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Harnessing Claims to Improve Detection of Surgical Site Infections following Hysterectomy and Colorectal Surgery

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Surgical site infection (SSI) surveillance is performed using a variety of methods with unclear performance characteristics. We used claims data to identify records for review following hysterectomy and colorectal surgery. Claims-enhanced screening identified SSIs missed by routine surveillance and could be used for targeted chart review to improve SSI detection.

Approximately 300,000 surgical site infections (SSIs) occur annually in the United States, resulting in more than 8,000 deaths and costs up to \$10 billion.^{1 2} SSI prevention is a major goal of the Department of Health and Human Services. Hospitals must report SSIs following abdominal hysterectomy and colon surgery to the Centers for Disease Control and Prevention's National Healthcare Safety Network (NHSN) to comply with the Centers for Medicare and Medicaid Services (CMS) Inpatient Quality Reporting (IQR) program.³⁻⁴

Hospitals vary in the resources they commit to SSI surveillance, resulting in variability in the completeness of self reported SSI rates.⁵ As public reporting increases, standardized metrics and methods are needed, especially when interhospital comparisons are used to determine hospital reimbursement. In addition, improved methods are needed for validating hospital SSI rates to minimize intentional or unintentional underreporting.

Administrative claims can identify patients likely to have an SSI and improve identification of pre-and-postdischarge SSIs compared with traditional surveillance methods.^{6 8} This study evaluates the utility of claims data to enhance SSI detection following hysterectomy and colorectal surgery.

METHODS

We conducted retrospective cohort studies at 2 academic medical centers, extending analyses of populations previously described by Yokoe et al.⁸ Patients undergoing hysterectomy or colorectal surgery between July 1, 2003, and June 30, 2005, were eligible for inclusion. Each hospital's infection prevention program conducted routine prospective SSI surveillance using NHSN definitions.³ Routine surveillance included re-view of microbiology and readmission diagnoses for post-operative patients, in addition to review of cases reported by medical staff. All patients identified as having an SSI through routine surveillance had their medical records re-reviewed to confirm SSI. For both procedures, we also reviewed medical records for a random sample of up to 200 patients per hospital not previously known to have an SSI. We reviewed medical records from the initial hospitalization and any subsequent hospitalizations at the same hospital within 30 days. Out-patient records were not reviewed.

We estimated the number of SSIs missed by routine surveillance by multiplying the proportion of randomly selected patients found to have an SSI by the total number of patients who were not known to have an SSI. This estimate was added to the number of SSIs identified through routine surveillance to determine a new denominator for sensitivity calculations. We also extracted *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis and procedure codes from all hospitalizations for patients whose medical records were reviewed. This included cases identified by

routine surveillance and all random-sample patients. We then screened for the use of ICD-9-CM codes suggestive of SSL. Our goal was to find a combination of ICD-9-CM codes with high sensitivity for detecting review-confirmed SSIs while maintaining an adequate positive predictive value (PPV) to minimize record review burden.

We calculated sensitivities for both routine surveillance and surveillance enhanced by ICD-9-CM code screening. We used weighted 2 x 2 tables to extrapolate the numbers needed to calculate PPV for surveillance using ICD-9-CM codes, based on previously described methods.⁸ Statistical testing was performed using SAS statistical software, version 9.2 (SAS Institute). The hospitals' institutional review boards approved the study protocol.

RESULTS

Among 832 hysterectomies, we confirmed SSI in 14 patients previously identified by routine surveillance (6 superficial, 8 deep or organ/space [D-OS]). Medical record review of a random sample of 344 patients not previously known to have an SSI identified 9 additional SSIs (5 superficial, 4 D-OS). We found 6 ICD-9-CM codes (Figure 1) that identified 93% (13/14) of SSIs detected by routine surveillance, including 89% (7/8) of D-OS SSIs. These codes also identified 67% (6/9) of SSIs in the random sample.

Extrapolating to the entire study population, the 6 selected ICD-9-CM codes had a sensitivity of 68% (24/36) for detecting SSI, compared with 39% (14/36) for routine surveillance (Figure 1). The overall SSI rate utilizing claims-based screening followed by medical record review (claims-enhanced surveillance) was 2.9%, versus 1.7% based on routine surveillance. The D-OS SSI rate was 1.4% based on claims-enhanced surveillance, versus 1.0% based on routine surveillance.

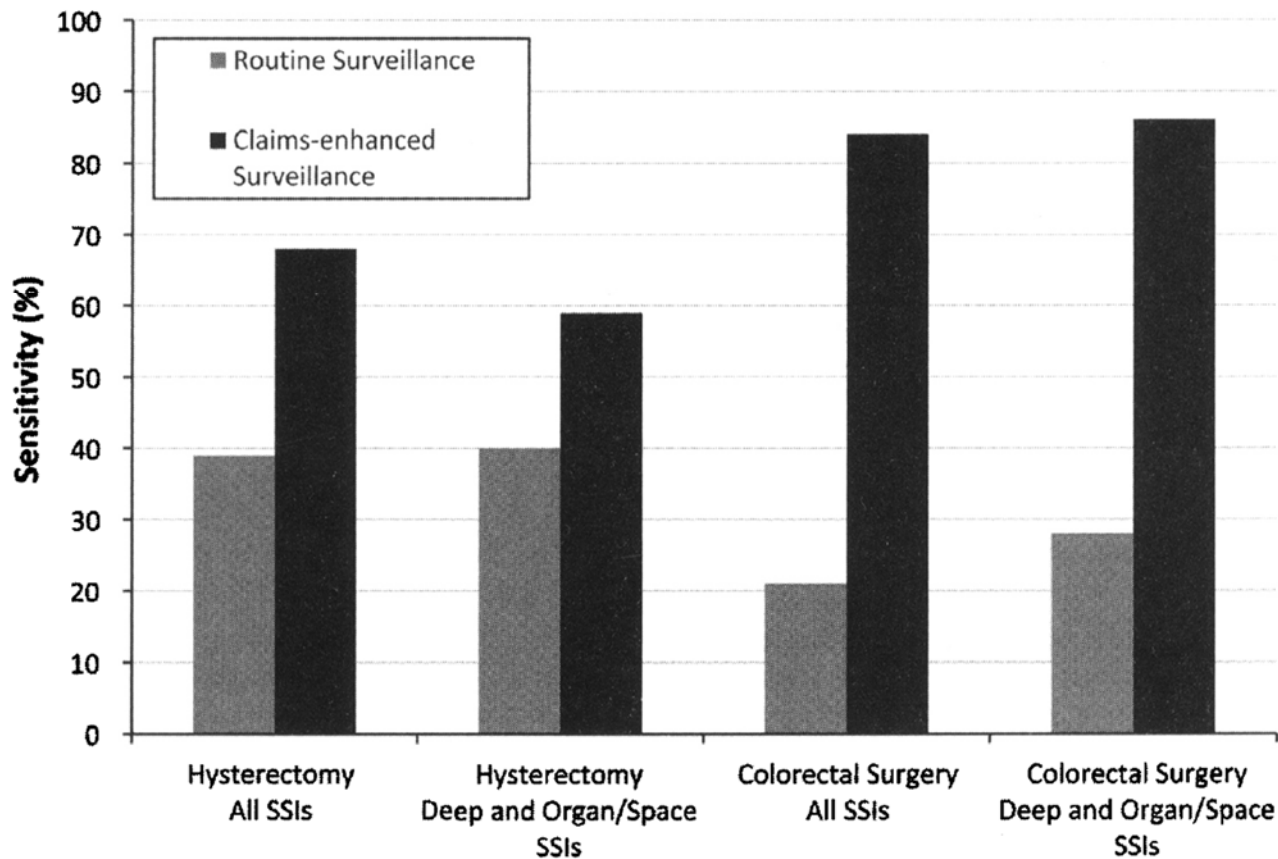


FIGURE 1. Sensitivity of routine and claims-enhanced surveillance for surgical site infections (SSIs) following hysterectomy and colorectal surgery. Claims-enhanced surveillance involved the use of *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD9-CM) diagnosis and procedure codes to screen medical records for SSI following hysterectomy and colorectal surgery followed by medical record review. ICD-9-CM codes to screen for SSI following hysterectomy: 567.22, 682.2, 998.31, 998.32, 998.51, and 998.59. ICD-9-CM codes to screen for SSI following colorectal surgery: 54.0, 54.11, 54.19, 86.04, 86.22, 86.28, 567.21, 567.22, 567.29, 567.38, 569.5, 569.61, 569.81, 682.2, 879.9, 998.31, 998.32, 998.51, 998.59, and 998.6.

Using claims codes to trigger chart review identified 1 SSI for every 2 hysterectomy procedures reviewed (24/41; PPV, 59%), with 1 in 4 charts identifying a D-OS SSI (12/41; PPV, 29%). The negative predictive value (NPV) of the selected codes was 98.5%.

Among 2,782 colorectal procedures, we confirmed SSI in 62 patients previously identified by routine surveillance (29 superficial, 33 D-OS). Medical record review of a random sample of 304 patients not previously known to have an SSI identified 27 additional SSIs (16 superficial, 11 D-OS). We found 20 ICD-9-CM codes (Figure 1) that identified 90% (56/62) of SSIs identified by routine surveillance, including 94% (31/33) of D-OS SSIs. These codes also identified 81% (22/27) of SSIs in the random sample.

Extrapolating to the entire study population, the 20 selected ICD-9-CM codes had a sensitivity of 84% (243/290) for detecting SSI, compared with 21% (62/290) for routine surveillance (Figure 1). The overall SSI rate utilizing claims-enhanced surveillance was 8.7%, versus 2.2% based on routine surveillance. The D-OS SSI rate was 3.7% based on claims-enhanced surveillance, versus 1.1% based on routine surveillance. Using claims codes to trigger chart review identified 1 SSI for every 3 colorectal procedures reviewed (243/702; PPV, 35%), with 1 in 7 charts identifying a D-OS SSI (103/702; PPV, 15%). The NPV of the selected codes was 97.7%.

DISCUSSION

Rates of SSI following abdominal hysterectomy and colon surgery will be used by CMS along with other quality metrics to determine reimbursement levels.⁴ Complete surveillance is problematic, however, because resources vary over time and between healthcare facilities. In this study, we show that claims-enhanced surveillance can help to identify SSIs missed by routine surveillance, identifying nearly twice as many SSIs following hysterectomy and 4 times more SSIs following colorectal surgery.

Our study had several limitations. First, only 2 hospitals were included in this analysis. Additional research to evaluate the generalizability of these codes across hospitals is needed, as coding practices may vary from hospital to hospital and over time. Second, we used medical record review of a random sampling of patients to estimate results for the entire cohort, with a potential impact on the precision of our estimates. Third, results are based on data from 2003 to 2005, and current coding and SSI surveillance practices may have substantially changed since then. Fourth, claims data generated by inpatient hospitalizations will miss SSIs that are diagnosed and treated solely in the outpatient setting. Finally, use of claims-enhanced surveillance relies on accurate coding by healthcare providers. Use of multiple ICD-9-CM codes to trigger chart review maximizes sensitivity while attempting to avoid "gaming," in which certain codes are intentionally avoided.⁹

Our results suggest that claims-enhanced SSI surveillance can be used to identify patients who are likely to have developed SSI following hysterectomy and colorectal procedures. These patients can then be targeted for review. This method can improve standardization of SSI surveillance across hospitals and has the potential to streamline the efforts of infection preventionists while improving case detection.

Claims-enhanced surveillance can also be utilized by state and federal agencies as a tool to focus efforts around validation of hospital-submitted SSI data. The ICD-9-CM codes presented here are currently being used by the CMS IQR program to identify "candidate SSI events" for further review during validation.¹⁰

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