidelines suggest that prophylaxis for up to 48 hours may be appropriate for cardiac procedures in order to avoid CSI, due to the need to perform several

invasive procedures secondary to the surgical process, such as cardiopulmonary bypass, use of venous and urinary invasive devices, blood transfusion and others[22-24].

Regarding this aspect, it is worth noting that, in this study, the continuation of antibiotic prophylaxis in the control group, not affected by SSI, corresponded to 100%. Among the patients who developed SSI, on the other hand, only 63.2% maintained it; the other part used the antibiotics only during the intraoperative period. Other studies show the same non-compliance with the guidelines regarding the use of antibiotics in the perioperative period and analyze the impact of this action[24-25].

A multicenter study conducted in Brazil on the factors related to the lack of compliance with the use of the institutional protocols of antibiotic prophylaxis in the perioperative period concluded that most of the professionals involved in the surgical process knew the institutional guidelines and stated that the main problems for the lack of compliance with the proper and recommended use were the lack of discipline in the surgical center and the non-disclosure of guidelines for the use of antibiotic prophylaxis[25]. Thus, innovative solutions are needed in this area, as the current conventional intervention methods are not producing the desired results.

Hence, identifying the risk factors associated with one type of infection is quite complex, as factors that determine the infection frequently occur simultaneously. In this sense, effective prevention occurs through the concomitant control of these risk factors.

The surgical process requires that its actors work in harmony, in this case, health professionals, especially nurses and physicians involved, responsible for performing most care and assistance provided to surgical patients during the perioperative period, turning professional practice into a powerful tool for quality and safety in this context.

This study was local, developed in a single hospital service, and its results cannot be extrapolated to other hospital services. The main limitation of the study is related to the small sample and its inability to statistically determine the association between risk factors and the occurrence of SSI in this population. Other limitations were related to the difficulty to get access to physical records, determined by the storage and organization conditions and absent or improper records. Nevertheless, important and similar risk characteristics could be shown for groups of exposed patients. Therefore, the implantation and continuous use of a comprehensive database of surgical information, involving the pre, intra and postoperative periods, can expand this knowledge and support more robust future work in the different surgical specialties.

This study is intended to contribute to the health service and its professionals, in order to subsidize knowledge and strategies to reduce SSI-related morbidity and mortality rates in cardiac surgeries, considering that the place of study is a reference service for cardiological surgeries in the Unified Health System in the region, as well as being a renowned teaching hospital for health professionals in Brazil.

Conclusion

The results showed similarities in the risk factors that may influence the occurrence of SSI, both in patients who developed and did not develop this infection. The results corroborate the vast literature on the risk factors related to this complication.

It is concluded that the risk factors for surgical site infection in patients submitted to cardiac surgeries require that the professionals involved in the process exert greater control to reduce the rates of these complications.

In the characterization of the patients submitted to cardiac surgical procedures in the hospital studied, in both cases and controls, risk factors such as preoperative hospitalization for more than 24 hours, compromised physical status (ASA III) , chronic diseases such as hypertension and DM, and discontinuous and non-uniform use of antibiotic prophylaxis could be observed.

The high number of SSI cases in the postoperative period of cardiac surgical

procedures and all characteristics described in this study require that the perioperative health team possesses greater knowledge and takes further initiatives to implement more effective measures for the control of risk factors that may be related to the development of these infections, identifying potential problems and acting to ensure safety in the care of surgical patients and reduction of morbidity and mortality.

Collaborations:

1. conception, design, analysis and interpretation of data: Cláudia Silva Marinho Antunes Barros, Luana Stela de Araújo Castro, and Marimeire Morais Conceição;

2. writing of the article and relevant critical review of the intellectual content: Cláudia Silva Marinho Antunes Barros, Ana Lúcia Arcanjo Oliveira Cordeiro, Luana Stela de Araújo Castro, Marimeire Morais Conceição, and Márcia Maria Carneiro Oliveira;

3. final approval of the version to be published: Cláudia Silva Marinho Antunes Barros, Ana Lúcia Arcanjo Oliveira Cordeiro, and Márcia Maria Carneiro Oliveira.

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