



An analysis of 3,954 cases to determine surgical wound classification accuracy: Does your institution need a monday morning quarterback?

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ABSTRACT

Introduction: Surgical site infections reporting has financial implications for institutions under Centers for Medicare and Medicaid Services (CMS) Pay-for-Performance programs. Surgical Wound Classification (SWC) is an important factor in performing risk adjustment and affects the accuracy of the Standardized Infection Ratio (SIR). This in turn leads to more accurate inter-hospital ratings and reimbursement. This study aims to measure (1) services and procedures associated with the highest rates of misclassification and (2) whether temporal factors influenced misclassification.

Methods: Accuracy of SWC was assessed by comparing the wound classification documented by the Operating Room (OR) nurse at the time of the operation to the actual SWC determined from in-depth chart review using Centers for Disease Control and Prevention (CDC) wound classification algorithm by a trained reviewer. Cases were reviewed once operative reports were available.

Results: Review of 3954 cases yielded an overall discordance rate of 22.15% (N = 876), with most cases being under-classified. Services with the highest rates of discordance include cardiothoracic (38.46%) and general surgery (37.86%), followed by general oncology (29.46%), OB-GYN (28.93%), urology (27.27%), and plastic surgery (27.14%). Procedures with the highest discordance rates are laparoscopic appendectomy (66.67%), cholecystectomy (52.90%), exploratory laparotomy (49.21%), and split-thickness skin graft (36.84%). Discordance rates were significantly higher (p = 0.0001) during weekends compared to weekdays, while operations starting after-hours during the week did not show a significant difference from daytime hours.

Conclusion: At a level 1 trauma academic medical center, certain procedures were found to be misclassified in regards to SWC more often than other types of cases. The timing of the case, such that they occurred on the weekends also contributed to higher discordance rates between original and corrected wound classifications. Recognizing cases, services, and temporal factors frequently associated with misclassification of wound class can help allocate limited resources to maximize improvement of this important metric.

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Introduction

Surgical wound classification (SWC), first introduced by the National Academy of Sciences in 1964, has been the foundation for infectious risk assessment and surgical decision-making.¹

The current SWC system which stratifies wounds into 4 categories (clean, clean-contaminated, contaminated, and dirty) plays a

central role in surgical site infection (SSI) risk stratification models.¹ SSIs are a significant burden to the United States healthcare system, complicating 2–5% of the nearly 15 million procedures performed in the US each year.² SSIs are associated with increased mortality risk and substantial financial burden on our health care system, costing roughly \$10 billion each year.²

It has been recognized for years that the risk of infection varies by wound class; the first wound class studies published in the 1960s demonstrates rates of infection of 3.3% for clean wounds, 10.8% for clean-contaminated wounds, 16.3% for contaminated wounds, and 28% for dirty wounds.¹ More recent studies conducted with the National Surgical Quality Improvement Program (NSQIP)

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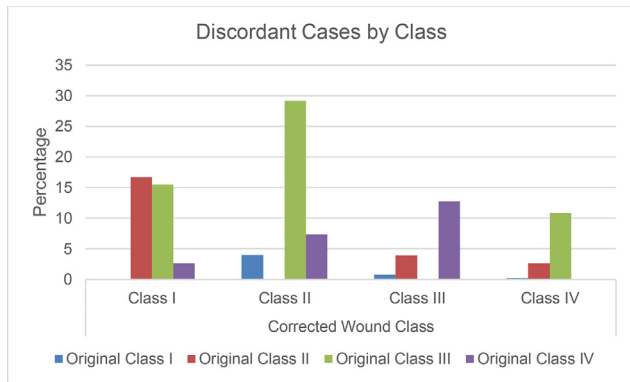


Fig. 1. Discordance Rates by Surgical Wound Class for All Cases and the Direction of Misclassification. Class I had a discordance rate of 5.24%, class II had a discordance rate of 23.32%, class III had a discordance rate of 55.45%, and class IV had a discordance rate of 22.71%. Class II and III had an overall tendency to be under-classified. Concordant cases were excluded for clarity.

data suggests that SWC may not be a useful variable in risk adjusted models given the other variables within this database.³ However, the Medicare Pay for Performance programs require reporting of surgical site infections through the Center for Disease Control's (CDC) National Hospital Safety Network (NHSN) which is a widely used system to track Healthcare Associated Infections (HAI). This reporting system considers numerous variables, including diabetes mellitus, ASA score, emergent/elective status of a case, BMI and wound class as variables in their logistic regression model.⁴ The subsequent Standardized infection ratio (SIR) that is developed and reported is therefore partially dependent on accurate reporting of wound class. Under-classifying wounds, in particular, could have a detrimental effect to institutional reputation and incur financial penalties.

In most hospitals around the country, the determination and documentation of SWC is performed by the operating room nurse.⁵ A retrospective review evaluated 312 pediatric appendicitis cases and compared diagnosis-based SWC with nurse-obtained SWC and discovered a 92% discordance.⁶ The discordance in surgical wound classification is a common and pervasive problem and contributing factors include insufficient knowledge of wound classification by the operating room nurse and lack of participation from the surgeon.⁷

From prior work, we knew that our institution had a 67–80% concordance rate with regards to SWC.⁸ Our retrospective analysis of surgical wound classification reviewed 3954 charts at the University of New Mexico Hospital in an attempt to answer the following questions: Which surgical services have the highest rates of misclassification? Which specific procedures within these services are more likely to be misclassified? Do temporal factors such as normal hours versus after-hours, week day versus weekend, and month of the year impact discordance rates? We hypothesized that a specific subset of cases and operations conducted after-hours and on weekends were contributing disproportionately to the discordance rate. In exploring these questions, we hope to identify high yield areas for intervention, thus assisting in dedication of limited resources to improve accuracy of wound classification.

Methods

Institutional review board approval was obtained. A dedicated Registered Nurse (RN) abstractor performed a retrospective review of 3954 charts from the electronic medical record 48 h after surgery was completed. All patients over the age of 18 who underwent

Table 1

Discordance Rates by Service. Cardiothoracic surgery and general surgery have the highest rates of discordance. General surgery, orthopedics, and urology make up over half of the discordant cases.

Service	N Discordant	N Total	% Discordance
Cardiothoracic	25	65	38.46
General Surgery	262	692	37.86
General Oncology	66	224	29.46
OB-GYN	46	159	28.93
Urology	96	352	27.27
Plastic Surgery	54	199	27.14
Oromaxillofacial Surgery	10	42	23.81
Vascular Surgery	40	202	19.80
Orthopedic Surgery	131	820	15.98
ENT	75	505	14.85
Gynecologic Oncology	15	103	14.56
Urogynecology	5	80	6.25
Neurosurgery	20	409	4.89
Pain	2	45	4.44

surgery at the University of New Mexico Hospital in the Main Operating Room between the period 09/21/2017 to 04/03/2018 were included in the study. After extensive training in the use of the CDC classification algorithm, correct wound class assignment was determined from analysis of the operative note. This correct wound class assignment was compared to the wound class assignment entered in the EMR by the circulating RN at the time of surgery. Later classification was more accurate because the reviewing nurse had the operative report and increased training. If the discrepancies were not obvious, they were discussed and verified by the surgeon champion of NSQIP. Encounter type, procedure type, documented SWC, primary surgeon, surgical service, operating room number, date of surgery, time of surgery, and surgery duration were also extracted from the electronic medical record.

Results

SWC was audited for 1527 class I, 1102 class II, 703 class III, and 612 class IV cases, with discordance rates of 5.24%, 23.32%, 55.4%, and 22.71% respectively. Compared with the initial classification entered by the circulating RN, there was an overall discordance rate of 21.96% (N = 877), with an overall tendency to be under-classified. The direction of misclassification for each class is represented in Fig. 1. The monthly discordance rate ranged between 17 and 25% from September to April with a variance of 0.09%.

Services with the highest rates of discordance include cardiothoracic (38.46%) and general surgery (37.86%), followed by general oncology (29.46%), OB-GYN (28.93%), urology (27.27%), and plastic surgery (27.14%). Services with the highest numbers of discordant cases includes general surgery (262), orthopedics (131), and urology (96), making up over half of all total discordant cases. Table 1 shows the complete list of services with associated discordance rates.

By procedure, laparoscopic appendectomy, cholecystectomy, exploratory laparotomy, and split-thickness skin graft were most commonly misclassified. Laparoscopic appendectomies were performed by general surgery. Cholecystectomies were performed by general surgery, general oncology, and vascular surgery. Exploratory laparotomies were performed by general surgery, general oncology, gynecologic oncology, obstetrics/gynecology, urology, and vascular surgery. Split-thickness skin grafts were performed by ENT, general surgery, orthopedics, plastic surgery, and vascular surgery. All of these procedures had reported SWCs that were most commonly under-classified, with the direction of misclassification shown in Table 2. Class III had the highest rate of discordance and 160 of the 226 discordant cases included the four procedures

Table 2

Discordance Rates by Procedure. Laparoscopic appendectomy, cholecystectomy, exploratory laparotomy, and split-thickness skin graft were the procedures with the highest rates of discordance. The SWC assignments for these cases were most often under-classified.

Procedure	Laparoscopic Appendectomy (N = 48)	Cholecystectomy (N = 138)	Exploratory Laparotomy (N = 191)	Skin Graft Split Thickness (N = 76)
Discordance	66.67% (N = 32)	52.90% (N = 73)	49.21% (N = 94)	36.84% (N = 28)
Overclassified or under classified	Under (N = 31) Over (N = 1)	Under (N = 70) Over (N = 3)	Under (N = 77) Over (N = 17)	Under (N = 22) Over (N = 5)

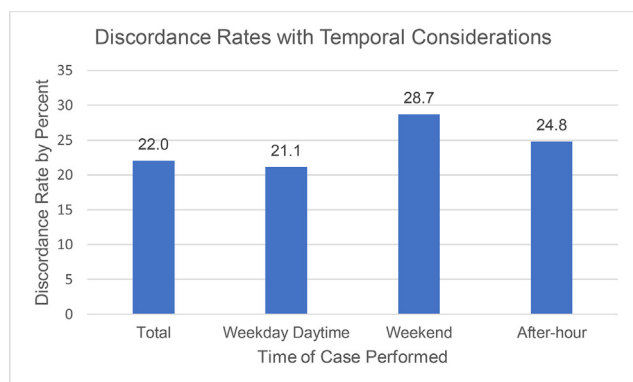


Fig. 2. Discordance Rates with Temporal Considerations. There is a significant increase in discordance rates on weekends in comparison to discordance rates during the week. There was no significance difference between after hours and day hours discordance rates.

previously listed. Class II had 257 discordant cases and 42 of these cases were nephrectomies or kidney transplants. Class IV had 139 discordant cases with 28 exploratory laparotomies and 8 appendectomies.

Temporal factors were evaluated by chi squared analysis to determine the effect on discordance rates. There was no significant difference ($p = 0.066$) between after-hours (24.82%) when compared to day cases (21.60%); however, there was a significant difference ($p = 0.0001$) between discordance rates during the weekend (28.73%) when compared to cases from the week (21.14%). The comparison of discordance rates with temporal considerations is shown in Fig. 2. The direction of misclassification for weekend cases is shown in Table 3.

Discussion

SSIs are important metrics in quality reporting with significant financial penalties associated with poor performance for both the hospital value-based purchasing program as well as the Hospital-Acquired Condition (HAC) reduction program. The importance of surgical wound class as a predictor of infection, especially in large databases that take numerous patient and procedural factors into account is questionable.^{3,9} However, the financial penalties associated with high infection rates are calculated through the SIR used by the Center for Disease Control's (CDC) NHSN. This data is used by

the value-based purchasing program as well as the HAC reduction program with hospitals in the lowest quartile subject to a 1% financial penalty.⁴ Misclassifying wounds, especially under-classifying wounds, can be detrimental to the perception of the quality of care provided at a given institution.

There are many studies documenting the inaccuracies of wound classification at various institutions and the use of targeted educational interventions to improve accuracy.^{8,10} However, we know that education often does not lead to sustained improvement and other strategies should be employed to ensure correct reporting of wound class. Moreover, there is disagreement as to whether the wound class should change based on the occurrence of an unintended consequence (i.e., bowel injury during a cholecystectomy). This practice does not allow for the standardization of wound class assignment and may give the surgeon and the institution an unfair advantage when it comes to predicting risk of infection. However, numerous small studies have shown that a lack of awareness and a lack of communication is the most common factors leading to inaccuracies for even straightforward cases with no unintended consequences. It is also a predictable problem when emergent exploratory laparotomies are performed with no communication at the end of the case as to the actual wound class. Most institutions have limited resources and many competing interests when it comes to quality reporting. Our study aims to clarify where resources may be used for maximum benefit. Our hypothesis was supported by the fact that certain types of procedures were largely responsible for the majority of discordant cases, and weekends, but not after-hours, were significantly affected. Analyzing all cases for wound class accuracy is not practical, but recognizing the frequently misclassified cases, services that tend to be less accurate and the times of the week when this tends to be worse, will help in allocating resources to this issue.

The strengths of this study include the large number of cases evaluated as well as the rigorous methodology used. A single abstractor reviewed all cases eliminating any error due to inter-observer variability. Both emergency, elective and trauma cases were included in this study. Limitations of this study include the fact that the cases reviewed were all performed at a single institution and did not include pediatric cases. Errors could have occurred if the reviewer misinterpreted the operative note, or if the operative note omitted important details that affected wound classification.

At our institution, reviewing cases which occurred over the weekends with the focus on laparoscopic appendectomy, cholecystectomy, exploratory laparotomy, and split-thickness skin graft

Table 3

Discordance Rates by SWC for Weekend Cases. A statistically significant difference was seen in discordance rates between week day cases and weekend cases. Furthermore, class II and class III wounds in weekend cases were most frequently misclassified.

Misclassified as: (% Discordance)	Actual Class			
	Class I (N = 171)	Class II (N = 58)	Class III (N = 151)	Class IV (N = 148)
Class I	–	31.03	18.54	2.70
Class II	5.26	–	23.84	6.08
Class III	2.34	8.62	–	14.19
Class IV	0	3.45	11.26	–

may be the most efficient method to reduce discordance rates. Other tactics to improve this metric that have been employed at our institution are the use of reference cards with the algorithm readily available to the staff and including this algorithm into nursing competency requirements. Attempts are also being made to incorporate a debrief by the attending surgeon at the end of each procedure as standard practice.

Along with frequent education and decision support tools built into the electronic medical record, focused review of commonly misclassified cases at one's institution can help to improve the accuracy of quality reporting.

Declaration of competing interest

Sanjog Singh: No conflicts of interest
 Sahitya Podila: No conflicts of interest
 Grace Pyon: No conflicts of interest
 John Blewett: No conflicts of interest
 Jancy Jefferson: No conflicts of interest
 Rohini Mckee: No conflicts of interest

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