

Original Article

Influence of Infrastructure on the Incidence of Hospital-Acquired Infections in a University Hospital

Influência da Infraestrutura na Incidência de Infecções Relacionadas à Assistência em um Hospital Universitário

Influencia de la Incidencia de Infecciones Relacionadas a la Asistencia en un Hospital Universitario

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ABSTRACT

Background and Objectives: hospital infrastructure is regulated by RDC nº 50/2002 of ANVISA. This regulation aims to ensure minimal conditions for the prevention of harm to health workers and patients, such as hospital-acquired infections (HAI). With the objective of analyzing the occurrence of HAIs among inpatients of the hospital, we compared the period in which the hospital operated at an old building (that did not comply with current regulation) and at a new building, built according to the regulation. **Methods:** the sample comprised 1,240 HAI notifications from patients in the hospital from 2015 to 2017. In 2015 and 2016 the hospital operated at the old building, and in 2017 it was in the new building. Notifications on active search and telephone surveys were used for data collection and statistical analysis. The project was approved by the Research Ethics Committee protocol no. 72613517.9.0000.5020. **Results:** the monthly frequency of HAIs ranged from 28 to 63 cases in 2015; from 0 to 79 in 2016; and from 0 to 74 in 2017. The prevalence was between 3.9 and 8.3 in 2015; between 0 and 23.3 in 2016; and between 0 and 2.7 in 2017. Incidence ranged from 9.5 to 20.4/1000 patients in 2015; from 0 to 27.4/1000 patients in 2016; from 0 to 27.4/1000 patients in 2017. **Conclusion:** there were no significant statistical differences within the analyzed period. Although it could contribute to avoid infections, infrastructure does not seem to be a determining factor for the occurrence of such infections.

Descriptors: Hospital Infection; Infection Control; Patient safety.

RESUMO

Justificativa e Objetivos: A infraestrutura hospitalar é regulada pela RDC nº 50/2002, da ANVISA. Esta norma visa garantir parâmetros mínimos para a prevenção de danos aos trabalhadores da saúde e pacientes, como as Infecções Relacionadas à Assistência à Saúde (IRAS). Com o objetivo de analisar a ocorrência de IRAS em pacientes internados em hospital, comparou-se os períodos de funcionamento em um prédio antigo (inadequado às normas vigentes) e em um prédio novo, construído conforme as normatizações. **Métodos:** A amostra compreendeu 1.240 notificações de IRAS de pacientes de 2015 a 2017. Sendo que em 2015 e 2016 o hospital funcionava no prédio antigo e em 2017 no prédio novo. As notificações em fichas de busca ativa e fonada, foram utilizadas para a coleta de dados e análise estatística. **Resultados:** A frequência mensal de IRAS em 2015 variou de 28 a 63 casos; em 2016, de 0 a 79; em 2017, de 0 a 74. A prevalência em 2015 foi de 3,9 a 8,3; em 2016, de 0 a 23,3; em 2017, de 0 a 2,7. A incidência foi de 9,5 a 20,4/1000 pacientes em 2015; de 0 a 27,4/1000 em 2016; de 0 a 27,4/1000 em 2017. **Conclusão:** não houve diferenças estatisticamente significativas no período analisado. Embora possa contribuir para evitar infecções, a infraestrutura física não parece determinante para a ocorrência das infecções. **Descritores:** Infecção Hospitalar; Controle de Infecções; Segurança do Paciente.

RESUMEN

Justificación y Objetivos: la infraestructura hospitalaria es regulada por la RDC n° 50/2002, de ANVISA. Esta norma visa garantizar parámetros mínimos para la prevención de daños a los trabajadores de la salud y pacientes, como las infecciones relacionadas a la asistencia a la salud (IRAS). Con el objetivo de analizar la ocurrencia de IRAS en pacientes internados en el hospital, se comparó los períodos de funcionamiento en un predio antiguo (inadecuado a las normas actuales) y un predio nuevo, construido conforme las normativas. **Métodos:** la muestra comprendió 1.240 notificaciones de IRAS de pacientes de 2015 a 2017. Siendo que en 2015 y 2016, el hospital funcionaba en el predio antiguo y en 2017, en el predio nuevo. Las notificaciones en fichas de búsqueda activa y telefoneada fueron utilizadas para la recolección de datos y análisis estadística. El proyecto fue aprobado por el Comité de Ética en Pesquisa con Seres Humanos, protocolo n° 72613517.9.0000.5020. **Resultados:** la frecuencia mensual de IRAS en 2015 fue desde 28 hasta 63 casos; en 2016, desde 0 hasta 79; en 2017, desde 0 hasta 74. La prevalencia en 2015 fue desde 3,9 hasta 8,3; en 2016, desde 0 hasta 23,3; en 2017, desde 0 hasta 2,7. La incidencia fue desde 9,5 hasta 20,4/1000 pacientes en 2015; desde 0 hasta 27,4 en 2016; desde 0 hasta 27,4 en 2017. **Conclusión:** no hubo diferencias estadísticamente significativas el período analizado. Además de poder contribuir para evitar las infecciones, la infraestructura física no parece ser determinante para la ocurrencia de infecciones. **Descriptor:** Infección Hospitalaria; Control de Infecciones; Seguridad del paciente.

INTRODUCTION

Hospital-acquired infections are a major problem in healthcare facilities. To fight this problem, strenuous efforts to comply with legal precepts are necessary, because if it is avoided, professional performance is harmless.¹

Hospital infections (HI), currently known as hospital-acquired infections (HAIs), have received more specific attention in recent years due to the large number of cases recorded in health environments and their aggravating factors, leading to several complications in patients' prognostic.²

At a scientific level, there have been advances in infection control every year since the 17th century, when health care was carried out in an empiric manner. However, with new discoveries and research in the area, now there is a stronger scientific basis for the implementation and application of standards that favor the provision of more qualified health care.³

In Brazil, the institution responsible for establishing regulations and monitoring compliance is the Ministry of Health (MS) and the National Health Surveillance Agency (ANVISA), which annually gathers data from health institutions and provides technical updates on procedures that must be followed in the hospital routine.²

The Ministry of Health implemented, in Ordinance No. 2,216, of 1998, the Hospital Infection Control Service, which is responsible for the control and prevention of HAIs, reducing their incidence and severity.⁴⁻⁵ In the Hospital Infection Control Commission (HICC), the work of nurses is essential for the development of services, as these professionals are responsible for inspecting the units and the work of health professionals, preparing and updating standard operating procedures, performing epidemiological surveillance of HAIs, conducting active search and telephone surveys, and strengthening the knowledge of professionals through permanent and continuing education, among other functions.⁵ The data collected in active search and telephone surveys are analyzed according to ANVISA's diagnostic criteria for HAIs, available in their free

technical manuals on the website: <https://www.ccih.med.br/anvisa-lanca-segunda-edicao-dos-criterios-diagnosticos-das-iras/>

Some types of infections are more frequent in hospitals: lower respiratory tract infections associated with mechanical ventilation (VAP); catheter-related bloodstream infections (CRBSI); urinary tract infections (UTI), related or not to the use of indwelling urinary catheter; and surgical site infections (SSI) related to invasive surgical procedures.⁶

Society is constantly changing and needs in all sectors of society are always expanding. In hospital units it is no different, and they need to expand and reformulate their infrastructure to satisfy the customer and provide quality comprehensive assistance.⁷ This can influence behavioral changes in the multi-professional health team, increasing adherence to practices aimed at patient safety and infection control, such as hand hygiene.

A university hospital in the North Region of Brazil was subjected to major structural changes, that transformed an old infrastructure, that did not comply with the legislation in force, in a more modern institution, compatible with the regulations. Thus, the objective of this research was to compare the incidence of HAIs in patients admitted to this hospital, before and after changes in physical facilities.

MATERIALS AND METHODS

This is a quantitative, cross-sectional, retrospective study, with the definition of a guiding question. The study population comprises all individuals hospitalized for diagnostic or therapeutic procedures at the University Hospital (UH), in the years 2015 and 2016, when the hospital operated in the old building, that did not comply with current regulations and in 2017, when the hospital operated in the new building, built in accordance with current legislation. The project was approved by the Research Ethics Committee of the Federal University of Amazonas, through the CAAE protocol: 72613517.9.0000.5020.

Data were collected from the active search and telephone survey forms of the Hospital-Acquired Infection Control Service (HAICS), from patients classified as having HAIs. The HU is a medium-sized hospital with 150 beds; 1,900 to 4,400 patients/day per year; occupancy rate between 45% and 98% throughout the year; and around 25 and 48 patients diagnosed with HAIs per month. The change from the old building to the new building occurred from December 2016 to March 2017. Considering these indicators, the diagnosed infections that met ANVISA's diagnostic criteria for HAIs, according to the hospital's infection control team, were included in our study.

A total of 1,240 notifications of nosocomial infections were evaluated in active search forms from 2015 to 2017. Data collection was performed using the HAICS database. It is a physical and electronic database, with records of all patients investigated and diagnosed with HAIs and their respective classification according to ANVISA criteria.

It is worth noting that the cases of surgical site infections, unlike the others, were collected both by active search, in the inpatient units, and by telephone monitoring, carried out by the infection control team. This follow-up is performed with all surgical patients 30 days after the

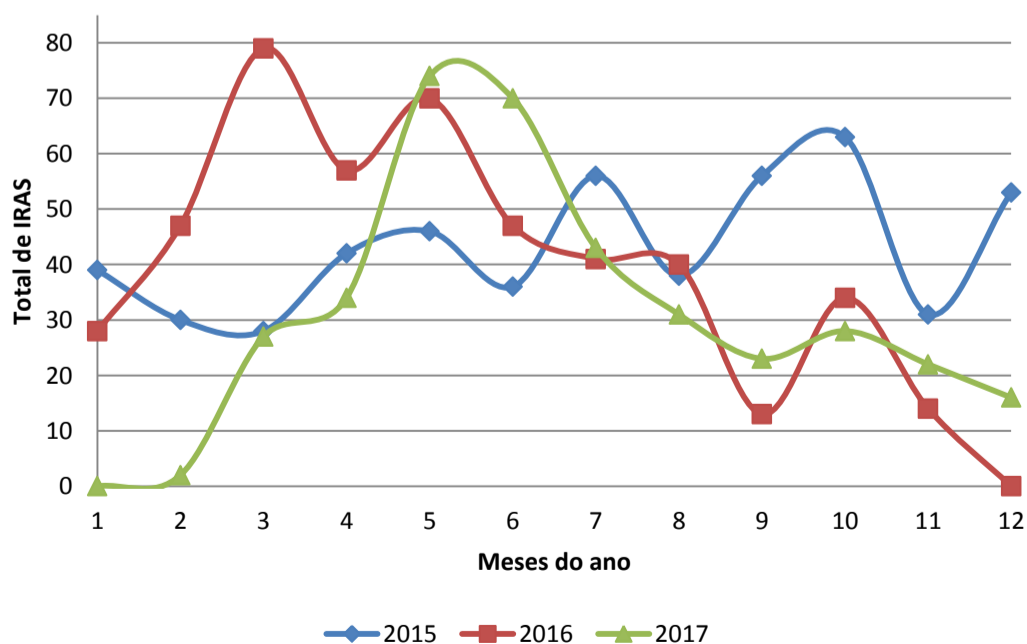
procedure and with patients undergoing video surgery or using prostheses at 60 and 90 days after the surgical procedure.

The incidence of HAIs was compared using descriptive and inferential statistical data, obtained through the HAI database for the years 2015, 2016 and 2017. HAICS/HUGV computers and Excel® software were used as resources for tabulation of data and elaboration of tables and figures. The SPSS® software was used to perform Kruskal-Wallis tests, to assess whether there was a statistically significant variation in the values collected in the years analyzed.

The results of this research did not pose direct risks to its participants. Since it was a collection of documentary data – diagnostic data of HAIs notified by the professionals of HAICS at the UH – there were no changes in medical diagnosis and therapeutic decisions for hospitalized patients and the researchers made no interventions in the routine practices of the hospital. The findings of this study, however, may diverge from the statistics on incidence and prevalence of HAIs in the UH previously provided by the HAICS team, since data from 2015 and 2016 were adapted to the new HAIs nomenclature, due to the update of diagnostic criteria by ANVISA in 2017.

RESULTS

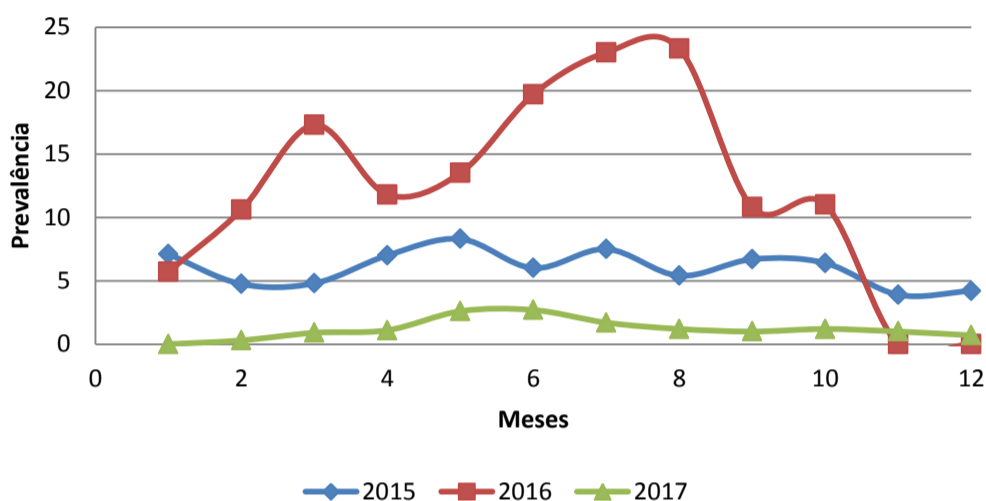
Evaluating the three-year period, there is an annual mean of 54.3 records of infections. Regarding the HAIs identified, there is a change in the distribution pattern over the months, in each year analyzed. In 2015, March had the lowest number of cases of HAIs (28) and October had the highest, with 63 HAIs (**Figure 1**). In 2016, there were no cases of HAIs in December and the peak was in March, with 79 HAIs notified. In 2017, there were no cases in January and 74 cases in May. It is worth noting that between December 2016 and March 2017, when the hospital was in the transition from the old to the new building, admissions were suspended and only patients who could not be discharged from the institution were kept. According to the Kruskal-Wallis test, there were no statistically significant differences in the occurrence of HAIs over the months, in the three years, comparing the years individually.



Total of HAIs // Months

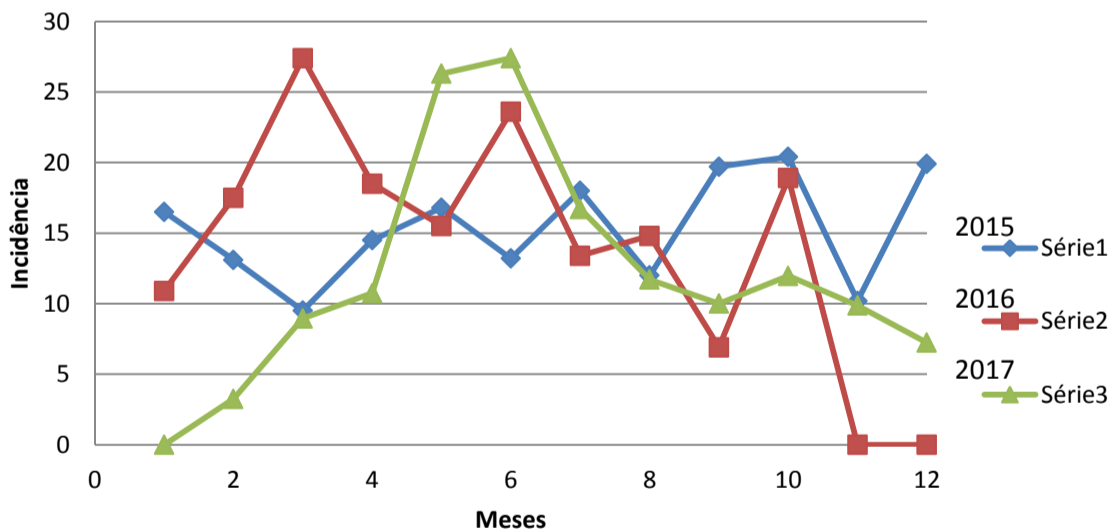
Figure 1. Monthly distribution of total number of HAIs at the university hospital over the three-year period.

The prevalence of HAIs was stable in the three-year period (**Figure 2**). In 2015, the prevalence ranged from 3.9 to 8.3; in 2016, from 0 to 23.3; and, in 2017, from 0 to 2.7. In the comparison between the three years, the apparent variations showed no statistically significant difference in the comparison between the years, according to the Kruskal-Wallis test. The incidence of HAIs also oscillated, with no statistically significant difference; in 2015, it varied from 9.5 to 20.4/1000 patients; in 2016, from 0 to 27.4/1000 patients; and in 2017, from 0 to 27.4/1000 patients (**Figure 3**).



Prevalence // Months

Figure 2. Prevalence of HAIs over the months, in the three-year period evaluated.

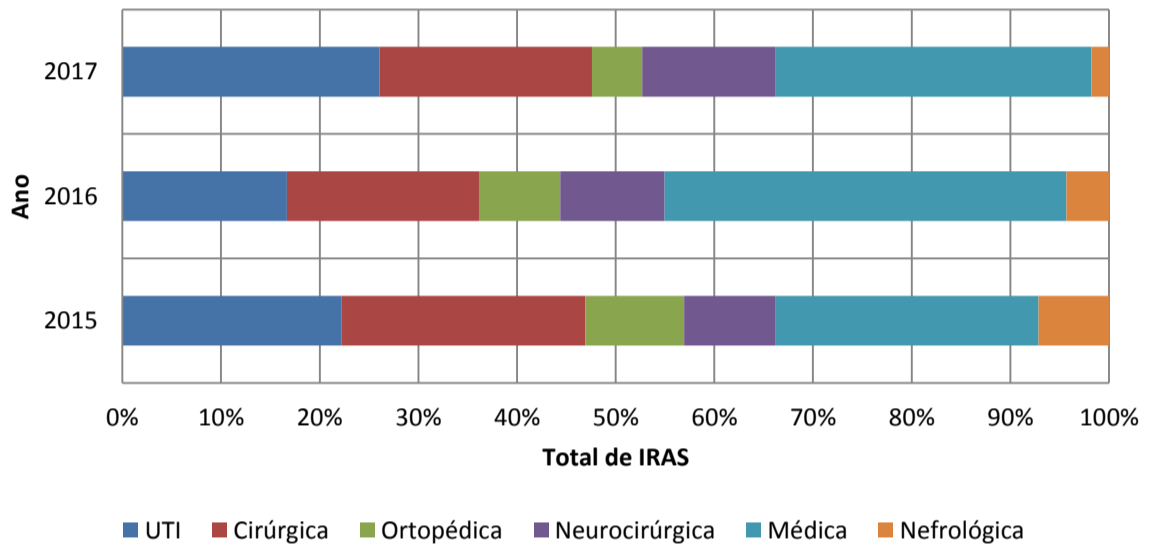


Incidence // Months

Figure 3. Incidence of HAIs/1,000 patient-days over the months, in the three-year period evaluated, at the University Hospital.

When analyzing the occurrence of HAIs by hospitalization (**Figure 4**), the hospital department with the highest number of HAIs in the three-year period was the Medical Clinic (138 HAIs in 2015, 188 in 2016 and 107 in 2017), followed by the Surgical Clinic (128 HAIs in 2015 and 90 in 2017) or Intensive Care Unit (87 HAIs in 2017). Regarding the distribution of HAIs by

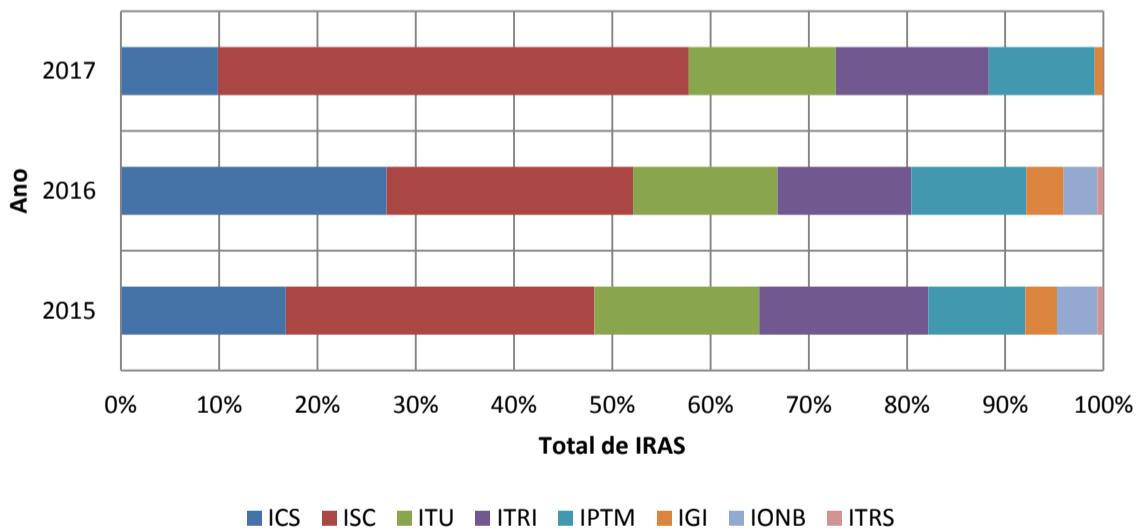
body topography (**Figure 5**), there was a predominance of SSIs in 2015 (146 cases), with almost two times the number of the second most frequent HAI, Lower Respiratory Tract Infection (LRTI), with 80 cases. In 2016, the occurrence of BSI stands out, with 127 cases, followed by the occurrence of 118 SSI. In 2017, the occurrence of SSI once again stands out, with 160 cases; this number is almost three times greater than that of the second most frequent HAI, LRTI, with 52 cases. The variations in the occurrence of each group of HAIs by clinic or by body topography were not statistically significant when comparing each group, independently, over the three-year period.



Year // Total of HAIs

ICU // Surgical // Orthopedic // Neurosurgery // Medical // Nephrological

Figure 4. Annual distribution of HAIs per clinic at the University Hospital.



Year // Total of HAIs

BSI // SSI // UTI // LRTI // SSTI // GI Infection // EENT // URTI

Figure 5. Annual distribution of HAIs, by body topography of patients at the University Hospital, over the three-year period. BSI (Bloodstream infection), SSI (Surgical site infection), UTI (Urinary tract infection), LRTI (Lower respiratory tract infection), SSTI (Skin and soft tissue infection), GI infection (Gastrointestinal infection), EENT (Eye, Ear, Nose, and Throat Infection), URTI (Upper respiratory tract infection).

DISCUSSION

The physical structure of health institutions in Brazil is regulated by ANVISA, through RDC No. 50/2002.⁷ This document regulates not only the aesthetic standards for the physical structure of the institution, but also the minimum conditions necessary for the execution of diagnostic and therapeutic techniques, in a safe way for patients and health professionals.

The relationship between the hospitality sector and patient safety is also important, as it involves issues associated with infrastructure and quality of services, which can influence the incidence of infections in users.⁷ Regarding the building structure, a term that is widely used currently is hospitality, which is related to humanization in healthcare environments, which helps understanding some issues regarding the incidence of HAIs and the services provided in this area.⁸

The data in the present study show some variations in absolute numbers of the occurrence of HAIs over the years in the three-year period evaluated and over the months in each year. However, these variations were not statistically significant and seem to be associated with the usual care flow of the institution.

It is also worth mentioning that, in December 2016, there were no new admissions to the hospital unity, due to the transition from the old building to the new facilities. Therefore, in this period there was a decrease in the total number of HAIs reported, which affected the few patients who remained hospitalized. The same situation justifies the lower number of cases at the beginning of 2017, since this transition was only completed in March 2017.

Among the clinics of the hospital, the medical clinic has the highest number of HAI reports, which is possibly related to the large flow of patients and the variety of pathologies in it. Second highest incidence is in the surgical clinic, a place that receives patients undergoing surgical and invasive procedures. Then, the ICU, which deals with a high degree of complexity regarding the patients' health status and patients who are more vulnerable to infections, as demonstrated in a study by Santos *et al.* (2016), which assessed this environment and the high risk of developing HAIs in the ICU.⁹

Regarding body topography, there was a greater number of SSIs. However, in the second year of the study there was a higher number of BSIs, corroborating the findings of Alvim *et al.* 2019, that demonstrated an epidemiological clinical profile and found similar topographies, emphasizing BSI and the rapid spread of infections in the hospital environment when appropriate prevention measures were not adopted. Watanabe *et al.* (2015) point out that there is a great variation in the incidence of BSIs in hospital units due to their multiple causes and to the prevention actions carried out in the units.¹⁰⁻¹¹

Due to the importance of promoting patient safety, adherence to patient safety protocols, such as hand hygiene protocol and protocols that standardize procedures that require aseptic technique, should be encouraged and protocols should follow ANVISA's standards. The institution's CCIH must formulate protocols that are appropriate to the reality of the institution, especially in relation to cleaning, disinfection and/or sterilization of materials.¹²⁻¹³⁻¹⁴

Thus, it is understood that, although it can contribute to avoid HAIs, the physical structure is not a determining factor for the occurrence of infections in this UH (University hospital). HAIs can be kept under control even in health institutions that operate in buildings with a physical infrastructure different from the regulations established by health service control

institutions. However, depending on the precariousness of these conditions and the compliance with the norms in each place, the results regarding HAIs may change considerably.

The data presented here demonstrated that the changes in the physical structure of the institution in these three years were not associated with changes in infection control indicators.

The scenario revealed in this study shows that, in the case under study, the physical structure did not have a positive or negative influence on the occurrence of HAIs, which may indicate that other circumstances or processes may be more determinant for the prevention of these infections.

These results demonstrate that a broader analysis on conditioning and determining factors for the occurrence of hospital-acquired infections is necessary. Care processes, compliance with protocols, adherence to standardized techniques and the profile of professionals should be analyzed, aiming to identify other factors that allowed controlling HAIs in different physical environments – a building over 50 years old and a new one.

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Gabriella Martins Soares: conception, design, data collection and analysis, and writing of the manuscript.

Isac Silva de Jesus: conception, planning, design, data collection and analysis, and writing, review and final approval of the manuscript.

FOR LAYOUT