American Journal of Infection Control xxx (2014) 1-4

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Surgical site infection rates in 4 cities in Colombia: Findings of the International Nosocomial Infection Control Consortium

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Key Words:
Network
Hospital infection
Health care-associated infection
Surgical wound infection
Developing countries
Limited resources countries
low income countries

Background: Surgical site infections (SSIs) are a threat to patient safety. However, there are no available data on SSI rates stratified by surgical procedure (SP) in Colombia.

Methods: From January 2008-December 2010, a prospective surveillance study on SSIs was conducted by the International Nosocomial Infection Control Consortium (INICC) in 4 hospitals in 4 cities within Colombia using the definitions of the Centers for Disease Control and Prevention-National Healthcare Safety Network (CDC-NHSN). SPs were classified into 10 types, according to ICD-9 criteria.

Results: We recorded 193 SSIs associated with 5,063 SPs. SSI rates per type of SP were the following, compared with INICC and CDC-NHSN rates, respectively: 9.1% for laminectomy (vs 1.7% and 1.0%), 8.3% for cardiac surgery (vs 5.6% and 1.3%), 3.9% for appendix surgery (vs 2.9% and 1.4%), 5.5% for abdominal hysterectomy (vs 2.7% and 1.6%), 4.4% for prostate surgery (vs 2.1% and 1.2%), 4.5% for spleen surgery (vs 5.6% and 2.3%), 4.3% for vaginal hysterectomy (vs 2.0% and 0.9%), and 3.0% for gallbladder surgery (vs 2.5% and 0.6%).

Conclusions: Compared with CDC-NHSN rates, SSIs rates in our study hospitals were higher in most types of SPs, whereas compared with INICC, they were similar in 5 of the analyzed types, and higher in 4 types. This study represents an important advance toward knowledge of epidemiology in Colombia that will allow us to introduce targeted interventions.

The burden posed by surgical site infections (SSIs) on patients includes pain, suffering, delayed wound healing, increased use of antibiotics, revision surgery, increased length of hospital stay, and greater rates of mortality and morbidity, all of which are also reflected in excess health care costs.[1] However, the incidence of SSIs in Colombia has not been systematically studied. Therefore, there are neither global SSI rates nor SSI rates stratified by surgical procedure (SP) according ICD-9 criteria[2-4] that would enable a basis for international benchmarking.[5]

According to World Bank categorization,[6] 68% of countries are low-income and lower–middle-income economies—also referred to as lower-income countries or developing countries. Today, lower-income countries comprise >75% of the world population. However, the incidence of SSIs in limited-resource countries has not been systematically assessed.[7,8]

Surveillance programs focused on health care-associated infections (HAIs)—including SSIs—are essential tools to prevent their incidence and reduce their adverse effects. As widely shown in the

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The funding for activities carried out at International Nosocomial Infection Control Consortium headquarters were provided by Victor D. Rosenthal and the Foundation to Fight against Nosocomial Infections.

VDR provided the study idea, conception, and design; software development; data assembly, data analysis, and interpretation; epidemiologic analysis; administrative, technical, and logistic support; and drafting of the article. All authors provided critical revision of the article for important intellectual content, final approval of the article, provision of study patients, and collection of data.

Conflicts of interest: None to report.

http://dx.doi.org/10.1016/j.ajic.2014.06.010

literature from high-income countries, particularly in the United States, the implementation of an effective surveillance approach can lead to a reduction in the incidence of HAI by as much as 30%, and by 55% in the case of SSIs.[9] Several reports of the International Nosocomial Infection Control Consortium (INICC) have shown that if surveillance and infection control strategies are applied in limited-resource countries, HAIs can be reduced significantly in these countries, as well.[10-12]

As stated in a report published by the World Health Organization in 2011,[13] limited-resource countries, like Colombia, only have published data on SSI rates stratified by level of wound contamination. Our multicenter study, conducted between January 2008 and December 2010 in 4 hospitals in 4 cities within Colombia, is the first to report an analysis of SSIs rates for 10 types of surgical procedures (SPs) stratified according to ICD-9 code and Centers for Disease Control and Prevention-National Healthcare Safety Network (CDC-NHSN) definitions.

METHODS

Background on INICC

The INICC is an open, nonprofit HAI surveillance network that applies methods based on CDC-NHSN definitions.[14] INICC was established to measure and control HAIs worldwide and foster the use of evidence-based prevention measures through the analysis of standardized data collected on a voluntary basis by its member hospitals. Since its inception in 2002, INICC has increasingly gained new members and now comprises nearly 1,000 hospitals in 200 cities of 50 countries in Latin America, Asia, Africa, the Middle East, and Europe, making it the only source of aggregate standardized international data on the epidemiology of HAIs.[15]

Study setting and design

From January 2008-December 2010 we conducted a cohort prospective multicenter surveillance study of SSIs in patients undergoing SPs in 4 hospitals located in 4 cities within Colombia. Two of the 4 participating hospitals are private community institutions, 1 is a teaching hospital, and 1 is a public hospital. Each hospital's institutional review board agreed to the study protocol.

INICC surveillance program

As part of the first stage of the INICC program on SSI prevention, infection control professionals (ICPs) at each participating hospital were trained on conducting outcome surveillance of SSI rates[16] according to the standard CDC-NHSN definitions for superficial incisional infection, deep incisional infection, and organ/space infection, including laboratory and clinical criteria.[14]

For analytical purposes, collected data were stratified into 10 SPs according to ICD-9 code.[2-4,17] ICPs reviewed each SP report to find all performed procedures and identify ICD-9 codes, and then reviewed them with the surgeon in charge of the SP. Patients who underwent SPs received follow-up during the first 30 postsurgical days to detect early SSIs, or for 12 months for prosthesis SSIs. These data were sent to INICC headquarters, where data were validated and SSI rates were calculated using the number of SPs as the denominator and the number of SSI as the numerator.

Data on the duration of SP, level of contamination, and American Society of Anesthesiologists infection risk index classification,[18] according to each patient's physical condition, were not collected. Therefore, it was not possible to calculate the infection risk index of each SP; thus, we pooled the different risk categories included in the CDC-NHSN report 2006-2008[19] to obtain the mean rate of SSIs and compared this rate with our results.

Table 1
Surgical site infections (SSIs) of participating Colombian hospitals, by type of procedure

Code	Procedure name	No. of procedures performed	No. of SSIs identified	SSI rate*	No. of hospitals
APPY	Appendix surgery	947	37	3.9 (2.8-5.3)	2
CARD	Cardiac Surgery	363	30	8.3 (5.6-11.6)	2
CHOL	Gallbladder surgery	464	14	3.0 (1.7-5.0)	2
FUSN	Spinal fusion	152	4	2.6 (0.5-7.3)	1
FX	Open reduction of fracture	2499	75	3.0 (2.4-3.7)	1
HYST	Abdominal hysterectomy	344	19	5.5 (3.4-8.5)	2
LAM	Laminectomy	22	2	9.1 (1.1-29.2)	1
PRST	Prostate surgery	181	8	4.4 (1.9-8.5)	1
SPLE	Spleen surgery	22	1	4.5 (0.1-22.8)	1
VHYS	Vaginal hysterectomy	69	3	4.3 (0.9-12.2)	1
All		5063	193	3.8 (3.3-4.4)	4

*Values for SSI rate are given as % (95% confidence interval).

SPs

The 10 SPs (ICD-9 code) included in this study are: appendix surgery (APPY), cardiac surgery (CARD), gallbladder surgery (CHOL), spinal fusion (FUSN), open reduction of fracture (FX), abdominal hysterectomy (HYST), laminectomy (LAM), prostate surgery (PRST), spleen surgery (SPLE), and vaginal hysterectomy (VHYS).[14]

Statistical analysis

EpiInfo version 6.04 b (CDC, Atlanta, Georgia) and SPSS 16.0 (IBM-SPSS Inc, Chicago, Illinois) were used to conduct data analysis.

Relative risk ratios, 95% confidence intervals, 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. SPs with the highest SSI rates were laminectomy (9.1%) and cardiac surgery (8.3%).

Table 2 compares SSI rates in our study with SSI rates in the INICC 2005-2010[15] and CDC-NHSN 2007-2009.[19] Compared with the CDC-NHSN report,[19] SSI rates were significantly higher in 7 out of 10 of the analyzed types of SP (ie, appendix surgery, cardiac surgery, abdominal hysterectomy, laminectomy, prostate surgery, vaginal hysterectomy, and gallbladder surgery) and similar in 3 types of SP (ie, spinal fusion, spleen surgery, and open reduction of fracture).

Compared with the INICC 2005-2010,[15] SSIs rates were significantly higher in our study hospitals in 5 out of 10 of the analyzed types of SPs (ie, appendix surgery, cardiac surgery, abdominal hysterectomy, laminectomy, and prostate surgery), similar in 4 of the 10 SPs (ie, vaginal hysterectomy, gallbladder surgery, spinal fusion, and spleen surgery), and lower in 1 SP (ie, open reduction of fracture).

DISCUSSION

Our study was designed to determine the incidence of SSIs in 4 hospitals located in 4 cities within Colombia, a limited-resource economy. In our study, SSI rates for appendix surgery, cardiac surgery, abdominal hysterectomy, laminectomy, and prostate surgery are

Table 2
Surgical site infection (SSI) rates in participating Colombian hospitals compared with hospitals participating in the International Nosocomial Infection Control Consortium (INICC) and the Centers for Disease Control and Prevention National Healthcare Safety Network (CDC-HNSN)

Code	Procedure name	Colombia SSI rate	INICC 2005-2010 SSI rate	Colombia vs INICC	CDC- NHSN 2007-2009 SSI rate*	Colombia vs CDC-NHSN
APPY	Appendix surgery	3.9	2.9	1.35 (0.94-1.88) .04	1.4	2.77 (1.88-4.07) .0001
CARD	Cardiac Surgery	8.3	5.6	1.5 (0.99-2.16) .023	1.3	6.42 (4.43-9.32) .0001
CHOL	Gallbladder surgery	3.0	2.5	1.22 (0.66-2.1) .23	0.6	4.81 (2.74-8.43) .0001
FUSN	Spinal fusion	2.6	3.2	0.81 (0.22-2.13) .37	1.5	1.71 (0.64-4.58) .2773
FX	Open reduction of fracture	3.0	4.2	0.71 (0.56-0.9) .001	1.7	1.73 (1.32-2.26) .0001
HYST	Abdominal hysterectomy	5.5	2.7	2.02 (1.2-3.2) .0033	1.6	3.36 (2.13-5.3) .0001
LAM	Laminectomy	9.1	1.7	5.35 (0.61-21.75) .034	1.0	8.91 (2.22-35.7) .0001
PRST	Prostate surgery	4.4	2.1	2.1 (0.9-4.2) .03	1.2	3.8 (1.56-9.31) .0016
SPLE	Spleen surgery	4.5	5.6	0.81 (0.02-5) .47	2.3	1.95 (0.23-16.2) .53
VHYS	Vaginal hysterectomy	4.3	2.0	2.22 (0.45-6.77) .11	0.9	4.97 (1.6-15.6) .0022

NOTE. Values are given as % or relative risk (95% confidence interval) *P* value.
*Pooled risk categories.

higher than reported rates from both INICC 2005-2010[15] and CDC-NHSN 2006-2008.[19] Similarly, if compared with data from the last report published by the European Centre for Disease Prevention and Control surveillance of surgical site infections in Europe, 2008-2009 (including Austria, Germany, Spain, Finland, France, Hungary, Italy, Lithuania, Malta, Netherlands, Norway, Portugal, and United Kingdom),[20] our SSI rates are also higher in laminectomy (1.3 [95% CI, 1.1-1.5]) and gallbladder surgery (1.4 [95% CI, 1.3-1.5]). SSI rates are higher than CDC-reported rates,[15] but similar to INICC rates in the cases of gallbladder surgery and vaginal hysterectomy.[19] SSI rates for spinal fusion and spleen surgical procedures are similar both to INICC-reported[15] and CDC-NHSN-reported SSI rates.[19] Finally, SSI rates for open reduction of fracture are lower than INICC rates,[15] but higher than the CDC-NHSN rates.[19]

During past decades, the CDC has been the only source available to provide a basis for comparison of infection rates with hospitals worldwide. Comparing US hospital rates with those of hospitals from Western Europe and Oceania is considered valid, due to their similar socioeconomic conditions. In contrast, comparing US rates with 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 socioeconomic factors. US hospitals enjoy >50 years of unrivalled experience in infection control and surveillance, sufficient human and medical supply resources availability, and a comprehensive legal framework backing infection control programs and mandating surveillance and hospital accreditation policies. The higher SSI rates found in our study, in comparison to the rates for CDC hospitals, should be viewed in light of this discrepancy. The relation between HAI rates and type of hospital (public, academic, or private), as well as between HAI rates and country socioeconomic level (defined as low income, mid-low income, and high income) have recently been analyzed and published by INICC.[21,22] Findings showed that higher country socioeconomic level was correlated with lower infection risk.[21,22]

Within this context, INICC reports can be an alternative valid benchmarking tool for HAI rates in hospitals worldwide due to their shared factual and socioeconomic hospital backgrounds.

Higher SSI rates, in comparison with CDC-NHSN reports, 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 is that in almost all limited-resources countries there are no legally enforceable regulations for the implementation of infection control programs. Furthermore, if there is a legal framework, adherence to and compliance with 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 Colombia, 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 influence in areas with extremely low nurse-to-patient ratios (a situation that has been shown to be highly connected to high HAI rates), hospital overcrowding, lack of medical supplies, and in an insufficient number of experienced nurses or trained health care 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.[10-12]

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 ICD-9, the definitions described by CDC-NHSN to identify SSIs, and the methodology described by CDC-NHSN to calculate SSI rates.

Study limitations

Our study had 3 main limitations. First, we were unable to calculate the risk category of the SPs because we did not collect information on the duration of each SP, the level of contamination, or the American Society of Anesthesiologists score. Second, we were not able to collect data on gender, age, use of antibiotics, microorganism profile, and bacterial resistance, nor implement any other kind of postdischarge surveillance such as telephone calls, visits, or letters to patients. However, since 2012 these data are being collected by INICC member hospitals, thereby enabling this assessment in the future. Third, with a small sample size of cases for some SPs, these results should be interpreted with caution. In reviewing the literature, no systematic data were found on SSI global rates and SSI rates stratified by SP, and there were no available published data on which specific clinical SSI-preventing interventions are routine practice in Colombia.

CONCLUSIONS

Comparisons between our findings and the data reported by INICC 2005-2010[8] show that SSI rates were similar in 5 of 10 analyzed types of SP, whereas if compared with the CDC-NHSN 2006-2008,[19] SSI rates in our study were significantly higher in 7 of 10 analyzed SPs and similar in 3 SPs. This article represents

important advances toward the knowledge of SSI epidemiology in Colombia that will allow us to introduce targeted interventions. Furthermore, our study shows that INICC provides valuable international benchmarking data in addition to data from the CDC-NSHN, whose participating hospitals have unrivalled infection control experience and resources.

Acknowledgments

The authors thank the many health care professionals at each member hospital who assisted with the conduct of surveillance in their hospital, including the surveillance nurses, clinical microbiology laboratory personnel, and the physicians and nurses providing care for patients during the study. Without the cooperation and generous assistance of the following professionals the INICC would not be possible: Mariano Vilar and Débora López Burgardt, INICC headquarters, Buenos Aires, Argentina; Altaf Ahmed, Carlos A. Álvarez-Moreno, Anucha Apisarnthanarak, Luis E. Cuéllar, Bijie Hu, Namita Jaggi, Hakan Leblebicioglu, Montri Luxsuwong, Eduardo A. Medeiros, Yatin Mehta, Ziad Memish, and Lul Raka, INICC country coordinators and secretaries; Carla J. Alvarado, Nicholas Graves, William R. Jarvis, Patricia Lynch, Dennis Maki, Gerald McDonnell, INICC Advisory Board; and Toshihiro Mitsuda, Cat Murphy, Russell N. Olmsted, Didier Pittet, William Rutala, Syed Sattar, and Wing Hong Seto, who generously support this unique international infection control network.

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