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Original Article

Surgical Site Infections Rates in More Than 13,000 Surgical Procedures in Three Cities in Peru: Findings of the International Nosocomial Infection Control Consortium (INICC)

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Abstract

Background: Surgical site infections (SSIs) are a threat to patient safety. However, there are not available data on SSI rates stratified by surgical procedure (SP) in Peru.
Methods: From January 2005 to December 2010, a cohort prospective surveillance study on SSIs was conducted by the International Nosocomial Infection Control Consortium (INICC) in four hospitals in three cities of Peru. Data were recorded from hospitalized patients using CDC-NHSN's methods and definitions for SSI. Surgical procedures (SPs) were classified into 4 types, according to ICD-9 criteria.
Results: We recorded 352 SSIs, associated to 13,904 SPs (2.5%; CI, 2.3–2.8) SSI rates per type of SP were the following for this study's Peruvian hospitals, compared with rates of the INICC and CDC-NHSN reports, respectively: 2.9% for appendix surgery (vs. 2.9% vs. 1.4%); 2.8% for gallbladder surgery (vs. 2.5% vs. 0.6%); 2.2% for cesarean section (vs. 0.7% vs. 1.8%); 2.8% for vaginal hysterectomy (vs. 2.0% vs. 0.9%).
Conclusions: Our SSIs rates were higher in all of the four analyzed types of SPs compared with CDC-NHSN, whereas compared with INICC, most rates were similar. This study represents an important advance in the knowledge of SSI epidemiology in Peru that will allow us to introduce targeted interventions.

It is difficult to ignore the burden posed by surgical site infections (SSIs) on patients' safety in Peru in terms of pain, suffering, delayed wound healing, increased use of antibiotics, revision surgery, increased length of hospital stay, mortality and morbidity, which are also reflected in excess health care costs. Previous studies showed high rates of SSI related to abdominal surgery [1,2]. However, as far as we are concerned, the incidence of SSIs in Peru 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 [3–6], which would enable a basis for international benchmarking [7].

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 [8]. Today, lower-income countries comprise more than 75% of the world population [8]. However, far too little attention has been paid to the incidence of SSIs in limited-resource countries, where standard methodological approaches are urgently needed [9,10].

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 case of SSI, through the implementation of an effective surveillance approach [11].

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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 [12–14]. 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 [15]. Now our objective is to provide a comprehensive analysis of each country.

As stated in the report published by the World Health Organization in 2011, limited-resource countries, such as Peru, only have published data on SSI rates stratified by level of wound contamination, such us clean, clean contaminated, contaminated, and dirty [16]. This multicenter study conducted between January 2005 and December 2010 at four hospitals in three cities in Peru 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. Centers for Disease Control and Prevention-National Healthcare Safety Network (U.S. CDC-NHSN) [17]. 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, INICC has increasingly gained new members and now comprises nearly 1000 hospitals in 200 cities of 50 countries in Latin America, Asia, Africa, the Middle East, and Europe, becoming the only source of aggregate standardized international data on the epidemiology of HAIs [15].

Study setting and design

From January 2005 to December 2010, we conducted a cohort prospective multicenter surveillance study of SSIs on patients undergoing SPs in four medium-sized hospitals in three cities in Peru. Two of the hospitals participating in this study are academic teaching, and two are public. 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 [18], according to the standard CDC-NHSN definitions for superficial incisional, deep incisional, and organ/space infections, including laboratory and clinical criteria [17].

Data collection

Data by type of SP were collected from the book of surgical procedures of operating theatre 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 [3–6]. Infection control professionals (ICPs) reviewed each report of the SP in order to find all performed surgical procedures, and identify ICD-9 Codes. The collected data were validated at the INICC Central Office in Buenos Aires before their inclusion as reported infections into the INICC's database. Validation process included revision of age, gender, length of stay, among other data revised for consistency.

Data on the duration of SPs, level of contamination, and for the infection risk index classification of the American Society of Anaesthesiology (ASA) [19] 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, since our data are not stratified by risk categories, we pooled the different risk categories included in the CDC-NHSN report 2006–2008 [20] 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: Appendix surgery (APPY); Gallbladder surgery (CHOL); Cesarean section (CSEC); and Vaginal hysterectomy (VHYS).

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. P-values < 0.05 were reported as statistically significant. The initial assumption was that the SSI rate is higher in this study than in the INICC and CDC-NHSN reports. To compare incidence densities of SSI we considered as ''exposed'' the data of this study and ''non-exposed'' the events of the INICC and CDC benchmarks.

Results

Table 1 shows SSI rates, stratified by SP, including number of SPs, number of SSIs, and SSI rate with 95% confidence intervals. SPs with the highest SSI rates were small appendix surgery (2.9%) and gallbladder surgery (2.8%).

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 higher in all of the analyzed types of SPs (APPY, CHOL, CSEC, VHYS).

Compared with the INICC Report, SSIs rates were higher in this study's hospitals in one out of four of the analyzed types of SPs (CSEC), and similar in three out of four of them (APPY, CHOL, VHYS).

Discussion

The present study was designed to determine the incidence of SSIs in three cities in four hospitals of Peru, a

TABLE 1. SURGICAL SITE INFECTIONS OF THE PARTICIPATING PERUVIAN HOSPITALS BY TYPE OF PROCEDURE

CODE	*Procedure name*	*Procedures,* n	*SSI,* n	*Peru SSI rate, % (95% CI)*	*No. of hospitals*
1. APPY	Appendix surgery	4644	135	2.9% (2.4–3.4)	1
2. CHOL	Gallbladder surgery	1656	47	2.8% (2.1–3.8)	1
3. CSEC	Cesarean section	7460	166	2.2% (1.9–2.6)	3
4. VHYS	Vaginal hysterectomy	144	4	2.8% (0.8–7.0)	1
All		13,904	352	2.5% (2.3–2.8)	4

INICC = International Nosocomial Infection Control Consortium; SSI = Surgical site infection; CI = Confidence interval.

limited-resource economy. In our study, SSI rates for SSI rates for CSEC are higher than both INICC and CDC-NHSN's reported SSI rates. SSI rates for APPY, CHOL and VHYS are higher than CDC-NHSN, but similar to INICC [10,20].

For decades, the CDC has been the only source available to provide a basis for comparison of infection rates with hospitals worldwide. Comparing U.S. CDC's hospitals' rates with those of hospitals from Western Europe and Oceania is considered valid, because of their similar socioeconomic conditions. In contrast, the comparison of between CDC's rates and those of hospitals with limited resources—or with sufficient available resources, but without enough experience in the field of infection control—should involve the consideration of the mentioned disadvantages in terms of socio-economic and factors. On the one hand, U.S. hospitals enjoy more than 50-year unrivalled experience in infection control and surveillance, sufficient human and medical supply resources availability, and a comprehensive legal framework backing infection control programs and including mandatory surveillance and hospital accreditation policies. The higher SSI rates found in our study, in comparison to the rates for CDC's hospitals, have also been influenced by such factual background. The relation between the HAI rates and 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 [21,22]. Such studies' findings showed that a higher country socio-economic level was correlated with a lower infection risk [21,22]. Within this context, INICC reports can be an alternative valid benchmarking tool for HAI rates in hospitals worldwide because of their shared factual and socioeconomic hospital backgrounds.

Such higher SSI rates, in comparison with the U.S. CDC-NHSN report, may reflect the typical hospital situation in limited-resources countries as a whole [23], and several reasons have been exposed to explain this fact [24,25]. 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 Peru, 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, hospital over-crowding, lack of medical supplies, and in an insufficient number of experienced nurses or trained healthcare workers [24,25].

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% implementing multidimensional 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 [12–14].

For a valid comparison of a hospital's SSI rates with the rates from INICC hospitals, it is required that the hospitals

TABLE 2. SURGICAL SITE INFECTION RATES IN THE PARTICIPATING PERUVIAN HOSPITALS, COMPARED WITH THE HOSPITALS OF THE INTERNATIONAL NOSOCOMIAL INFECTION CONTROL CONSORTIUM AND THE U.S. CENTERS FOR DISEASE CONTROL AND PREVENTION NATIONAL HEALTHCARE SAFETY NETWORK

CODE	*Procedure name*	*Peru SSI rate, %*	*INICC 2005–2010, SSI rate, %*	*Peru vs INICC (RR, 95% CI, P)*	*US CDC- NHSN 2007–2009 SSI rate (pooled risk categories)*	*Peru vs CDC-NHSN (RR, 95% CI, P)*
1. APPY	Appendix surgery	2.9%	2,9%	1.0 (0.84–1.2) 0.953	1.4%	2.06 (1.57–2.07) 0.001
2. CHOL	Gallbladder surgery	2.8%	2,5%	1.1 (0.8 –1.6) 0.39	0.6%	4.52 (3.18–6.42) 0.0001
3. CSEC	Cesarean section	2.2%	0,7%	3.13 (2.7 –3.7) 0.0001	1.8%	1.21 (1.02–1.44) 0.030
4. VHYS	Vaginal hysterectomy	2.8%	2,0%	0.67 (0.2 –1.8) 0.23	0.9%	3.18 (1.18–8.56) 0.016

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

concerned start collecting their data by applying definitions of SPs as provided by ninth edition of the ICD-9, the definitions described by CDC NHSN in order to identify SSIs, and the methodology described by CDC-NHSN to calculate SSI rates.

Study limitations

Because of 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 to differentiate superficial, deep and organ/space SSIs, data of microorganism profile and bacterial resistance, nor implement any other kind of post discharge surveillance, such as phone calls, visits or letters to patients. However, since 2012 these data have been currently collected by INICC member hospitals, thereby enabling the assessment in the future of SSI risk index associated with SPs. Third, with a small sample size of cases in some SPs, these results should be interpreted with caution. There may be some underreporting of SSIs, as some patients may have presented a SSI after the study period (such as, orthopedic procedures and implants) and these may not have been included. In reviewing the literature, no systematic data was found on SSI global rates and SSI rates stratified by SP. For this reason, it is worth mentioning that despite the mentioned limitations, substantial and useful data is provided in this study, which is a first step to advance our understanding of the SSI rate in Peru.

Conclusions

The comparison between this study's findings in Peru and the data reported by the INICC 2005–2010 [10] showed that SSI rates were similar in most of the analyzed SPs, whereas if compared with the CDC-NHSN for 2006–2008 [20], SSI rates in this study from Peru were higher in all of the analyzed types of SPs. This paper represents an important advance towards the knowledge of SSI epidemiology in Peru 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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