



## Brief Report

# Validation of surgical site infection surveillance data in colon procedures reported to the Connecticut Department of Public Health



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## Key Words:

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A validation study of 692 patients undergoing colon surgery during the fourth quarter of 2012 identified 102 surgical site infections, of which 34% were not reported to the National Healthcare Safety Network. Possible reasons for underreporting included the misinterpretation of the National Healthcare Safety Network surgical site infection definition and variations in case-finding methods. Colon procedure denominator data were also reviewed to determine inaccuracies. Error rates were highest for implant presence (34%), endoscope use (32%), and procedure duration (33%).

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Hospitals participating in the Centers for Medicare and Medicaid Services Hospital Inpatient Quality Reporting Program are using the Centers for Disease Control and Prevention National Healthcare Safety Network (NHSN) Surveillance System to report surgical site infections (SSIs) following inpatient colon procedures.<sup>1-3</sup> SSI data reported to the Centers for Medicare and Medicaid Services via NHSN are used to qualify hospitals for annual payment updates and public reporting at the Department of Health and Human Services Hospital Compare Web site.<sup>4</sup> Increasing attention to publicly reported data deems it important to validate data reported to NHSN. Studies highlight institutional variation and underreporting of health care-associated infections, including previous Connecticut data validation audits.<sup>5,6</sup> We present work on the reliability and consistency of the application of NHSN surveillance definitions regarding colon surgical procedure reporting to NHSN in Connecticut.

## METHODS

A blinded retrospective medical record review was conducted in 30 Connecticut acute care hospitals to identify SSIs following colon procedures. Hospitals submitted a list of patients having undergone an NHSN-defined colon operative procedure during the fourth quarter of 2012.<sup>2</sup> Each patient's medical record was reviewed, and clinical data, laboratory reports, and radiology reports were exam-

ined to determine whether an SSI occurred, whether the infection was health care-associated, and which NHSN criteria were used to meet the case definition.<sup>2</sup> The agreement between an SSI assessed to be present by reviewers, and those entered into the NHSN database was determined. Discrepant cases were discussed with infection preventionists (IPs) and possible reasons for misclassifications were recorded. Using reviewers' classification of infection as the gold standard, the sensitivity, specificity, positive predictive value, and negative predictive value of the colon SSI surveillance data submitted to NHSN by hospitals were determined. The Connecticut Department of Public Health (DPH) reviewers included 3 NHSN-trained nurses with 30 years combined infection prevention and control (IPC) experience.

Assessing denominator data accuracy, the NHSN database was downloaded and the agreement between denominator data elements collected by reviewers and those entered into the NHSN database was determined. The proportions of missing or inaccurate values, including wound class, duration or urgency of operation, and use of a scope or implant, was evaluated.

The relationship between SSI agreement, SSI detection time, and culture results was examined using the  $\chi^2$  test.<sup>7</sup> Ninety-five percent confidence intervals (CIs) were calculated. *P* values < .05 were considered significant.

## RESULTS

A validation study of 692 patients undergoing colon surgery in Connecticut during the fourth quarter of 2012 identified 102 (15%) SSIs, of which 67 (66%) were reported to NHSN (Table 1), yielding a sensitivity for hospital NHSN-reported colon SSIs of 65.6%. Of the 590 no-SSIs identified, there was agreement on 589 (99%) of the

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Conflicts of interest: None to report.

**Table 1**

Results of validation chart review of surgical site infections (SSIs) following colon surgery reported by Connecticut Hospitals and the Connecticut Department of Public Health (CT DPH), October 1- December 31, 2012

CT DPH reports	Connecticut hospital reports to National Healthcare Safety Network		Total
	SSI	No-SSI	
SSI	67 (66%) (true positives)	35 (34%) (false negatives)	102
No SSI	1 (false positives)	589 (true negatives)	590
Total	68	624	692

NOTE. Sensitivity = True positives  $\times$  100 / 67 = 67  $\times$  100 = 65.6%. True positives + false negatives = 67 + 35 = 102. Specificity = True negatives  $\times$  100 / 589 = 589  $\times$  100 = 99.8%. True negatives + false positives = 589 + 1,590. Positive predictive value = True positives  $\times$  100 / 67 = 67  $\times$  100 = 98.5%. True positives + false positives 67 + 1 = 68. Negative predictive value = True negatives  $\times$  100 / 589 = 589  $\times$  100 = 94.4%. True negatives + false negatives = 589 + 35 = 624.

events identified by the hospital NHSN reports, yielding a specificity of 99.8%. The overall positive predictive value for the hospital reports was 98.5% and the overall negative predictive value was 94.4%. Review of discordant cases revealed potential reasons for the misidentification of SSIs not reported to NHSN. When examining SSIs by type (superficial, deep, or organ/space), the relationship between SSI agreement and timing of SSI diagnosis was significant ( $\chi^2$  [2, 102] = 4.40;  $P$  = .036). Forty percent of discordant SSIs were organ/space infections. The majority of concordant SSIs (67%; 95% CI, 56%-78%) were more likely to be diagnosed on postdischarge/readmission, whereas discordant SSIs (54%; 95% CI, 38%-71%) were more likely to be diagnosed on admission. This indicates 2 possible reasons for discordant reporting: it is more difficult to locate and obtain SSI NHSN definition criteria on initial admission, and SSIs are easier to diagnose upon subsequent admission with a physician diagnosis or diagnosis code suggestive of SSI.

Reviewing discordant SSIs based on microbiologic cultures, the majority of concordant SSIs, regardless of infection type, met surveillance criteria based on positive cultures. Of the 67 concordant SSIs, 76% were based on positive cultures (95% CI, 66%-86%), whereas 54% of the discordant SSIs were based on positive cultures (95% CI, 38%-71%;  $\chi^2$  [2, 102] = 5.09;  $P$  = .024).

All charts (590 no-SSIs and 102 SSIs) were assessed to determine inaccuracies in denominator data elements reported to NHSN. Table 2 indicates more discrepancies in no-SSIs reported versus SSIs

**Table 2**

Results of Connecticut Department of Public Health (CT DPH) validation chart review: Inaccuracies in colon procedure denominator data elements, October 1-December 31, 2012

NHSN colon procedure denominator data elements	Classification by CT DPH reviewer:	
	Inaccuracies in denominator data elements	
	No SSI (n = 590)	SSI (n = 102)
Anesthesia	44 (7.45)	3 (2.94)
American Society of Anesthesiologists score*	71 (12.03)	9 (8.82)
Wound class*	116 (19.66)	23 (22.54)
Procedure duration, h*	165 (27.96)	25 (24.50)
Procedure duration, min*	194 (32.88)	29 (28.43)
Endoscope*	189 (32.03)	24 (23.52)
Implant	194 (32.88)	35 (34.31)
Emergency	82 (13.89)	10 (23.52)
Trauma	59 (10.00)	4 (3.92)
Surgical site infection type	-	22 (21.56)
Colon procedure missing in NHSN	58 (9.83)	2 (1.96)

NOTE. Values are presented as n (%).

NHSN, National Health Care Safety Network.

\*Indicates NHSN variables used for risk adjustment in 2010 report.<sup>8</sup>

reported. Error rates were highest with the presence of an implant (33% no-SSI vs 34% SSI), use of an endoscope (32% vs 24%), and procedure duration: hours (28% vs 25%) and procedure duration: minutes (33% vs 28%). Almost 10% of no-SSI colon procedures were missing in the NHSN database and 22% of SSI types were inaccurate.

## DISCUSSION

This study identified 34% underreporting of colon SSIs to NHSN. Postadjudication calls with IPs identified the misinterpretation of SSI definitions and variations in case-finding methods as possible reasons for the underreporting. In the majority of cases, although the IP recognized the presence of an organ/space SSI before surgery, she reported the development of the SSI postoperatively as present on admission, and not reportable to NHSN. The study identified that all 3 types of discordant SSIs had fewer positive cultures, indicating the primary case-finding method was dependent on microbiology reports. The postadjudication calls identified that many IPs were unaware of SSI Surveillance Criteria C for deep and organ/space infections. The calls identified superficial incisional infections were not reported due to the misinterpretation of SSI Superficial Surveillance Criteria C; specifically, this criteria does not always require a culture.

Case-finding limitations included that the majority of concordant cases were identified on postdischarge or readmission, indicating the postdischarge case-finding system influenced the rate of concordance. Readmission diagnosis of deep and organ/space SSIs and physician postdischarge reports of superficial SSIs were the primary methods of case finding for postdischarge surveillance. In both methods, physician-diagnosed SSIs led to easy recognition and reporting by the IP, leading to accuracy of SSI reporting.

The range of denominator reporting errors (3%-34%) indicated potential sources of errors, including the misunderstanding of certain elements of NHSN denominator definitions, such as endoscope use, an implant, and surgical procedure time; the lack of time to find and accurately report data elements; the absence of data quality checks for manually entered elements; and the incompatibility of data extraction programs.

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