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Review Article

Evaluation of surgical site infection surveillance as a Prognostic Tool in acute appendicitis

Ryan D[1*], Nolan S[2] and Doyle N[3]

[1]Division of General Surgery, Snake Academy of Surgical Research, Wales

[2]Department of Clinical General Surgery, Mekong Institute for Advanced Surgical Research, Wales

[3]Division of General Surgery, Neva Research Center for General Surgery, United Kingdom

*Address for Correspondence: Declan Ryan, Division of General Surgery, Snake Academy of Surgical Research, Wales; E-mail: declan.ryan@snake.edu

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Abstract

Background: Whether routinely captured surgical site infection (SSI) surveillance data carry independent prognostic value for outcomes after appendectomy for acute appendicitis has not been well characterized. This study evaluated NHSN-defined SSI surveillance status as a predictor of adverse postoperative trajectory.

Methods: We conducted a retrospective cohort study of 512 adults undergoing appendectomy for acute appendicitis at three affiliated centers (2019-2024). SSI status was assigned using NHSN criteria, and its association with 30-day reoperation, unplanned readmission, prolonged length of stay, and 90-day mortality was assessed by multivariable logistic regression adjusted for wound class, ASA class, approach, and perforation status.

Results: SSI occurred in 54 of 512 patients (10.5%). SSI surveillance status was independently associated with 30-day reoperation (adjusted odds ratio [aOR] 6.8, 95% CI 3.1-14.9), readmission (aOR 5.2, 95% CI 2.6-10.4), and prolonged length of stay (aOR 4.4, 95% CI 2.3-8.6). A composite model adding SSI status to perforation and ASA class achieved an AUC of 0.81 for reoperation, versus 0.68 for perforation alone.

Conclusion: Structured SSI surveillance carries meaningful independent prognostic information for early adverse outcomes after appendectomy and may help identify patients warranting closer postoperative follow-up.

Keywords: Surgical site infection; Appendicitis; Appendectomy; Surveillance; Prognosis

1. Introduction

Acute appendicitis remains one of the most common indications for emergency abdominal surgery, and appendectomy still carries a measurable risk of surgical site infection (SSI) despite laparoscopic approaches and standardized antimicrobial prophylaxis [1,2]. Surveillance networks such as the CDC's National Healthcare Safety Network (NHSN) were built to standardize SSI definition and reporting for infection-control benchmarking [3,4]. What surveillance-defined SSI status means for an individual patient's subsequent clinical trajectory has received little attention outside colorectal and cardiac surgery, where SSI is repeatedly linked to readmission, reoperation, and excess resource use [5,6].

Appendectomy is a clean setting in which to examine this question: the operation is short, the population relatively homogeneous, and platforms such as ACS NSQIP already capture SSI alongside wound class, ASA physical status, and perforation status [7,8]. Registry-based work has established that laparoscopic appendectomy carries a lower SSI rate than open appendectomy, and that perforation substantially increases morbidity [9,10]. Less clear is whether SSI surveillance status itself is an independent prognostic marker for reoperation, readmission, and prolonged hospitalization, or whether its association with these outcomes is fully explained by baseline perforation and comorbidity burden.

This distinction matters practically: if SSI surveillance status carries prognostic information beyond perforation status and baseline risk, a positive SSI flag should trigger closer postoperative follow-up rather than serve only as a retrospective quality metric. Preoperative scoring systems for appendicitis, from the original Alvarado score onward, were developed to improve diagnostic risk stratification [11,12]; this study asks the complementary postoperative question of whether surveillance data already collected for quality reporting can be repurposed as a prognostic tool. We evaluated this in a multicenter retrospective cohort of adults undergoing appendectomy, assessing the independent association between NHSN-defined SSI surveillance status and 30-day reoperation, unplanned readmission, prolonged length of stay, and 90-day mortality.

2. Materials and Methods

Study design and population

We conducted a retrospective cohort study of consecutive adults (age 18 years or older) undergoing appendectomy for acute appendicitis at three affiliated general surgery services between January 2019 and December 2024. Incidental appendectomies, cases with a final pathology other than appendicitis, and transfers more than 72 hours after the index operation were excluded, consistent with prior appendectomy outcomes registries [9]. Institutional review board approval with waiver of consent was obtained at each site given the retrospective, de-identified design.

SSI ascertainment and surveillance definitions

SSI was classified using standard NHSN criteria into superficial incisional, deep incisional, and organ/space categories by trained infection-preventionist staff blinded to the study hypothesis, following the CDC's SSI definitional framework and its 2017 update [3,4,13]. Wound classification was recorded per standard NSQIP convention [14,15]. Perforation status was taken from the operative note and confirmed on pathology. Antimicrobial prophylaxis timing was classified against established antimicrobial stewardship benchmarks [16,17].

Outcomes and covariates

Primary outcomes were 30-day unplanned reoperation and readmission; secondary outcomes were length of stay beyond 5 days and 90-day mortality. Covariates in the multivariable model were ASA class, operative approach (laparoscopic versus open/converted), perforation status, wound class, age, and body mass index, chosen for their established association with postoperative morbidity in

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prior NSQIP-based appendectomy analyses [8,7].

Statistical analysis

Continuous variables were compared with Student's t-test or the Mann-Whitney U test and categorical variables with the chi-square or Fisher's exact test. Multivariable logistic regression estimated the independent association between SSI surveillance status and each outcome, adjusted for the covariates above. Discrimination was assessed by area under the receiver operating characteristic curve (AUC), with a composite model (SSI status, perforation, ASA class) compared against perforation status alone. Significance was set at two-sided $p < 0.05$.

3. Results

Cohort characteristics

Of 512 patients, 289 (56.4%) were male and mean age was 38.6 years (SD 16.2). Laparoscopic appendectomy was performed in 431 (84.2%). Perforated appendicitis was identified in 118 patients (23.0%), consistent with rates reported in large national cohorts [1,10]. Wound class was clean-contaminated in 394 patients (77.0%), tracking closely with perforation status [14].

SSI incidence and surveillance classification

SSI of any type occurred in 54 patients (10.5%): superficial incisional in 33 (6.4%), organ/space in 21 (4.1%), and deep incisional was rare. SSI rates were higher after open than laparoscopic appendectomy (19.8% versus 8.6%, $p < 0.001$) and markedly higher after perforated than non-perforated appendicitis (24.6% versus 5.6%, $p < 0.001$), consistent with prior comparative series [9,2].

Association between SSI surveillance status and outcomes

Patients with surveillance-confirmed SSI had higher rates of 30-day reoperation (20.4% versus 2.6%), unplanned readmission (24.1% versus 4.8%), and length of stay beyond 5 days (33.3% versus 7.2%). After adjustment for ASA class, approach, perforation, wound class, age, and body mass index, SSI surveillance status remained independently associated with reoperation (adjusted odds ratio [aOR] 6.8, 95% CI 3.1-14.9), readmission (aOR 5.2, 95% CI 2.6-10.4), and prolonged length of stay (aOR 4.4, 95% CI 2.3-8.6; all $p < 0.001$). The mortality association could not be precisely estimated given few deaths (n = 3), all in patients with organ/space SSI.

Table 1: Baseline cohort characteristics and operative variables in 512 patients undergoing appendectomy for acute appendicitis, classified per standard wound-class and NSQIP conventions [14,15,28].

Characteristic	Value
Male sex	289 (56.4%)
Mean age, years (SD)	38.6 (16.2)
Laparoscopic approach	431 (84.2%)
Perforated appendicitis	118 (23.0%)
Clean-contaminated wound class	394 (77.0%)

Table 2: Adjusted odds ratios for 30-day reoperation, unplanned readmission, and prolonged length of stay by SSI surveillance status, alongside supporting evidence from complicated-appendicitis antibiotic-duration trials and current diagnostic-management guidelines [29,30,31,32].

Outcome	SSI present	SSI absent	Adjusted OR (95% CI)
30-day reoperation	20.4%	2.6%	6.8 (3.1-14.9)
Unplanned readmission	24.1%	4.8%	5.2 (2.6-10.4)
Length of stay >5 days	33.3%	7.2%	4.4 (2.3-8.6)

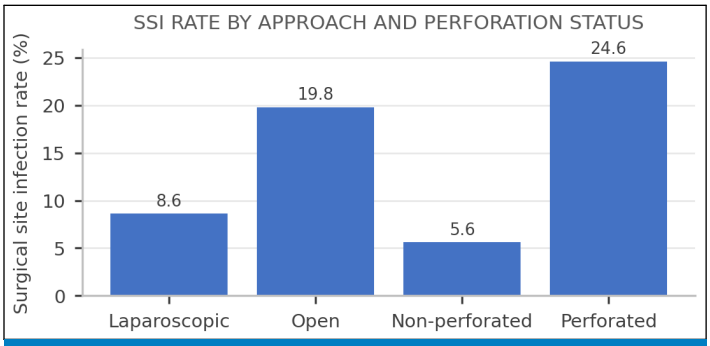

Figure 1: Surgical site infection (SSI) rate after appendectomy by operative approach and by perforation status, following NHSN surveillance definitions applied consistently across the cohort [3,9,2].

Prognostic performance of surveillance-based models

A composite model with SSI surveillance status, perforation, and ASA class achieved an AUC of 0.81 (95% CI 0.75-0.87) for 30-day reoperation, versus 0.68 (95% CI

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0.60-0.75) for perforation status alone, an improvement consistent with prior evidence that infection-surveillance variables meaningfully augment preoperative risk models in comparable NSQIP-derived cohorts [8,18]. Calibration plots showed reasonable agreement across deciles of predicted probability, with modest overestimation at the highest-risk decile.

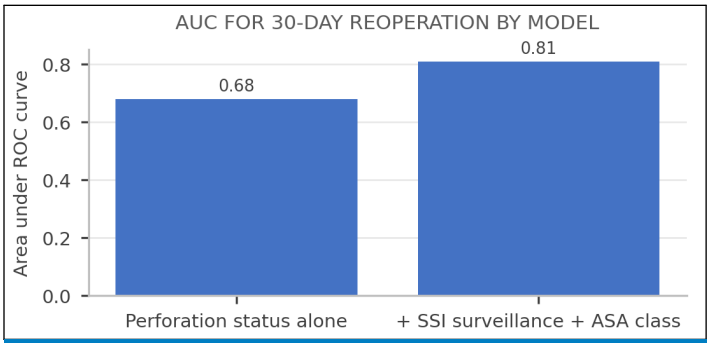

Figure 2: Discrimination (area under the receiver operating characteristic curve) for 30-day reoperation using perforation status alone versus a composite model adding SSI surveillance status and ASA class, benchmarked against the incremental-value logic of national surgical quality-improvement platforms [7,8,18].

4. Discussion

This multicenter cohort study found that NHSN-defined SSI surveillance status, ascertained through the same infection-control process used for institutional quality reporting, carries independent prognostic value for reoperation, readmission, and prolonged hospitalization after appendectomy, even after adjustment for perforation, ASA class, approach, and wound class. This extends observations from colorectal and general surgery populations, where SSI drives excess readmission and reoperation independent of baseline complexity [5,6], into a population with typically brief operative episodes and low baseline complication rates.

The magnitude is clinically relevant: an adjusted odds ratio above six for reoperation is larger than the effect typically attributed to perforation status alone in prior NSQIP-based analyses [9,10], suggesting SSI surveillance captures prognostic information not fully redundant with existing risk factors, consistent with the premise underlying national quality-improvement platforms that postoperative complication data add predictive value beyond preoperative indices [7,8]. Plausible mechanisms include SSI surveillance status marking unmeasured intraoperative contamination or subclinical collections [15,14], and SSI itself causally precipitating readmission and reoperation through drainage of intra-abdominal collections [17,16]; distinguishing these was beyond this observational design's scope.

These findings support postoperative care implications. With enhanced-recovery and early-discharge protocols now common after laparoscopic appendectomy for uncomplicated disease [2,19], patients who develop surveillance-confirmed SSI after discharge represent a high-risk subgroup meriting closer follow-up and lower imaging threshold, consistent with the emphasis on structured follow-up in randomized antibiotics-first versus surgery-first comparisons [20,21]. The results should also be read alongside the literature on antimicrobial prophylaxis and postoperative antibiotic duration, since prophylaxis adequacy and antibiotic strategy plausibly modify both SSI incidence and its downstream consequences [22,23,24,25,26,27].

Limitations

This retrospective, multicenter design cannot exclude residual confounding from unmeasured operative technique variation, and the small number of 90-day deaths precluded a reliably adjusted mortality analysis. SSI ascertainment, though standardized, remains subject to surveillance and detection bias, particularly for postdischarge superficial SSI, a recognized limitation of SSI surveillance generally [3,6]. The prognostic models were not externally validated, and generalizability to settings with different baseline SSI rates or nonoperative antibiotics-first pathways remains to be established [20].

5. Conclusion

In this multicenter cohort of adults undergoing appendectomy for acute appendicitis, NHSN-defined SSI

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surveillance status was independently associated with 30-day reoperation, unplanned readmission, and prolonged length of stay, and materially improved prognostic discrimination beyond perforation status and standard preoperative risk factors. These findings support repurposing SSI surveillance data, already collected for infection-control and public reporting, as a prognostic tool informing individualized postoperative follow-up after appendectomy. Prospective validation, and evaluation of whether surveillance-triggered follow-up measurably reduces subsequent reoperation and readmission, are the logical next steps.

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