ORIGINAL ARTICLE

Can Additional Information Be Obtained from Claims Data to Support Surgical Site Infection Diagnosis Codes?

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OBJECTIVE.   *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis codes are increasingly used to identify healthcare-associated infections, often with insufficient evidence demonstrating validity of the codes used. Absent medical record verification, we sought to confirm a claims algorithm to identify surgical site infections (SSIs) by examining the presence of clinically expected SSI treatment.

METHODS.   We performed a retrospective cohort study, using private insurer claims data from persons less than 65 years old with *ICD-9-CM* procedure or Current Procedure Terminology (CPT-4) codes for anterior cruciate ligament (ACL) reconstruction from January 2004 through December 2010. SSIs occurring within 90 days after ACL reconstruction were identified by *ICD-9-CM* diagnosis codes. Antibiotic utilization, surgical treatment, and microbiology culture claims within 14 days of SSI codes were used as evidence to support the SSI diagnosis.

RESULTS.   Of 40,702 procedures, 401 (1.0%) were complicated by SSI, 172 (0.4%) of which were specifically identified as septic arthritis. Most SSIs were associated with an inpatient admission (232/401 [58%]), and/or surgical procedure(s) for treatment (250/401 [62%]). Temporally associated antibiotics, surgical treatment procedures, and cultures were present for 84% (338/401), 61% (246/401), and 59% (238/401), respectively. Only 5.7% (23/401) of procedures coded for SSI after the procedure had no antibiotics, surgical treatments, or cultures within 14 days of the SSI claims.

CONCLUSIONS.   More than 94% of patients identified by our claims algorithm as having an SSI received clinically expected treatment for infection, including antibiotics, surgical treatment, and culture, suggesting that this algorithm has very good positive predictive value. This method may facilitate retrospective SSI surveillance and comparison of SSI rates across facilities and providers.

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Increasingly, billing or claims data are being used to identify healthcare-associated infections, including surgical site infections (SSIs). The accuracy of *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis codes to identify infections has been reported in a number of studies with varying results, depending on the surgical procedures studied and the diagnosis codes used to indicate infection.[1-10] Anterior cruciate ligament (ACL) reconstruction is a surgical procedure for which there has been no validation of the *ICD-9-CM* diagnosis codes to identify subsequent SSIs.

Infection following ACL reconstruction is rare, and most reports in the literature are single-center studies with a small number of infections. Among studies with 5 or more cases of septic arthritis or SSI, reported infection rates range from 0.14% to 1.96%;[11-25] 12 of the 15 studies reported rates of less than 1.0%. Infection after ACL reconstruction is uncommon, but it can lead to poor outcomes, including articular cartilage destruction, arthrofibrosis, loss of range of motion,

and reduced activity level.[11-15,17,23,26] While there are no defined treatment guidelines, typical treatment of ACL reconstruction–related infection includes antibiotics and arthroscopic or open drainage of the knee.[27,28]

We sought to determine whether additional information could be obtained from administrative claims data to support the diagnosis of SSI following ACL reconstruction. In the absence of a gold standard such as medical chart review, we used clinically expected treatments available in the administrative claims—specifically, antibiotic utilization, use of microbiology cultures, and surgical treatment for infection—to support the coding of SSI.

METHODS

Data Source

We conducted a retrospective cohort study, using the HealthCore Integrated Research Database (HIRD). Individuals represented in the HIRD include lives from 14 WellPoint-

affiliated plans. WellPoint is an independent licensee of the Blue Cross and Blue Shield (BCBS) Association and serves its members as the Blue Cross licensee for California and the BCBS licensee for Colorado, Connecticut, Georgia, Indiana, Kentucky, Maine, Missouri (excluding 30 counties in the Kansas City area), Nevada, New Hampshire, New York (as the BCBS licensee in 10 New York City metropolitan and surrounding counties and as the Blue Cross or BCBS licensee in selected upstate counties only), Ohio, Virginia (excluding the northern Virginia suburbs of Washington, DC), and Wisconsin. Thirteen plans were used for this research. Data in the HIRD include all fully adjudicated claims submitted for reimbursement from providers, facilities, and outpatient pharmacies and are linked to health plan enrollment information.

Fully insured members from 6 months to 64 years of age who were enrolled in a health plan that included medical coverage of hospital and physician services were eligible for selection into the study cohort. Prescription drug coverage was also required in order to assess antibiotic utilization. Exclusions included members with an *ICD-9-CM* diagnosis code or prescription claim indicating HIV-positive status at any time (for patient privacy) and members likely to have incomplete data (eg, those enrolled in a capitated plan or in multiple plans at the time of surgery). We also excluded members enrolled in a plan with hospital coverage only, since up to 60% of SSIs are identified and managed in the ambulatory setting.[29] Medical and pharmacy claims were restricted to paid claims.

The claims data available for this study contained up to 5 *ICD-9-CM* diagnosis codes per claim. Facility (hospital or ambulatory) claims included Uniform Billing (UB-92/UB-04) revenue and Healthcare Common Procedure Coding System (HCPCS) codes. Hospitals included up to 5 *ICD-9-CM* procedure codes per claim, while ambulatory facilities reported Current Procedure Terminology (CPT-4) procedure codes. Provider claims included both CPT-4 and HCPCS codes.

We utilized the American Hospital Association Annual Survey of Hospitals (Health Forum) and the Outpatient Surgery Center Profiling Solution data (IMS Health) in order to determine whether the ACL reconstruction was performed at a hospital or a freestanding ambulatory surgery center. The facility information from these two data sources was matched to the operative facility via National Provider Identifier codes, where available; otherwise, matching was performed with facility name and address fields.

ACL Reconstruction Patient Population

We identified ACL reconstruction procedures performed on an inpatient or outpatient basis at a hospital or a freestanding ambulatory surgery center by using *ICD-9-CM* and CPT-4 procedure codes from all facility (other than home health agencies) and provider claims among members eligible for cohort entry aged 6 months to 64 years between January 1, 2004, and December 31, 2010 (Table 1). The ACL reconstruction patient population was refined by excluding procedures likely to have erroneous claims for ACL reconstruction, procedures in members whose enrollment ended on the day of the surgical procedure, complicated procedures or procedures in patients considered medically complicated, and procedures in which the surgery date could not be determined from the available information in the claims (see below for description).

Identification and Exclusion of Erroneous Claims for ACL Reconstruction

We created an algorithm to identify problematic claims, which we defined as facility claims that contained apparent CPT-4, HCPCS, or UB-04 revenue codes truncated to 4 digits and populated in the fields reserved for *ICD-9-CM* procedure codes. This error appeared to occur during processing of certain types of non-inpatient facility claims (A. E. Wallace and M. A. Olsen, unpublished data). Claims in which an ACL procedure code was the only procedure code present, with no other claims submitted for the same date, were also classified as problematic and excluded.

Exclusion of Complicated Patients and Procedures

The overall aim of this research study was to estimate the risk of SSI after ACL procedures by surgical facility type. For this reason, we excluded ACL reconstruction procedures performed in medically complicated patients who would be very unlikely to undergo surgery in an ambulatory setting and would have a risk profile very different from that of most ACL patients. We defined medically complicated patients as persons with end-stage renal disease or septicemia between 7 days before and 1 day after the ACL procedure date (Table 1).

We also excluded ACL reconstruction procedures performed at the time of or after another surgical procedure during the same admission, since these procedures would be complex and attribution of an SSI to a particular procedure would not be possible. These additional surgical procedures were identified via CPT-4 and *ICD-9-CM* procedure codes from the National Healthcare Safety Network (NHSN) list of procedures for SSI surveillance.[30] We also excluded ACL reconstruction procedures in which any of the following procedures were coded within 7 days of ACL surgery, since these represent more complex ACL reconstructions: partial ostectomy, limb-lengthening procedure, internal fixation of bone of leg, open reduction of fracture of leg, or patellectomy (Table 1).

Finally, we excluded ACL reconstructions performed on or after calendar day 3 (where day 1 was the day of admission) of an inpatient admission. The rationale for choosing the day 3 cutoff is that scheduled, elective surgical procedures are typically performed either on the day of admission or on the following day. A surgical procedure performed on hospital day 3 or later would be unlikely to be the primary reason for admission. Therefore, these patients would not have had

TABLE 1. Codes Used to Identify Anterior Cruciate Ligament (ACL) Reconstruction, Procedure Exclusions, and Evidence for Surgery

	CPT-4 codes	ICD-9-CM procedure codes	UB-04 revenue codes	ICD-9-CM diagnosis codes
Codes used to identify ACL reconstruction procedure				
ACL reconstruction	27407, 27409, 27427–27429, 29888	81.43, 81.45		
Codes used for ACL reconstruction exclusion				
End-stage renal disease				585.6, V45.1, V45.11, V45.12, V56.0, V56.1, V56.2, V56.8
Septicemia				038.0–038.9, 790.7
Partial ostectomy, limb lengthening procedure, internal fixation of bone of leg, open reduction of fracture of leg, patellectomy	27228, 27236, 27244, 27245, 27248, 27254, 27269, 27350, 27506, 27507, 27511, 27513, 27514, 27535, 27536, 27540, 27758, 27759, 27766, 27769, 27784, 27792, 27814, 27822, 27823, 27826–27828	77.85, 77.86, 77.87, 77.89, 78.35, 78.37, 78.39, 78.55, 78.56, 78.57, 78.59, 79.25, 79.26, 79.35, 79.36, 79.55, 79.56		
Codes used as additional evidence for ACL reconstruction surgery				
Anesthesia	01320, 01380, 01400			
Tendon graft	20924, 20926			
Surgery-related revenue codes			0201, 0360, 0361, 0369, 0370, 0379, 0490, 0499, 0963, 0964, 0975	

NOTE. CPT-4, Current Procedural Terminology, 4th edition; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification; UB, Uniform Billing.

TABLE 2. Codes Used to Identify Surgical Site Infection (SSI) following Anterior Cruciate Ligament Reconstruction

	ICD-9-CM diagnosis codes
Knee-specific infection codes to identify SSI	
Septic arthritis	711.06, 711.96
Other infection to lower leg or joint prosthesis	711.66, 730.06, 730.16, 730.26, 730.96, 996.66, 996.67
General infection codes to identify SSI	
Postoperative infection	998.5–998.59
Infective myositis	728.0

NOTE. ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification.

the opportunity to have the surgery performed at a freestanding ambulatory surgery center.

Establishing the Surgery Date and Use of Supporting Evidence for Surgery

ACL reconstruction dates within 7 days were collapsed into a single surgery due to potential inaccuracy in dates, particularly on provider claims.[31] In these instances, we compared facility and provider surgery dates and incorporated supplemental evidence (eg, claims for anesthesia and tendon graft procedures) from unique providers to determine the most likely surgery date. We excluded ACL reconstruction procedures coded by either a provider or a facility only, unless there was additional evidence that a surgical procedure took place, that is, claims for anesthesia services, tendon graft procedure, or a surgery-related UB-04 revenue code (Table 1).

Identification of SSIs

Claims for SSIs first recorded from 2 to 90 days after eligible procedures were identified via ICD-9-CM diagnosis codes (Table 2). We excluded individual SSI claims with locations that were not consistent with a provider diagnosis (eg, lab-

oratory, patient's home) and those with CPT-4 codes for pathology services (88104–88399). This was done to avoid capturing an SSI that may have been a rule-out or a working diagnosis.

Timing of SSI

The date of SSI onset was defined according to the timing and location of diagnosis. For SSIs coded by an inpatient facility during the original operative admission, we assigned the date of SSI to the discharge date if the difference between the discharge and admission dates was greater than or equal to 2 days. For SSIs diagnosed during a subsequent inpatient admission, the date of SSI onset was assumed to be the date of hospital admission. For SSIs diagnosed by a provider or in an ambulatory setting, the onset date was defined as the first service date with an ICD-9-CM diagnosis code for SSI.

The observation period for development of SSIs was through 90 days after surgery, with earlier censoring for the end of insurance enrollment, subsequent ACL reconstruction, knee replacement, or other knee or leg surgery (ie, partial ostectomy, limb-lengthening procedure, internal fixation of bone of leg, open reduction of fracture of leg, or patellec-

TABLE 3. Codes Used as Supplemental Evidence for Surgical Site Infection (SSI) following Anterior Cruciate Ligament Reconstruction

	ICD-9-CM or CPT-4 procedure codes	Antibiotic
Antibiotic		Aminoglycosides, aztreonam, cephalosporins, cilastatin and imipenem, colistin, daptomycin, doripenem, ertapenem, erythromycin-sulfisoxazole, fluoroquinolones, imipenem-cilastatin, lincosamides, linezolid, loracarbef, meropenem, penicillins, quinupristin-dalfopristin, rifampin, sulfamethoxazole-trimethoprim, sulfonamides, tetracyclines, tigecycline, trimethoprim, and vancomycin
Knee-specific surgical treatment for SSI	27301, 27303, 27310, 27330, 27331, 27334, 27335, 27360, 29870, 29871, 29873, 29875, 29876, 29884, 80.06, 80.16, 80.26	
General surgical treatment for SSI	10060, 10061, 10180, 20000, 20005, 20680	
Microbiology culture	87040, 87070, 87071, 87073, 87075, 87076, 87077	

NOTE. ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification; CPT-4, Current Procedural Terminology, 4th edition.

tomy). In patients with subsequent surgeries, we censored 1 day after the subsequent surgery. Non-knee-specific ICD-9-CM diagnosis codes for infection (eg, 998.59) were not classified as SSIs if they were first coded after a subsequent non-knee NHSN surgery within 90 days.

An ICD-9-CM diagnosis code for an SSI from 30 days before to 1 day after surgery was considered to indicate a preexisting infection. These ACL procedures were excluded from the study, since our goal was to identify incident cases of SSI.

Evidence Supporting the Diagnosis of SSI

Prescription and medical claims for antibiotics, ICD-9-CM and CPT-4 procedure codes for surgical treatment, and CPT-4 codes for microbiology cultures were used to support the occurrence of an SSI (Table 3). Among persons with an incident SSI ICD-9-CM diagnosis code attributable to the ACL procedure, we considered antibiotic, surgical treatment, and culture claims 1–90 days after ACL reconstruction that were within 14 days of a date of an SSI diagnosis code and before applicable censoring to be supporting evidence for the coded SSI.

Statistical Analysis

All statistical analyses used the χ^2 test. All data management and analyses used SAS, version 9.3 (SAS Institute). This study was approved by the Washington University Human Research Protection Office.

RESULTS

A total of 41,837 ACL reconstruction procedures met all eligibility criteria and were identified during the 7-year study period. The number of distinct procedures was reduced to 40,702 procedures among 38,883 patients after removal of procedures with no supporting evidence for the procedure (n = 686), complicated ACL procedures and procedures in medically complicated patients (n = 393), and ACL reconstructions performed at the time of a preexisting SSI (n = 56). More than one ACL reconstruction was performed during the study period in 4.4% of patients. The procedures were evenly distributed over the study years. Most procedures were performed as day surgery at a hospital or at a freestanding ambulatory surgery center. Most ACL reconstruction procedures involved males, and the median age was 29 years (range, 2–64 years; Table 4).

SSIs were identified by ICD-9-CM diagnosis codes after 401 (1.0% [95% confidence interval (CI), 0.9%–1.1%]) procedures. The median time to onset was 20 days (interquartile range, 10–33 days), with 293 (73%) SSIs identified up to 30 days after the ACL reconstruction procedure. Fifty-four percent (n = 218) had at least one knee-specific SSI code, as defined in Table 2. Fifty-eight percent (n = 232) of patients had a hospital admission associated with their SSIs. A total of 250 patients (62%) had one or more surgical procedures

TABLE 4. Characteristics of Anterior Cruciate Ligament Reconstruction Procedures in 38,883 Patients

Characteristic	n (%)
Total procedures	40,702
Age, median (range), years	29 (2–64)
Age <18 years	7,436 (18.3)
Male	24,490 (60.2)
Location of procedure[a]	
Inpatient	1,953 (4.8)
Day surgery at hospital	15,769 (38.7)
Ambulatory surgery center	12,526 (30.8)
Missing facility type[b]	10,454 (25.7)
Procedures by year	
2004	5,664 (13.9)
2005	5,874 (14.4)
2006	6,041 (14.8)
2007	5,989 (14.7)
2008	6,134 (15.1)
2009	5,751 (14.1)
2010	5,249 (12.9)

NOTE. Unless otherwise specified, data are no. (%) of procedures.
[a] "Inpatient" and "day surgery" represent matches to a facility in the American Hospital Association (AHA) Annual Survey of Hospitals (Health Forum); inpatient classification was based on an inpatient designation in the HealthCore claims data. "Ambulatory surgery center" represents a match to a facility in the IMS Health Outpatient Surgery Center Profiling Solution data.
[b] Facility type was classified as missing because there was no facility claim for procedure (n = 4,065), no match to a facility in the AHA Annual Survey of Hospitals or the IMS Health Outpatient Surgery Center Profiling Solution data (n = 6,366), or a match to multiple facilities (n = 23).

for treatment (median, 1; range, 0–5). Among those with an SSI, 43% (n = 172) had at least one code for septic arthritis, for an overall incidence of septic arthritis of 0.4% (95% CI, 0.4%–0.5%). Persons with septic arthritis were more likely to have had an inpatient admission at the time of infection and more likely to have had surgical treatment than persons coded for SSI but not septic arthritis (Table 5).

Overall, 84.3% (338/401) of SSIs had a temporally associated antibiotic claim, 61.4% (246/401) had a temporally associated claim coded for surgical treatment, and 59.4% (238/401) had a temporally associated claim for microbiology culture. In total, 155/401 (38.7%) SSIs had 3 types of supporting evidence (ie, antibiotics, surgical treatment, and culture), as seen in the center of the overlapping circles in Figure 1, 134 (33.4%) had 2 types of evidence (ie, 70 SSIs had surgical treatment and antibiotics, 56 SSIs had antibiotics and culture, and 8 SSIs had surgical treatment and culture), and 89 (22.2%) had one type of supporting evidence. Only 23 (5.7%) SSIs had no additional claim for an antibiotic, surgical treatment, or culture to support the diagnosis of SSI, for a positive predictive value (PPV) of 94.3% (378/401; Figure 1). The

TABLE 5.   Characteristics of Surgical Site Infection (SSI) and Septic Arthritis following 40,702 Anterior Cruciate Ligament Reconstruction Procedures

Characteristic	Total SSI	Septic arthritis	SSI, no septic arthritis	P^a
Total	401	172	229	
Incidence, %	1.0	0.4	0.6	
Infection coded during an inpatient admission, n (%)	232 (57.9)	137 (79.7)	95 (41.5)	<.01
Surgical treatment for SSI[b] in postoperative period, n (%)	250 (62.3)	149 (86.6)	101 (44.1)	<.01

[a] As determined by the χ^2 test.

[b] See "Methods" for specific *ICD-9-CM* (*International Classification of Diseases, Ninth Revision, Clinical Modification*) and CPT-4 (Current Procedural Terminology, 4th ed.) procedure codes used for surgical treatment.

PPV of our SSI algorithm was 89.5% (359/401) when only antibiotics and surgical treatment were considered as supporting evidence. The proportion of antibiotic, surgical treatment, and culture claims data associated with SSI did not vary significantly on the basis of whether the onset of SSI was up to 30 days or 31–90 days after the ACL reconstruction procedure (Table 6).

Among the 338 persons with an SSI and a temporally associated antibiotic, the most common classes of antibiotics prescribed were cephalosporins (59%), vancomycin (28%), and fluoroquinolones (21%). Among the 246 persons with an SSI and an associated surgical procedure for treatment, 164 (67%) had an arthroscopy procedure, 101 (41%) had an arthrotomy procedure or removal of implant, and 92 (37%) had another incision-and-drainage procedure.

DISCUSSION

The use of administrative data to identify healthcare-associated infection is challenging, but these data can be an important resource for relatively rare events such as SSIs. Some authors have concluded that billing and claims data cannot be reliably used for SSI surveillance.[4,9,10] We found that 94.3% of patients identified as having an SSI by our rigorous claims algorithm also received clinically expected treatment for infection; a more conservative PPV estimate excluding culture was still very high, at 89.5%. While we could not confirm the SSIs with medical chart review, our results suggest that the claims algorithm we used to identify SSIs has very good PPV.

We used only *ICD-9-CM* diagnosis codes that were specific to SSIs and/or were consistent with the NHSN clinical SSI
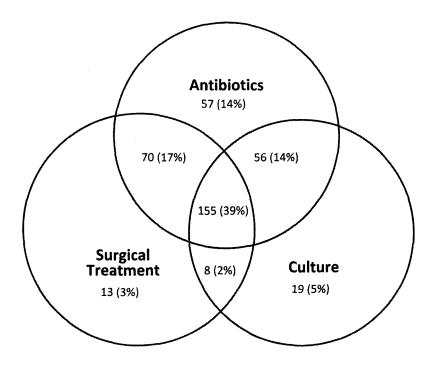

FIGURE 1.   Description of supporting evidence for 401 cases of surgical site infection (SSI) after anterior cruciate ligament reconstruction procedures. Twenty-three (5.7%) of the 401 SSIs identified by *ICD-9-CM* (*International Classification of Diseases, Ninth Revision, Clinical Modification*) diagnosis codes had no subsequent claims for antibiotics, surgical treatment for SSI, or microbiology cultures.

TABLE 6. Surgical Treatment and Use of Antibiotics and Culture within 14 Days of Anterior Cruciate Ligament Reconstruction-Associated Surgical Site Infection (SSI) by SSI Onset

Characteristic	Total SSI, n (%)	SSI onset ≤30 days from procedure, n (%)	SSI onset >30 days from procedure, n (%)	P^a
Total	401	293	108	
At least 1 claim for				
Antibiotics	338 (84.3)	250 (85.3)	88 (81.5)	.35
Surgical treatment	246 (61.4)	178 (60.8)	68 (63.0)	.69
Culture	238 (59.4)	173 (59.0)	65 (60.2)	.84
Antibiotics, surgical treatment, and/or culture	378 (94.3)	278 (94.9)	100 (92.6)	.38

^{a} As determined by the χ^2 test.

definition. Studies that used specific SSI *ICD-9-CM* diagnosis codes (eg, 998.5, 998.51, and 998.59)[1-3] were more likely to report a higher PPV than studies using a larger range of diagnosis codes including ones less specific for SSI.[4,9,10] We also used available information to distinguish preexisting and incident infections and censored at the time of any subsequent procedures. This censoring reduced the likelihood of attributing an SSI after a subsequent surgery to the index ACL reconstruction, which has been reported previously as a source of misclassification bias when using administrative data.[3,10]

In our large, geographically diverse study population, we found the incidence of SSI following ACL reconstruction to be 1.0%. This rate is higher than that in 12 of the 15 studies we identified in the published English-language literature.[11,13-18,20,21,23-25] There are several potential reasons for our findings. We used claims data from across the spectrum of care, rather than from readmission[20] or single-center medical record review, to identify infections.[11-19,22-25] The inclusion of outpatient claims has been shown by others to capture at least twice as many SSIs as inpatient surveillance alone.[7,29] Only 2 studies that reported low SSI rates were from multiple institutions. Maletis et al.[21] reported an overall SSI rate of 0.46% (0.3% deep SSI, 0.1% superficial SSI), using a Kaiser Permanente registry, with all outcomes verified by chart review. Jameson et al.[20] utilized data from the English National Health Service and reported a rate of 0.25% for deep infection within 30 days and 0.75% for wound complication (infection and hematoma), but identification of complications relied solely on hospital readmissions. Another explanation for the lower SSI rates in the literature is that most studies included only more severe SSIs (eg, septic arthritis).[11-20,22,24,25] For example, in 12 published studies, all patients with reported SSIs received intravenous antibiotics,[11-19,22,24,25] while in another 12 studies, all cases with SSIs required surgical treatment.[11-20,22,25] While the incidence of total SSIs in our current study is about twice that of reported rates, our reported incidence rates of septic arthritis (0.4%) and more severe infections (ie, infections requiring hospital admission [0.6%] and/or surgical treatment [0.6%]) are consistent with the SSI rates reported in the literature.

Limitations of claims data for SSI surveillance include is-

sues common to secondary analysis of data collected for other purposes (ie, billing and reimbursement). Therefore, some data elements that are important for SSI risk prediction surveillance, such as procedure dates, may be less accurate, since they do not affect reimbursement. There is also likely undercoding of SSIs, particularly minor infections, during the 90-day global surgical provider reimbursement period.[32] Thus, our calculation of SSI incidence after ACL reconstruction likely underestimates the true infection rate, since minor infections that occurred within the global reimbursement period may not have been coded. In addition, our findings may not be generalizable to all ACL reconstruction procedures, because we limited our surgical population to less complex procedures. While medical chart review is considered the gold standard for validation, medical records were not available for private insurer claims data study. However, medical chart review is often limited to single-center studies, while our data represent hundreds of facilities and providers, which increases the generalizability of our findings. Future studies could use medical chart review as the gold standard to confirm our findings but would require procedures from various practice settings (eg, urban/rural, ambulatory/inpatient). Our use of temporally associated clinical treatment for SSI to support coding of SSI is reproducible and allows patients to be tracked across the spectrum of care.

More than 94% percent of patients identified by our claims algorithm as having an SSI received clinically expected treatment for infection, suggesting that the algorithm has very good PPV. This method may facilitate retrospective surveillance and comparison of SSI rates across facilities and providers.

the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

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