Surgical procedures and their correlation with the rate of nosocomial infection: negative impacts on the recovery process of inpatients in the Paraense Amazon

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Abstract— *The study aimed to bring current data on hospital infections, identifying the number of infections in four years in five hospitals in western Pará (Brazil). Data collection was carried out by consulting the information bank of the Health Department of the Municipality of Santarém. These hospitals operate in the municipality of Santarém, in the northern region of Brazil. Public or private hospitals that perform surgical procedures were used as inclusion criteria. The study identified that the Regional Hospital of Baixo Amazonas has the highest rates of nosocomial infections and that bloodstream infection was the most frequent in this unit. In addition, there was a notable correlation between the total number of surgeries performed in hospitals and the total number of deaths from nosocomial infections and between the total number of infections and the total number of deaths from infections.*

Keywords—*Hospital infection, Amazonia, surgical procedures.*

I. INTRODUCTION

Hospital infection (HI) is one acquired after the patient's admission to the hospital and whose manifestation is triggered during hospitalization or after discharge [1], which may be related to the patient's clinical condition and procedures (such as bladder catheterization, access venous tube, nasogastric tube, complex surgeries, among others) performed by the health team in the hospital. Scholars claim that from the moment that patients started to be treated in hospitals, the transmission of infectious agents in the hospital environment became a cause for concern, since the occurrence of this contributes to the development of complications in the clinical picture and to increased risk of death, especially for more serious and immunocompromised clients [2].

In view of this concern, strategies were created in Brazil to prevent infections (such as those in the bloodstream, surgical sites, intestinal, respiratory and digestive tracts, and in other topographies) in hospital environments. Among these strategies are the Hospital Infection Control Commissions (CCIH), which are responsible, basically, for standardizing measures to prevent the transmission of microorganisms from one patient to another (both directly and indirectly [3], and from patient to patient. health professionals and vice versa.

Despite the existence of this Commission, hospital infection rates in Brazil are still considered high. In 2000, the IH prevalence rate of the reference and teaching hospitals, located in the capital Teresina, was released, and is presented as follows: Hospital Areolino de Abreu, 37.7%; Maternity Dona Evangelina Rosa,

11.3%; Children's Hospital Lucídio Portela, 35.7%; Hospital for Infectious-Contagious Diseases , 23.7%, and Hospital Getúlio Vargas, 31.1%. Thus, the prevalence of IH in the five reference hospitals in Teresina was 27.9% [4], that is, 12.9 % more than the prevalence registered at the national level, which is 15 %, according to the data from the Ministry of Health [5]. In addition to these significant results, other researchers estimate the occurrence of great variation in the coefficients of lethality due to nosocomial infection, ranging from 9 to 58%, reaching 40% among bloodstream infections, according to a multicenter study in Brazilian hospitals [6].

Given such statistical data, there is a need to invest in research focused on the theme, since through these, it is possible to identify whether factors such as the complexity of hospitals, the demand for care and the techniques used during hospital procedures, are contributing to the occurrence of the rates presented, and from that, investing even more in actions that aim to inspect, control and reduce the rates of nosocomial infections in Brazil and in the world. With the above, the study aimed to bring current data about hospital infections, identifying the amount of infections in four years in five hospitals in the west of Pará (Brazil), and correlates ing these infection rates to the number of surgeries performed in hospitals and the coefficient of deaths from infection found in these same units.

II.   METHODOLOGY

It is a quantitative, analytical, cross-sectional research, being a modality of epidemiological study in which factor and effect are observed in the same historical moment . P odemos investigate "cause" and "effect" simultaneously and determine the association between exposure and disease. Its main advantage is to generate information necessary to understand the endemic-epidemic process and thus subsidize intervention strategies [7].

Data collection was carried out by consulting the information bank of the Health Department of the Municipality of Santarém, through audits. These hospitals, targets of the research, operate in the municipality of Santarém, located in the west of the state of Pará, in the northern region of Brazil. Public or private hospitals that performed surgical procedures were used as inclusion criteria.

The data were tabulated in the Microsoft Excel 2010 software and analyzed using SPSS 20.0. The Chi- square test was used to assess the types of infections per hospital and in which hospital would be the most incident, ANOVA to evaluate comparisons of infections in all hospitals. Spearman 's coefficient to assess the correlation between the total number of surgeries and the total number of hospital infections, the correlation between the total number of surgeries and deaths from hospital infections and the correlation between the total number of hospital infections and the total number of deaths resulting from such infections.

III.   RESULTS

The present study reveals that the occurrence of HI in the evaluated hospitals is significant. The data in Table 1 show among the hospitals which stands out considerably, in comparison with the others, in each type of infection and which infection was more frequent, in comparison with the others, in the same hospital. The result of the ANOVA Test (0.0002) identified that among hospitals the one with the highest rate of infection of the urinary tract, respiratory tract, bloodstream, surgical site and in other topographies is the Hospital Regional do Baixo Amazonas (HRBA) . The Santarém Municipal Hospital (HMS), in turn, stood out in terms of the incidence of skin and soft tissue infections and the intestinal tract.

Table 1. Chi-square test to assess types of infections by hospital and ANOVA to assess comparisons of infections in all hospitals

	HRBA	HMS	HMSF	HUOP	HIC	P
Urinary tract infection	50	32	0	1	1	<0.0001
Respiratory tract infection	53	24	0	0	4	<0.0001
Bloodstream infection	**75**	22	1	0	5	<0.0001
Infections in other topographies	58	19	3	1	**15**	<0.0001
Surgical site infection	60	**59**	**27**	3	4	<0.0001
Infection of skin and soft tissues	4	14	2	**9**	3	0.0033
Intestinal tract infection	0	14	0	0	4	Ns
P	<0.0001	<0.0001	Ns	ns	0.0005	0.0002

* HRBA - Regional Hospital of Baixo Amazonas, * HMS - Municipal Hospital of Santarém, * HMSF - Hospital and Maternity Sagrada Família, * HUOP - Hospital Unimed Oeste do Pará, * HIC- Hospital Imaculada Conceição, * ns - does not apply, * p- statistical significance.

The result of the Chi-square test reveals that in HRBA, the most incident infection was that of the bloodstream; in HMS and HMSF the greatest number of infections were those in the surgical site; in HUOP, skin and soft tissue infections were the most frequent; and in HIC, there was a greater occurrence of infections in other topographies.

Table 2. Spearman 's coefficient to assess the correlation between total surgeries and total hospital infections.

	Total surgeries	Total hospital infections
HRBA	3971	255
HMS	3879	188
HMSF	2091	31
HUOP	1272	16
HIC	1058	36
coefficient Spearman	0.7000	
P	0.1881	

* HRBA - Regional Hospital of Baixo Amazonas, * HMS - Municipal Hospital of Santarém, * HMSF - Hospital and Maternity Sagrada Família, * HUOP - Hospital Unimed Oeste do Pará, * HIC- Hospital Imaculada Conceição, * p- statistical significance.

In this research, the Spearman Coefficient (0.7000), shown in Table 2, detected that there is no significant correlation between the total number of surgeries and the total number of nosocomial infections in the evaluated hospitals.

Table 3. Spearman 's coefficient to assess the correlation between total surgeries and deaths from nosocomial infections.

	Total surgeries	Deaths from hospital infections
HRBA	3971	40
HMS	3879	24
HMSF	2091	0
HUOP	1272	0
HIC	1058	0
coefficient Spearman	0.8944	
P	0.0405	

* HRBA - Regional Hospital of Baixo Amazonas, * HMS - Municipal Hospital of Santarém, * HMSF - Hospital and Maternity Sagrada Família, * HUOP - Hospital Unimed Oeste do Pará, * HIC- Hospital Imaculada Conceição, * p- statistical significance.

The Spearman coefficient (0.8944), shown in Table 3, detects that the greater the number of surgeries, the greater the probability of deaths from IH. This fact is triggered since the surgical center is one of the most critical areas of the hospital environment, considering that the activities performed in it are of high potential for contamination, which can lead to the occurrence of deaths from IH. However, despite the relevant coefficient found, there are no similar or corroborative results in the literature, which reinforces the need for further research addressing the subject studied.

Regarding the data obtained in Table 4, the Spearman coefficient shows that there is a significant correlation (0.8944) between the total number of hospital infections and the total number of deaths resulting from such infections.

Table 4. Spearman 's coefficient to assess the correlation between total hospital infections and total deaths from such infections.

	Total hospital infections	Deaths from hospital infections
HRBA	255	40
HMS	188	24
HMSF	31	0
HUOP	16	0
HIC	36	0
coefficient Spearman	0.8944	
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* HRBA - Regional Hospital of Baixo Amazonas, * HMS - Municipal Hospital of Santarém, * HMSF - Hospital and Maternity Sagrada Família, * HUOP - Hospital Unimed Oeste do Pará, * HIC- Hospital Imaculada Conceição, *p- statistical significance.

IV. DISCUSSION

The coefficient found by the ANOVA Test in relation to the HRBA, may be due to the fact that this institution provides medium and high complexity care to patients in serious condition and who need major procedures. Therefore, for meeting a demand with a high degree of vulnerability of the immune system, and for the possible existence of technical failures by health professionals during the execution of hospital procedures (such as bladder catheterization, venous access, complex surgeries, mechanical pulmonary ventilation, among others.), the urinary tract infection index, respiratory tract, blood flow, surgical site and other topographies in this unit, were more expressive when compared to the other institutions evaluated.

As for the fact that the HMS has the highest amount of infection of the skin and soft tissues and of the intestinal tract, it should be noted that this situation may have occurred due to inadequate asepsis of the environment, to the immune system of the individuals, to insufficient nutritional supply for recovery. the clinical picture, the long period of hospitalization to which patients are submitted to this unit, which provides a greater risk of developing pressure ulcers and consequently infectious foci, in addition, the inputs may not have been sufficient to meet all demand assisted (taking into account that the HMS receives patients from over 22 municipalities across Pará).

Another issue that can be raised about this high quantity in the HMS, are the care of the health team, especially nursing, which may not have been adequate, given that in most municipal hospitals in Brazil there is a disproportionality between the number of patients professionals and the number of customers.

Although HRBA and HMS have the highest rates of HI, we can consider that it is not only these that have this high incidence, but that there have been cases of underreporting in other hospital institutions, since the HI commissions have not yet been put in place. practice in its entirety. Researchers claim that underreporting not only translates into unreal infection rates in a given service, but also prevents the implementation of effective measures to control and prevent its complications [8].

Regarding the results obtained from the Chi-square test , only the incidence of infection in the bloodstream of HRBA was similar to that found in other studies conducted in Brazil. At the State Hospital of Surumé -SP, in 2011, it was observed that bloodstream infection was also the most frequent, affecting 97 patients (72.9%), constituting 38.2% of the total of 254 infections . In other studies carried out, the incidence of infections in surgical sites, skin and soft tissues and in other topographies, were the lowest found in hospitals, a result that corroborates that obtained in this research. In an analysis performed at a large University Hospital in the city of Belo Horizonte in the years 2009 and 2010, infections of the surgical site, skin and other topographies such as: eye, ear, nose, mouth, each represented only 2.9% of all infections [9,10].

These results presented, mainly with regard to the findings of bloodstream infection, reinforce the idea that the innumerable invasive procedures (such as central and peripheral venous access) performed in hospital units, combined with the disuse of PPE's , and the inadequacy of sepsis and antisepsis employed during the performance of

such procedures, can increase the rate of infection in this topography in hospitals in Brazil.

Regarding the results found in other research regarding infection at the surgical site, certain reflections are generated, since the surgical procedure is one of the procedures in which the patient is more likely to acquire infections due to the exposure to which he is submitted, despite In addition, research shows that the coefficient of infections in this region is still not significant. This means that the number of surgical procedures performed in a hospital will not necessarily lead to an increase in infection rates.

The result of the Spearman coefficient (0.7000), shown in Table 2, reinforces the thesis that the surgical procedure is not the only determinant of the occurrence of HA. It is necessary to remember that there are endogenous and exogenous sources to the patient that also contribute to the development of these infections. Among several scholars, there is a consensus that about 70% to 80% of hospital infections are of endogenous origin, that is, they are due to predisposing diseases or clinical conditions, which aggravate the patient's susceptibility [11]. The exogenous infection, in turn, caused by microorganisms from the hospital sector (present in the environment, in the hands of professionals or in the instruments used in the patient), also contributes widely for the client to acquire the infection.

From the above, it is clear that the surgical act itself, when combined with endogenous and exogenous factors, can be considered a risk factor for the development of IH and also for the occurrence of deaths from these infections. The following tables identify precisely the correlation between the total number of surgeries performed in hospitals with the total number of deaths from IH and the correlation between the total number of hospital infections and the total number of deaths resulting from such infections, respectively.

In Brazil, this problem is considered serious considering that 720,000 people are infected in Brazilian hospitals per year and, of these, 144,000, that is, 20%, evolve to death. In a study carried out in a pediatric teaching hospital in São Paulo, of the 69 deaths that occurred in 1993, nosocomial infection was the direct cause of death in 30.4% of children, another 50.8%, the infection contributed to death . In another study carried out at a University Hospital in Belo Horizonte in 2009 and 2010, of the 254 patients followed, 60 (23.6%) died. In the analysis of patients who died, 5 (8.3%) were colonized by resistant microorganisms and 9 (15%) had infections related to health care [12,2,10].

In view of the relevance of the statistical results presented, it is reinforced how important it is that the actions of the Hospital Infection Control Program are actually carried out in hospital units, in order to change the current Brazilian scenario regarding the theme. Brazil, despite many efforts, still faces an adverse reality of what can be considered satisfactory: lack of human and material resources in health institutions (mainly public ones), absence of Hospital Infection Control Commission working in most hospitals , or even, professionals exercising the function without adequate knowledge of the activity - which results in an increase in hospital infection rates in the country [3].

V. CONCLUSION

The study identified that the Hospital Regional do Baixo Amazonas has the highest rates of most hospital infections and that bloodstream infection was the most frequent in this unit. In addition, there was a notable correlation between the total number of surgeries performed in hospitals and the total number of deaths due to nosocomial infections and between the total number of infections and the total number of deaths resulting from infections.

Such results reinforce the thesis that the studied theme is an important problem to be debated and evaluated. It is known that in many hospitals, situations such as work overload and the disproportionate relationship between the number of patients and the team contribute to routine breaks in preventive procedures, such as hand hygiene. Because of this situation, the coordination of hospital institutions needs to continually develop strategies to inhibit the occurrence of inappropriate habits by health professionals, and thus contribute to reducing the incidence of infections in hospitals.

One of the strategies that could be adopted would be the educational actions, since they allow the reflection of the performance of each one and provide the learning and modification of improper practices carried out on a daily basis. In addition, another strategy that could be adopted by health teams and academic researchers, would be aimed at the constant conduct of research on HI, since through these, they would present current data that would allow understanding the epidemiology of these infections, and from that, reduce the share of morbidity, mortality and hospital expenses, directing control measures for infections.

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