ORIGINAL ARTICLE

Use of Medicare Claims to Identify US Hospitals with a High Rate of Surgical Site Infection after Hip Arthroplasty

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OBJECTIVE. To assess the ability of Medicare claims to identify US hospitals with high rates of surgical site infection (SSI) after hip arthroplasty.

DESIGN. Retrospective cohort study.

SETTING. Acute care US hospitals.

PARTICIPANTS. Fee-for-service Medicare patients 65 years of age and older who underwent hip arthroplasty in US hospitals from 2005 through 2007.

METHODS. Hospital rankings were derived from claims codes suggestive of SSI, adjusted for age, sex, and comorbidities, while using generalized linear mixed models to account for hospital volume. Medical records were obtained for validation of infection on a random sample of patients from hospitals ranked in the best and worst deciles of performance. We then calculated the risk-adjusted odds of developing a chart-confirmed SSI after hip arthroplasty in hospitals ranked by claims into worst- versus best-performing deciles.

RESULTS. Among 524,892 eligible Medicare patients who underwent hip arthroplasty at 3,296 US hospitals, a patient who underwent surgery in a hospital ranked in the worst-performing decile based on claims-based evidence of SSI had 2.9-fold higher odds of developing a chart-confirmed SSI relative to a patient with the same age, sex, and comorbidities in a hospital ranked in the best-performing decile (95% confidence interval, 2.2–3.7).

CONCLUSIONS. Medicare claims successfully distinguished between hospitals with high and low SSI rates following hip arthroplasty. These claims can identify potential outlier hospitals that merit further evaluation. This strategy can also be used to validate the completeness of public reporting of SSI.

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Nearly 400,000 patients undergo primary hip arthroplasty in US hospitals annually, and surgical site infection (SSI) is reported after 0.5%–3.0% of these procedures.[1,2] These infections account for substantial morbidity and more than $500 million per year in potentially preventable costs.[2] Thus, the Centers for Medicare and Medicaid Services (CMS) is working with the Centers for Disease Control and Prevention (CDC) to implement a value-based purchasing (pay-for-performance) program that targets SSI as a measure of hospital quality.[3]

CMS plans to evaluate performance on the basis of SSI data that are self-reported by hospitals through the CDC National Healthcare Safety Network (NHSN).[4] The validity of interhospital comparisons of SSI risk will therefore depend on hospital-level case identification, but hospitals vary in the resources that they commit to SSI surveillance. This is especially true for surveillance after hospital discharge, which is when the majority of SSIs occur; such surveillance has been difficult to standardize.[5-7] In addition, case-mix adjustment is limited to a relatively small number of data elements.[8,9]

Payer-based claims contain diagnosis and procedure codes that are routinely collected for billing. These data track the full spectrum of health care use and markedly increase identification of both SSIs that occur before hospital discharge and those that occur after discharge.[10-17] The goal of this study was to use Medicare claims to identify US hospitals with high versus low rates of SSI after hip arthroplasty. This approach has the potential to trigger audits and to enhance the data that hospitals are self-reporting to the NHSN.

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METHODS

Study Design and Patient Population

This was a retrospective cohort study of fee-for-service Medicare recipients 65 years of age and older who underwent primary total (*International Classification of Diseases, 9th Revision* [ICD-9], 81.51) or partial (ICD-9 81.52) hip arthroplasty from January 1, 2005, through December 31, 2007. These two procedures have been targeted for SSI reduction by the Surgical Care Improvement Project (SCIP). In accordance with CDC/NHSN SSI surveillance recommendations for implant procedures, we screened claims submitted within 1 year after surgery for evidence of SSI.[18] We excluded Medicare Advantage (managed care) participants, because claims data were not available for this group. This study was approved by the Harvard Pilgrim Health Care institutional review board. Agreements between CMS and the CDC Prevention Epicenters Program assured patient and hospital confidentiality.

To avoid uncertainty in attributing an SSI to a specific procedure, we excluded patients who underwent any of the 118 coded procedures targeted by SCIP within the 60 days before hip arthroplasty.[19] Patients with multiple surgical dates for hip arthroplasty during their index hospitalization were also excluded, because claims codes could not be linked to an individual procedure. Finally, we excluded patients who had claims suggestive of hip infection in the 30 days before surgery (Table A1).

Members of our group previously identified 61 SSI codes (5 ICD-9 procedure codes, 38 ICD-9 diagnosis codes, and 18 current procedural terminology [CPT] codes) that identified SSI after hip arthroplasty with greater sensitivity than traditional infection control surveillance.[17] We identified all patients with at least 1 of these 61 SSI codes in the 365 days after hip arthroplasty. For patients who underwent another SCIP procedure within 365 days, we only evaluated SSI codes for the period between the hip surgery and the subsequent surgery. We included codes submitted under Medicare Part A from inpatient and outpatient facilities as well as Medicare Part B physician claims. We did not include codes submitted under Medicare Part A from nursing homes, home health, or hospice facilities. Data were obtained 18 months after the study period to account for usual delays in submission of Medicare claims and to ensure that greater than 95% of claims were received.

Ranking of US Hospitals by Claims Suggestive of SSI after Hip Arthroplasty

We collaborated with the Oklahoma Foundation for Medical Quality (OFMQ), a national quality resource center for Medicare's Quality Improvement Organization Program. OFMQ personnel applied our claims-based surveillance strategy to Medicare claims that they retained and produced a risk-adjusted ranking of hospitals using a generalized linear mixed model developed by our group.[16] We risk-adjusted for individuals' age in 5-year increments, sex, and the presence of 15 comorbidities that predict mortality in Medicare patients (ICD-9 components of the revised Romano score for Medicare populations).[20,21] Earlier studies have shown these factors to be associated with SSI.[16,22-24] Hospitals were ranked on the basis of their empirical Bayes estimators or predicted random effects. This resulted in hospitals with low procedure volumes being drawn away from the extremes. In other words, rankings near the top or bottom required more evidence, as represented by more procedures.

Hospitals were then grouped into deciles on the basis of these rankings. Our hypothesis was that, in the aggregate, patients whose procedures were performed in hospitals that were ranked in the worst-performing decile would have higher odds of confirmed infection than would patients whose procedures were performed in hospitals that were ranked in the best-performing decile.

Clinical Chart Review

Through our collaboration with OFMQ, we identified a random sample of 1,000 patients with at least 1 SSI code, 500 each from hospitals in the best- and worst-performing deciles. For each patient, we requested all full-text inpatient and outpatient records that were flagged by 1 or more of our SSI codes. These records were requested and reviewed under 42 U.S.C. section 241(a), also known as the *Public Health Service Act* 301(a), as part of ongoing CDC/CMS efforts to improve SSI surveillance.

Records were requested, received, scanned, and encrypted by Information Collection Enterprises, a CMS contractor. Chart abstractions were completed by research assistants trained in the application of CDC criteria and verified by an infectious diseases physician with expertise in hospital epidemiology. All received records were reviewed for the presence or absence of an SSI using CDC/NHSN criteria.[18] Patient records were maintained in a secure network location accessible only to study staff, and all abstracted data was deidentified before analysis.

For each chart-confirmed SSI, we collected data on depth (superficial incisional, deep incisional, or organ/space SSI) and time since hip arthroplasty. When SSI was not confirmed, alternative reasons for SSI codes were recorded: infection at another body site, noninfectious diagnosis (eg, hematoma and dehiscence without infection), insufficient data documentation, or clinically suspected incisional infection that did not meet CDC/NHSN criteria (eg, superficial incisional SSI beyond 30 days and description of cellulitis at the surgical site without documentation of further criteria needed for SSI diagnosis).

Analysis

We assessed whether undergoing hip arthroplasty in a worst- versus best-decile hospital was associated with a higher rate

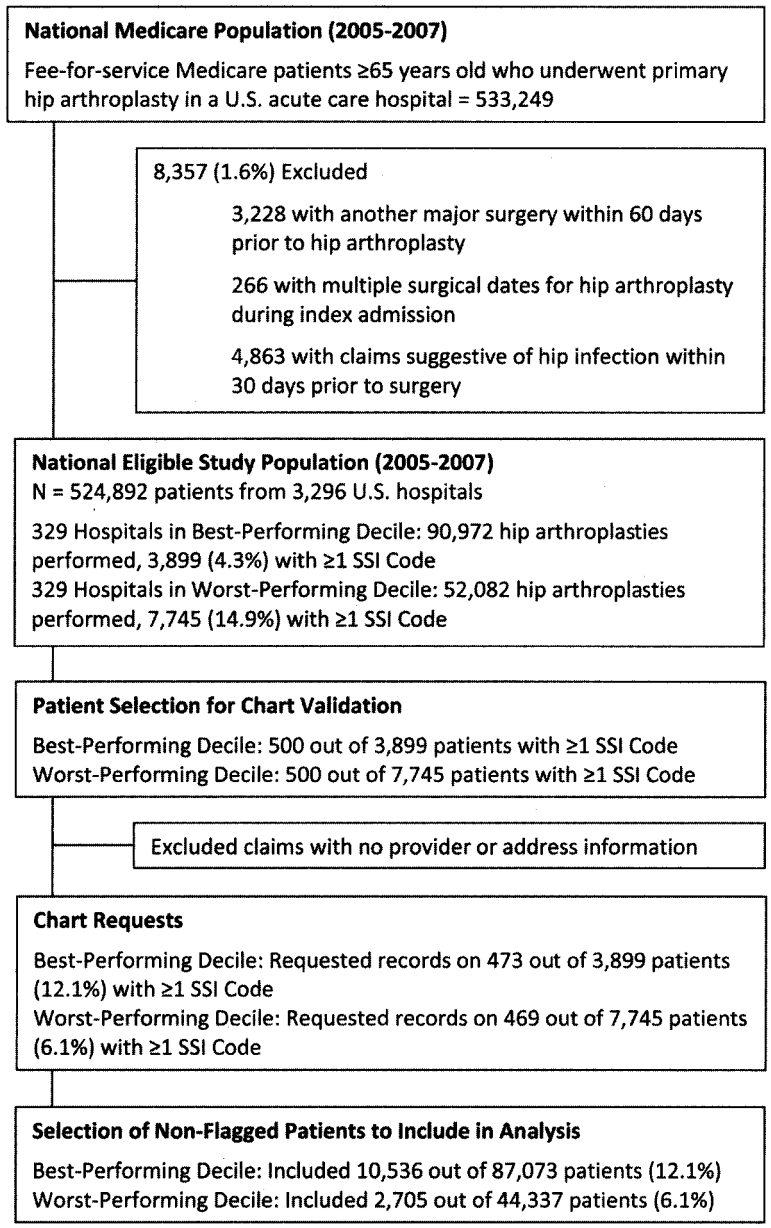

FIGURE 1. Study population. SSI, surgical site infection.

of confirmed SSI. Patients with a confirmed SSI were those with SSI code(s) who were selected for chart review and had chart confirmation of SSI. Patients with no confirmed SSI were (1) patients with SSI code(s) who were selected for chart review and did not have chart confirmation of SSI (including those whose medical records were either not received or contained insufficient data to assess SSI status) and (2) a proportional sample of patient treated at hospitals from the same decile drawn randomly from among patients with no SSI codes. This last group was selected in proportion to the fraction of patients with an SSI code for whom we requested records in each of the 2 deciles. We assumed that patients without an SSI code did not have an SSI, because our earlier work found that claims-based surveillance had a sensitivity of 100%.[17]

The χ^2 test was used to compare the proportion of patients with SSI codes who had a surgical site infection confirmed on clinical chart review in best- versus worst-decile hospitals. We also performed a logistic regression for the outcome of chart-confirmed SSI after risk adjustment. Our primary predictor was whether the surgery was performed in a worst- versus best-decile hospital based on adjusted claims rankings. The other covariates were age, sex, and the 15 comorbidities for case-mix adjustment.[20,21] Age was modeled as a continuous

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TABLE 1. Comorbidities in Patients with Hip Arthroplasty with and without a Surgical Site Infection (SSI) Code

Variable	No. (%) of patients	
	SSI code (n = 41,970)	No SSI code (n = 482,922)
Male sex	14,180 (33.8)	152,733 (31.6)
Age, years		
65–69	5,428 (12.9)	75,275 (15.6)
70–74	6,876 (16.4)	88,232 (18.3)
75–79	8,995 (21.4)	103,513 (21.4)
80–84	9,700 (23.1)	101,883 (21.1)
⩾85	10,971 (26.1)	114,019 (23.6)
Diabetes without end organ damage	7,874 (18.8)	77,391 (16.0)
Diabetes with end organ damage	5,664 (13.5)	35,441 (7.3)
Congestive heart failure	15,803 (37.7)	128,499 (26.6)
Chronic pulmonary disease	13,235 (31.5)	121,844 (25.2)
Cerebrovascular disease	11,254 (26.8)	98,836 (20.5)
Moderate to severe renal disease	5,538 (13.2)	38,264 (7.9)
Peripheral vascular disease	13,221 (31.5)	106,607 (22.1)
Mild liver disease	619 (1.5)	4,518 (0.9)
Severe liver disease	198 (0.5)	1,046 (0.2)
Myocardial infarct	4,191 (10.0)	35,177 (7.3)
Dementia	6,305 (15.0)	53,975 (11.2)
Hemiplegia	1,005 (2.4)	7,077 (1.5)
Any tumor	5,526 (13.2)	56,704 (11.7)
Metastatic solid tumor	1,253 (3.0)	10,911 (2.3)
HIV/AIDS	46 (0.1)	238 (0.1)

predictor. The remaining covariates were modeled as dichotomous predictors. All analyses were performed in SAS, version 9.2 (SAS).

RESULTS

Study Population

There were 524,892 eligible Medicare patients who underwent hip arthroplasty in 3,296 US hospitals from 2005 through 2007 (Figure 1). Hospitals performed a median of 34 hip arthroplasties per year involving Medicare patients (interquartile range, 13–73 procedures per year). Table 1 compares comorbidities in patients with a code suggestive of SSI versus those in patients with no SSI code.

Hospital-Specific Unadjusted Risk Based on SSI Claims Codes

Across hospitals, the median percentage of patients who underwent hip arthroplasty who were assigned a code suggestive of SSI was 7.8% (interquartile range, 5.3%–11.1%). Without adjustment, the best-performing and worst-performing deciles were mostly populated by hospitals with low procedure volume whose rates were thus unstable. Ninety percent of the hospitals in the best-performing decile, and 74% of the hospitals in the worst-performing decile performed less than 20 hip arthroplasties per year involving Medicare patients.

Hospital-Specific Adjusted Risk Based on SSI Claims Codes

After risk adjustment for age, sex, comorbidities, and surgical volume, only 41 (12.5%) of 329 hospitals that were in the best-performing decile on the basis of unadjusted rates remained in the best-performing decile on the basis of adjusted rates, whereas 179 (54.4%) of 329 hospitals that were in the worst-performing decile remained in the worst-performing decile. Figure 2 shows the adjusted relative odds of having at least 1 SSI code among Medicare patients who underwent primary hip arthroplasty. As shown in Figure 1, 4.3% of patients in best-decile hospitals and 14.9% of patients in worst-decile hospitals had at least 1 code suggestive of SSI. The median number of hip arthroplasties performed that involved Medicare patients annually was 73 (interquartile range, 45–119) in best-decile hospitals and 34 (interquartile range, 17–65) in worst-decile hospitals ($P < .001$).

Chart Validation in Worst- versus Best-Ranked Hospitals

Of the 1,000 patients randomly selected for clinical chart review, we had mailing information to request records on 473 patients who underwent hip arthroplasty in a best-decile hospital and 469 patients who underwent hip arthroplasty in a worst-decile hospital. This included requests for 604 charts linked to Part A inpatient claims, 452 charts linked to Part A outpatient claims, and 1,441 charts linked to Part B physician claims. We did not request records from physician claims that overlapped an inpatient hospitalization, because these records were assumed to be part of the inpatient record that was requested from the hospital.

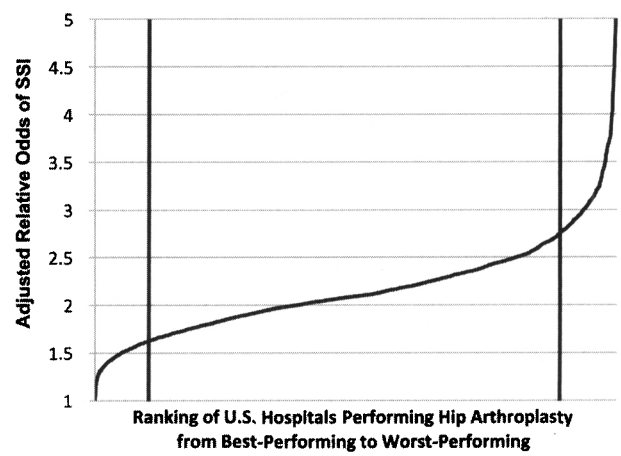

FIGURE 2. Adjusted relative odds of surgical site infection (SSI) for US hospitals performing hip arthroplasty for Medicare patients. Best- and worst-decile hospitals are indicated with vertical lines. Outlier hospitals with the 5 highest adjusted relative odds (range, 5.02–8.82) are not shown, representing 0.2% of all hospitals.

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TABLE 2. Identification of Surgical Site Infection (SSI) among Patients with an SSI Code for Whom Medical Records Were Received

Variable	No. (%) of patients		
	Best-decile hospitals (n = 348)	Worst-decile hospitals (n = 280)	P
No SSI	213 (61)	164 (59)	.50[a]
Noninfectious diagnosis	99 (28)	77 (28)	.79[a]
Infection at another site	94 (27)	72 (26)	.71[a]
Cellulitis at site of surgical incision	14 (4)	6 (2)	.25[b]
Superficial incisional SSI >30 days	6 (2)	9 (3)	.29[b]
SSI	135 (39)	116 (41)	.50[a]
Superficial incisional	43 (12)	33 (12)	.83[a]
Deep incisional	26 (7)	20 (7)	.88[a]
Organ/space	66 (19)	63 (23)	.28[a]

[a] χ^2 test.
[b] Fisher's exact test.

We received 89% of charts linked to Part A claims and 38% of charts linked to Part B claims. Based on the data included in received records, we were able to determine whether an SSI was present for 348 (74%) of 473 selected patients from best-decile hospitals and 280 (60%) of 469 selected patients from worst-decile hospitals. Table 2 shows the results for the 628 patients with sufficient data received.

Clinical chart review confirmed SSI in an equal proportion of patients with SSI codes in best- and worst-decile hospitals. With the conservative assumption that patients whose charts were not returned or had insufficient data to assess SSI did not actually have an SSI, our final confirmation rates among patients with an SSI code were 135 (29%) of 473 in best-decile hospitals and 116 (25%) of 469 in worst-decile hospitals (P = .2). Among chart-confirmed SSIs, the distribution of superficial incisional, deep incisional, and organ/space infections was similar between the best- and worst-decile hospitals.

Among the 628 patients with sufficient data to determine a diagnosis, eliminating 4 poor-performing codes increased the predictive value of the remaining codes to 50%. These 4 poor-performing codes were ICD-9 86.22 (excisional debridement of wound, infection, or burn), 86.28 (nonexcisional debridement of wound, infection, or burn), 686.8 (other specified local infections of skin and subcutaneous tissue), and 686.9 (unspecified local infection of skin and subcutaneous tissue). Eliminating these 4 codes would have resulted in failure to detect 1 superficial SSI.

Of the 251 confirmed SSIs, 244 (97%) were diagnosed after initial discharge from the hospital. These included 70 (90%) of 76 superficial incisional SSIs and 174 (99%) of 175 deep incisional and organ/space SSIs. Among patients who developed an SSI after discharge from the hospital, only 74% were readmitted to the hospital where the hip arthroplasty was performed, despite the fact that 90% of these patients required at least 1 rehospitalization. The median length of stay for hip arthroplasty was 5 days (interquartile range, 4–7 days), whereas the median length of time until an SSI was diagnosed was 16.5 days for superficial incisional SSIs (interquartile range, 11–21.5 days) and 30 days for deep incisional and organ/space SSIs (interquartile range, 21–59 days). A total of 9 (20%) of 46 deep incisional SSIs and 23 (18%) of 129 organ/space SSIs presented more than 3 months after the hip arthroplasty, with 4 (9%) of 46 deep incisional SSIs and 15 (12%) of 129 organ/space SSIs presenting more than 6 months after hip arthroplasty.

Adjusted Risk of Chart-Confirmed SSI among Worst- versus Best-Ranked Hospitals

There was a significant difference in the rate of confirmed SSIs between best- and worst-decile hospitals (1.2% vs 3.6%; $P < .001$). This difference was significant for superficial, deep, and organ/space infections (Table 3).

After adjustment for age, sex, and comorbidities, patients who underwent hip arthroplasty in worst-decile hospitals had a nearly 3-fold higher odds of developing an SSI compared with those who underwent the procedure in best-decile hospitals (odds ratio, 2.9 [95% confidence interval, 2.2–3.7]; $P < .001$). The result was similar when limited to deep incisional and organ/space SSI (odds ratio, 3.0 [95% confidence interval, 2.2–4.1]; $P < .001$).

DISCUSSION

Current surveillance methods for SSI are highly variable. Payer-based claims have been shown to enhance detection of SSI after arthroplasty in small multicenter studies.[17,25] We now show that national Medicare claims can identify US hospitals with significantly higher rates of SSI after arthroplasty.

Claims codes suggestive of SSI after hip arthroplasty were successful in identifying US hospitals with a 3-fold difference in chart-confirmed SSI after adjustment for age, sex, and comorbidities. This difference was the same regardless of depth. This is an important finding, because CMS and state health departments have been particularly interested in iden-

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TABLE 3. Rate of Chart-Confirmed Surgical Site Infections (SSIs) in Best- versus Worst-Decile Hospitals

SSI	No. (%) of patients		P
	Best-decile hospitals (n = 11,009[a])	Worst-decile hospitals (n = 3,174[b])	
All	135 (1.2)	116 (3.7)	<.0001
Superficial incisional	43 (0.4)	33 (1.0)	<.0001
Deep incisional	26 (0.2)	20 (0.6)	.0006
Organ/space	66 (0.6)	63 (2.0)	<.0001

[a] Includes 135 case patients and 10,874 control subjects (213 patients with no SSI on clinical chart review, 125 patients for whom records were either not received or for whom insufficient data were provided to assess for an SSI, and the proportional sample of 10,536 nonflagged patients).
[b] Includes 116 case patients and 3,058 control subjects (164 patients with no SSI on clinical chart review, 189 patients for whom records were either not received or for whom insufficient data were provided to assess for an SSI, and the proportional sample of 2,705 nonflagged patients).

tifying hospitals with high rates of deep incisional and organ/space SSIs, which are the infections associated with the highest morbidity and costs.[26-28]

We opted to focus on primary hip arthroplasty, because these surgical procedures should involve no preexisting infection, whereas revision surgical procedures may be done because of underlying infection that is present at the time of surgery. Although NHSN does not currently differentiate between primary and revision surgical procedures when reporting SSIs, the risk of SSI is 2 times higher after revision arthroplasty, with a nearly 4 times higher risk of deep incisional and organ/space SSI.[29]

It is important to recognize that most SSIs in our study occurred after the patient was discharged from the hospital, with approximately one-quarter of readmitted patients being admitted to a different hospital. These infections will not be reported to NHSN unless communication is made to the hospital where the surgical procedure occurred. One benefit of claims is the ability to link potential SSIs, regardless of where care is sought, to the hospital where the surgical procedure was performed.

Identifying a standardized and efficient approach for SSI surveillance is highly valuable, because public reporting of SSIs is increasingly mandated. Claims data can help to validate the accuracy and completeness of self-reported data and ultimately improve the meaningfulness of interhospital comparisons. Eleven states currently employ some form of validation for SSI reporting.[30] In fact, our data support the recent finding in New York state that claims codes improve auditing for SSI capture.[31] However, we identify a broader, and somewhat different, set of SSI codes. The New York codes were designed to maximize capture of SSIs already reported to NHSN, whereas our codes were designed to maximize capture of all SSIs, both reported and unreported, across all health care settings.

These findings are consistent with our earlier work on coronary artery bypass graft surgery (CABG), arthroplasty, and vascular surgery, which suggested that claims-triggered chart review is superior to random selection of records for validation and is more efficient than reviewing all postoperative records or readmissions.[16,17,25] In addition, we showed that Medicare claims similarly identified hospitals associated with a high risk of SSI after CABG.[16]

Our broad set of codes maximizes sensitivity while identifying an SSI for every 3–4 patients reviewed. In fact, capture of SSI with these codes may be better in practice, because we made the conservative assumption that patients with no received records or incomplete records did not have an SSI. Still, if some of these patients did, in fact, have an SSI, we would expect the odds of SSI in worst- versus best-decile hospitals to be unchanged, because the confirmation rate among patients with an SSI code was similar between best- and worst-decile hospitals.

Including infrequently used codes does not increase the surveillance workload, but it does even out differences in coding practices. The codes presented here were previously shown to increase SSI detection 4.7-fold compared with traditional surveillance after hip arthroplasty.[17] Still, if used to enhance surveillance and public reporting, ongoing monitoring will be needed to evaluate whether hospitals or clinicians avoid certain codes on our list. Although a broad set of codes is important to prevent gaming, we found that CPT codes were redundant to other selected ICD-9 codes and could potentially be excluded.

In our study, we used claims to identify outlier hospitals. Although claims allow for case-mix adjustment, it is possible that additional differences in case-mix or in coding practices might explain the outlier status of individual hospitals. Therefore, additional evaluation of hospitals is warranted. If a higher rate is confirmed, the hospital can be evaluated for modifiable practices to prevent SSI. Similarly, evaluation of hospitals with low risk of SSI might identify best practices that can be disseminated.

Finally, it is important to point out the difficulty in as-

sessing the performance of hospitals with low procedure volumes. Even if a hospital's true rate is high, the facility might easily have no infections during a 2-year period. Conversely, if the true rate is low, a single infection can have a large impact on the facility rate. Additional work in this arena is critical to ensure that low-volume hospitals can be accurately included in national SSI benchmarking.

In summary, Medicare claims successfully ranked US hospitals on the basis of SSI risk after hip arthroplasty and demonstrated a 3-fold rate difference between worst- versus best-performing hospitals. This methodology can be implemented by hospitals for more comprehensive and efficient SSI detection. In addition, CMS and state health departments can use this methodology for validation assessments of mandated reporting and to identify hospitals that merit additional evaluation aimed at improving surgical care.

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APPENDIX

TABLE A1. Hip Surgical Site Infection Indicator Codes

Code type	Code	Code text
ICD-9 procedure	84.56[a]	Insertion of cement spacer
ICD-9 procedure	86.01[a]	Aspiration of skin and subcutaneous tissue (abscess, hematoma, seroma)
ICD-9 procedure	86.04	Other incision with drainage of skin and subcutaneous tissue
ICD-9 procedure	86.22[a,b]	Excisional debridement of wound, infection, or burn
ICD-9 procedure	86.28[a,b]	Nonexcisional debridement of wound, infection, or burn
ICD-9 diagnosis	686.8[b]	Other specified local infections of skin and soft tissue
ICD-9 diagnosis	686.9[b]	Unspecified local infection of skin and/or soft tissue
ICD-9 diagnosis	711.00[a]	Pyogenic arthritis, site unspecified
ICD-9 diagnosis	711.05[a]	Pyogenic arthritis, pelvis and thigh
ICD-9 diagnosis	711.08[a]	Pyogenic arthritis, other specified sites
ICD-9 diagnosis	711.09[a]	Pyogenic arthritis, multiple sites
ICD-9 diagnosis	711.40[a]	Arthropathy associated with other bacterial diseases, site unspecified
ICD-9 diagnosis	711.45[a]	Arthropathy associated with other bacterial diseases, pelvis and thigh
ICD-9 diagnosis	711.48[a]	Arthropathy associated with other bacterial diseases, other specified sites
ICD-9 diagnosis	711.49[a]	Arthropathy associated with other bacterial diseases, multiple sites
ICD-9 diagnosis	711.90[a]	Unspecified infective arthritis, site unspecified
ICD-9 diagnosis	711.95[a]	Unspecified infective arthritis, pelvis and thigh
ICD-9 diagnosis	711.98[a]	Unspecified infective arthritis, other specified sites
ICD-9 diagnosis	711.99[a]	Unspecified infective arthritis, multiple sites
ICD-9 diagnosis	730.00[a]	Acute osteomyelitis, site unspecified
ICD-9 diagnosis	730.05[a]	Acute osteomyelitis, pelvis and thigh
ICD-9 diagnosis	730.08[a]	Acute osteomyelitis, other specified site
ICD-9 diagnosis	730.09[a]	Acute osteomyelitis, multiple sites
ICD-9 diagnosis	730.10[a]	Chronic osteomyelitis, site unspecified
ICD-9 diagnosis	730.15[a]	Chronic osteomyelitis, pelvis and thigh
ICD-9 diagnosis	730.18[a]	Chronic osteomyelitis, other specified site
ICD-9 diagnosis	730.19[a]	Chronic osteomyelitis, multiple sites
ICD-9 diagnosis	730.20[a]	Unspecified osteomyelitis, site unspecified
ICD-9 diagnosis	730.25[a]	Unspecified osteomyelitis, pelvis and thigh
ICD-9 diagnosis	730.28[a]	Unspecified osteomyelitis, other specified site

TABLE A1 (*Continued*)

Code type	Code	Code text
ICD-9 diagnosis	730.29[a]	Unspecified osteomyelitis, multiple sites
ICD-9 diagnosis	730.90[a]	Unspecified infection of bone, site unspecified
ICD-9 diagnosis	730.95[a]	Unspecified infection of bone, pelvis and thigh
ICD-9 diagnosis	730.98[a]	Unspecified infection of bone, other specified site
ICD-9 diagnosis	730.99[a]	Unspecified infection of bone, multiple sites
ICD-9 diagnosis	996.60[a]	Infection and inflammatory reaction due to unspecified device, implant
ICD-9 diagnosis	996.66[a]	Infection and inflammatory reaction due to internal joint prosthesis
ICD-9 diagnosis	996.67[a]	Infection and inflammatory reaction due to internal orthopedic device, implant
ICD-9 diagnosis	996.69[a]	Infection and inflammation due to internal prosthetic implant
ICD-9 diagnosis	998.5	Postoperative infection, not elsewhere classified
ICD-9 diagnosis	998.51	Infected postoperative seroma
ICD-9 diagnosis	998.59	Other postoperative infection
ICD-9 diagnosis	998.6	Persistent postoperative fistula
CPT	10140	Incision and drainage of hematoma, seroma, or fluid collection
CPT	10160[a]	Puncture aspiration of abscess, hematoma, bulla, or cyst
CPT	10180[a]	Incision and drainage, complex, postoperative wound infection
CPT	12021	Treatment of superficial wound dehiscence; with packing
CPT	13160	Secondary closure of surgical wound or dehiscence, extensive or complicated
CPT	20000[a]	Incision of soft-tissue abscess, superficial
CPT	20005[a]	Incision of soft-tissue abscess, deep
CPT	26990[a]	Incision and drainage, pelvis or hip joint area; deep abscess or hematoma
CPT	26991[a]	Incision and drainage, pelvis or hip joint area; infected bursa
CPT	26992[a]	Incision, bone cortex, pelvis and/or hip joint (OM or bone abscess)
CPT	27030[a]	Arthrotomy, hip, with drainage (eg, infection)
CPT	27070[a]	Partial excision (eg, osteomyelitis or bone abscess); superficial (wing of ilium, greater trochanter of femur)
CPT	27090	Removal of hip prosthesis
CPT	27091	Removal of hip prosthesis, complicated, with or without spacer
CPT	27122	Acetabuloplasty, resection femoral head (girdlestone)
CPT	27301[a]	Incision and drainage, deep abscess, bursa or hematoma, thigh or knee region
CPT	27303[a]	Incision, deep, with opening or bone cortex, femur or knee (eg, osteomyelitis or bone abscess)
CPT	35860	Exploration for postoperative hemorrhage, thrombosis or infection, extremity

NOTE. CPT, current procedural terminology; ICD-9, *International Classification of Diseases, Ninth Revision.*

[a] We excluded patients who had any of the marked claims suggestive of hip infection in the 30 days before surgery.

[b] These 4 poor-performing codes were discussed in "Results." We propose that they should be removed from the code list.

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