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Surgical Site Infection Surveillance Following Ambulatory Surgery

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Abstract

We assessed 4045 ambulatory surgery patients for surgical site infection (SSI) using claims-based triggers for medical chart review. Of 98 patients flagged by codes suggestive of SSI, 35 had confirmed SSIs. SSI rates ranged from 0 to 3.2% for common procedures. Claims may be useful for SSI surveillance following ambulatory surgery.

Most operations in the United States are now performed in the outpatient setting.[1] However, little is known about infection rates following these procedures or how best to monitor for these complications, despite reports of serious lapses in infection control practices at ambulatory surgery centers.[2,3]

Traditional surgical site infection (SSI) surveillance methods, which focus on inpatient hospitalization and readmission at the facility where the procedure was performed, are likely inadequate for monitoring complications following ambulatory surgery. Our prior work has shown that claims data can improve SSI surveillance following inpatient surgery procedures.[4–7] We evaluated a surveillance strategy of using routinely collected claims data followed by medical record review among ambulatory surgery patients in a large managed care organization.

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METHODS

This was a retrospective cohort study across 3.7 million member-years for Harvard Pilgrim Health Care members who received care through Atrius Health, an alliance of 6 medical groups in Massachusetts. We identified adult members (≥18 years old) who had *Current Procedural Terminology* (CPT) or *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) procedure codes for selected common ambulatory surgical procedures (Table 1) performed from January 1, 2000, through December 31, 2008, with no overnight hospital stay following surgery. We searched claims records for acute care hospitalizations and/or any ICD-9-CM or CPT code suggestive of SSI (SSI code) within 60 days (Table 1). Patients who had undergone another ambulatory procedure within the previous 6 months were excluded.

We reviewed medical records for all patients with hospitalizations or SSI codes to assess for SSI, using the CDC's National Healthcare Safety Network surveillance definitions.[8] We estimated the sensitivity and positive predictive value (PPV) of hospitalization and SSI codes to identify medical record–confirmed SSIs (the gold standard) for each procedure. Sensitivity calculations were based on the total number of confirmed SSIs identified using hospitalization or SSI code triggers. We estimated SSI rates for each procedure and calculated 95% CIs for overall SSI rates and pooled sensitivity/PPV using the Wilson score method. Analyses were performed using SAS, version 9.3 (SAS Institute).

RESULTS

There were 4045 targeted ambulatory procedures performed during the study period (Table 2). The mean age in the cohort was 51 years and 55% of the patients were women. Herniorrhaphies (N = 1370) and cholecystectomies (N = 1126) accounted for the majority (62%) of procedures. Two hundred twenty records were flagged for review: 98 (2.4%) were associated with an SSI code and 146 (3.6%) were associated with a hospitalization (24 had both a hospitalization and SSI code).

There were 36 confirmed SSIs (25 superficial incisional, 2 deep incisional, and 9 organ/space), identified at a median of 12 days after index procedures (range, 2–57 days). Confirmed SSI rates ranged from 0% for laminectomies (0/325 procedures) and pubovaginal slings (0/486) to 3.2% (4/126) for appendectomies, for an overall rate of 0.9% (36/4045 procedures) (95% CI, 0.6%–1.2%). Outpatient SSI codes alone identified 20 superficial, 1 deep, and 2 organ/space SSIs; inpatient SSI codes alone identified 5 superficial, 1 deep, and 5 organ/space SSIs; and hospitalizations alone identified 2 organ/space SSIs.

SSI codes identified 35 of 36 confirmed SSIs (sensitivity, 97%; 95% CI, 86%–99%) with a PPV of 36% (95% CI, 27%–45%). Outpatient SSI codes identified 23 of 36 cases (sensitivity, 64%; 95% CI, 48%–78%) with a PPV of 30% (95% CI, 21%–41%) whereas inpatient SSI codes identified 11 of 36 cases (sensitivity, 31%; 95% CI, 18%–47%) with a PPV of 52% (95% CI, 32%–72%). Hospitalization claims had an overall sensitivity of 36% (13 of 36 cases) (95% CI, 22%–52%) and PPV of 8.9% (95% CI, 5.3%–15%). The combination of hospitalization or any SSI code had a PPV of 16% (95% CI, 12%–22%) (Table 2).

DISCUSSION

We found that the overall risk of SSI is not insignificant following several common ambulatory surgical procedures. SSI rates for pacemaker placement (0.4%), cholecystectomy (0.5%), herniorrhaphy (1.3%), and appendectomy (3.2%) procedures in our study were comparable with or higher than rates reported to National Healthcare Safety Network for those procedures following inpatient surgery during 2006–2008 (0.4%, 0.6%, 1.2%, and 1.4%, respectively).[9] Furthermore, we found that claims codes from both inpatient and ambulatory encounters can identify potential SSIs, including deep incisional and organ/space SSIs, following ambulatory procedures. On the basis of the PPV of 36%, focusing on the 2.4% of patients who receive an SSI code following ambulatory surgery would efficiently identify approximately 1 true case of SSI of every 3 cases reviewed. In contrast, screening based on postprocedure hospitalizations alone had low sensitivity (36%), underscoring the fact that many ambulatory surgery SSIs are superficial incisional and managed in the outpatient setting, and a PPV of only 8.9%, reflecting a predominance of non–SSI-related causes for hospitalization.

As surgical procedures increasingly shift to ambulatory settings, tracking postoperative complications will become critical, particularly given the relevance of healthcare-associated infections to reimbursement and interfacility comparisons. Hospital-based surveillance methods are inadequate because SSIs following ambulatory surgery often do not require hospitalization; more than half of the confirmed SSIs in our study (23 of 36 cases) were managed in an outpatient setting. Furthermore, if hospitalized, patients who underwent surgery at a freestanding ambulatory surgery center will likely be treated at a different facility. A screening strategy using claims data is appealing since these data are routinely collected by payers and reflect healthcare encounters in the outpatient and inpatient setting. Claims-based SSI surveillance based on encounters across the spectrum of healthcare could potentially be used by insurers or quality improvement organizations to assess the burden of infectious complications following ambulatory surgery and to target areas for improvement.

Recently, Owens et al. also found relatively low but non-negligible SSI rates (0.5% overall) among low-risk ambulatory surgery patients using administrative data from 8 states, but they did not perform medical record review to verify National Healthcare Safety Network SSI criteria.[10] Our results suggest that claims data alone might significantly overestimate true SSI rates but can be used to flag a reasonable number of high-likelihood cases for record review.

Our study has several important limitations. First, the number of patients meeting screening criteria was small, limiting the precision of results. Second, for this exploratory study, we did not extract detailed comorbidity data and SSI estimates were not risk-adjusted, limiting comparison with other populations. Assessing methods for meaningful SSI risk adjustment among ambulatory surgery patients will be important to incorporate into future studies. Third, because we reviewed only cases that had an SSI code or hospitalization, our screening strategy may have led to an underestimation of SSI rates and overestimation of the sensitivity/specificity of claims if SSIs occurred among those without a claims-based trigger. Prior studies comparing the performance of routine SSI surveillance with claims-enhanced surveillance, however, have shown that claims-based screening identified the majority of SSIs following a variety of inpatient surgical procedures.[4–7] Fourth, we examined 1 practice in 1 managed care organization. Additional research is needed to evaluate the generalizability of these results.

In conclusion, ambulatory surgery SSI rates may mirror inpatient rates for some common procedures but are likely to be underestimated using traditional hospital-based surveillance. On the basis of the results of this study, claims-based SSI surveillance in conjunction with targeted medical record review may be a useful strategy following ambulatory surgery.

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TABLE 1

Current Procedural Terminology (CPT) or International Classification of Diseases, Ninth Revision, Clinical Modification

(ICD-9-CM) Codes Used to Identify Selected Ambulatory Surgery Procedures and to Screen for Surgical Site Infection (SSI Codes)

	ICD-9-CM or CPT codes
Ambulatory procedures	
Anterior cruciate ligament repair	*CPT*: 29888
Appendectomy	*ICD-9-CM*: 47.0, 47.01, 47.09, 47.2, 47.91, 47.92, 47.99; *CPT:* 44960, 44970, 44979, 49315, 56315
Cholecystectomy	*ICD-9-CM*: 51.03, 51.04, 51.13, 51.21–51.24; *CPT:* 47420, 47425, 47440, 47460, 47550, 47562–64, 47600, 47605, 47610–47612, 47620, 47630, 49310–11, 56324, 56340–56342
Herniorrhaphy	*ICD-9-CM*: 17.11–17.13, 17.21–17.24, 53.00–53.05, 53.10–53.17, 53.21, 53.29, 53.31, 53.39, 53.41–53.43, 53.49, 53.51, 53.59, 53.61–53.63, 53.69; *CPT:* 49520–21, 49525, 49550, 49553, 49555, 49557, 49560–61, 49565–66, 49568, 49570, 49572, 49585, 49587, 49659
Laminectomy	*ICD-9-CM*: 03.01, 03.02, 03.09; *CPT:* 63001, 63005, 63011–12, 63015–63017, 63020, 63030, 63040, 63042, 63045–63047, 63056, 63075
Pacemaker placement	*ICD-9-CM*: 17.51,17.52, 37.70–37.77, 37.79–37.83, 37.85–37.87, 37.89, 37.94–37.99, 00.50–00.54; *CPT:* 33206–08, 33212–33218, 33220, 33222–23, 33233–35, 33240–41, 33244, 33249
Pubovaginal sling	*ICD-9-CM*:59.4–59.6, 59.71; *CPT:* 57288, 57423
SSI screening codes	
Procedures	*ICD-9-CM*: 86.01, 83.49, 86.22, 86.28, 86.04, 86.09, 96.59, 91.71–91.73; *CPT:* 10160–61, 10140, 10180, 11000, 11005, 11008, 11040–44, 12020–21, 13100–02, 13131–33, 13160, 14000–01, 14040–41, 15100, 15120, 15200, 15240, 15852, 20000, 20005, 21501, 21510, 21920, 21925, 22010, 97597–98, 97602, 97605–06
Diagnoses	ICD-9-CM: 320, 324, 567.22, 567.38, 614.3, 682.2, 682.6–682.9, 711.06, 730.00, 730.05–730.08, 995.90–995.92, 996.60–996.63, 996.65–996.67, 996.69, 998.31, 998.32, 998.5, 998.51, 998.59, 998.83, 998.9

TABLE 2

Confirmed Surgical Site Infections (SSIs) Following Selected Ambulatory Surgery Procedures and Performance of 60-Day Hospitalizations and SSI Codes as Triggers for Medical Record Review

Procedure	Medical record–confirmed SSIs				SSI codes (outpatient)			SSI codes (inpatient)			Any SSI code			Hospitalizations			Total flags (SSI code or hospitalizations)[a]	
	Sup	Deep	Organ/ Space	Total (%)	Flags (%)	Sens (%)	PPV (%)	Flags (%)	Sens (%)	PPV (%)	Flags (%)	Sens (%)	PPV (%)	Flags (%)	Sens (%)	PPV (%)	Flags (%)	PPV (%)
Appendectomy (n=126)	1 *(1 C)*[b]	0	3 *(1 H, 2 C +H)*[c,d]	4 (3.2)	5 (4.0)	1/4 (25)	1/5 (20)	3 (2.4)	2/4 (50)	2/3 (67)	8 (6.3)	4/4 (100)	4/8 (50)	11 (8.7)	3/4 (75)	3/11 (27)	14 (11)	4/14 (29)
ACL repair (n=385)	3 *(2 C, 1 C +H)*	0	4 *(1 C, 3 C +H)*	7 (1.8)	5 (1.3)	3/7 (43)	3/5 (60)	4 (1.0)	4/7 (57)	4/4 (100)	9 (2.3)	7/7 (100)	7/9 (78)	7 (1.8)	4/7 (57)	4/7 (57)	12 (3.1)	7/12 (58)
Cholecystectomy (n=1,126)	4 (4 C)	0	2 *(1 C, 1 H)*	6 (0.5)	21 (1.9)	5/6 (83)	5/21 (24)	3 (0.3)	0/6 (0)	0/3 (0)	24 (2.1)	5/6 (83)	5/24 (21)	47 (4.2)	1/6 (17)	1/47 (2.1)	68 (6.0)	6/68 (8.9)
Herniorrhaphy (n=1,370)	17 *(13 C, 4 C+H)*	1 *(1 C)*	0	18 (1.3)	40 (2.9)	14/18 (78)	14/40 (35)	8 (0.6)	4/18 (22)	4/8 (50)	48 (3.5)	18/18 (100)	18/48 (38)	38 (2.8)	4/18 (22)	4/38 (11)	77 (5.7)	18/77 (23)
Laminectomy (n=325)	0	0	0	0 (0)	1 (0.3)	0/0 (N/A)	0/1 (0)	0 (0)	0/0 (N/A)	0/0 (N/A)	1 (0.3)	0/0 (N/A)	0/1 (0)	15 (4.6)	0/0 (N/A)	0/15 (0)	16 (4.9)	0/16 (0)
Pacemaker (n=227)	0	1 *(1 C+H)*	0	1 (0.4)	3 (1.3)	0/1 (0)	0/3 (0)	3 (1.3)	1/1 (100)	1/3 (33)	6 (2.6)	1/1 (100)	1/6 (17)	19 (8.4)	1/1 (100)	1/19 (5.3)	22	1/22 (4.5)
Pubovaginal sling (n=486)	0	0	0	0 (0)	2 (0.4)	0/0 (N/A)	0/2 (0)	0 (0)	0/0 (N/A)	0/0 (N/A)	2 (0.4)	0/0 (N/A)	0/2 (0)	9 (1.9)	0/0 (N/A)	0/9 (0)	11 (9.7)	0/11 (0)
Total (n = 4045)	25 *(20 C, 5 C+H)*	2 *(1 C, 1 C +H)*	9 *(2 C, 2 H, 5 C+H)*	36 (0.9)	77 (1.9)	23/36 (64)	23/77 (30)	21 (0.5)	11/36 (31)	11/21 (52)	98 (2.4)	35/36 (97)	35/98 (36)	146 (3.6)	13/36 (36)	13/146 (8.9)	220 (5.4)	36/221 (16)
95% CI				0.6–1.2	1.5–2.4	48–78	21–41	0.3–0.8	18–47	32–72	2.0–2.9	86–99	27–46	3.1–4.2	22–52	5.3–15	4.8–6.2	12–22

NOTE. ACL, anterior cruciate ligament; N/A, not applicable; PPV, positive predictive value; Sens, sensitivity; Sup, superficial.

[a]The total number of flags is generally equal to the sum of outpatient SSI code flags and hospitalization flags; however, 3 patients (2 appendectomies, 1 herniorrhaphy) had separate outpatient SSI codes and inpatient hospitalizations without associated SSI codes.

[b]"C" indicates SSIs that occurred in cases flagged by SSI codes alone.

[c]"H" indicate SSIs that occurred in cases flagged by hospitalizations alone.

[d]"C+H" indicates SSIs that occurred in cases flagged by both SSI codes and hospitalizations.