



Practice Management: Surgical Education

## Perioperative Harm Index facilitates prioritization of improvement initiatives☆

Jessica Cronin<sup>\*</sup>, Eugenie Heitmiller, Rahul K. Shah

<sup>a</sup> Children's National Medical Center, Washington, DC

<sup>b</sup> George Washington University School of Medicine, Washington, DC



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### ABSTRACT

**Introduction:** Perioperative services constitute a significant portion of the care delivery, the impact, and the potential risk in healthcare organizations. Tremendous attention has been paid towards hospital-acquired conditions; however perioperative services have not received similar attention. There is a need for a standardized manner to report on conditions in perioperative services which facilitates prioritization of quality improvement initiatives.

**Materials and methods:** Preventable harm and quality of care indicators were selected based on a review of the literature and available datasets, as well as from safety and quality measures in our organization. Metrics were derived from myriad national quality improvement initiatives and collaboratives. A structure was created to obtain the metrics in a near real-time manner and present the Perioperative Harm Index across the organization. Specific initiatives were targeted as necessitating immediate, short-term, or longer duration prioritization for improvement initiatives.

**Results:** A Perioperative Harm Index was created using 11 metrics that represent the spectrum of surgical care. The metrics facilitate prioritization of improvement initiatives and have resulted in improvement projects including perioperative normothermia in neonatal intensive care unit patients having procedures in the operating room, reduction of post-operative nausea and vomiting, and decrease in surgical site infections in selected procedures.

**Conclusions:** A Perioperative Harm Index facilitates immediate shared understanding of the harm resulting from the care of surgical patients. As such, this index enables rapid and rationale prioritization for improvement activities. Our harm index is shared, is broadly generalizable, and has facilitated prioritization of improvement opportunities and appropriate allocation of improvement resources at our organization.

**Levels of Evidence:** Level V.

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In most hospitals, the past decade has seen marked efforts in the realm of quality improvement and patient safety, which have been a result of intentional leadership. [1] Tremendous work has been targeted towards hospital-acquired infections and hospital-associated conditions. [2] These efforts have appropriately focused on areas such as the intensive care units, emergency departments, and in-patient wards. Although much of the revenue (margin) and risk comes from perioperative services, and despite the fact that anesthesia was one of the specialties which led the patient safety and quality improvement era of the past decades, perioperative services is an area that has not received much attention in the peer-reviewed literature with regards to prioritization of quality improvement initiatives. This may be due to

the broad reach of perioperative services and the inherent difficulty in coordinating multiple services and stakeholders to identify improvement opportunities.

In a simplistic sense, “perioperative services” is a broad term that encompasses the patient's journey from decision to have surgery, to the scheduling process and pre-operative preparation, to the actual day of surgery, the intra-operative outcomes, the post-operative phase which includes the recovery room, recovery in the hospital (if necessary) and ultimately at home, with subsequent post-operative visits to close the loop of the surgical encounter. Surgical care constitutes a significant proportion of health care utilization and resources and, as such, is amenable to quality improvement initiatives. [3] The vast reach of perioperative services is perhaps the reason why broad reaching quality improvement initiatives have not specifically targeted prioritization of quality improvement in perioperative services as a macrosystem and thus provides an opportunity for education and research.

In pediatric healthcare, Brill et al. are credited with creating a preventable harm index; this is a dashboard (or matrix) that demonstrates

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\* Corresponding author at: Division of Anesthesiology, Children's National Medical Center, 2nd Floor, Main, 111 Michigan Avenue, NW, Washington, DC 20010.

E-mail address: [jcronin@childrensnational.org](mailto:jcronin@childrensnational.org) (J. Cronin).

the number of events of particular hospital-acquired conditions (adverse drug events, unplanned extubations, hospital-acquired infections, etc.). [4] The brilliance of their sentinel work demonstrated that by creating such an index, tracking, and improving upon these measures, they were able to dramatically improve the safety and quality of care of patients in their hospital. A version of the preventable harm index can now be found across pediatric and adult hospitals in the United States. Building on this novel approach, Brilli's team at Nationwide Children's focused on specific units and conditions and took the preventable harm index one step further with the creation of clinical care indices. [5] This approach has been adopted in several clinical settings and specialties including the emergency department, neurosurgical patient care, and radiology.

This manuscript details our hospital's approach towards tracking and measuring, prioritizing improvement opportunities, and ultimately striving to improve the quality and safety of perioperative services at Children's National Medical Center. We hypothesized that by using a blend of a preventable harm index and clinical care indices, what we refer to as a "Perioperative Harm Index", and advertising this Perioperative Harm Index to front-line staff, that we could prioritize some immediate, short-term improvements in clinical care that we could show now, and ultimately, long-term improvements, which may take years to develop and sustain.

## 1. Material and methods

As this project was designated as a quality improvement initiative, it was not under the purview of our Institutional Review Board at Children's National Medical Center. Preventable harm and quality of care indicators were selected with input from the quality and safety officer of the hospital (author), anesthesiologists, nurses, surgeons, and performance improvement specialists. The metrics were chosen based on a review of the literature, available datasets, as well as from safety and quality measures in our organization (this was compulsory to have alignment with the Perioperative Harm Index and the organizational Zero Harm Index). Specifically, metrics were derived from Wake up Safe (WUS), Merit-Based Incentive System (MIPS), Solutions for Patient Safety (SPS), the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP-Pediatric) and the ACS verification quality improvement program. (Table 1).

A structure was created to obtain the metrics in a near real-time manner and present the Perioperative Harm Index across the unit as well as to hospital leadership in a periodic manner. The Perioperative Harm Index serves as the source of truth with regards to outcomes in these domains. As a result of the Perioperative Harm Index, specific initiatives were targeted as necessitating immediate, short-term, or longer duration prioritization for improvement initiatives.

The framework supporting the Perioperative Harm Index includes hosting the index on our internal, secure servers. The programs used to collate and visualize the data are not more complex than those included in standard applications (e.g. Excel, Microsoft, Redmond, WA).

## 2. Results

In 2017, a Peri-Operative Harm Index was created to include the following measures: perioperative hypothermia in neonatal ICU patients, preoperative antibiotic timing compliance, surgical site infections in targeted procedures, anesthesia STAT calls in the OR and recovery areas, and Rapid Response Team (RRT) calls for episodes requiring escalation of care in postoperative patients on nursing units, postoperative nausea and vomiting in high risk populations, and inadvertent extubations in post-surgical patients (Fig. 1).

The Perioperative Harm Index was shared in various forums such as: our institution's academic symposium for perioperative departments including all surgical specialties, anesthesia department, and nursing staff, in addition to safety and quality committees and hospital leadership

**Table 1**

Referenced safety and quality organizations and data collected processes used for individual quality metrics of perioperative harm index.

Metric	Reference	Data Source / Data Collection Process
Hypothermic and Hyperthermic NICU patients	MIPS	Electronic medical record with NICU nurse review of individual cases Electronic medical record review, NSQIP-Pediatric database, hospital infection control department which tracks all positive bacterial cultures
Surgical site infections and Preop antibiotics	NSQIP-Pediatrics; SPS	Review of intra-hospital communication log which documents when Anesthesia STAT alarms are initiated
Anesthesia STATs in PACU and OR	MIPS, WUS, ACS verification QI program	Data analysis using electronic medical record evaluating use of rescue anti-emetics, patient surveys
PONV in high-risk patients	MIPS WUS, ACS	Review of intra-hospital adverse event log, which documents every RRT event
Rapid Response Teams (RRT) called for perioperative patients	verification QI program, NSQIP-Pediatrics	Review of intra-hospital adverse event log, which documents every inadvertent extubation event and electronic medical record reports
Inadvertent Extubations	ACS verification QI program; SPS	Review of intra-hospital adverse event log which documents all such transfers
Transfers from ambulatory surgical center to main hospital	ACS verification QI program	

MIPS, Centers for Medicare and Medicaid Services' Merit-Based Incentive Payment System; SPS, Solutions for Patient Safety; NSQIP-Pediatrics, American College of Surgeons National Surgical Quality Improvement Program; ACS verification QI program - American College of Surgeons (ACS) Children's Surgery Verification (CSV) Quality Improvement Program; WUS, Wake Up Safe.

meetings. The Perioperative Harm Index was shared periodically from meetings that span internal division meetings, to meetings led by the Surgeon-in-Chief, to board level of quality meetings at the hospital level.

The Perioperative Harm Index was used to help assist the Division of Anesthesiology and Center for Surgical Care to identify and prioritize quality improvement initiatives. Subsets of teams of nurses, physicians, and performance improvement specialists focused on individual quality improvement initiatives. The results of these projects included a reduction in perioperative neonatal hypothermia. In 2016, the incidence of hypothermia ( $T < 36^{\circ}\text{C}$ ) in NICU patients was 10% immediately postoperatively. This variable was reported based on electronic medical records and review of cases by NICU nurses. This metric was then included in the Perioperative Harm Index as a high-priority initiative, which ensured visualization by all levels of organization and ongoing tracking on a near-real time basis. After a team of neonatologists, anesthesiologists, NICU nurses, operating room nurses, and anesthesia technicians implemented interventions, the incidence of neonatal hyperthermia decreased to 3% for the last 6 months of 2017 and this rate has been sustained over 12 months in 2018. The same pattern of successful quality improvement was found in other areas including a decrease in surgical site infections in patients undergoing laparoscopic appendectomy and cardiac procedures, and a reduction in post-operative nausea and vomiting in high-risk surgical patients.

The timeline to prepare the Perioperative Harm Index was approximately six to 9 months and included the following steps: identification of which metrics are being collected at present, identification and coordination with hospital quality leadership to assist in understanding the impact of perioperative services harm within the organization, identification of who will be accountable for the data collection and validation, creation of the dashboard and visualization, socialization of the dashboard to the surgical services, and roll-out of a methodology to identify priorities for improvement.

Table 2 demonstrates prioritization of improvement opportunities in perioperative services at our hospital as a result of having the information



Fig. 1. Perioperative Harm Index.

immediately accessible and visualized on the Perioperative Harm Index. Projects were prioritized based on feasibility of the specific projects, the motivation of subgroups of stakeholders that are involved in the quality improvement effort, and institutional priorities.

**Table 2**  
Improvement opportunities prioritization from the Perioperative Harm Index.

Time Line	Quality Improvement Plan
Immediate	<ul style="list-style-type: none"> <li>• Maintaining normothermia in neonatal intensive care unit patients undergoing procedures in the operating rooms</li> <li>• Reducing post-operative nausea and vomiting in high-risk surgical patients</li> </ul>
Short-Term	<ul style="list-style-type: none"> <li>• Evaluating healthcare disparities in perioperative adverse events</li> <li>• Developing a pain pathway for Nuss procedure</li> <li>• Decreasing case delays due to NPO violations</li> </ul>
Long-Term	<ul style="list-style-type: none"> <li>• Reducing surgical site infections in targeted procedures (cardiac) and non-targeted procedures (laparoscopic appendectomy)</li> <li>• Creating an opioid stewardship program</li> <li>• Developing Early Recovery After Surgery (ERAS) Pathways</li> <li>• Improving outcomes in neuromuscular scoliosis</li> </ul>
In Planning Stages	<ul style="list-style-type: none"> <li>• Reducing surgical site infections (colorectal)</li> </ul>

### 3. Discussion

This manuscript represents a novel approach towards identification, prioritization, and improvement of perioperative care via a Perioperative Harm Index. As our organization's safety and quality has programmatically evolved its infrastructure, it has become apparent that there is a need to apply the same robust principles to all aspects of the hospital. The Perioperative Harm Index utilized principles well known in the peer reviewed literature such as the Preventable Harm Index and Clinical Care Indices to achieve three major functions: 1) identify and track patient harm, 2) prioritize improvement opportunities, and 3) improve outcomes for patients.

Perioperative services struggle with how to best identify and track harm. Since the care delivered in perioperative services is spread throughout the organization and also throughout time, there are two variables that must be addressed: spatial and temporal. In the peer reviewed literature, the closest analog to a Perioperative Harm Index is that described by Cravero et al. and his team at Children's Boston in which they describe the need and creation of an anesthesia tracking dashboard; [6] this is similar to the study from McLaughlin et al. that is a Division specific index. [7] McLaughlin's group took a very similar approach around 2009 within a specific department (Neurosurgery) at the University of California Los Angeles in which they utilized specific

measures to track outcomes and then prioritize improvement opportunities. Donnelly et al. also described a unit-based scorecard and quality improvement dashboard for radiology in a children's hospital. [8] All of these efforts demonstrate a novel commitment to describing and improving quality improvement at a macro-level, however they fall short of having the data cascade up the organizational structure to the macro system of the realm of perioperative services. Our approach at Children's National is to take a broader view of the macro system of surgical care and create our tracking system and dashboard for the entire realm of perioperative services. In our organization, this initiative was supported by the Chief Quality and Safety Officer's (author RKS) office in terms of salary support, coordination of data, and socialization of the initiative. It seems prudent that organizations creating macro system visualizations for quality improvement have central support from the organization rather than relying on each individual department to support the initiatives. It was no small feat to assimilate the potential harm from such a broad swath of patient care. The Perioperative Harm Index greatly facilitates identification and tracking of the harm events. The value of the Perioperative Harm Index is that the data and conditions can roll up to the organizational version of the Preventable Harm Index.

Although the Perioperative Harm Index provides quick and easy visualization of data and trends, it took a tremendous effort to create this index. First, the data does not come from one source; there are myriad disparate sources of data. (Table 1) Once each data source was identified, the data needed to be validated and cross-checked with multiple other data sources. Second, there needed to be a way in which to consistently and reliably obtain this data. A Perioperative Harm Index is of no value with data that is not congruent with billing diagnoses, clinical outcomes, and other quality data. The time and effort required for reconciliation with disparate data sources within the hospital should not be underestimated. In the creation of the Perioperative Harm Index, this effort required over 6 months of clinician and analyst work effort to ensure veracity and consistency with the dashboard and the hospital level data. Third, a powerful visualization was created. Effort was taken to ensure a consistent message across the organization. Our hospital has branded our Preventable Harm Index [5] as the "Zero Harm Index", as such, the Perioperative Harm Index carries a similar name and sentiment. Finally, socialization of the harm index is an important concept as it is novel on a macro-level for Perioperative services to have aggregate outcomes data.

It was necessary to take the time to ensure that the harm index was transparent and shared with the respective divisions and then with the perioperative leadership. Interestingly, the value of transparency is highlighted by Dowding et al., who discuss that there exist hundreds of approaches to dashboards and analytics that can assist the clinicians in measuring and tracking quality indicators; they suggest that making the data fully transparent (e.g. on screensavers) would greatly assist in adoption and buy-in [9]. In our organization, we have not moved to this level of transparency because our computers (and hence, screensavers)

are distributed widely throughout the organization, including patient rooms. However, the importance of Dowding's suggestion is of value when considering how to continue socializing and spreading the impact of the Perioperative Harm Index within our organization.

The technical aspect of developing and maintaining dashboards requires information technology support. Stone-Griffith et al., when discussing the need for Emergency Departments to have data dashboards, which are most often focused on throughput to help manage volumes and triage, focused on the role of the hardware and back-end support for these data dashboards [10]. The Perioperative Harm Index at Children's National was developed and is hosted using standard applications found on most desktops (e.g., Excel, Microsoft Corp. Redmond, WA, etc.). The data burden, at present, is miniscule compared to other datasets because the Perioperative Harm Index pulls data from massive data sets (finance, operations) and aggregates the data into an effective visualization.

The Perioperative Harm Index should not be considered a quality improvement tool for the macro system in isolation. The real value of the initiative is the alignment with organizational work and priorities. For example, the measures tracked and improved also are consistent with those that are involved in various accreditation and regulatory efforts for the hospital (Department of Health, Joint Commission, American College of Surgeons Children's Surgical Verification program, etc.). Thus, the Perioperative Harm Index provides immediate feedback on improvement opportunities and success/failures; it also provides a bridge for regulatory and accreditation work.

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