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Original Article

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

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Abstract

Background: Surgical site infections (SSIs) are the most common healthcare-associated infections (HAI) in lower-income countries. This is the first study to report the results of surveillance on SSI stratified by surgical procedure in seven Vietnamese cities.
Methods: This was a prospective, active SSI surveillance study conducted from November 2008–December 2010 in seven hospitals using the U.S. Centers for Disease Control and Prevention's National Healthcare Safety Network (CDC-NHSN) definitions and methods. Surgical procedures (SPs) were classified into 26 types according to the International Classification of Diseases Edition 9 criteria.
Results: We recorded 241 SSIs, associated with 4,413 SPs (relative risk [RR] 5.5%; 95% confidence interval [95% CI] 4.8–6.2). The highest SSI rates were found for limb amputation (25%), colon surgery (33%), and small bowel surgery (21%). Compared with CDC-NHSN SSI report, our SSI rates were higher for the following SPs: Limb amputation (25% vs. 1.3%; RR 20.0; p = 0.001); appendix surgery (8.8% vs. 3.5%; RR 2.54; 95% CI 1.3–5.1; p = 0.001); gallbladder surgery (13.7% vs. 1.7%; RR 7.76; 95% CI 1.9–32.1; p = 0.001); colon surgery (18.2% vs. 4.0%; RR 4.56; 95% CI 2.0–10.2; p = 0.001); open reduction of fracture (15.8% vs. 3.4%; RR 4.70, 95% CI 1.5–15.2; p = 0.004); gastric surgery (7.3% vs. 1.7%; RR 4.26; 95% CI 2.2–8.4, p = 0.001); kidney surgery (8.9% vs. 0.9%; RR 10.2; 95% CI 3.8–27.4; p = 0.001); prostate surgery (5.1% vs. 0.9%; RR 5.71; 95% CI 1.9–17.4; p = 0.001); small bowel surgery (20.8% vs. 6.7%; RR 3.07; 95% CI 1.7–5.6; p = 0.001); thyroid or parathyroid surgery (2.4% vs. 0.3%; RR 9.27; 95% CI 1.0–89.1; p = 0.019); and vaginal hysterectomy (14.3% vs. 1.2%; RR 12.3; 95% CI 1.7–88.4; p = 0.001).
Conclusions: Our SSIs rates were significantly higher for 11 of the 26 types of SPs than for the CDC-NHSN. This study advances our knowledge of SSI epidemiology in Vietnam and will allow us to introduce targeted interventions.

It is difficult to ignore the burden posed by surgical site infections (SSIs) on patient safety in terms of pain, suffering, delayed healing, increased use of antibiotics, bacterial resistance, revision surgery, longer hospital stays, morbidity, and death, which also are reflected in excess health care costs [1]. It recently was estimated that SSI represents 31% of the healthcare-acquired infections (HAI) in a U.S. hospital, making them the most common type of HAI [2]. Similarly, SSIs are the most common type of HAI in lower-income countries [3].

According to the World Bank's categorization, 68% of the world's countries are low-income and lower middle-income economies—which also can be referred as developing countries. Today, such countries account for more than 75% of the world's population [4]. However, the incidence of SSIs in limited-resource countries has not been assessed systematically [5,6].

Surveillance programs focused on HAIs—including SSIs—are essential tools to reduce their incidence and their

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adverse effects. 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 [7]. Several reports of the International Nosocomial Infection Control Consortium (INICC) have shown that if surveillance and infection control strategies also are applied in limited-resource countries, HAIs can be reduced significantly [8–10].

The first joint effort to provide data on the epidemiology of SSI was made by INICC between 2006 and more recently for the purpose of providing a big picture of SSI rates in limited-resource countries. Our objective here is to provide a comprehensive analysis of SSI rates in each country [11].

As stated in the report by the World Health Organization in 2011 [3], limited-resource countries such as Vietnam have published only data on SSI rates stratified by the extent of incision contamination (clean, clean contaminated, contaminated, and dirty) [12] or by other variables such as patient characteristics, type of surgery, surgery timing, and co-existing diagnoses [13]. The present multi-center study, conducted between November 2008 and December 2010 in seven hospitals in seven cities of Vietnam, is the first to report an analysis of the SSIs rates stratified by 26 types of surgical procedures (SPs) and by risk categories according to the Ninth Edition of the International Classification of Diseases (ICD-9) and the U.S. Centers for Disease Control and Prevention's National Healthcare Safety Network (CDC-NHSN).

Patients and Methods

Study Setting and Design

From November 2008 to December 2010, we conducted an active cohort, patient-based, prospective multi-center surveillance study of SSIs in patients undergoing SPs in seven large hospitals (a mean of 516 beds) located in different cities (Pho Noi, Hung Yen, Ninh Binh, Hue Yen Bai, Hanoi, and Can Tho) in Vietnam. Three of the hospitals are academic teaching, and the other four are public. Each hospital's Institutional Review Board approved the study protocol.

Surveillance Program

Infection control professionals (ICPs) at each participating hospital were trained to conduct outcome surveillance of SSI rates [14] according to the standard CDC-NHSN definitions [15]. Monitoring included patient-based prospective surveillance. Because of financial constraints, post-discharge and ante-discharge surveillance methods could not be applied in every case to detect SSIs after in-patient and out-patient operations.

Data Collection

Data by type of SP were collected from the book of surgical procedures of the operating theatre at each participating hospital. The ICPs reviewed each medical report to find all surgical procedures performed and identify the appropriate ICD-9 codes. The ICPs also collected data on SSIs after evaluating patients and cultures. The data collected included the list of all patients who underwent SPs. These data were entered on printed forms, and SSI rates were calculated using the number of SPs as the denominator and the number of SSIs as the numerator.

Surgical Procedures

For analytic purposes, data were stratified into 26 types of SPs according to the ICD-9 criteria [16–19]. Benchmarking was performed against the U.S. CDC-NHSN [20]. The 26 SP were: Abdominal aortic aneurysm repair (AAA); limb amputation (AMP); appendix surgery (APPY); bile duct, liver, or pancreatic surgery (BILI); breast surgery (BRST); cardiac surgery (CARD); gallbladder surgery (CHOL); colon surgery (COLO); craniotomy (CRAN); cesarean section (CSEC); spinal fusion (FUSN); open reduction of fracture (FX); gastric surgery (GAST); herniorrhaphy (HER); hip prosthesis placement (HPRO); abdominal hysterectomy (HYST); knee prosthesis insertion (KPRO); kidney surgery (NEPH); prostate surgery (PRST); rectal surgery (REC); small bowel surgery (SB); spleen surgery (SPLE); thoracic surgery (THOR); thyroid or parathyroid surgery (THYR); vaginal hysterectomy (VHYS); and exploratory abdominal surgery (XLAP) [15].

Risk Categories

We calculated the risk of each SP following the National Nosocomial Infections Surveillance System risk index [21] that applies a range from zero to three points for the absence or presence of the following three composite variables: Incision classification as either contaminated or dirty (one point), American Society of Anesthesiologists (ASA) pre-operative assessment score of 3, 4, or 5 (one point), and a duration of the operation exceeding the 75th percentile of operation time (one point).

Table 1. Characteristics of Participating Hospitals

N	*City*	*Type*	*No. of beds*	*Years of experience of ICN or ICP in infection control*
1	Pho Noi	Public	400	5
2	Hung Yen	Public	600	10
3	Ninh Binh	Public	600	7
4	Hue	University	2,170	15
5	Yen Bai	Public	460	10
6	Hanoi	University	1,900	15
7	Can Tho	University	500	10

ICN = infection control nurse; ICP = infection control practitioner.

Table 2. Surgical Site Infection Rates by Risk Index Category

Surgical Procedure Code	*Procedure Description*	*Duration Cutpoint, Min*	*Risk Index Category*	*No. of Procedures*	*No. of SSIs*	*No. of Hospitals*	*SSI Rate, %*	*95% CI*
AAA	Abdominal aortic aneurysm repair	210	0, 1	1	0	1	0	–
AMP	Limb amputation	70	0, 1	4	1	3	25.0	0.6–80.6
AMP	Limb amputation	70	2, 3	3	0	2	0	–
APPY	Appendix surgery	60	0, 1	616	41	7	6.7	4.8–8.9
APPY	Appendix surgery	60	2, 3	136	12	7	8.8	4.6–14.9
BILI	Bile duct	100	0, 1	99	13	7	13.1	7.2–21.4
BILI	Bile duct	100	2, 3	21	4	6	19.0	5.4–41.9
BRST	Breast surgery	82	0	5	0	3	0	–
BRST	Breast surgery	82	1	2	0	2	0	–
BRST	Breast surgery	82	2, 3	2	0	1	0	–
CARD	Cardiac surgery	30	0, 1	1	0	1	0	–
CHOL	Gallbladder surgery	90	0	96	4	6	4.2	1.1–10.3
CHOL	Gallbladder surgery	90	1	71	2	7	2.8	0.3–9.8
CHOL	Gallbladder surgery	90	2, 3	15	2	4	13.3	1.7–40.5
COLO	Colon surgery	120	0	33	6	6	18.2	7.0–35.5
COLO	Colon surgery	120	1	39	6	6	15.4	5.9–30.5
COLO	Colon surgery	120	2	23	4	3	17.4	5.0–38.8
COLO	Colon surgery	120	3	3	1	2	33.3	0.8–90.6
CRAN	Craniotomy	120	0, 1	52	2	5	3.8	0.5–13.2
CRAN	Craniotomy	120	2, 3	6	1	3	16.7	0.4–64.1
CSEC	Cesarean section	45	0	740	1	3	0.1	0–0.8
CSEC	Cesarean section	45	1	153	2	3	1.3	0.2–4.6
CSEC	Cesarean section	45	2, 3	5	0	2	0	–
FUSN	Spinal fusion	107	0	9	0	2	0	–
FUSN	Spinal fusion	107	1	2	0	2	0	–
FUSN	Spinal fusion	107	2, 3	1	0	1	0	–
FX	Open reduction of fracture	90	0	269	10	7	3.7	1.8–6.7
FX	Open reduction of fracture	90	1	114	9	7	7.9	3.7–14.5
FX	Open reduction of fracture	90	2, 3	19	3	6	15.8	3.4–39.6
GAST	Gastric surgery	120	0, 1	123	9	6	7.3	3.4–13.4
GAST	Gastric surgery	120	2, 3	42	3	4	7.1	1.5–19.5
HER	Herniorrhaphy	60	0	98	2	7	2.0	0.2–7.2
HER	Herniorrhaphy	60	1	21	1	7	4.8	0.1–23.8
HER	Herniorrhaphy	60	2, 3	2	0	2	0	–
HPRO	Hip prosthesis placement	120	0	10	0	2	0	–
HPRO	Hip prosthesis placement	120	1	5	0	2	0	–
HYST	Abdominal hysterectomy	60	0	59	0	3	0	–
HYST	Abdominal hysterectomy	60	1	11	0	2	0	–
HYST	Abdominal hysterectomy	60	2, 3	1	0	1	0	–
KPRO	Knee prosthesis insertion	140	0	1	0	1	0	
KPRO	Knee prosthesis insertion	140	1	2	0	1	0	–
NEPH	Kidney surgery	100	0, 1	202	18	7	8.9	5.4–13.7
NEPH	Kidney surgery	100	2, 3	19	1	3	5.3	0.1–26.0
OGU	Other genitourinary	70	0, 1, 2, 3	352	18	7	5.1	3.1–8.0
OMS	Other musculoskeletal	69	0, 1, 2, 3	96	5	7	5.2	1.7–11.7
OSKN	Other integumentary system	60	0, 1, 2, 3	154	21	7	13.6	8.6–20.1
OTH	Other operative procedures not included in the NHSN categories	94	0, 1, 2, 3	136	6	7	4.4	1.6–9.4
OVRY	Ovarian surgery	60	0, 1	67	1	4	1.5	0–8.0
OVRY	Ovarian surgery	60	2, 3	2	0	2	0	–
PRST	Prostate surgery	80	0, 1	98	5	6	5.1	1.7–11.5
PRST	Prostate surgery	80	2, 3	9	0	3	0	–
REC	Rectal surgery	62	0	53	2	6	3.8	0.5–13.0
REC	Rectal surgery	62	1, 2	69	1	7	1.4	0–7.8
REC	Rectal surgery	62	3	8	0	3	0	–
SB	Small bowel surgery	118	0	31	6	6	19.4	7.5–37.5
SB	Small bowel surgery	118	1, 2, 3	53	11	7	20.8	10.8–34.1
SPLE	Spleen surgery	105	0, 1, 2, 3	23	1	6	4.3	0.1–21.9

(*continued*)

Table 2. (Continued)

Surgical Procedure Code	*Procedure Description*	*Duration Cutpoint, Min*	*Risk Index Category*	*No. of Procedures*	*No. of SSIs*	*No. of Hospitals*	*SSI Rate, %*	*95% CI*
THOR	Thoracic surgery	45	0, 1	30	1	6	3.3	0.1–17.2
THOR	Thoracic surgery	45	2, 3	4	0	2	0	–
THYR	Thyroid and/or parathyroid surgery	61	0, 1, 2, 3	42	1	6	2.4	0.1–12.6
VHYS	Vaginal hysterectomy	70	0	28	1	4	3.6	0.1–18.3
VHYS	Vaginal hysterectomy	70	1, 2, 3	7	1	2	14.3	0
VS	Vascular	115	0	3	0	2	0	–
VS	Vascular	115	1, 2, 3	8	2	2	25.0	3.2–65.1
XLAP	Exploratory abdominal surgery	90	0, 1	4	0	3	0	–

CI = confidence interval.

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), 95% confidence intervals (CIs), and p values were determined for all primary and secondary outcomes.

Results

We recorded 4,413 SPs during the study period. Regarding patients' demographic characteristics, 55% (2,426) were female; the age mean was 41.6 years, and the mean ASA score was 1.3. Twenty-one percent of the incisions (n = 909) were classified as clean, 48% (2,115) as clean-contaminated, 15% (672) as contaminated, and 16% (717) as dirty. The hospital characteristics are shown in Table 1.

Table 2 shows SSI rates stratified by risk category. The SP with the highest SSI rates were AMP (25%; risk category 0, 1), BILI (19%; risk category 2, 3), COLO (33.3%; risk category 3); SB (20.8%; risk category 1, 2, 3), and VS (25%; risk category 1, 2, 3).

There were 210 positive cultures related to SSI. The most frequently isolated microorganisms were *Escherichia coli*, which represented 39% [24]. The rate of resistance to ceftriaxone, ceftazidime, and ciprofloxacin of this microorganism was 62%, 71%, and 36%, respectively. The second most commonly isolated microorganism was *Klebsiella pneumoniae* (16%), which was resistant to ceftriaxone in 57%, to ceftazidime in 67%, and to imipenem in 20% of cases. Other microorganisms found were *Enterococcus* spp. (10%), *Acinetobacter baumannii* (8%), *Streptococcus* spp. (6%), *Proteus mirabilis* (6%), *Candida* spp. (5%), and *Enterobacter* spp. (2%).

In Table 3, we compare the SSI rates of this study with the NSHN 2006–2008 SSI rates. Our rates were significantly higher in 42% (11 of 26) of the analyzed SPs (AMP, APPY, CHOL, COLO, FX, GAST, NEPH, PRST, SB, THYR, VHYS), whereas in 54% (14) of the analyzed SPs (AAA, BILI, BRST, CARD, CRAN, FUSN, HER, HPRO, HYST, KPRO, REC, SPLE, THOR, XLAP), SSI rates were similar in this study and the CDC-NHSN report. In one SP (CSEC in risk category 0), the rates were higher in the CDC-NHSN than in this report.

Discussion

The present study was designed to determine the incidence of SSI rates in seven cities in Vietnam, a limited-resource country. This is the first study of SSI in Vietnam that incorporates the risk categories of the CDC-NHSN, which allowed us to benchmark our rates against the rates presented in the CDC-NHSN Report 2006–2008. [20] From this comparison, it can be observed that SSI rates for appendix, colon, kidney, gallbladder, gastric, prostate, small bowel, and thyroid or parathyroid surgeries; limb amputation; open reduction of fracture; and vaginal hysterectomy are higher in our study than in the CDC-NHSN report [20]. In the cases of abdominal aortic aneurysm repair, bile duct, liver or pancreatitis surgery, breast surgery, cardiac surgery, craniotomy, spinal fusion, herniorrhaphy, hip prosthesis placement, abdominal hysterectomy, knee prosthesis insertion, rectal surgery, spleen surgery, thoracic surgery, and exploratory abdominal surgery, our SSI rates are similar to those of CDC-NHSN [20]. Finally, the SSI rate for cesarean section in our study was lower than CDC-NHSN rate [20].

In a study conducted in two Vietnamese hospitals by Nguyen et al., the global SSI rate was 10.9% [13], which is higher than the 5.5% global rate found in the presesnt study. The baseline rates of the study of Le et al. were 8.3% and 7.2%, which are higher than our rate [22]. The SSI rate found by Sohn et al. was 14.3%, which is three times the 5.5% rate found in our study [12]. The study by Sohn et al. also showed that resistance to ceftriaxone was among the highest, which also was the case in our study. A reason the rates of SSI in this study are lower than in some other studies from Vietnam is that the data collected in our study are from academic teaching and provincial public hospitals that have good microbiologic laboratories to support the diagnosis of SSI.

The relation between the rates of HAI and their association with the type of hospital (public, academic, and private), and the relation between HAI rates and the country's socioeconomic status (defined as low, mid low, and high income) were published recently by the INICC [23, 24]. Such studies' findings showed that a higher country socio-economic level correlated with a lower infection risk [23, 24].

Our higher SSI rates in comparison with US CDC-NHSN report also may be explained because in Vietnam, the first guidelines for the prevention of SSI were published by the Ministry of Health in 2012. Furthermore, our rates may reflect the typical hospital situation in limited-resources countries as a whole [25], and several reasons have been offered to explain this fact [26, 27]. Among the primary plausible causes, it can be mentioned that, in almost all the limited-resource countries, there are no legally

Table 3. Comparison with Risk Category and NHSN 2006–2008

Surgical Procedure Code	*Procedure Description*	*Risk Index Category*	*SSI rate in this study, %*	*SSI rate in CDC-NHSN, %*	*RR (95% CI), P value*
AAA	Abdominal aortic aneurysm repair	0, 1	0	2.1	0.00 (undefined), 0.884
AMP	Limb amputation	0, 1	25.0	1.3	20.0 (undefined), 0.001
AMP	Limb amputation	2, 3	0	3.0	0.00 (undefined), 0.762
APPY	Appendix Surgery	0, 1	6.7	1.2	5.78 (3.9–8.6), 0.001
APPY	Appendix Surgery	2, 3	8.8	3.5	2.54 (1.3–5.1), 0.006
BILI	Bile duct, liver or pancreatitis surgery	0, 1	13.1	8.1	1.63 (0.9–3.0), 0.116
BILI	Bile duct, liver or pancreatitis surgery	2, 3	19.0	13.7	1.40 (0.5–3.9), 0.523
BRST	Breast surgery	0	0	0.9	0.00 (undefined), 0.828
BRST	Breast surgery	1	0	3.0	0.00 (undefined), 0.808
BRST	Breast surgery	2, 3	0	6.4	0.00 (undefined), 0.721
CARD	Cardiac Surgery	0, 1	0	1.1	0.00 (undefined), 0.916
CHOL	Gallbladder surgery	0	4.2	0.2	18.0 (6.0–54.2), 0.001
CHOL	Gallbladder surgery	1	2.8	0.6	4.61 (1.1–19.2), 0.021
CHOL	Gallbladder surgery	2, 3	13.3	1.7	7.76 (1.9–32.1), 0.001
COLO	Colon surgery	0	18.2	4.0	4.56 (2.0–10.2), 0.001
COLO	Colon surgery	1	15.4	5.6	2.75 (1.2–6.1), 0.009
COLO	Colon surgery	2	17.4	7.1	2.46 (0.9–6.6, 0.062
COLO	Colon surgery	3	33.3	9.5	3.52 (0.5–25.2), 0.1807
CRAN	Craniotomy	0, 1	3.8	2.2	1.79 (0.4–7.2), 0.407
CRAN	Craniotomy	2, 3	16.7	4.7	3.58 (0.5–25.7), 0.175
CSEC	Cesarean section	0	0.1	1.5	0.09 (0.0– 0.7), 0.003
CSEC	Cesarean section	1	1.3	2.4	0.54 (0.13–2.2), 0.374
CSEC	Cesarean section	2, 3	0	3.8	0.00 (undefined), 0.662
FUSN	Spinal fusion	0	0	0.7	0.00 (undefined), 0.802
FUSN	Spinal fusion	1	0	1.8	0.00 (undefined), 0.848
FUSN	Spinal fusion	2, 3	0	4.1	0.00 (undefined), 0.839
FX	Open reduction of fracture	0	3.7	1.1	3.35 (1.7–6.7), 0.001
FX	Open reduction of fracture	1	7.9	1.8	4.44 (2.3–8.8), 0.001
FX	Open reduction of fracture	2, 3	15.8	3.4	4.70 (1.5–15.2), 0.004
GAST	Gastric surgery	0, 1	7.3	1.7	4.26 (2.2–8.4), 0.001
GAST	Gastric surgery	2, 3	7.1	4.2	1.69 (0.5–5.3), 0.367
HER	Herniorrhaphy	0	2.0	0.7	2.77 (0.6–11.8), 0.150
HER	Herniorrhaphy	1	4.8	2.4	1.97 (0.3–14.1), 0.493
HER	Herniorrhaphy	2, 3	0	5.2	0.00 (undefined), 0.746
HPRO	Hip prosthesis placement	0	0	0.7	0.00 (undefined), 0.795
HPRO	Hip prosthesis placement	1	0	1.4	0.00 (undefined), 0.788
HYST	Abdominal hysterectomy	0	0	1.1	0.00 (undefined), 0.421
HYST	Abdominal hysterectomy	1	0	2.2	0.00 (undefined), 0.623
HYST	Abdominal hysterectomy	2, 3	0	4.0	0.00 (undefined,) 0.840
KPRO	Knee prosthesis insertion	0	0	0.6	0.00 (undefined), 0.939
KPRO	Knee prosthesis insertion	1	0	1.0	0.00 (undefined), 0.888
NEPH	Kidney surgery	0, 1	8.9	0.9	10.2 (3.8–27.4), 0.001
NEPH	Kidney surgery	2, 3	5.3	4.5	1.17 (0.1–10.0), 0.887
PRST	Prostate surgery	0, 1	5.1	0.9	5.71 (1.9–17.4), 0.001
PRST	Prostate surgery	2, 3	0	2.9	0.00 (undefined), 0.609
REC	Rectal surgery	0	3.8	3.5	1.09 (0.2–4.9), 0.912
REC	Rectal surgery	1, 2	1.4	8.0	0.18 (0.03–1.3), 0.056
REC	Rectal surgery	3	0	26.7	0 (undefined), 0.1441
SB	Small bowel surgery	0	19.4	3.4	5.63 (2.34–13.6), 0.001
SB	Small bowel surgery	1, 2, 3	20.8	6.7	3.07 (1.7–5.6), 0.001
SPLE	Spleen surgery	0, 1, 2, 3	4.3	2.3	1.86 (0.2–15.5), 0.558
THOR	Thoracic surgery	0, 1	3.3	0.8	4.36 (0.6–33.8), 0.123
THOR	Thoracic surgery	2, 3	0	2.0	0.0 (undefined), 0.775
THYR	Thyroid and/or parathyroid surgery	0, 1, 2, 3	2.4	0.3	9.27 (1.0–89.1), 0.019
VHYS	Vaginal hysterectomy	0	3.6	0.7	4.93 (0.7–35.3), 0.078
VHYS	Vaginal hysterectomy	1, 2, 3	14.3	1.2	12.3 (1.7–88.4), 0.001
XLAP	Exploratory abdominal surgery	0, 1	0	1.7	0.00 (undefined), 0.796

CDC = U.S. Centers for Diseases Control and Prevention; CI = confidence interval; NHSN = National Healthcare Safety Network; RR = relative risk; SSI = surgical site infection.

enforceaguidelines; 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 recently has been much progress in health care in some developing countries, such as Vietnam, 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 facilities with extremely 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 an insufficient number of experienced nurses or trained healthcare workers [26, 27].

Participation in INICC has played a fundamental role, not only in increasing the awareness of HAI risks in participating hospitals in developing countries, but also in providing an exemplary basis for the institution of infection control practices. In many INICC hospitals, the formerly high incidence of HAI has been reduced by 30%–70% by implementing multidimensional programs that include a bundle of infection control interventions, education, outcome surveillance, process surveillance, feedback on HAI rates, and performance feedback of infection control practices. These measures have been applied for central line-associated blood stream infections, mechanical ventilator-associated pneumonia, and catheter-associated urinary tract infections [8–10].

For a valid comparison of a hospital's SSI rates with the rates from the CDC, it is required that the hospitals start collecting their data by applying definitions of SPs as provided by 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.

This study has some important limitations. First, because of financial constraints, we did not implement post-discharge surveillance with phone calls, visits, or letters to patients. Surveillance was performed only for those patients who returned to the hospital to consult for SSI symptoms or signs and excluding those patients who did not return or who attended another healthcare facility. Second, regarding some selective SPs, such as spine and breast procedures, although these are clean procedures, which could explain the low infection rate, the sample size is too small to draw any conclusions, and these results should be interpreted with caution. In reviewing the literature, no systematic data were found on global SSI rates and SSI rates stratified by SP. For this reason, it is worth mentioning that substantial and useful data nevertheless are provided in this study, which is a first step in advancing our understanding of the SSI rate in Vietnam.

Conclusions

Our SSIs rates in Vietnam were higher in 42% of the 26 analyzed types of SPs than in the CDC-NHSN. This paper represents an important advance in the knowledge of SSI epidemiology in Vietnam that will allow us to introduce targeted interventions.

Acknowledgments

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Disclosure Statement

The authors have 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 identifiable only to the infection control team.

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