Surgical Site Infection Rates in Four Cities in Brazil: Findings of the International Nosocomial Infection Control Consortium

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Original Article

Surgical Site Infection Rates in Four Cities in Brazil: Findings of the International Nosocomial Infection Control Consortium (INICC)

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Abstract

Background: There are no data on surgical site infection (SSI) rates stratified by surgical procedures (SPs) in Brazil, and our objective was to report such rates.
Methods: From January 2005 to December 2010 we conducted a surveillance study on SSIs in four hospital members of the International Nosocomial Infection Control Consortium (INICC) in four Brazilian cities. We applied the U.S. Centers for Disease Control and Prevention's National Healthcare Safety Network's (CDC-NHSN's) surveillance methods. Surgical procedures were classified into following types following ICD-9 criteria.
Results: We recorded 349 SSIs, associated to 61,863 SPs (0.6%; CI, 0.5–0.6). SSI rates per type of SP were compared with INICC and CDC-NHSN reports, respectively: 2.9% for cardiac surgery (vs. 5.6%, $p=0.001$ vs. 1.3%, $p=0.001$); 0.4% for cesarean section (vs. 0.7%, $p=0.001$ vs. 1.8%, $p=0.001$); 5.4% for craniotomy (vs. 4.4% $p=0.447$ vs. 2.6% $p=0.005$) and 1.1% for vaginal hysterectomy (vs. 2.0% $p=0.102$ vs. 0.9% $p=0.499$.)
Conclusions: Our SSI rates were greater in two of the four analyzed types of SPs compared with CDC-NHSN, but similar to most INICC rates. These findings on the epidemiology of SSI in Brazil will enable us to introduce targeted interventions for infection control.

It is difficult to ignore the burden posed by surgical site infections (SSIs) on patients' safety in Brazil in terms of pain, suffering, delayed surgical site healing, increased use of antibiotics, revision surgery, increased length of hospital stay, mortality rates and morbidity, which are also reflected in excess health care costs [1–3]. In response to the need to control healthcare-associated infections (HAIs), the Brazilian Ministry of Health has implemented institutional surveillance since 1992, making it mandatory for private and public hospitals to set up a HAI control committee [4]. However, as far as we are concerned, the incidence of SSIs in Brazil has not been systematically studied. Therefore, there are neither global SSI rates nor SSI rates stratified by surgical procedure (SP) according to the ninth edition of the International Classification of Diseases (ICD-9) criteria [5–8], which would enable a basis for international benchmarking [9].

According to the World Bank's categorization based on 2012 gross national income per capita, 68% of the world countries are low-income and lower middle-income economies—also referred to as lower income countries, or developing countries [10]. Today, lower income countries comprise more than 75% of the world population [10]. However, far too little attention has been paid to the incidence of SSIs in limited-resource countries, where standard methodological approaches are urgently needed [11].

Surveillance programs focused on healthcare-associated infections (HAI)—including surgical site infections (SSI)—are essential tools to prevent their incidence and reduce their adverse effects, thereby allowing for the reduction of patients' risk of infection. As widely shown in the literature from high income countries, including the U.S., the incidence of HAI can be reduced by as much as 30%, and by 55% in the

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case of SSI, through the implementation of an effective surveillance approach [12].

Within the scope of developing countries, several reports of the International Nosocomial Infection Control Consortium (INICC) have also shown that if surveillance and infection control strategies are applied in limited-resource countries, HAIs can also be reduced substantially [13]. The first joint effort to provide data on the epidemiology of SSI was made by INICC between 2005 and now, for the purpose of providing a big picture of SSI rates in limited-resource countries [14]. Now our objective is to provide a comprehensive analysis of each country [15–17].

As stated in the report published by the World Health Organization in 2011, emerging economies such as Brazil only have published data on SSI rates stratified by level of surgical site contamination [18]. This multi-center study conducted between January 2005 and December 2010 at four hospitals in four cities in Brazil is the first to report an analysis on the SSIs rates within four types of surgical procedures (SPs) stratified according to the ICD-9 and NHSN, which will allow us to introduce targeted interventions.

Patients and Methods

Background on INICC

The INICC is an open, non-profit, HAI surveillance network that applies methods based on the U.S. CDC-NHSN [19]. The INICC was established to measure and control HAIs worldwide in hospitals through the analysis of standardized data collected on a voluntary basis by its member hospitals, fostering the use of evidence-based preventive measures. Since its international inception in 2002, the INICC has increasingly gained new members and is now comprised of nearly 1000 hospitals in 200 cities in 50 countries in Latin America, Asia, Africa, Middle East, and Europe, becoming the only source of aggregate standardized international data on the epidemiology of HAIs worldwide [13].

Study setting and design

From January 2005 to December 2010, we conducted a cohort prospective multi-center surveillance study of SSIs on patients undergoing SPs in four medium-sized hospitals in four cities in Brazil. The participating hospitals are medium-sized (with 300 hospital beds, approximately) private institutions, which include two teachings hospitals. Each hospital's Institutional Review Board agreed to the study protocol.

INICC surveillance program

As part of the INICC program on SSI prevention, infection control professionals (ICPs) at each participating hospital were trained for conducting outcome surveillance of SSI rates [20], according to the standard CDC-NHSN definitions for superficial incisional, deep incisional, and organ/space infections, including laboratory and clinical criteria [19].

Data collection

Data by type of SP were collected from the book of surgical procedures of operating theater at each participating hospital. The collected data included the list of patients who underwent SPs; these patients were followed up during the 30 post-operative days to detect early SSIs, or for 12 mo for prosthesis SSIs.

These data were sent to INICC headquarters, where SSI rates were calculated, using the number of SP as denominator and the number of SSI as numerator.

For analytical purposes, collected data were stratified into four SPs according to the ninth edition of the International Classification of Diseases (ICD-9) criteria [5–8]. Infection control professionals (ICPs) reviewed each report of the SP in order to find all performed surgical procedures, and identify ICD-9 Codes.

Because of a limited budget, data on the duration of SPs, level of contamination, and for the infection risk index classification of the American Society of Anaesthesiology (ASA) [21] according to the patient's physical condition were not collected. For this reason, it was not possible to calculate the infection risk index of each SP. Therefore, because our data are not stratified by risk categories, we pooled the different risk categories included in the CDC-NHSN report 2006–2008 [22] to obtain the mean rate of SSIs and we compared this rate with our results.

Surgical procedures

The four SPs included in this study are those described in the ICD-9 and listed in CDC-NSHN report, as follows: Cardiac surgery (CARD); cesarean section (CSEC); craniotomy (CRAN); and vaginal hysterectomy (VHYS) [19].

Statistical analysis

EpiInfo® version 6.04b (CDC, Atlanta, GA) and SPSS 16.0 (SPSS Inc., an IBM company, Chicago, Illinois) were used to conduct data analysis.

Relative risk (RR) ratios, 95% confidence intervals (CIs) and p-values were determined for all primary and secondary outcomes.

Results

Table 1 shows SSI rates, stratified by SP, including number of SPs, number of SSIs, and SSI rate with 95% confidence ◄T1

Table 1. Surgical Site Infections of the Participating Brazilian Hospitals by Type of Procedure

CODE	*Procedure name*	*Procedures, n*	*SSI, n*	*Brazil SSI rate, %*	*No. of hospitals*
CARD	Cardiac surgery	2,528	74	2.9% (2.3–3.7)	2
CSEC	Cesarean section	58,138	250	0.4% (0.4–0.5)	2
CRAN	Craniotomy	279	15	5.4% (3.0–8.7)	1
VHYS	Vaginal hysterectomy	918	10	1.1% (0.5–2.0)	1

INICC, International Nosocomial Infection Control Consortium; SSI, Surgical Site Infection.

Table 2. Surgical Site Infection Rates in the Participating Brazilian Hospitals, Compared With the Hospitals of the Centers for Disease Control and Prevention National Healthcare Safety Network

CODE	*Procedure name*	*Brazil SSI rate, %*	*CDC- NHSN 2006-2008 SSI rate (pooled risk categories)*	*Brazil vs. CDC-NHSN RR, 95% CI, p*
CARD	Cardiac surgery	2.9%	1.3%	2.28 (1.8–2.9) 0.001
CSEC	Cesarean section	0.4%	1.8%	0.23 (0.2–0.3) 0.001
CRAN	Craniotomy	5.4%	2.6%	2.06 (1.2–3.5) 0.005
VHYS	Vaginal hysterectomy	1.1%	0.9%	1.25 (0.7–2.4) 0.499

CI, confidence interval; SSI, Surgical Site Infection; CDC, Centers for Diseases Control and Prevention; NHSN, National Healthcare Safety Network; RR, relative risk.

intervals. Surgical procedures with the highest SSI rates were craniotomy (5.4%) and cardiac surgery (2.9%).

T2 ▶ Table 2 compares SSI rates in this study with SSI rates in the INICC Report 2005–2010 and CDC NHSN 2007–2009. Compared with the CDC-NHSN report, SSI rates were substantially greater in two out of the four analyzed SPs (CARD, CRAN), whereas in one of them (VHYS), the SSI rate was similar in this study and in the CDC-NHSN report.

Compared with the INICC Report, SSIs rates were substantially lower in this study's hospitals in one out of the four analyzed SPs (CARD), and similar in two of them (CRAN, VHYS). The surgical site infection rate for CSEC was lower in this study than it was in both INICC and NHSN reports.

Discussion

The present study was designed to determine the incidence of SSIs in four cities in four hospitals of Brazil, a limited-resource economy. In our study, the SSI rate for cardiac surgery was lower than INICC 2005–2010 [23] and greater than the SSI rate reported in CDC-NHSN for 2006–2008 [22]. For craniotomy, the SSI rate was similar to INICC and also greater than the CDC rate [22,23]. The SSI rate for vaginal hysterectomy was similar to both INICC and CDC rates [22,23]. Finally, the SSI rate for cesarean section was lower in this study than in INICC and NHSN publications [22,23]. To explain this lower SSI rate in cesarean section procedures in Brazil, it must be highlighted that the criteria for indication of cesarean section are different in the US and Brazil [24,25]. Evidence suggested that the rate of cesarean sections was influenced by type of hospital; that is, whether private or public, and a different rate of cesarean sections has been found in different countries worldwide [26]. In Brazil, the prevalence of cesarean sections has considerably increased over the last three decades, particularly in private clinics, where the indication of cesarean sections can be in 84.3% of deliveries, [24,25,27] whereas in public clinics, it ranges from 18 to 19% [27]. In Brazil, non-medical factors for cesarean section indication—including patient's request, daytime birth, and obstetrician with private practice, rather than clinical ones—such as gestational hypertension; non-cephalic presentation; and gestational age >41 wks—are more frequent in private institutions than in public hospitals [28]. This means that cesarean sections are frequently indicated in the absence of patient's intrinsic infection risk.

For decades, the CDC has been the only source available to provide a basis for comparison of infection rates with hospitals worldwide. INICC emerges as an alternative benchmarking tool for HAI rates in hospitals worldwide because of their shared socioeconomic hospital backgrounds.

The relation between the rates of HAI rates and their association to the type of hospital (public, academic, and private), and the relation between HAI rates and the country socioeconomic level (defined as low income, mid low income, and high income) have recently been analyzed and published by the INICC [29,30]. Such studies' findings showed that a greater country socio-economic level was correlated with a lower infection risk [29,30].

The greater SSI rates, in comparison with US CDC-NHSN report, may reflect the typical hospital situation in limited-resources countries as a whole [31], and several reasons have been exposed to explain this fact [32,33]. Among the primary plausible causes, it can be mentioned that, in almost all the limited-resources countries, there are still no legally enforceable regulations for the implementation of infection control programs, such as national infection control guidelines; yet, if there is a legal framework, adherence to and compliance with the guidelines can be most irregular and hospital accreditation is not mandatory. However, there has recently been much progress in health care in some developing countries, such as

Table 3. Surgical Site Infection Rates in the Participating Brazilian Hospitals, Compared With the Hospitals of the International Nosocomial Infection Control Consortium ◀AU2

CODE	*Procedure name*	*Brazil SSI rate, %*	*INICC 2005-2010, SSI rate, %*	*Brazil vs. INICC RR, 95% CI, p*
CARD	Cardiac surgery	2.9%	5.6%	0.53 (0.4–0.7) 0.001
CSEC	Cesarean section	0.4%	0.7%	0.60 (0.5–0.7) 0.001
CRAN	Craniotomy	5.4%	4.4%	1.22 (0.7–2.0) 0.447
VHYS	Vaginal hysterectomy	1.1%	2.0%	0.56 (0.3–1.1) 0.102

CI, confidence interval; INICC, International Nosocomial Infection Control Consortium; SSI, Surgical Site Infection; RR, relative risk.

Brazil, where new technologies have been introduced and official regulations support infection control programs. This new trend in health care is expected to have a positive impact in cases with low nurse-to-patient staffing ratios—which have proved to be highly connected to high HAI rates—and hospital over-crowding, lack of medical supplies, and an insufficient number of experienced nurses or trained healthcare workers [32,33]. The Brazilian hospitals that participated in our study are private institutions that enjoy accreditation and sufficient administrative and financial support to fund infection control programs, such as the INICC multidimensional approach [32,33].

Participation in INICC has played a fundamental role, not only in increasing the awareness of HAI risks in the INICC hospitals, but also in providing an exemplary basis for the institution of infection control practices. In many INICC hospitals, for example, the high incidence of HAI has been reduced by 30% to 70% by implementing multi-dimensional programs that include a bundle of infection control interventions, education, outcome surveillance, process surveillance, feedback of HAI rates, and performance feedback of infection control practices, for central line associated bloodstream infections, mechanical ventilator associated pneumonia, and urinary catheter associated urinary tract infections [34–36].

For a valid comparison of a hospital's SSI rates with the rates from INICC hospitals, it is required that the hospitals concerned start collecting their data by applying definitions of SPs as provided by the ninth edition of the ICD-9, the definitions described by CDC NHSN in order to identify SSIs, and then the methodology described by CDC-NHSN to calculate SSI rates.

Because of a lack of budget, this study has three main limitations. First, we were unable to calculate the risk category of the SPs, because we did not collect the duration of each SP, the level of contamination, and the ASA score. Second, we were not able to collect data of microorganism profile and bacterial resistance. However, since 2012, these data are currently collected by INICC member hospitals, thereby enabling the assessment in the future of SSI risk index associated with SPs. Third, there was a selection bias in the facilities enrolled in our study. Fourth, with a small sample size of cases in some SPs, these results should be interpreted with caution. In reviewing the literature, no data was found on this topic and future studies are, therefore, recommended.

Conclusions

Our SSIs rates were statistically substantially greater in two out of the four analyzed types of SPs compared with CDC-NHSN, whereas compared with INICC, most rates were similar. This manuscript represents an important advance towards the knowledge of SSI epidemiology in Brazil that will allow us to introduce targeted interventions. Furthermore, this study shows that INICC is a valuable international benchmarking tool, in addition to the CDC-NSHN, whose participating hospitals have unrivalled infection control experience and resources.

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Author Disclosure Statement

All authors report no conflicts of interest related to this article. No competing financial interests exist. Every hospital's Institutional Review Board agreed to the study protocol, and patient confidentiality was protected by codifying the recorded information, making it only identifiable to the infection control team.

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