



A novel approach to leveraging electronic health record data to enhance pediatric surgical quality improvement bundle process compliance



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ABSTRACT

Purpose: Quality improvement (QI) bundles have been widely adopted to reduce surgical site infections (SSI). Improvement science suggests when organizations achieve high-reliability to QI processes, outcomes dramatically improve. However, measuring QI process compliance is poorly supported by electronic health record (EHR) systems. We developed a custom EHR tool to facilitate capture of process data for SSI prevention with the aim of increasing bundle compliance and reducing adverse events.

Methods: Ten SSI prevention bundle processes were linked to EHR data elements that were then aggregated into a snapshot display superimposed on weekly case-log reports. The data aggregation and user interface facilitated efficient review of all SSI bundle elements, providing an exact bundle compliance rate without random sampling or chart review.

Results: Nine months after implementation of our custom EHR tool, we observed centerline shifts in median SSI bundle compliance (46% to 72%). Additionally, as predicted by high reliability principles, we began to see a trend toward improvement in SSI rates (1.68 to 0.87 per 100 operations), but a discrete centerline shift was not detected.

Conclusion: Simple informatics solutions can facilitate extraction of QI process data from the EHR without relying on adjunctive systems. Analyses of these data may drive reductions in adverse events. Pediatric surgical departments should consider leveraging the EHR to enhance bundle compliance as they implement QI strategies.

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Surgical site infections (SSI) persist as a significant source of preventable morbidity across pediatric surgical departments [1–3]. Successful national collaboration among children's hospitals has resulted in the identification and dissemination of evidence-based best practices, or "bundles", for preventing SSI [4,5]. Modern improvement science and high-reliability principles predict that measurable and sustainable reductions in adverse events will occur when institutions achieve >95% compliance with nationally-validated quality improvement (QI) bundles [6–8]. However, due to variation in personnel, expertise, culture and finances, individual institutions must develop local mechanisms for executing successful compliance audits of their QI bundles. Manual chart review, unit-based rounding, observation checklists, and electronic health record (EHR) documentation represent some of the various approaches employed to measure QI process compliance [9–11].

Abbreviations: QI, quality improvement; SSI, surgical site infection; EHR, electronic health record; SPS, Solutions for Patient Safety.

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Given their ubiquity and comprehensive integration into patient care workflows, modern EHR systems represent an ideal resource to leverage for QI process reporting [12]. However, deploying an EHR-based tool to specifically measure SSI bundle compliance has several unique challenges: (a) SSI prevention bundle elements target multiple patient microenvironments (i.e., outpatient clinic, preoperative testing, intra-operative care, etc.); (b) the EHR does not readily compile data for a single patient across multiple encounters or visits; and (c) several elements of the SSI prevention bundle do not clearly correspond to a discrete point of documentation in the EHR. Thus, while institutions may utilize their EHR for select aspects of SSI bundle auditing, complete analysis of QI process compliance may require use of ancillary tracking systems, manual paper auditing, and/or laborious chart reviews. Such inefficiencies may limit the total number of cases that can be audited in a given reporting period, thereby prompting some degree of random-sampling and data extrapolation to estimate bundle compliance for the target population. Taken together, these limitations motivated us to develop a custom EHR tool to facilitate the timely, high-volume capture of our process data for SSI prevention, with the aim of increasing bundle compliance and reducing adverse events.

Table 1
Institutional Pediatric SSI Prevention Bundle.

PreOp Call – Were chlorhexidine wipes received?
Chlorhexidine Wash (Night Before Surgery)
Chlorhexidine Wash (Morning of OR)
PreOp MRSA Screening Nasal Swab
PreOp Nasal Decolonization
IntraOp Hair Removal
IntraOp Skin Prep
IntraOp Antibiotic Timing
IntraOp Antibiotic Type
IntraOp Antibiotic Dose and Redosing

1. Methods

Our institutional pediatric SSI prevention bundle (Table 1) was adapted from the nationally-validated, evidence based elements provided by the Solutions for Patient Safety (SPS) collaborative network [5,13]. We then paired each item in the SSI bundle with a discrete element of documentation within the institutional EHR (Epic Clinical Systems, Verona, WI). For those bundle elements which lacked a corresponding data placeholder in the EHR, we created new discrete data entry fields to facilitate their electronic documentation. The select EHR data elements were then aggregated as a panel of print groups that could be assembled into a single, visually-concise display (Fig. 1).

We aligned our target audit population with the cohorts most consistently identified in national SSI prevention efforts [14–16], and as defined by the SPS guidelines [4,17]. All children at our institution aged 18 years or younger who underwent open-chest cardiac surgery, spine surgery with hardware implantation, or manipulation of a ventricular cerebrospinal fluid shunt between June 1, 2013 to February 28, 2015 were identified using a customized business-object report within the EHR. The case selection achieved through this report was validated

against individual surgeon operative logs as supplied by their respective surgical departments. The print group display template was then superimposed onto this monthly surgical case list, allowing a single auditor (a nurse or physician member of the Children’s Services SSI prevention committee) to rapidly review every case that met national SSI reporting criteria for bundle compliance. Implementation of our EHR-based audit tool began on June 1, 2014. Prior to this, bundle compliance was assessed through a manual review of individual records for patients in the reporting cohort. Validation of data retrieved by the customized EHR tool was performed through manual chart review over the first three months of its implementation.

Our process compliance rates were reported to SPS on a monthly basis, and benchmarked against network hospitals. At the institutional level, process and outcome data were also analyzed monthly by a central committee, and then distributed back to individual clinical units for their own review. Areas of persistent process noncompliance triggered targeted educational efforts to focus on deficiencies in SSI bundle performance.

SSI events were defined using diagnostic criteria established by the Centers for Disease Control and Prevention National Healthcare Safety Network [18]. These occurrences were captured through a variety of internal reporting mechanisms: surgeon self-reporting, identification by pediatric hospitalists and intensivists, monitoring of microbiology lab culture results for pediatric patients, and administrative surveillance of billing and diagnosis codes. SSI events were reported to SPS on a monthly basis, as well as to other compliance agencies (i.e., Society of Thoracic Surgeons, American College of Surgeons, New York State Department of Health, etc.). Following identification of an SSI event, a focused and brief apparent cause analysis (ACA) was triggered according to standardized institutional Children’s Services methodology, and a detailed review of the case was performed with the involved surgeon and members of the SSI prevention team. A report of those findings is

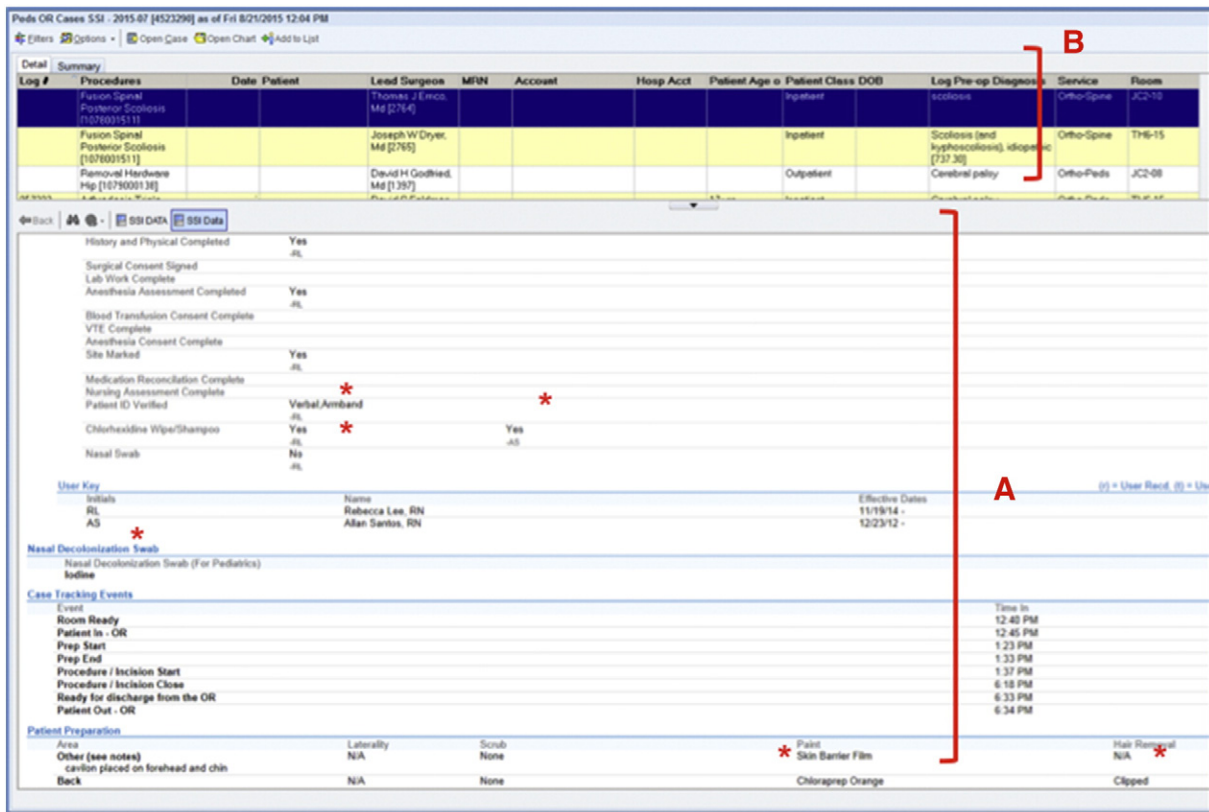


Fig. 1. SSI prevention report linked to target audit case-log within the EHR. (A) The print group display template contains discrete data for all ten bundle elements; the screen-capture scrolling limits rendered only 6 bundle elements (*) visible in this example. (B) The SSI report is dynamically superimposed onto the monthly surgical case list, allowing a single auditor to simply scroll down the list and rapidly review every bundle element in every case that met national SSI reporting criteria.

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