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Utilization of a Dual Surveillance Program to Reduce Surgical-site Infections

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Abstract

Background: Surveillance plays a pivotal role in the surgical-site infections (SSIs) prevention through identifying infections, monitoring changes in infection rates, and evaluating the effectiveness of intervention strategies. **Methods:** This retrospective study reviewed SSI surveillance systems implemented at the Children's National Health System in 3 phases between 2007 and 2016 including all surgical procedures. The targeted surveillance was conducted in cardiovascular, spinal fusion, and ventricular shunt surgeries and required an infection preventionist (IP) to review all procedures, to identify SSIs that meet the CDC's National Healthcare Safety Network definition. SSIs in the remaining surgical procedures were identified through the review of positive microbiology reports daily and followed by full chart review if the specimen type and/or patient location were suggestive of a surgical history. Timely feedback of SSI to stakeholders was the primary mode of intervention, with additional interventions implemented for the 3 targeted surveillance procedures. Data collected between 2013 and 2016 were analyzed to account for a definition change in 2013. **Results:** For the 3 targeted surveillance procedures, IP reviewed 2,255 procedures and identified 43 SSIs. For the remaining procedures, IPs identified 123 SSIs confirmed by one or more pathogens. The overall SSI rate had a 31% decrease. The cardiovascular and spinal fusion SSI rate had a 61% and 84% decrease, respectively. The ventricular shunt SSI rate increased 29% due to 2 episodes of recurrent infections in 2 patients. **Conclusions:** It is prudent for hospitals to continue monitoring SSI by establishing surveillance programs with optimal approaches. *(Pediatr Qual Saf 2018;3:e121; doi: 10.1097/pq9.0000000000000121; Published online October 31, 2018.)*

INTRODUCTION

Surgical-site infections (SSI) are one of the most common healthcare-associated infections in the United States.[1,2] An estimated 1 to 3 out of 100 patients undergoing surgery may develop an SSI, and in 2011 alone, 157,500 SSIs occurred among patients admitted for inpatient surgery.[2,3] Pediatric SSIs refer to those infections that occur in patients undergoing a surgical procedure in pediatric units within general hospitals or in free-standing children's hospitals. In 2011, the pediatric SSI rate was estimated to be 1.8%.[4] These infections harm patients and pose detrimental impacts on families by prolonging the length of hospital stay, causing additional medical costs, affecting the quality of life, and jeopardizing patients' lives.[5–7] The mortality rate among patients with an SSI is 3%, with 75% of these deaths are directly attributable to an SSI.[8]

As 1 study estimates, 55% of SSIs were preventable with current evidence-based strategies.[9] Data from the Centers for Disease Control and Prevention National Healthcare Safety Network (NHSN) demonstrated that SSI rates in 10 selected surgical procedures decreased by 19% between 2008 and 2013, after hospitals were motivated to prevent SSIs in response to the public reporting of SSI rates and financial incentives provided to hospitals with lower SSI rates.[10] Pediatric hospitals participating in the Solution for Patient Safety national hospital engagement network have demonstrated successes in the SSI prevention and reported a 21% reduction in SSI rate within 6 months after implementing a bundle of preventive measures across network hospitals.[11]

Surveillance serves as a fundamental tool to measure the burden of disease and successes in the prevention effort. It consists of systematic and ongoing data collection, management, analysis, and interpretation, followed by dissemination to stakeholders such as surgeons.[12,13] Though a robust surveillance system is critical for improving patient outcomes, it may also be resource consuming, and thus warrants careful consideration when

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defining areas in which to implement a surveillance program. Traditionally, the Infection Prevention and Control program (IPCp) in a hospital relies on local epidemiological data to select surgical procedures that are considered to be high risk, high impact, and high volume ("3H") for targeted surveillance. This approach, however, has to be adjusted in the present setting when regulatory agencies mandate hospitals and/or when Infection Prevention is requested by hospital administration to provide surveillance data for externally predefined procedures.[14] In light of this paradigm shift, this study was conducted to understand the value of each surveillance approach and described a longitudinal process that defined discrete surgical procedures for surveillance, established intervention measures, and assessed the effectiveness of the program in the environment with limited resource allocation.

METHODS

This study took place at Children's National Medical Center, a 313-bed freestanding pediatric tertiary care hospital in the District of Columbia that offers general, tertiary, and quaternary critical care and surgery services to pediatric patients. Each year, we perform approximately 14,000 surgical procedures in the 20 operating rooms located on the main campus and an ambulatory surgical center.

Since 2007, the IPCp at the Children's National Medical Center has implemented SSI surveillance in all surgical procedures with 3 phases. Phase I began in 2007 and only included cardiovascular (CV) surgeries based upon the "3H" selection criteria. This surveillance generated SSI rates that have been used to measure the quality of care and the effectiveness of preventive measures. Phase II began in January 2012 and included spinal fusion and ventricular shunt procedures. This surveillance was to fulfill a requirement defined by Solutions for Patient Safety (Cincinnati, Ohio), a national collaborative network that the institution had joined. Phase III began in July 2013 and included all of the remaining procedures. This decision was based on a risk assessment conducted by infection preventionists (IPs). Of the surgical procedures performed between January 2013 and March 2013, we randomly selected 10% procedures for chart review and categorized each procedure as an SSI or non-SSI using the NHSN definition. Subsequently, we continued the SSI surveillance by focusing on deep and organ space SSIs with the goal to reduce SSI-associated hospital readmissions or emergency department (ED) visits.

Limited by the resources available, we utilized 2 methods to conduct the SSI surveillance. We first employed targeted surveillance method in CV, spinal fusion, and ventricular shunt procedures and had IPs to review all procedures to identify infections that met the NHSN SSI definition. The surveillance for the remaining procedures was conducted by IPs to review microbiology culture results daily. Based upon the patient's location and specimen type, IPs identified the individuals with infection suggestive of a surgical history and proceeded with a full chart review to determine the SSI status.

Systematic and timely feedback was the primary intervention strategy for all procedures. Immediately after IP identified an SSI, IP was responsible for notifying the primary surgeon and Service Chief and encouraged the surgeon to recall any possible missed opportunities that might have contributed to the SSI. IPs then informed perioperative leaderships, including anesthesiologist and nursing staff, who tracked SSI incidents using a quality scoreboard. During the monthly perioperative Performance Improvement Quality Safety committee, attendees representing services including but not limited to anesthesiology, perioperative nursing, environmental services, and infection prevention discussed individual SSI case as well as the trend in infection rate. As appropriate, attendees also discuss intervention opportunities and monitor progress.

Additional intervention measures were instituted for CV, spinal fusion, and ventricular shunt procedures. These interventions included preoperative bathing with chlorhexidine impregnated cloth (CV and spinal fusion procedures) and monitoring staff compliance with the preoperative antibiotic prophylaxis administration timing and dosing.

The IPCp maintained the database that included a line list of SSI cases, infection-related readmissions or ED visits, number of procedures, and compliance with preoperative chlorhexidine bathing and antibiotic prophylaxis administration. In 2013, the CDC implemented a significant change in the NHSN definition of an SSI. Thus, we only collected and analyzed data from January 2013 through December 31, 2016, for consistency.

RESULTS

Between 2013 and 2016, IPs identified 43 SSIs by reviewing a total of 2,255 procedures encompassing 1,172 CV, 464 spinal fusions, and 619 ventricular shunt procedures. The SSI rate per 100 procedures decreased in CV by 61% from 3.5 in 2013 to 1.4 in 2016 ($P = 0.12$) and in spinal fusion by 84% from 5.5 in 2013 to 0.9 in 2016 ($P = 0.07$). The SSI rate in ventricular shunt procedures increased from 1.7 in 2013 to 2.2 in 2016 ($P = 1.00$), as a result of 2 episodes of recurrent infections in 2 patients in 2016 (Fig. 1).

The risk assessment conducted between January 2013 and March 2013 revealed 4 SSIs, resulting in an estimated overall rate of 1.7 per 100 procedures. However, the infection rate in gastrointestinal procedures was 6.5%. One patient required hospital readmission, while another patient visited the ED twice for wound management. Between January 2014 and December 2016, IPs identified 123 SSIs confirmed by one or more pathogens, which resulted in an overall infection rate of 0.28 in every 100 surgical procedures except for CV, spinal fusion, and

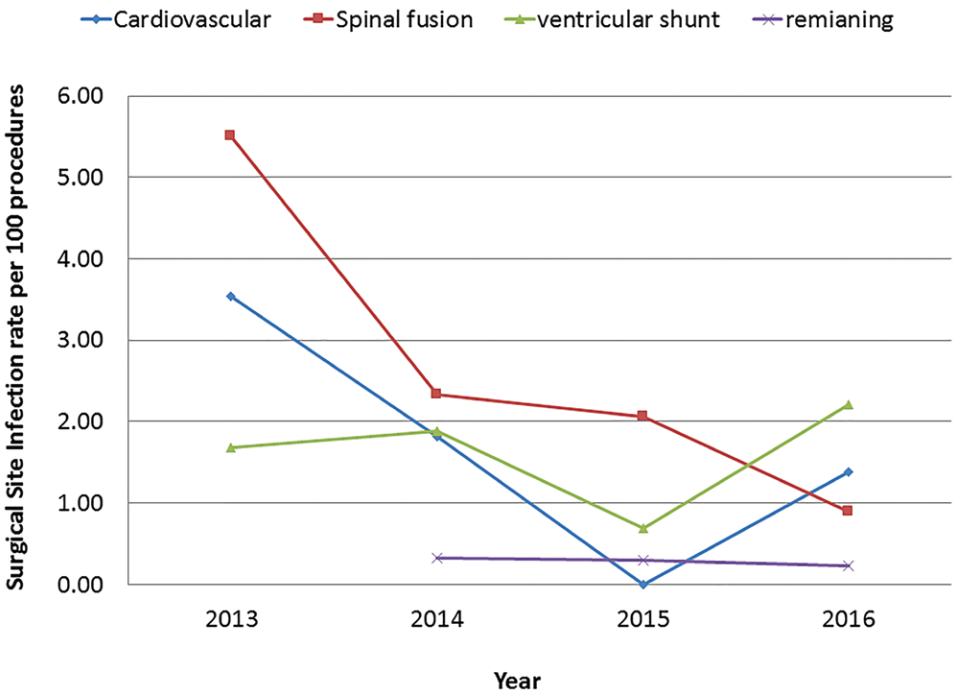

Fig. 1. Surgical site infection rate by procedure, 2013–2016.

ventricular shunt procedures. Of these patients with an SSI, 66 (54%) required a hospital readmission with an additional 9 (7%) patients who visited an ED at least once for wound management. The infection rate was decreased by 31% from 0.33% in 2014 to 0.23% in 2016. Of note, the number of SSIs decreased consecutively from 48 in 2014, 43 in 2015, to 32 in 2016 (Fig. 1).

DISCUSSION

Facing the increased demands for improving patient safety and care quality by reducing healthcare-associated infections including SSIs, surveillance efforts must be balanced to satisfy the regulatory requirement and/or administration requests, and to respond to immediate risks as identified by institutional risk assessments. Challenged by limited resources, an IPCp is obligated to strategically select the surveillance area as well as a method to meet all requirements. In this study, SSI surveillance was used as an example to demonstrate the process of defining a goal and an objective, selecting surveillance methods, instituting interventions, and assessing the effectiveness of surveillance and intervention measures.

This longitudinal study described 2 distinctive approaches to the detection and prevention of SSIs in all procedures. Targeted surveillance was the first approach and was employed in procedures that met the "3H" feature for performance improvement purposes and administrative reporting purposes. This approach focused on individual procedures and required IPs to review over 2,000 medical charts to identify the 43 cases that met the SSI definition. The majority of cases were identified in 2013 when the surveillance began. Interventions were subsequently instituted and were successful to reduce the infection rate by 61% and 84% in CV and spinal fusion surgeries, respectively. Our experience reflects the success of the Solution for Patient Safety national hospital engagement network, through which hospitals are provided tools to institute and maintain the best practices.[15]

In contrast to the targeted surveillance, we used microbiology testing results to trigger the identification of SSIs in all remaining procedures. We initiated this surveillance based upon findings from an institutional risk assessment. This surveillance encompassed a broad range of procedures but focused on infections that were highly detrimental and costly to patients and healthcare systems. This approach involved fewer charts to review but still enabled IPs to detect and respond to unusual infection patterns and engage stakeholders in SSI prevention activities.

These 2 methods complemented each other and targeted infections with outcomes that may lead to hospital readmissions or returns to the operating room.[16] On the other hand, the 2 approaches had their distinct advantages and disadvantages. As CDC has outlined, targeted surveillance is a comprehensive approach and requires continuous monitoring of all patients for all events and/or procedures. It is suitable for surveillance activities in clearly defined procedures. However, its benefit, as measured by the number of infections detected in relevant to resources needed, may vary by the disease incidence.

On the other hand, surveillance based on microbiology culture results detected a high number of infections with relatively fewer resources. Nevertheless, this approach relied on IP's experience and vigilance to identify the

patient that warranted full chart review and may suffer inconsistency in the case finding. This approach is suitable for assessing overall infection risks and identifying areas that could benefit from more intensive surveillance and intervention. In addition to these traditional surveillance methods, we find it noteworthy to mention electronic surveillance. It uses a combination of parameters including but not limited to administrative claim data, antibiotic prescription data, and readmission data to detect SSIs. This method has been validated and proved sensitive and less costly in selected adult patient procedures,[17–19] but its application in pediatric patients remains to be defined.

It is of note that our institution has benefited from using the risk assessment to define surveillance activities. Risk assessment in healthcare settings is a process that systematically assesses the range of risk the institution faces, the level of ability to mitigate these risks, the likelihood for the risk to occur, and their potential impacts. By accounting for these elements using a weighted scoring system, risk assessment generates a priority scoring for each risk to aid the selection of priority areas that would require attention and resources to address. Besides this single institution–based risk assessment approach, the American College of Surgeons National Surgical Quality Improvement Program Pediatric program has offered a multi-institutional, multi-specialty program to address surgical quality improvement for children since 2008. The program uses a sampling strategy tailored to children to determine an SSI rate first in the sample patient population and then the entire cohort of patients undergoing the same procedure in the institution.[20] The SSI rates are standardized and risk-adjusted.[4] Thus, rates are comparable across institutions and useful to identify procedures with high SSI rates that warrant further attention.

As a single site retrospective study, our dual surveillance approach has limitations such as small sample size and lack of generalizability. Nonetheless, findings from this study underscore the important role that surveillance can play in preventing SSIs and contribute to the current literature that supports surveillance and prompt intervention activities.[16,21] As hospitals continue to strive for high quality and safety of patient care, it is prudent for hospitals to consider mixed approaches and to enhance abilities for early identification and remediation of infection risks.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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