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What Is the Real Rate of Surgical Site Infection?

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QUESTION ASKED: What is the real rate of surgical site infection (SSI) after surgery for gynecologic malignancy and benign gynecologic disease?

SUMMARY ANSWER: Overall SSI rates differed greatly between the University HealthSystem Consortium (UHC), National Surgical Quality Improvement Program (NSQIP) and National Healthcare Safety Network (NHSN) (1.5%, 8.8%, and 2.8% respectively, $P < .001$) due to wide variation in reporting methodology. Variation was notable among deep (UHC, 0.7%; NSQIP, 4.7%; NHSN, 1.3%; $P < .001$) and organ space infections (UHC, 0.4%; NSQIP, 4.4%; NHSN, 1.4%; $P < .001$) as well as when the reporting agencies were compared with institutional chart review by the authors. Also, because of differences in reporting methodology, only 19 cases (24.4%) were included in more than one database and only one case was included in all three databases (1.3%).

WHAT WE DID: We compared SSI rates after gynecologic surgery obtained from the UHC, NSQIP and NHSN databases and the reporting methodologies used by these agencies among themselves. We also compared the SSI rates reported by these agencies to the SSI rate obtained from chart review.

WHAT WE FOUND: There was significant variation in the rate of SSI after gynecologic surgery reported by national reporting agencies. Variations in reporting methodology also resulted in limited overlap between reporting agencies in identification of cases with SSI.

BIAS, CONFOUNDING FACTORS, DRAWBACKS: A limitation of this analysis is that these data are from a single institution and relate to SSI after surgery for gynecologic malignancy and benign gynecologic disease. Results may not be generalizable for the rate of SSI after surgery in other institutions or specialties. Finally, care must be taken when comparing the reported rates of SSI across agencies as there is variation in the denominators on the basis of the differing inclusion and exclusion criteria.

REAL-LIFE IMPLICATIONS: There is discordance among national reporting agencies tracking the rate of SSI. Adopting standardized metrics across agencies could improve consistency and accuracy in assessing SSI rates. When planning an initiative to improve SSI rates and patient outcomes, it is important to assess which metric and reporting method will be most useful and appropriate (Fig). [JOP](#)

See the figure on the following page.

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FIG. Overlap among databases. Cases included in two databases (red arrows); case included in three databases (black arrow). NHSN, National Healthcare Safety Network; NSQIP, National Surgical Quality Improvement Program; UHC, University HealthSystem Consortium.

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Abstract

Purpose

Surgical site infections (SSIs) are associated with patient morbidity and increased health care costs. Although several national organizations including the University HealthSystem Consortium (UHC), the National Surgical Quality Improvement Program (NSQIP), and the National Healthcare Safety Network (NHSN) monitor SSI, there is no standard reporting methodology.

Methods

We queried the UHC, NSQIP, and NHSN databases from July 2012 to June 2014 for SSI after gynecologic surgery at our institution. Each organization uses different definitions and inclusion and exclusion criteria for SSI. The rate of SSI was also obtained from chart review from April 1 to June 30, 2014. SSI was classified as superficial, deep, or organ space infection. The rates reported by the agencies were compared with the rates obtained by chart review using Fisher's exact test.

Results

Overall SSI rates for the databases were as follows: UHC, 1.5%; NSQIP, 8.8%; and NHSN, 2.8% ($P < .001$). The individual databases had wide variation in the rate of deep infection (UHC, 0.7%; NSQIP, 4.7%; NHSN, 1.3%; $P < .001$) and organ space infection (UHC, 0.4%; NSQIP, 4.4%; NHSN, 1.4%; $P < .001$). In agreement with the variation in reporting methodology, only 19 cases (24.4%) were included in more than one database and only one case was included in all three databases (1.3%).

Conclusion

There is discordance among national reporting agencies tracking SSI. Adopting standardized metrics across agencies could improve consistency and accuracy in assessing SSI rates.

INTRODUCTION

Surgical site infections (SSIs) are potentially avoidable postoperative complications that lead to increased patient morbidity and health care expenditures.¹⁻³ Although several

national agencies monitor the rate of SSI as a marker of the quality and safety of surgical care, there is no standard reporting methodology.⁴⁻⁶ The procedure for detecting SSI, the inclusion and exclusion criteria, and

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the definition of SSI vary among agencies.⁴⁻⁶ Because there are no regulations to create uniform reporting methodologies among agencies, an in-depth understanding of the variation in reported SSI rates is likely to remain relevant to health care institutions and to the general public.

Greater awareness of the danger of SSI has occurred in recent years, in part because of an increase in public reporting.⁴⁻⁶ For instance, *U.S. News and World Report* included wound complications in their calculations to determine the rankings of the best hospitals.⁷ Public reporting has been suggested as an effective method to improve patient care.⁸ Unfortunately, there is significant variation in expectations of and regulations related to public reporting of SSI.⁹ The agencies we examine here include the Centers for Disease Control and Prevention's National Healthcare Safety Network (NHSN), the University HealthSystem Consortium (UHC; now known as Vizient), and the American College of Surgeons' National Surgical Quality Improvement Program (NSQIP).

Because of the negative consequences of developing SSI, many institutions are instituting quality improvement initiatives to decrease the SSI rate.^{1,2,10-15} An integral part of any quality improvement initiative, however, is understanding the metrics used to determine the success of the initiative. As a result, our objective was to analyze the differences among the rates of SSI after surgery for gynecologic malignancy in our institution, obtained from national reporting agencies. We also compared the SSI rates obtained from these national reporting agencies with the SSI rates obtained from investigator chart review.

METHODS

After approval by the Quality Improvement Assessment Board, we queried the UHC, NSQIP, and NHSN databases from July 2012 to June 2014 for SSI rates after abdominal surgery performed by a gynecologic oncologist or general gynecologist at our institution. In addition, the rate of SSI was obtained from chart review for all abdominal surgery cases performed by a gynecologic oncologist or general gynecologist at our institution from April 1 to June 30, 2014. The definition of SSI for the chart review was any described infection of the surgical incision or intra-abdominal space requiring antibiotics. Both open and minimally invasive (laparoscopic or robotic) cases were included.

If not classified by reporting agency, SSIs were classified by investigators as superficial, deep, or organ space infection (OSI) according to the system endorsed by the Centers for Disease Control and Prevention. Superficial SSI involves the

skin to the level above the fascia. Deep SSI involves the fascia and/or muscle layer. OSIs involve any part of the body deeper than the fascial/muscle layers that is opened or manipulated during the operative procedure. Superficial or deep infections could be present with OSIs and were not considered to be mutually exclusive when documented by chart review.

The rates of SSI reported by the agencies and those obtained by chart review were compared using Fisher's exact test. Variation in the reporting of the different types of SSI and the amount of overlap among the agencies were noted. A *P* value of $< .05$ was considered to be statistically significant for all analyses. Stata version 13.1 statistical software (STATA, College Station, TX; Computing Resource Center, Santa Monica, CA) was used for all statistical analyses.

RESULTS

Table 1 lists the methods by which the different databases detect SSI, including inclusion criteria, exclusion criteria, and definition of SSI. UHC relies on automated search criteria using coding to detect SSI, whereas NSQIP, NHSN, and chart review use trained reviewers. The length of the postoperative assessment period varies as well. NSQIP, NHSN, and chart review include a 30-day postoperative period during which SSI can be diagnosed. UHC includes only cases of SSI that occur during the same hospital admission as that of the preceding surgery. UHC and chart review have the broadest inclusion criteria. UHC includes all surgical cases for evaluation; however, a minimal 2-day length of stay is required, thereby excluding the majority of minimally invasive surgeries. Chart review includes all abdominal surgery cases. NSQIP selects 13% to 17% of eligible surgical cases, which include hysterectomy and/or surgery involving the large bowel. NSQIP also uses a systematic sampling process with rotating 8-day cycles to minimize selection bias. Finally, NHSN reviews all eligible surgical cases involving hysterectomy and/or surgery on the large bowel. However, cases involving the rectum or that are classified as in the fifth interquartile range for surgical time, age, and American Society of Anesthesiologists physical status score are excluded.

Not all databases include cases of SSI treated at other hospitals after surgery. NSQIP, NHSN, and chart review include cases of SSI admitted to outside hospitals if there is sufficient information available either in our institution's medical record or as reported by the outside hospital to the agency. UHC includes only SSIs that were diagnosed at our institution. In addition, the definition of what qualifies as an SSI varies among databases. UHC and chart review have the most

Table 1. SSI Criteria by Database

Database	Detection Method	30-Day Postoperative Follow-Up	Inclusion Criteria	Track Admissions to Other Hospitals	SSI Definition
UHC	ICD9/ICD10 Coding	No	All surgical cases with length of stay > 2 days	No	Infected postoperative seroma OR other postoperative infection including SSI, intra-abdominal infection, or sepsis
NSQIP	Trained reviewers	Yes	Selection of 13%-17% of hysterectomy and colorectal surgery cases	Yes	Purulent incisional drainage OR culture-positive incision OR superficial incision deliberately opened and culture positive or not cultured* AND Physical signs/symptoms of SSI OR diagnosis by practitioner
NHSN	Trained reviewers	Yes	All hysterectomy or colorectal surgery cases except rectal surgery or cases > 5th IQR for operating time, age, or ASA status	Yes	Purulent incisional drainage OR culture-positive incision OR superficial incision deliberately opened and culture positive or not cultured* AND Physical signs/symptoms of SSI OR diagnosis by practitioner
Chart review	Trained reviewers	Yes	All surgical cases	Yes	Infection of the surgical incision or organ space requiring antibiotics

Abbreviations: ASA, American Society of Anesthesiologists; ICD9, International Classification of Diseases (9th revision); ICD10, International Classification of Diseases (10th revision); IQR, interquartile range; NHSN, National Healthcare Safety Network; NSQIP, National Surgical Quality Improvement Program; SSI, surgical site infection; UHC, University HealthSystem Consortium.

*Definition related to superficial SSI.

inclusive definitions of SSI. UHC includes any patient with a diagnosis code corresponding to an infected postoperative seroma (International Classification of Diseases [9th revision] code 998.51) or other postoperative infection (International Classification of Diseases [9th revision] 998.59), which includes SSI, intra-abdominal infection, or sepsis. Chart review includes any infection of the surgical incision or abdominal space that occurred within 30 days of surgery, diagnosed in the medical record as requiring antibiotics. NSQIP and NHSN use the same definition of SSI. This definition differs when applied to superficial or deep or OSIs, but it broadly involves either purulent incisional drainage, evidence of wound culture positivity or a practitioner deliberately opening an incision, and either clear physical examination findings consistent with SSI or clearly stated SSI diagnosis by practitioner.

A total of 75 cases of SSI among 1,540 surgeries were detected by the reporting agencies over a 2-year period. Of note for the NSQIP rate, the denominator takes into consideration that only a fraction of all surgeries are reviewed for SSI. Overall,

the rate of SSI was reported as 1.5% by UHC, 8.8% by NSQIP, and 2.8% by NHSN ($P < .001$). There was also significant variation reported between the rates of deep and OSI. NSQIP reported the highest rate of deep infection (4.7%) compared with UHC (0.7%) and NHSN (1.3%); $P < .001$. NSQIP also reported the highest rate of OSI (4.4%) compared with NHSN (1.4%) and UHC (0.4%); $P < .001$. The reported rate of superficial SSI did not differ significantly among agencies (UHC, 0.7%; NSQIP, 1.3%; NHSN, 0.5%; $P = .30$).

In agreement with the significant differences in the reporting methodologies among the reporting agencies, there was a limited amount of overlap in the cases of SSI. As illustrated in Fig 1, only 19 cases (25.3%; red arrows) were included in more than one database and only one case (1.3%; black arrow) was included in all three databases. The largest amount of overlap occurred between the NSQIP and the NHSN databases. Eleven cases (14.7%) were included in both the NSQIP and the NHSN databases, four cases (5.3%) were included in both the NSQIP and the UHC databases, and two

FIG 1. Overlap among databases. Cases included in two databases (red arrows); case included in three databases (black arrow). NHSN, National Healthcare Safety Network; NSQIP, National Surgical Quality Improvement Program; UHC, University HealthSystem Consortium.

cases (2.7%) were included in both the NHSN and the UHC databases. Individually, the UHC database included 23 cases (30.7%), the NSQIP database included 28 cases (37.3%), and the NHSN database included 44 cases (58.7%).

The SSI rates reported by UHC, NSQIP, and NHSN were then compared for the 3-month period (April to June 2014) assessed by chart review. Overall, UHC reported a rate of 1.0% (two of 192), NSQIP, 7.5% (three of 40), and NHSN, 3.6% (seven of 192), whereas chart review reported a rate of 12.5% (29 of 232; $P < .001$). The rate of superficial and organ space SSI also varied significantly among groups. Chart review found a superficial SSI rate of 7.8% (18 of 232), whereas UHC reported a rate of 1.0% (two of 192), NSQIP, 0%, and NHSN, 0% ($P < .001$). NSQIP reported the highest rate of OSI at 5.0% (two of 40) compared with UHC, 0%, NHSN, 2.1% (four of 192), and chart review, 3.9% (nine of 232); $P = .01$. The rate of deep SSI was comparable across groups (UHC, 0%; NSQIP, 2.5%; NHSN, 1.6%; chart review, 1.7%; $P = .17$). Although all cases reported by the other databases were also included in the chart review database, the higher rate of deep and organ space SSI reported by NSQIP reflects a smaller denominator compared with chart review. The rates of SSI by reporting method are listed in Table 2.

Finally, the monthly variation in the overall SSI rate reported by the three agencies was compared with the variation found by chart review. We found significant variation in the reported SSI rates each month. The overall SSI rate reported for April 2014 was 0% by UHC, 7.7% by NSQIP, 1.6% by NHSN,

Table 2. SSI Rate by Database

Type of SSI	UHC (n = 192)	NSQIP (n = 40)	NHSN (n = 192)	Chart Review (n = 232)	P
Superficial	2 (1.0)	0 (0)	0 (0)	18 (7.8)	< .001
Deep	0 (0)	1 (2.5)	3 (1.6)	4 (1.7)	.17
OSI	0 (0)	2 (5.0)	4 (2.1)	9 (3.9)	.01
Overall*	2 (1.0)	3 (7.4)	7 (3.6)	29 (12.5)	< .001

NOTE. Data are presented as No. (%).

Abbreviations: NHSN, National Healthcare Safety Network; NSQIP, National Surgical Quality Improvement Program; OSI, organ space infection; SSI, surgical site infection; UHC, University HealthSystem Consortium.

*Superficial or deep SSI could be present with OSI and were not considered to be mutually exclusive when calculating the overall SSI rate.

and 13.1% by chart review ($P = .002$). For May 2014, the rates were UHC, 3.1%; NSQIP, 14.3%; NHSN, 1.6%; and chart review, 11.8% ($P = .03$). Lastly, for June 2014, the overall SSI rate reported by UHC was 0%; by NSQIP, 0%; by NHSN, 7.8%; and by chart review, 12.5% ($P = .01$).

DISCUSSION

Our findings suggest significant discordance among national agencies in many aspects of SSI reporting. We noted differences in the detection methodology, the inclusion and exclusion criteria, and the definitions used by each agency to determine SSI rates. There are inherent weaknesses and the potential for error in all the detection methods. Different inclusion and exclusion criteria may affect the number of cases available for evaluation. In addition, health care in the United States is fragmented, and patients may receive treatment, including for postoperative complications, at different hospitals. Many of the reporting methods do not track SSI treated at an institution different from where the surgery was performed. In addition, many clinically relevant SSIs are not included by some of the reporting agencies because of their restrictive definitions.

This variation in the reporting methodology also led to variability in the rate of SSI among groups. Overall, SSI rates ranged from 1% to 12.5%. Of the subtypes of SSI, this variation among agencies was most notable when examining the rate of superficial infections. Two agencies, NSQIP and NHSN, reported a rate of 0%, compared with the chart review rate of 7.8%.

Such inconsistency in reporting the rate of SSI is not a problem unique to health care in the United States. Even national health care systems, where there is an opportunity for

improved follow-up and consistency in detection techniques, have struggled with this issue.¹⁶ Reports from the United Kingdom have highlighted issues with SSI rate benchmarks and consistency and accuracy in reporting methodology.^{16,17} Similar to our results, there was substantial variation in inclusion and exclusion criteria and in the methodology by which the data were abstracted at different institutions in the British health care system.¹⁷

A limitation of this analysis is that these data are from a single institution and may not reflect the experience at other institutions. In addition, the data presented relate to SSI after surgery for gynecologic malignancy and benign gynecologic disease. These results may differ from the rate of SSI after surgery in other specialties. Finally, care must be taken when comparing the reported rates of SSI across agencies, because there is variation in the denominators on the basis of the different inclusion and exclusion criteria.

One of the strengths of our study was that it compared the reported rates of SSI from different agencies using a single study population. By keeping the study population the same, we were able to directly compare the results across the agencies. In addition, the rates reported by the different agencies were compared with chart review, adding another reporting methodology for comparison.

In conclusion, adopting standardized metrics across agencies could improve the consistency and accuracy in assessing SSI rates in institutions. This is a first step in creating a uniform national reporting system with greater transparency for patient safety. No method for detecting and reporting SSI described here is superior to others; rather, each has unique strengths and limitations. When planning an initiative to improve SSI rates, it is important to assess which metric and reporting method will be most useful. **JOP**

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST**What Is the Real Rate of Surgical Site Infection?**

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