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Surgical Wound Classification and Surgical Site Infections in the Orthopaedic Patient

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Abstract

Introduction: The Centers for Disease Control and Prevention created a surgical wound classification system (SWC: I, clean; II, clean/contaminated; III, contaminated; and IV, dirty) to preemptively identify patients at risk of surgical site infection (SSI). The validity of this system is yet to be demonstrated in orthopaedic surgery. We hypothesize a poor association between the SWC and the rate of subsequent SSI in orthopaedic trauma cases.

Methods: Nine hundred fifty-six orthopaedic cases were reviewed. Wounds were risk stratified intraoperatively using the SWC grades (I-IV). SSI was diagnosed clinically or with objective markers. The SWC was compared with SSI rates using a Fisher exact test. Significance was set at $P < 0.05$.

Results: Four hundred patients met the selection criteria. The rate of infection was not significantly different across the SWC grades ($P = 0.270$). There was a significantly higher risk of SSI among patients with diabetes ($P = 0.028$).

Conclusions: The Centers for Disease Control and Prevention SWC showed poor utility in predicting and risk stratifying postoperative SSIs in orthopaedic surgical cases.

Surgical site infection (SSI) is a dreaded complication of surgery, and the ability to identify risk factors for patients can be beneficial for managing patient expectations as well as optimizing good clinical outcomes. The National Nosocomial Infections Surveillance (NNIS) system set by the Centers for Disease Control and Prevention (CDC) ranked SSI third among all reported cases of inpatient nosocomial infections. Specifically, SSIs accounted for up to 16% of nosocomial infections in all hospitalized patients and 38% of all surgical patients.¹

SSIs remain a problem in surgery, despite significant advances in surgical techniques, modern technologies in the operating room, and preemptive measures such as perioperative intravenous antibiotics and preoperative skin antisepsis. SSIs will increase a patient's risk of morbidity and mortality and can have serious economic consequences.²⁻⁴ Estimates of the annual incidence of SSIs following all orthopaedic procedures are between 31,000 and 35,000.⁵

Active measures to identify important risk factors for developing SSI and preventing its sequelae led the CDC to create a risk model that

Table 1**Surgical Wound Classification Grades (I–IV) as Defined by the CDC****CDC Surgical Wound Classification Definitions**

Class I/Clean: An uninfected operative wound in which no inflammation is encountered, and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow no penetrating (blunt) trauma should be included in this category if they meet the criteria.

Class II/Clean-Contaminated: An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in a sterile technique is encountered.

Class III/Contaminated: Open, fresh, accidental wounds. In addition, operations with major breaks in a sterile technique (eg, open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute or no purulent inflammation is encountered are included in this category.

Class IV/Dirty-Infected: Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

CDC = Centers for Disease Control and Prevention.

includes the American Society of Anesthesiology (ASA) Score, procedure duration, and a surgical wound classification (SWC). The SWC is categorized by the degree of gross contamination (clean, clean-contaminated, contaminated, and dirty), and is used in conjunction with the ASA and procedure duration to identify those at risk of SSI.⁶ The original classification system was developed by the National Academy of Sciences and the National Research Council Cooperative Research study in 1964, with later modifications by the CDC in 1982. This classification system has been widely used, and although less prevalent as of recent, it is still being implemented at a number of institutions for hospital quality improvement measures, third-party payers,

and quality improvement collaborators.⁷ In the operating room, the surgical wounds are described as clean, clean-contaminated, contaminated, and dirty (Table 1). The SWC is based on crude analysis by the observer and is one of the three equally weighted components in the risk model. SSI has not been exclusively studied in the orthopaedic population using this classification system. The SWC has demonstrated efficacy for predicting SSI in visceral tissue;⁷ however, it has also been described as ineffective because of low interobserver reliability between healthcare providers and institutions.⁸ To our knowledge, there are no studies in the orthopaedic literature that have evaluated the prognostic utility of the CDC SWC system for orthopaedic SSI. Given its

consistent use in select institutions to risk-stratify patients at risk of SSI, our objective was to determine the prognostic value of the CDC SWC in the orthopaedic patient. This study was performed at a Level 1 Trauma Center, where the CDC SWC is implemented for all surgical procedures.

Methods

Nine hundred fifty-six consecutive orthopaedic surgery cases, from the year 2012, were recorded by the senior author onto a Microsoft Excel spreadsheet. Each chart was manually reviewed and appraised for further evaluation based on the selection criteria.

Following a chart review of each of the 956 cases, the eligible cases were then deidentified and organized into a custom-built Microsoft Access database to enable further analysis. The organized deidentified data, including relevant demographic information, perioperative data, SWC, ASA, and duration of surgical procedure, were included for further analysis. All procedures were performed by a single orthopaedic surgeon (ie, D.S., the senior author) at a single Level 1 Trauma Center. At any one time, each procedure included an orthopaedic surgery resident and/or orthopaedic surgery trauma fellow, along with the supervising orthopaedic attending surgeon. All cases were classified postoperatively using the CDC SWC, as defined in Table 1, by the treating attending surgeon and circulating nurse. The final class designation was a consensus agreement 100% of the time.

Dr. Seligson or an immediate family member serves as a board member, owner, officer, or committee member of the Kuntscher Society; has received research or institutional support from Pacira Pharma; and serves as a paid consultant to Stryker. None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this chapter: Dr. Onyekwelu, Mr. Yakkanti, Ms. Protzer, Ms. Pinkston, and Mr. Tucker.

Table 2**Mechanism of Injury Definitions****Injury Mechanisms**

Low-energy mechanisms dissipate approximately 100 foot-pounds of energy, such as falls from a curb.

Moderate-energy mechanisms involve dissipation of 300–500 foot-pounds of energy, such as skiing and bicycle injuries.

High-energy mechanisms involve greater than 2,000 foot-pounds of dissipated energy, such as automobile collisions.

Case Inclusion Criteria

1. All logged surgical cases during the study period (2012)
2. All cases had a minimum of 3-month follow-up for patients without implantable devices
3. All cases had a minimum of 12-month follow-up for patients with retained implantable devices

Case Exclusion Criteria

1. Elective arthroplasty
2. Patients younger than 18 years
3. Procedures that were not considered index (ie, revision surgery, removal of implant, or irrigation and débridement)
4. Patients without a surgical incision as part of their procedure (closed reduction and manipulation)

Collected data included demographics (age, sex, and body mass index), payer source (Medicare/Medicaid, private, and uninsured), injury type (closed versus open), mechanism of injury (Table 2), extremity (upper, lower, or pelvis), estimated blood loss, duration of surgery, orthopaedic devices (metallic and nonmetallic implants, external fixators, skeletal traction pins, and antibiotic bead chains), and the presence of tobacco use

Table 3**Classification of Surgical Site Infections, Summarized From the CDC/NHSN Surveillance Definitions for Specific Types of Infections⁵**

SSI	Criteria
Superficial incisional SSI	<p>Infection must occur within 30 d after any operative procedure and involve only the skin and subcutaneous tissue of incision.</p> <p>The patient must also have one of the following:</p> <ol style="list-style-type: none"> (1) Purulent drainage from incision (2) Organisms identified from an aseptically obtained specimen (3) Superficial incision that is deliberately opened by a surgeon or other designee and culture or non-culture-based testing is not performed, and at least one of the following signs or symptoms: pain or tenderness; localized swelling; erythema; or heat. (4) Diagnosis of a superficial incisional SSI by the surgeon or an attending physician or other designee
Deep incisional SSI	<p>Infection must occur within 30 or 90 d after the operative procedure and involve deep soft tissues of the incision (fascial and muscle layers).</p> <p>The patient must also have at least one of the following:</p> <ol style="list-style-type: none"> (1) Purulent drainage from the deep incision (2) A deep incision that spontaneously dehisces or is deliberately opened or aspirated by a surgeon, attending physician, or other designee, and the organism is identified by a culture or non-culture-based microbiologic testing method. The patient must also have one of the following: fever, localized pain, or tenderness. (3) An abscess or other evidence of infection involving the deep incision that is detected on gross anatomic or histopathologic examination or imaging test
Organ/space SSI	<p>Infection occurs within 30 or 90 d after the operative procedure and involves any part of the body deeper than the fascial/muscle layers that is opened or manipulated during the operative procedure and the patient has one of the following:</p> <ol style="list-style-type: none"> (1) Purulent drainage from a drain that is placed into the organ/space (2) Organisms are identified from an aseptically obtained fluid or tissue in the organ/space by a culture or non-culture-based microbiologic testing method. (3) An abscess or other evidence of infection involving the organ/space that is detected on gross anatomic or histopathologic examination or imaging test.

CDC = Centers for Disease Control and Prevention; NHSN = National Healthcare Safety Network, SSI = surgical site infection

and/or diabetes. Orthopaedic procedures were derived from the operative report and evaluated based on the specific diagnosis documented by the surgeon under the “pre- and post-operative diag-

nosis” section to ascertain index or revision procedures.

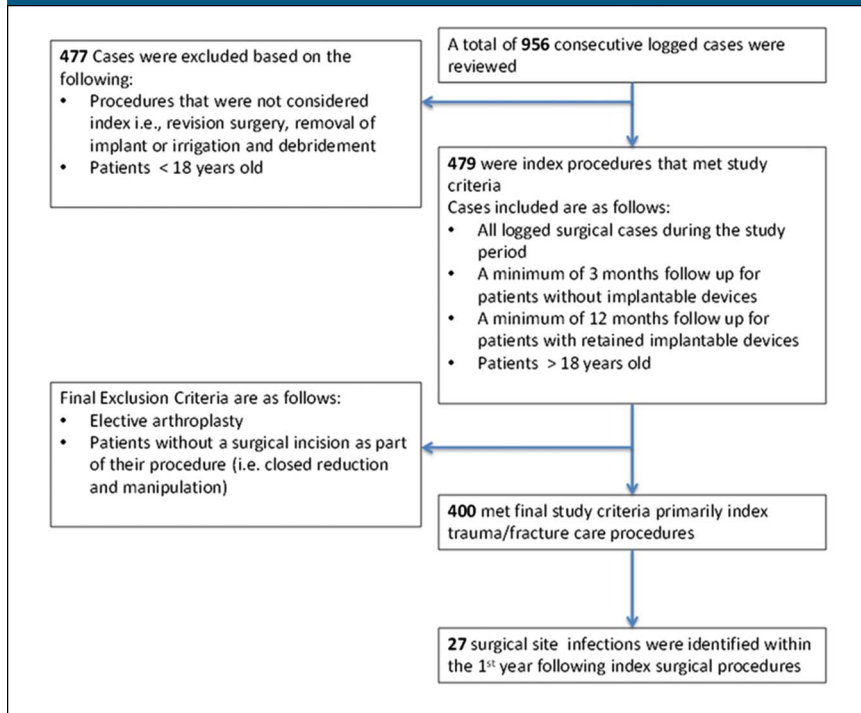
Laboratory data on elevated white blood count, C-reactive protein level, and erythrocyte sedimentation rate were recorded for only those patients

were performed using SAS version 9.4 (SAS Institute).

Results

Nine hundred fifty-six consecutively logged orthopaedic procedures were manually reviewed from the medical records, and 400 of 956 (42%) met the selection criteria (Figure 1). Twenty-seven cases of SSIs (6.8%) were identified, as summarized in Table 4. The demographics of the SSI cohort are as follows: lower extremity external fixators, 40.7%; open reduction internal fixation (ORIF) of the lower extremity, 14.8%; ORIF of pelvis/sacrum, 11.1%; ORIF of upper extremity, 7.4%; closed reduction and pinning of lower extremity, 3.7%; ankle fusion, 3.7%; pelvic external fixator, 3.7%; upper extremity closed reduction and percutaneous fixation, 3.7%; patellectomy, 3.7%; and nailing of intertrochanteric fracture, 3.7%. The location of the SSI cases was stratified as deep ($n = 14$, 51.9%), superficial ($n = 12$, 44.4%), or unknown ($n = 1$, 3.7%) (Table 3). There was no significant difference in the rate of infection across the SWC classes, ($P = 0.27$) (Figure 2). When classes III (contaminated) and IV (dirty) were combined and compared separately against class I (clean) and class II (clean/contaminated), there was no significant difference ($P = 0.15$). Likewise, when combined classes I/II (4.5% or 18 SSIs/299 cases) were compared with combined classes III/IV (8.9% or 9 SSIs/101 cases), there was no significant difference between the two combined groups ($P = 0.32$). Patient demographics were stratified by SSI (Table 4). The CDC SWC showed no association with the rate of SSI (Figure 3). In addition, a regression analysis of all three

Figure 1



Flow diagram of patient selection and review process

who were suspected of having an SSI. Eligible cases were reviewed for postoperative occurrence of SSI as defined by the CDC National Healthcare Safety Network (CDC/NHSN).⁴ Each patient's chart with respect to procedures was further evaluated for subsequent emergency department visits, readmission, antibiotic use, clinic visits suggesting SSI, and reoperations following the index procedure to "Rule out SSI," all within 12 months following the index procedure. Emergency department diagnosis, clinic diagnosis, or admission for infection/contamination of the surgical wound or area of previous incision was recorded as an SSI. Infections were stratified as superficial, deep, or organ space (Table 3). SSI was defined as infection up to 30 days postoperatively in cases without indwelling surgical implants, and up to 12 months in cases with retained implants. Moreover, all cases were

evaluated up to 12 months following surgery regardless of the implant status.

Of note, wires and external fixators, which are not otherwise specified in the original definitions of the SWC, were categorized as class II (clean-contaminated) because of their direct communication with the external environment.

Statistical Analysis

The SWC was compared with SSI rates using a Fisher exact test. Other predictors were tested for associations with SSIs using a Fisher exact test for categorical variables, and univariate generalized linear regression models were used for continuous variables. Logistic regression models were used to calculate adjusted odds ratios (ORs) and 95% confidence intervals (CIs). P values < 0.05 were considered statistically significant. All statistical analyses

Table 4

Summary of Results				
Case Demographics				
Characteristic	All Patients ^a	SSI		P
		Yes ^a	No ^a	
Age, yr	42.15 ± 17.15	44.41 ± 14.54	41.98 ± 17.33	0.4785
BMI, kg/m ²	27.31 ± 6.12	27.93 ± 5.23	27.27 ± 6.18	0.5906
ASA	2.34 ± 0.04	2.33 ± 0.14	2.34 ± 0.04	0.9406
Operative time, min (missing = 22)	99.33 ± 2.96	101.85 ± 11.07	99.13 ± 3.07	0.8131
Estimated blood loss, units (missing = 85)	104.19 ± 213.40	116.36 ± 135.30	103.28 ± 218.27	0.7820
Sex				0.2658
Female	159 (39.75)	8 (29.63)	151 (40.48)	
Male	241 (60.25)	19 (70.37)	222 (59.52)	
Smoker				0.5499
No	200 (50.00)	12 (44.44)	188 (50.40)	
Yes	200 (50.00)	15 (55.56)	185 (49.60)	
Diabetes ^a				0.0284
No	360 (90.00)	21 (77.78)	339 (90.88)	
Yes	40 (10.00)	6 (22.22)	34 (9.12)	
Insurance status				0.0547
Medicare/Medicaid	139 (34.75)	13 (48.15)	126 (33.78)	
Private	145 (36.25)	4 (14.81)	141 (37.80)	
Uninsured	116 (29.00)	10 (37.04)	106 (28.42)	
CDC wound classification criteria				0.2734
1	219 (54.75)	10 (37.04)	209 (56.03)	
2	80 (20.00)	8 (29.63)	72 (19.30)	
3	86 (21.50)	8 (29.63)	78 (20.91)	
4	15 (3.75)	1 (3.70)	14 (3.75)	
Antimicrobial beads				0.5049
No	359 (89.75)	23 (85.19)	336 (90.08)	
Yes	41 (10.25)	4 (14.81)	37 (9.92)	
Fracture type				0.4513
Closed	336 (84.00)	21 (77.78)	315 (84.45)	
Not applicable	5 (1.25)	0 (0.00)	5 (1.34)	
Open	59 (14.75)	6 (22.22)	53 (14.21)	
Extremity ^a				0.0038
Axial	44 (11.00)	4 (1.00)	48 (12.00)	
Lower	177 (44.25)	20 (5.00)	197 (49.25)	
Upper	152 (152)	3 (0.75)	155 (38.75)	
External fixator				0.2987
No	273 (68.25)	16 (59.26)	257 (68.90)	
Yes	127 (31.75)	11 (40.74)	116 (31.10)	
Mechanism of injury (missing = 30)				0.7154
High	243 (65.68)	18 (69.23)	225 (65.41)	

(continued)

ASA = American Society of Anesthesiology, BMI = body mass index, CDC = Centers for Disease Control and Prevention, SSI = surgical site infection.

^a Results are presented as mean ± SE or counts (percentages), as appropriate.

^b Significantly different response in those with and without SSI.

Results are tested in only those patients suspected of having an SSI.

Table 4 (continued)

Summary of Results				
Case Demographics				
Characteristic	All Patients ^a	SSI		P
		Yes ^a	No ^a	
Intermediate	63 (17.03)	5 (19.23)	58 (16.86)	0.0852
Low	64 (17.30)	3 (11.54)	61 (17.73)	
Bone graft				0.0852
No	363 (90.75)	22 (81.48)	341 (91.42)	
Yes	37 (9.25)	5 (18.52)	32 (8.58)	
Positive bone battery for SSI				<0.0001
No	388 (97.00)	15 (55.56)	373 (100.00)	
Yes	12 (3.00)	12 (44.44)	0 (0.00)	

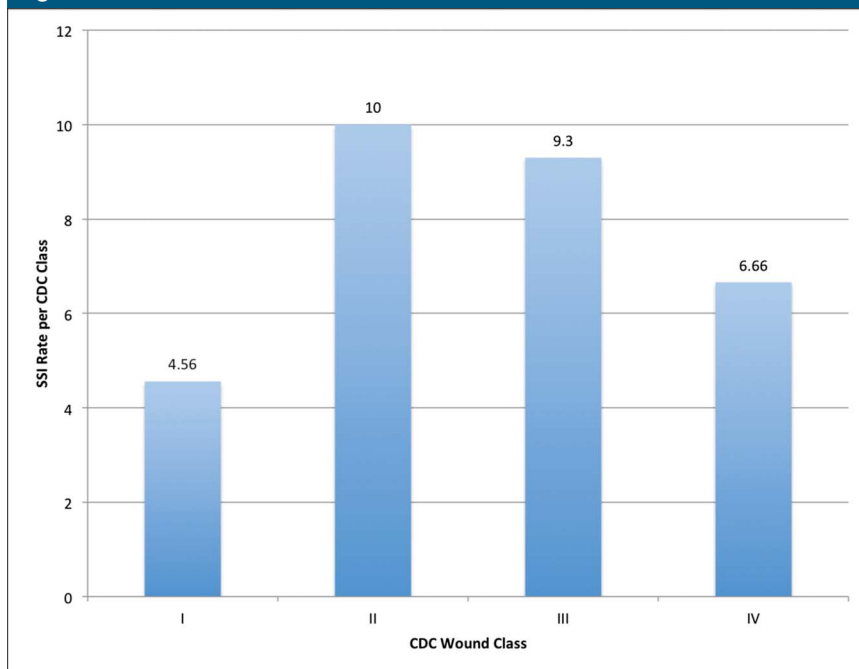
ASA = American Society of Anesthesiology, BMI = body mass index, CDC = Centers for Disease Control and Prevention, SSI = surgical site infection.

^a Results are presented as mean \pm SE or counts (percentages), as appropriate.

^b Significantly different response in those with and without SSI.

Results are tested in only those patients suspected of having an SSI.

Figure 2



CDC class versus SSI rate per class. There was no significant difference in the rate of infection across the CDC wound classes ($P = 0.27$); this trend remained true when CDC wound classifications III (contaminated) and IV (dirty/infected) were combined ($P = 0.15$). CDC = Centers for Disease Control and Prevention, SSI = surgical site infection.

variables among SSI cases, such as ASA score, procedure duration, and SWC, did not show a statistically

significant association with the SSI rate ($P = 0.95$, $P = 0.78$, and $P = 0.28$, respectively).

Patients with diabetes were at a significantly higher risk of developing SSI ($P = 0.028$). Of note, surgeries that resulted in an SSI and were performed on patients with diabetes were always of closed fracture type involving the lower extremities. The unadjusted OR of SSI among patients with diabetes was 2.85 (95% CI, 1.08–7.54; $P = 0.035$); when adjusted for age, the odds for developing SSI remained relatively high but was not statistically significant (OR [95% CI], 2.76 [0.99–7.69]; $P = 0.052$). Those with lower extremity injuries were at a significantly higher risk of developing SSI, ($P = 0.0038$) (Figure 4). The presence of SSI was significantly associated with a positive bone/tissue culture ($P < 0.0001$). Among those with SSI, rates of elevated C-reactive protein level, erythrocyte sedimentation rate, and white blood cell count were 15%, 56%, and 48%, respectively.

Patients in need of bone graft—ie, fractures with marked comminution, segmental bone loss, or nonunion following closed fracture treatment—had a higher incidence of SSI; this difference, however, was not statistically

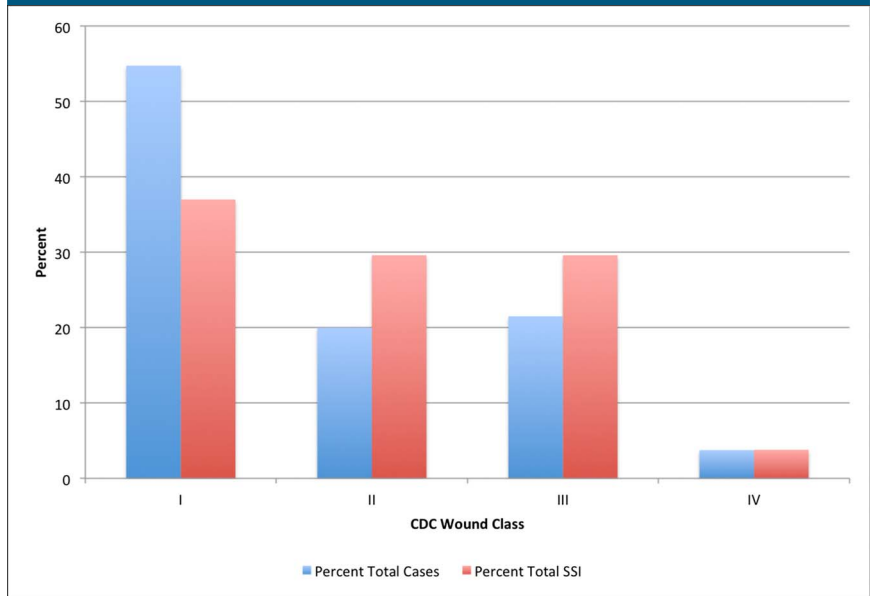
significant ($P = 0.085$). Similarly, patients who were uninsured or had Medicaid/Medicare had a much higher rate of SSI compared with privately insured patients (8.6% and 9.4% vs. 2.8%, respectively); however, this was not statistically significant ($P = 0.055$). When private patients were exclusively compared with Medicaid/Medicare and uninsured patients, there was a significantly lower rate of SSI seen in the private group (2.8% vs. 9.0%; $P = 0.021$). Polytrauma patients, including those with spine, intracranial, intra-abdominal, urological, and intrathoracic injuries, did not have a significantly higher incidence of SSI. The sample studied had 37/400 (9.3%) polytrauma patients, and of those, only 1/27 (3.7%) developed an orthopaedic procedure-related SSI.

Among patients who met the selection criteria (400 of 956), the median number of index surgeries performed on a daily basis was two (range, 1–9). The average daily rate of SSI among index procedures was 0.18, with most SSIs occurring on days when multiple procedures were performed.

Discussion

The SWC was designed as a component of the NNIS risk index to risk-stratify wounds based on a crude assessment of the degree of contamination. It is used along with the procedure duration and ASA score and could provide prognostic information on likelihood for SSI. However, the current data did not show an association (ie, direct relationship) of subsequent SSI and SWC grades (I–IV). This finding is in accordance with the poor concordance already seen in the general surgery literature evaluating the utility of the SWC. Ortega et al⁷ showed significantly lower rates of SSIs in the contaminated and dirty groups (classes III and IV, respectively) compared with the historically reported rates.

Figure 3



CDC classification versus percent cases/SSIs per class. Percentage of cases/SSIs in each class. CDC = Centers for Disease Control and Prevention, SSI = surgical site infection

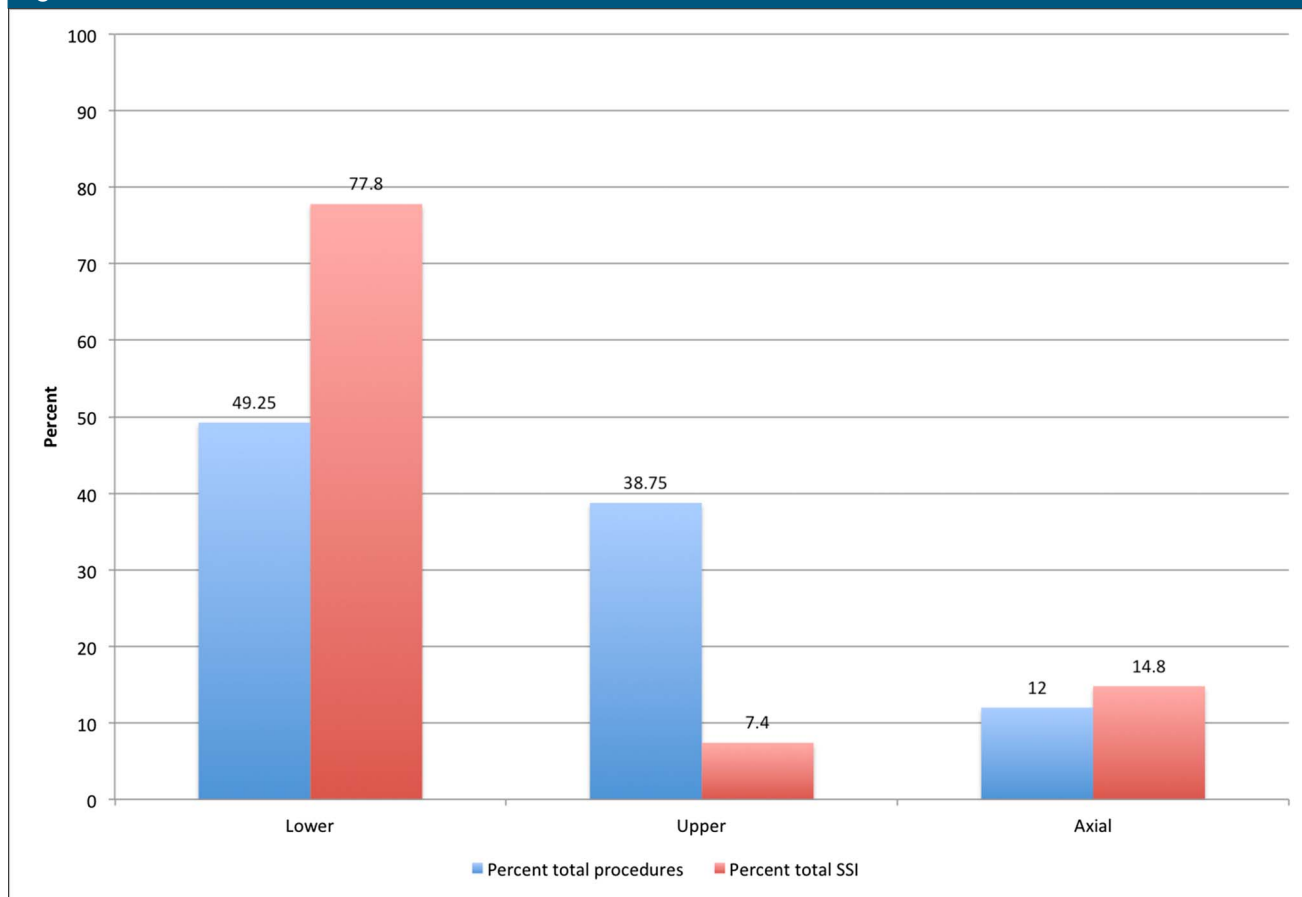
A recent multicenter study of 11 participating institutions reviewed 2,034 cases and showed a classification discordance of 44% across the participating institutions.⁸

The implementation of the SWC was part of a national effort to reduce SSI rates and to standardize reporting of these complications for quality improvement across institutions. Although the SWC is one of the three parameters, ASA and procedure duration being the other two, in the proposed risk model, it is the least objective and the one with wide interobserver variability. Moreover, if found efficacious with some modifications provided by the results seen in this study (insurance status, lower extremity injuries, and history of diabetes mellitus), it has the potential to influence treatment strategies and perioperative protocols, inform surveillance protocols, and manage expectations—ultimately improving patient outcomes.

We suggest that the initiative for quality improvement, SSI risk surveillance, and promoting standard-

ized institutional reporting of such events is important. The current study provides some objective insights that may be useful for future modifications of the current SWC and how it may apply to the orthopaedic patient. Some strengths of the current study are as follows: a retrospective design reviewing a single center and use of case logs of a single surgeon, which enabled consistent reporting of the SWC, thus avoiding the interobserver variability seen in previous SWC studies.⁹ Despite previously published results on the SWC, there are still hospital systems remaining that rely on the aforementioned risk model to risk-stratify patients and may imply prognostic utility for subsequent SSIs, perhaps not its original intended use. Consequently, newer and more robust SSI risk models are being developed, that is, the NHSN procedure-specific risk index models.^{8,10} These newer models are yet to be adopted widely among hospital systems and may improve nationwide reporting,

Figure 4



Extremity versus percent SSI. Patients with lower extremity injuries had a significantly higher incidence of SSI (20 of 197) compared with upper extremity injuries (3 of 155) or pelvic/sacrum injuries (4 of 48) ($P = 0.002$). CDC = Centers for Disease Control and Prevention, SSI = surgical site infection

standardize the analysis of SSI and at-risk patients, improve infection control initiatives, and promote the development of novel strategies to reduce SSI risk.

The patients evaluated in the study belonged exclusively to the adult population (age, ≥ 18 years) and largely included patients with orthopaedic trauma injuries. This represents a different demographic from the pediatric and general surgery literature studied by Levy et al.⁹ The results of this study can be particularly relevant to the general orthopaedic surgeon, orthopaedic traumatologist, hospital systems, and third-party payers, including Medicare/Medicaid, who value the SWC as

part of their quality improvement initiative. The current study includes a wide spectrum of orthopaedic procedures involving all four extremities (long bones, shoulders, knees, ankles, and wrists) and the pelvis.

A possible explanation as to why the current results did not show an association (direct or indirect) between the SSI rate/incidence and SWC grade might be due to current operating room standards, surgical techniques, perioperative wound protocols, improved efficacy of antibiotics, and active surveillance of high-risk patients (ie, open injuries). However, the variables that demonstrated significance or were positive prognostic indicators

for postoperative SSI, diabetes mellitus, lower extremity injury, and payer-source may strengthen future models.

Historically, diabetes mellitus is known to be associated with a higher risk of SSI and was found to be a significant risk factor for SSI in the current study. A univariate analysis following spine procedures by Olsen et al¹⁴ demonstrated that serum glucose levels preoperatively and within 5 days following surgery were significantly higher in patients in whom SSI developed than in uninfected patients. Specifically, patients with a preoperative serum glucose >125 mg/dL or a postoperative serum glucose of >200 mg/dL had

an OR of 3.4 for developing a subsequent SSI.¹⁴ This is consistent with our finding of an OR of 2.85 for patients with diabetes. Similarly, a study looking at postoperative infection rates in foot and ankle surgery among patients with and without diabetes showed that the presence of “complicated” diabetes increases the risk of postoperative infection by 10 and 6-fold compared with uncomplicated diabetes.¹⁵

The Lower Extremity Assessment Project (LEAP) study, a large prospective series evaluating lower extremity injuries, demonstrated that patients with lower extremity trauma are confronted with higher rates of wound infections and osteomyelitis compared with the pelvic/sacrum or upper extremities.¹⁶ Our data endorse this trend as lower extremity injuries accounted for a significantly larger proportion of resultant SSIs: 10.2% infection rate among lower extremity surgical procedures, and 1.9% among upper extremity procedures. Among all SSI cases, 74.1% were from the lower extremity.

Another interesting finding was that the payer-source proved to be a significant prognostic factor for SSIs when Medicaid/Medicare and uninsured patients were compared with privately insured patients (9.0% vs. 2.8%; $P = 0.021$). In addition, our findings are consistent with those from a separate study looking at patients who had undergone primary hip or knee arthroplasty: variables compared were complications, costs, and length of hospital stay for patients with Medicaid versus patients with non-Medicaid insurance.¹⁷ The patients with Medicaid were found to have a higher prevalence of postoperative SSI than those with non-Medicaid insurance (OR = 1.7; 95% CI = 1.3–2.1).¹⁷ Reasons for this are likely multifactorial and may necessitate further investigation to better understand any differences that predispose or protect against SSI.

Limitations to this study include a relatively small sample size (400 cases) eligible for further analyses. A larger sample size might have been possible with a multicenter approach, but such a study design did not allow for control of potential interobserver variability, which has been described by previous reports. All wounds were appraised by a single trauma/general orthopaedic surgeon and a circulating nurse, and a consensus was reached 100% of the time.

Another limitation is that the study cohort does contain polytrauma patients with both orthopaedic and nonorthopaedic injuries. In these patients, confounding variables such as systemic inflammatory response syndrome, septicemia, and secondary procedures performed by other surgical services can influence the risk of SSI. Other variables not controlled for are as follows: type of implants used and miscellaneous host-dependent variables—postoperative patient compliance, wound surveillance, and acute rehab versus home care. Similarly, these variables may influence one’s risk of SSI.¹⁸

Unlike the Gustilo and Anderson wound classification system, in which open fractures are classified and further subdivided (type I, type II, types IIIA, IIIB, and IIIC) with respect to the severity of soft tissue injury, the SWC fails to account for such intrinsic risk factors associated with SSI, that is, poor soft-tissue coverage, need for soft-tissue flap, or vascular repair. In addition, the former classification shows a positive correlation with postoperative wound complications (wound infection, osteomyelitis, and amputation) and a higher classification grade.¹⁹

In conclusion, the CDC SWC system did not show an association with the rate of SSI. As used by some facilities, it was not an effective prognostic indicator for SSIs in the orthopaedic patient. Certain variables were found to be positive prognostic indicators for future SSI

and may be worthy of inclusion in future risk-stratifying models. These variables include but are not limited to diabetes mellitus and lower extremity injuries.

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