Reducing Cancellations on the Day of Scheduled Surgery at a Children’s Hospital

Jayant “Nick” Pratap, MB BChir, MRCPCH, FRCA; Anna M. Varughese, MD, MPH, FRCA; Patti Mercurio, MSN, RN, NE-BC; Terri Lynch, RN, Teresa Lonnemann, BSN, RN, CPN, Andrea Ellis, MSN, RN, CPN, John Rugg, MBA; W. Ray Stone, MS; Cindi Bedinghaus, MSN, RN, NE-BC

BACKGROUND AND OBJECTIVES: Cancellation on the day of surgery (DoSC) represents a costly wastage of operating room (OR) time and causes inconvenience, emotional distress, and financial cost to families. A quality improvement project sought to reduce lost OR time due to cancelation.

METHODS: Key drivers of the process included effective 2-way communication with families, compliance with fasting rules, and decision-making on patient illness before the day of surgery. A multidisciplinary team conducted serial tests of change addressing the various key drivers. Interventions were simplified, colorful, personalized preoperative instruction sheets and text-message reminders to caregivers’ cellphones, as well as a defined institutional decision-making pathway to permit rescheduling before the day of surgery in case of patient illness concerns. After initial smaller-scale testing, the interventions were implemented across all patients and sites. Data were collected from the hospital information technology system and analyzed by using control charts and statistical process control methods.

RESULTS: Mean OR time lost due to DoSC was decreased from a baseline of 5.7 to 3.6 hours/day in testing with a subset of surgical services at the hospital’s base campus, and then from 6.6 hours to 5.5 hours/day when implemented across all services at both surgical sites.

CONCLUSIONS: By applying quality improvement methods, significant reductions were made in time lost due to DoSC. The impact can be significant by improving institutional resource utilization.

Cancelation on the day of surgery (DoSC) represents a costly wastage of operating room (OR) time but is frequent in children’s hospitals. Families suffer inconvenience, emotional distress, and financial cost. Reducing DoSC therefore improves OR utilization and also reduces impact on families. Likewise, rescheduling in advance, where appropriate, facilitates reshuffling of the operative list and accommodation of add-on cases and minimizes disruption to family life. Among the dimensions of health care quality enumerated by the Institute of Medicine, family-centeredness, efficiency, and timeliness are all impacted.

At the main campus of Cincinnati Children’s Hospital Medical Center (CCHMC) lost OR time averaged 5.7 hours each day (4.5% of total) by 2011 due to DoSC. The 3 most frequent reasons were as follows: patient illness, “no show,” and violations of nil per os (NPO) instructions, together accounting for 68.4% of lost OR time. These data are displayed in Fig 1 as a Pareto chart, which serves to direct quality improvement (QI) efforts by presenting reasons for process failure.
in decreasing frequency order. We describe a QI project to reduce time lost due to DoSC, which forms part of CCHMC’s value initiative aimed at a more productive use of resources.

METHODS

Ethical Aspects
As a QI project, this work was classified as nonhuman subjects research not requiring informed consent.

Setting
CCHMC is a 530–bed, urban, pediatric academic medical center that forms the primary care facility for Cincinnati and a tertiary care facility for southwestern Ohio, northern Kentucky, and southeastern Indiana. CCHMC’s surgical services performed ∼32 000 cases in fiscal year 2011. Approximately 40% of all cases consist of ear, nose, and throat (ENT) surgery. One-third of patients have noncommercial health insurance. CCHMC’s main campus conducted 23 000 of a full range of surgeries in fiscal year 2011. The geographically separated ambulatory surgery center undertook the remainder (shorter and less invasive procedures on predominantly healthy children) but was included only in the project’s implementation phase.

Improvement Team
The team consisted of 2 anesthesiologists, a nurse from the Same Day Surgery (SDS) unit, 3 SDS nurse-managers, and an ENT clinic nurse. Two team members had received formal QI training. A QI consultant and 2 information technology specialists provided technical support. The project started in July 2011 and used the Method for Improvement.

Planning the Interventions

Initial Analysis
To investigate underlying reasons for the most common causes of DoSC (Fig 1), baseline data were collected for each of the top 3 causes. Among a sample of 25 cancelations specifically for patient illness selected randomly from a 3-month period, only 20% had reported symptoms during a routine preoperative telephone call made 2 business days before surgery by a registered nurse from SDS; 40% had reported no symptoms. Of the remainder, nurses were unsuccessful in reaching a family member by telephone. All sickness cancelations in the sample were due to acute illness rather than chronic disease. Potential therefore existed for advance rescheduling if families would notify the hospital of illness before the day of surgery.

The team investigated what happened when SDS nurses discovered in advance that patients had acute symptoms. Many nurses felt they lacked authority to postpone surgeries, but anesthesiologists were rarely aware of concerns, perhaps because cases were not yet allocated to individual anesthesiologists at the time of the preoperative call. The nurses therefore felt uncertain whom they should contact. Most NPO violations resulted from confusion over instructions given to families (Fig 2), in particular regarding “light breakfasts” and “clear fluids,” suggesting a need for increased clarity and focused reminders.

While investigating no-show cancelations, we found that patients of CCHMC’s 2 busiest surgical services, ENT and Urology, were informed of their designated arrival time only from the SDS preoperative phone call, rather than at the time of scheduling like with other departments. Thus, families know when to arrive only if reached by phone by SDS; however, this contact was successfully made in only 57% of ENT and Urology no-shows. For others, a voicemail message was left if possible. Some contact details in the electronic medical record (EMR) appeared to be incorrect, but a separate QI project had recently addressed this and senior leadership felt that further efforts would be unproductive. Our analysis, however, identified an additional opportunity to establish contact if caregivers were requested to call the SDS nurses themselves 2 days before surgery rather than relying exclusively on families being approached by SDS.

To identify further key drivers for improvement we undertook both a simplified “failure modes and effects analysis” and team brainstorming sessions.

FIGURE 1
Pareto chart showing reasons for DoSC in a 6-month sample from April through October 2011.
agreed-upon prerequisites for improvement are outlined in Fig 3, along with appropriate interventions.

**Ramp 1: “Steps to Surgery” Instruction Sheet**

Family education was the focus of the first set of interventions. A pared-down, single-page “Steps to Surgery” sheet was designed to give step-by-step instructions for caregivers (Fig 4). To promote adherence, colorful graphics were used, and space was left to personalize with the child’s name and surgery date. To prevent confusion resulting from instructions for different age groups being present on the same sheet, entirely separate “Steps” sheets were created for infants and for older children. Similarly, directions referred only to the hospital’s main campus to prevent families from presenting to the wrong site.

Previous analysis of NPO violations (Fig 2) influenced the text of the instructions. Because the previously preferred phrase “light breakfast” was confusing, Steps sheets prohibit all solids after midnight for older children. Because infants are at higher risk of hypoglycemia, and because such errors occurred rarely in this group, solids were permitted for them until 5 hours before admission (usually 6.5 hours before surgery). A list of acceptable foods replaces the expression “light breakfast.” The sheet’s reverse side displays examples of solids and clears in pictorial form. Instructions also request caregivers to call SDS 2 business days before surgery to consult with nursing staff and to report any illness developing thereafter.

The sheet was reviewed first with family representatives and then tested with a group of 10 patients undergoing surgery. We then established a test with all ENT patients over a 6-week period.

**Ramp 2: Preoperative Text-Message Reminders**

Because reminders improve process reliability, we sought to offer such prompts to caregivers. Family council members from an economically deprived neighborhood suggested the use of text messages to cellphones via Short Message Service (SMS). They cited advantages of receiving messages even if out of credit and convenience in referring back to instructions.

Software was developed for scheduling text-message reminders of NPO and arrival instructions to be delivered the evening before surgery. With the aid of the hospital’s attorney, a script was prepared for gaining

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**FIGURE 2**

Pareto chart showing root causes in a sample of NPO violations investigated. Information is available for determination in 22 of 37 cases between July 23 and October 3, 2011.

**FIGURE 3**

Key driver diagram for the improvement project presenting the global and specific aims, theories (key drivers), and ideas for change (interventions). periop, perioperative; RN, registered nurse.
a standardized “check in” process was established for SDS nurses to discuss with an attending anesthesiologist any illness concerns identified. A written call log was implemented to ensure that all appropriate cases were discussed.

Implementation

After the ramped small tests of change, senior OR stakeholders agreed to support implementation of the “Steps to Surgery” sheets and text-message reminders for all surgical patients at both CCHMC’s main and ambulatory surgery campuses. A second set of Steps sheets was created to incorporate directions to the ambulatory center. The SMS software was rewritten to interface directly with the EMR to permit automatic texting without the need for nurse intervention.

Following institutional policy change, responsibility for text-messaging consent transitioned from SDS to surgical clinic clerks. The check-in process for advance decision-making on patient illness continued, but the task of determining fitness for surgery transitioned to a perioperative nurse practitioner, with an anesthesiologist allocated for further consultation if required.

Planning the Study of the Interventions

The project’s primary outcome was defined from its early phases as the total hours of OR time lost each day

FIGURE 4

“Steps to Surgery” sheet providing clear and focused instructions in a colorful and personalized format, in this case for caregivers of infants attending for surgery at the hospital’s main campus.
due to DoSC. This measure was chosen for correlating well with lost revenue, given that improved resource utilization was the team’s mandate from senior leadership.

Data on scheduled and canceled cases were routinely entered into the EMR (EPIC Systems, Verona, WI) by individuals independent of our ongoing QI efforts. The primary outcome measure for each nonholiday weekday was plotted on a statistical process control (SPC) chart for the project’s testing phase at the main campus.9 Charts were established to pull data automatically from the EMR. On a weekly basis, the QI team reviewed all qualitative and quantitative reports. The implementation phase was monitored by using a similar chart but with weekly data from both surgical campuses.

**Analysis**

Charts permitted display and analysis of variation in the time-series data and were used to evaluate the effectiveness of interventions. Upper and lower control limits (±3σ) were applied to assess process stability. Special-cause variation was defined as the presence of any of the following: (1) a “shift” of the mean or center line from ±8 consecutive points below or above the center line (data points on the centerline neither making nor breaking a run), (2) a “trend” from 6 consecutive data points in either direction, (3) 14 consecutive data points alternating above and below the center line, or (4) a data point outside of upper and lower control limits.10 Any special cause was investigated to learn about process properties; then, explanatory labels were added to the chart. Project milestones were similarly annotated. Where special cause coincides temporally with a plausible explanation, the process is regarded as having undergone change, and a new baseline is created.

**RESULTS**

Immediately after the project’s key interventions were tested, the control chart of the primary measure showed special-cause variation, specifically...
8 consecutive points below the centerline (Fig 5). In the >2 years for which EMR data are available, a special-cause variation "shift" had not previously occurred (data not shown). The mean OR time lost due to DoSC was reduced from a baseline of 5.7 hours to 3.6 hours/day at our main campus (37% improvement). The mean total scheduled OR time was 136.1 hours/day during the period depicted in Fig 5, although this time includes inpatients and emergency cases not subject to the project's interventions. Over the next 4 weeks, the only special-cause event identified was a single point above the upper control limit. Investigation revealed that an all-day case had been canceled due to failure of vital OR equipment, which was outside the scope of this project.

Two of the 3 interventions could not be continued after the epoch depicted in Fig 5. Specifically, the text-message reminders were discontinued because of changes in the hospital's information technology infrastructure, and the supply of colored "Steps to Surgery" sheets ran out. These instruction sheets were so favorably regarded by ENT clinic staff, however, that, independently of the QI team, black and white copies were distributed to families even after the planned "test of change" had ended. Several other surgical services became aware of the intervention and requested to use the instructions as well.

Although this initial success facilitated "buy in" from perioperative leadership, >12 months elapsed before securing funding for redesigned "Steps to Surgery" sheets and new text-message reminder software. Figure 6 charts the implementation across all services at both of CCHMC surgical campuses. One week after SMS reminders commenced, 9 points below the centerline indicated special-cause variation. That the special-cause variation occurred 6 weeks after initially distributing "Steps to Surgery" sheets was unsurprising, because surgery typically follows the clinic visit by several weeks. Widespread implementation of key interventions was associated with a reduction in mean OR time lost due to DoSC from a baseline of 6.6 hours to 5.5 hours/day (17% improvement). The mean OR time scheduled was 184.6 hours/day during the period depicted in Fig 6, although this time includes inpatients and emergency cases not subject to this project's interventions. More than 5 months after the implementation phase commenced, a special-cause event was noted through ongoing scrutiny of the SPC chart. Subsequent investigation revealed that some larger surgical clinics had run out of "Steps to Surgery" sheets and were unaware of the process for reordering.

DISCUSSION

Using the Model for Improvement, a multidisciplinary team devised, tested, and refined 3 sets of interventions to successfully reduce time lost due to DoSC at a large children's hospital. Although a full economic analysis is beyond the scope of the project, given ∼250 working days/year and an OR charge of $3000/hour, the potential additional revenue for OR time alone is estimated at ∼$800 000/year. Although not specifically tracked during the project, families' inconvenience and emotional distress were likely also reduced.

Particular challenges may have affected the outcome. First, with a baseline DoSC rate of ∼5%, the preoperative preparation process was already achieving high reliability. To further improve high-reliability systems, disproportionate effort and sophisticated strategies are required. Also, unlike many hospital-based improvement projects that focus on health care workers, the ultimate target of 2 of the 3 interventions was the behavior of caregivers and families within their

FIGURE 5
Control chart showing total hours of OR time lost each day due to DoSC at the hospital's main campus. The solid red line represents the mean OR time lost each day. The dotted red lines represent upper and lower control limits, which correspond to ±3σr from the mean. Special cause is shown by the "shift" of the mean below the centerline. The horizontal span of the gray boxes represents the time period during which the stated interventions were in place. h, hour.
Control chart showing mean combined daily hours of OR time lost each week due to DoSC at both of the hospital’s surgical campuses. The solid red line represents the mean daily OR time lost. The dotted red lines represent upper and lower control limits, which correspond to ±2σr from the mean. Special cause is shown by the “shift” of the mean below the centerline. The horizontal span of the gray boxes represents the time period during which the stated interventions were in place.

FIGURE 6

own homes. Because these individuals had no knowledge of the improvement project, any Hawthorne effect was likely minimized.

The team was disappointed that the degree of improvement was less during the implementation (17%) than during the testing phase (37%). The reasons are still under investigation and subject to further improvement effort, but some themes are already apparent. For example, “roll out” of the “Steps to Surgery” sheets requires that they are stocked and distributed at all locations where children are scheduled for surgery, which includes many outside locations and offices of private practice physicians undertaking surgeries at CCHMC. Also, some surgical services opted to distribute information sheets from their surgical campuses. The solid red line represents the mean daily OR time lost. The dotted red lines represent upper and lower control limits, which correspond to ±2σr from the mean. Special cause is shown by the “shift” of the mean below the centerline. The horizontal span of the gray boxes represents the time period during which the stated interventions were in place.

Increased OR efficiency has been reported to follow more accurate scheduling and alignment of staffing in the postanesthesia recovery unit.12 After a previous successful effort at CCHMC to reduce staff overtime costs by improving on-time day start and finish times,13 DoSC was selected for improvement. Although cancelation is more common for children than for adults,14 few studies describe the problem.15–19 Fewer still report alleviating it.1,20 Patel and Hannallah20 used a telephonic

before surgery. However, interventions early in the pathway suffer a lag effect before feedback is received due to the inevitable interval between scheduling and surgery. Resulting effects will therefore exhibit ramped onset due to variation in this lag between individuals.

From the outset, the project’s key outcome measure was lost OR time due to cancelation for any cause. This selection was most meaningful to senior decision-makers within the institution because of its correlation with lost revenue. Clinicians generally preferred to know the absolute number of families impacted, but most also appreciated a sense of time wasted as meaningful. For families, cancelation of longer or major procedures might perhaps be regarded as more important.

Reductions in DoSC benefit patients, caregivers, and the hospital. For families, last-minute cancelation carries emotional and practical impact. Tait et al2 found that one-third of mothers and over half of fathers missed a day of work, which was unpaid in almost half of cases. Moreover, their average round trip was >150 miles to the University of Michigan Medical Center. Disappointment, frustration, and anger were frequently reported. The current study did not ascertain psychological or practical impact, but it seems likely that the reduced DoSC also improved patient and family experience.

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screening process to reduce DoSC from 14.8% to 9.7%. A similar approach had already been incorporated into our processes. Boudreau and Gibson instead used universal face-to-face preoperative assessment. Similarities to our study include the setting of a large tertiary children’s hospital and acute illness as the most frequent cause of DoSC. Although no economic analysis was presented, it seems likely that considerably more resources were required to conduct the universal preoperative assessment clinic described than for the revised family information sheet, automated text-message reminder system, and improved internal communication pathway used in the project described here.

CONCLUSIONS
We identified key drivers critical to reducing cancellations of children’s surgical procedures on the scheduled day. Analysis-driven modifications to preoperative processes, tested and refined by using the Model for Improvement, led to a significant reduction in cancellations at a large tertiary children’s hospital. Clear and focused preoperative instructions, text-message reminders to caregivers, and a clearly defined internal decision-making process on patient illness all contributed to the project’s success.

REFERENCES