A comparison of two quality measurement tools in pediatric surgery—The American College of Surgeons National Surgical Quality Improvement Program-Pediatric versus the Agency for Healthcare Research and Quality Pediatric Quality Indicators☆,☆☆

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ABSTRACT

Background/Purpose: Identifying quality in pediatric surgery can be difficult given the low frequency of postoperative complications. We compared postoperative events following pediatric surgical procedures at a single institution identified by ACS-NSQIP Pediatric (ACS NSQIP-P) methodology and AHRQ Pediatric Quality Indicators (AHRQ PDIs), an administrative tool.
Methods: AHRQ PDI algorithms were run on inpatient hospital discharge abstracts for 1257 children in the 2010 to 2013 ACS NSQIP-P at our institution. Four events—pulmonary complications, postoperative sepsis, wound dehiscence and bleeding—were matched between ACS NSQIP-P and AHRQ PDI.
Results: Events were identified by ACS NSQIP-P in 7.9% of children and by AHRQ PDI in 8.0%. The four matched events were identified in 5.5% and 3.7%, respectively. Specificities of AHRQ PDI ranged from 97% to 100% and sensitivities from 0 to 2%. The largest discrepancy was in bleeding, where AHRQ PDI captured 1 of the 54 events identified by ACS NSQIP-P. None of the 41 pulmonary, sepsis, and wound dehiscence events identified by AHRQ PDI were clinically relevant according to ACS NSQIP-P.
Conclusions: Adverse events following pediatric surgery are infrequent; thus, additional measures of quality to supplement postoperative adverse events are needed. AHRQ PDIs are inadequate for assessing quality in pediatric surgery.

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In today's healthcare system there is considerable focus on quality improvement and reduction of adverse events that negatively impact patients' health and quality of life. This has resulted in the development of numerous tools to identify quality health care delivery. A particularly intensive effort has been directed at evaluating surgical care. These tools typically allow for benchmarking of outcomes between institutions and providers to facilitate identification of areas of concern and allocate resources to enable focused improvement. Increasingly, these quality measurements are being tied to reimbursement and are becoming transparent to the public to assist their choice of where to seek care. Given the substantial and broad implications of these tools, it is important to assess their effectiveness in accurately identifying the quality of surgical care, including pediatric surgery.

Describing quality outcomes in pediatric surgery can be difficult given the low volume of pediatric operative cases compared to adults and the low frequency of postoperative complications. Different stakeholders have developed several measures of pediatric surgical quality utilizing different methodologies. In 2006, the Agency for Healthcare Research and Quality (AHRQ) released the Pediatric Quality Indicators (AHRQ PDIs), which are a set of computer algorithms that identify adverse events from International Classification of Diseases 9, Clinical Modification (ICD-9-CM) diagnosis codes in hospitalized patients' discharge abstracts [1]. Fifteen of the 20 AHRQ PDIs are hospital-level quality and safety indicators, which identify complications in hospitalized patients through secondary ICD-9-CM codes for conditions not present on admission. AHRQ PDIs were a welcomed addition to the armamentarium of those seeking

to improve quality of care for hospitalized children at a time when few tools existed [2]. The AHRQ PDIs were found to be predictive of poor outcomes including mortality and increased length of stay [3]. In contrast, the American College of Surgeons National Surgical Quality Improvement Project–Pediatric (ACS NSQIP-P) is a clinically-derived tool that uses independent data abstractors adhering to a nationally recognized set of standards to track outcomes in pediatric surgery. Following the success of the Veterans Affairs NSQIP and adult NSQIP, ACS NSQIP-P was started in 2008 [4].

There are several causes for concern, however, in using AHRQ PDI for "comparative public reporting, trending, and pay-for-performance initiatives" [1]. First, the adverse events identified by AHRQ PDI are sufficiently rare that comparison between hospitals is often hindered by the low event rate and relatively small volume of pediatric patients [5]. Second, the events that are identified were often not preventable [6]. Finally, in adult surgical patients, the applicable AHRQ quality measures were found to have poor sensitivity for identifying clinically significant postoperative complications reported by ACS NSQIP [7]. The purpose of this study, therefore, was to compare identification of postoperative adverse events in pediatric surgical patients using the administratively based AHRQ PDI and the clinically-derived ACS NSQIP-P at a single academic institution. We hypothesized that similar to the adult surgical patient population the AHRQ PDI would not be sensitive or accurate measures of postoperative complications in children.

1. Methods

1.1. Data sources and patient selection

Following institutional review board approval of this study, we utilized two sources of data to study children <18 who underwent an inpatient surgical procedure at our Midwest, academic institution from 2010 to 2013: the ACS NSQIP-P and AHRQ PDI derived from patients' billing data.

The ACS NSQIP-P was developed following the success of the ACS NSQIP in evaluation of adult surgical outcomes. Similar to the adult ACS NSQIP, NSQIP-P includes information regarding patient demographics, preoperative clinical information, operative and anesthesia information, and postoperative 30-day outcomes including complications. ACS NSQIP-P also includes detailed information about infant prematurity, birth weight, and congenital anomalies. The ACS NSQIP-P data are entered by dedicated, trained nurse abstractors based upon direct chart review. A standardized, random monthly sampling process is used to identify children who underwent general, thoracic, plastic, ENT, orthopedic, urologic, and neurosurgical procedures. ACS NSQIP-P has been validated in the literature [4,8,9].

The AHRQ PDI are a set of computer-based algorithms run on secondary ICD-9-CM diagnosis codes for all inpatient pediatric admissions to identify complications. They have been previously validated in the literature as able to identify adverse events [3,6,10] and are used by the Department of Health and Human Services to follow trends in hospital quality [11]. Each AHRQ PDI has a set of exclusion ICD-9-CM codes to prevent identification of conditions that were present on admission as in-hospital complications.

1.2. Study design and analysis

We applied the AHRQ PDI algorithms, version 4.5, with their exclusion codes to all children at our institution who were sampled in the ACS NSQIP-P for an inpatient surgical procedure. We excluded the following AHRQ PDIs that were not relevant to postoperative adverse events: pediatric heart surgery volume and mortality, asthma admission, diabetes short-term complication admission, gastroenteritis admission, perforated appendix admission, and urinary tract admission. Four adverse events could be matched between ACS NSQIP-P and AHRQ PDI: pulmonary complications, wound dehiscence, postoperative sepsis and bleeding (Table 1). Identification of these events was compared between ACS NSQIP-P and AHRQ PDI. Positive predictive value and sensitivity were calculated for each of the four AHRQ PDI, using ACS NSQIP-P as the clinical gold standard for identification of postoperative adverse events. The medical records of patients with discordant identification of postoperative adverse events between ACS NSQIP-P and AHRQ PDI were manually reviewed to determine the reason for discordance.

2. Results

AHRQ PDIs were applied to the billing data for 1257 children in ACS NSQIP-P at our institution who underwent an inpatient surgical procedure during the study period. The mean (range) age was 8.2 (0–17), 2.5% were neonates, and 47.0% were female. General pediatric surgery and thoracic procedures were most frequent (41.2%) followed by orthopedic procedures (23.8%). A postoperative adverse event was identified by ACS NSQIP-P in 7.9% of patients and by AHRQ PDI in 8.0%. The four matched categories had events which were identified in 5.2% of children using ACS NSQIP-P and 3.7% of children using AHRQ PDIs. Demographic characteristics and postoperative events in ACS NSQIP-P and AHRQ PDI by specialty are shown in Table 2.

Only one patient had an adverse event identified by both ACS NSQIP-P and the corresponding AHRQ PDI—bleeding (Table 3). An additional 53 patients had postoperative bleeding according to ACS NSQIP-P that was not identified by the corresponding AHRQ PDI, while 4 patients had postoperative bleeding according to the AHRQ PDI that was not identified as clinically significant by ACS NSQIP-P. This was similar for pulmonary complications. None of the 4 clinically significant pulmonary complications identified by ACS NSQIP-P met the criteria for the associated AHRQ PDI and none of the 40 patients identified by the AHRQ PDI had a clinically significant pulmonary complication in ACS NSQIP-P. Thirteen patients, however, met the AHRQ PDI criteria for a postoperative pulmonary complication of ventilation for ≥4 days using the ACS NSQIP-P variable for duration of ventilation. Nine of these patients (69.2%) were also identified as having a postoperative pulmonary complication by AHRQ PDI. Wound dehiscence and postoperative sepsis were rare according to both methodologies. Because of the low

Table 1
Definitions of corresponding events in ACS NSQIP-Pediatric and AHRQ PDI.

Postoperative adverse event	ACS NSQIP-P	AHRQ PDI (1)
Pulmonary complications	Postoperative pneumonia Unplanned reintubation Pulmonary embolism	Postoperative respiratory failure[a]
Wound dehiscence	Postoperative wound disruption	Postoperative wound dehiscence
Postoperative sepsis	Postoperative sepsis	Postoperative sepsis[b]
Bleeding	≥25 mL/kg of packed or whole red blood cells given within postoperative 72 hours	Perioperative hemorrhage or hematoma[c]

ACS NSQIP-P = American College of Surgeons National Surgical Quality Improvement Project–Pediatric. AHRQ PDI = Agency for Healthcare Research and Quality Pediatric Quality Indicators.
[a] Includes postoperative mechanical ventilation ≥96 consecutive hours or ≤96 consecutive hours ≥2 days from the procedure, or reintubation ≥1 day(s) after procedure.
[b] Excludes hospitalization <4 days.
[c] Excludes patients with coagulation disorder or existing hematoma, hemorrhage, or related procedure prior to index procedure.