Improving the Timeliness of Procedures in a Pediatric Endoscopy Suite

Although many of the readers of PEDIATRICS do not provide endoscopic procedures, this Quality Report provides important information about how to improve timeliness and utilization of a limited resource.

abstract

BACKGROUND AND OBJECTIVE: Pediatric endoscopic procedures are essential in the evaluation and treatment of gastrointestinal diseases in children. Although pediatric endoscopists are greatly interested in increasing efficiency and throughput in pediatric endoscopy units, there is scarcely any literature on this critical process. The goal of this study was to improve the timeliness of pediatric endoscopy procedures at Children’s Hospital at Montefiore.

METHODS: In June 2010, a pediatric endoscopy quality improvement initiative was formed at Children’s Hospital at Montefiore. We identified patient-, equipment-, and physician-related causes for case delays. Pareto charts, cause and effect diagrams, process flow mapping, and statistical process control charts were used for analysis.

RESULTS: From June 2010 to December 2012, we were able to significantly decrease the first case endoscopy delay from an average of 17 to 10 minutes ($P < .001$), second case delay from 39 to 25 minutes ($P = .01$), third case delay from 61 to 45 minutes ($P = .05$), and fourth case delay from 79 to 51 minutes ($P = .05$). Total delay time decreased from 196 to 131 minutes, resulting in a reduction of 65 minutes ($P = .02$). From June 2010 to August 2011 (preintervention period), an average of 36% of first endoscopy cases started within 5 minutes, 51% within 10 minutes, and 61% within 15 minutes of the scheduled time. From September 2011 to December 2012 (postintervention period), the percentage of cases starting within 5 minutes, 10 minutes, and 15 minutes increased to 47% ($P = .07$), 61% ($P = .04$), and 79% ($P = .01$), respectively.

CONCLUSIONS: Applying quality improvement methods and tools helped improve pediatric endoscopy timeliness and significantly decreased total delays. Pediatrics 2014;133:e428–e433
METHODS
Formation of Pediatric Endoscopy QI Team at CHAM

This performance improvement study was conducted by the pediatric endoscopy QI team at CHAM, a tertiary and quaternary children’s hospital with 120 beds affiliated with Albert Einstein College of Medicine located in the Bronx, New York. The initial objectives included measuring the baseline incidence of delays and quantifying the length of delays to scheduled start times. Other objectives included identifying common causes for delays and developing process improvement plans to decrease delays.

To determine baseline incidence of delays, pediatric endoscopy quality assurance forms were created to prospectively capture the following data: scheduled in-room time (time when patient is scheduled to arrive in the endoscopy suite), actual in-room time, actual start time of procedure (defined as insertion of endoscope), end of procedure time (removal of endoscope), time when patient left the endoscopy suite, type of procedure, participating physicians (anesthesiology and pediatric gastroenterology), and reasons for the delay. The endoscopy nurses collected the data for each procedure. The percentage of cases starting on time and the individual length of delay for each case were measured. We identified patient-, equipment-, and physician-related causes for case delays, which are depicted in a cause and effect (fishbone/Ishikawa) diagram (Fig 1).

Primary process interventions included using Plan-Do-Study-Act procedures, sharing individual physician performance measures through e-mail communications and discussions at faculty meetings, revising procedure forms, providing procedure-related education materials to patients and families, and routinely calling patients’ caregivers 24 to 48 hours before their procedure. Pareto charts, cause and effect diagrams, process flow mapping, and statistical process control charts were used as the QI tools for this project.

Patient Flow Process for Pediatric Endoscopy

The pediatric endoscopy suite consists of 1 standard endoscopy room and a second room equipped with fluoroscopy and is open for endoscopic retrograde cholangiopancreatography. The suite is staffed by 2 full-time pediatric endoscopy nurses and 1 pediatric endoscopy technician.Ambulatory patients are registered by a receptionist and are then admitted to a 16-bed pediatric peri-anesthesia care unit (PACU). Inpatients are transported directly to the PACU from their inpatient floor/unit. The PACU serves the entire children’s hospital and is staffed by an additional 6 nurses. A history and physical examination are performed and the findings recorded by a physician in the PACU if they have not been completed before arrival. After the patient has been evaluated by both the anesthesiologist and the gastroenterologist, he or she is then transported to the endoscopy suite where the procedure is performed. After the procedure, the patient is transferred back to the PACU by the anesthesiologist and the pediatric endoscopy nurse for recovery. This entire process is detailed in a flowchart in Fig 2.

The endoscopy suite is used 2.5 days a week by 8 pediatric gastroenterologists. Currently, there is no blocked time for individual gastroenterologists. The endoscopy schedule for most days included a combination of inpatient and outpatient procedures performed by different gastroenterologists. The endoscopy schedule is structured to allot...
FIGURE 1
Cause and effect (fishbone) diagram of reasons for pediatric endoscopy delays. GI, gastroenterology; MD, physician.

FIGURE 2
Flowchart outlining the endoscopy process of a pediatric patient.
different times for each procedure. For example, 60 minutes are allocated for each esophagastroduodenoscopy (EGD), colonoscopy, or flexible sigmoidoscopy. However, 90 minutes are allocated for an EGD with colonoscopy. Anesthesia induction, actual procedure time, anesthesia recovery, and turnover time are calculated into each scheduled procedure.

Outcomes
A case was considered to be delayed if the patient arrived in the endoscopy suite >5 minutes after his or her scheduled time.

The reasons for delays were recorded. Delays were considered as patient-related if the patient was late for the procedure, the patient did not fast, or a medical clearance delayed the case (ie, awaiting results from a pregnancy test or complete blood count). If the endoscopist was not available at the scheduled start time, the delay was attributed to the pediatric gastroenterologist. Delays were considered as endoscopy equipment-related if the endoscopy equipment was not set up on time or was nonfunctional at the scheduled start time. Likewise, if the anesthesiologist was not available, the delay was attributed to the anesthesiologist, and if the anesthesia equipment was not set up, then the case delay was attributed to anesthesia-related causes.

Duration of procedure was defined as the time between the insertion of the endoscope and removal of the endoscope.

Data Analysis
Differences in means and proportions were calculated by using a 2-tailed Student’s t test. A P value <.05 was considered significant. Process and outcomes measures were analyzed by using x-bar statistical process control charts.

This project was approved by the Albert Einstein College of Medicine Institutional Review Board.

RESULTS
Procedures
From June 2010 to December 2012, a total of 1747 pediatric endoscopic procedures were performed on 1348 patients. A total of 1636 (93.5%) procedures were performed in the pediatric endoscopy suite. For the timeliness analysis, we excluded 113 cases that were done in the operating room, PICU, or adult endoscopy suite. Seventy-three percent of procedures were performed on ambulatory patients. The most common procedure was EGD followed by colonoscopy (Table 1).

Delays
We identified multiple reasons for delays (Supplemental Fig 4). In most endoscopy cases, a distinct cause of delay could be identified. However, in 33% of endoscopy cases, we could not identify a specific cause of delay. Late arrival of the gastroenterology physician caused 11% of delays in the preintervention period, which decreased to 4% in the postintervention period. Anesthesia-related causes, which included anesthesia setup and anesthesia physician late arrival, were reason for 50% of delays in the preintervention period, which decreased to 28% in the postintervention period. Other factors had less significant change.

From June 2010 to December 2012, we were able to significantly decrease the first case endoscopy delay from an average of 17 to 10 minutes (P < .001) (Fig 3), second case delay from 39 to 25 minutes (P = .01), third case delay from 61 to 45 minutes (P = .05), and fourth case delay from 79 to 51 minutes (P = .05) (Table 2). Total delay time for the day decreased from 196 to 131 minutes, resulting in a reduction of 65 minutes per day (P = .02). As a result of this QI work, we were able to increase our procedure volume in the postintervention period by performing 6 more procedures per month. From June 2010 to August 2011 (preintervention period), an average of 36% of first cases started within 5 minutes, 51% within 10 minutes, and 61% within 15 minutes of the scheduled start time. From September 2011 to December 2012 (postintervention period), the percentage of cases starting within 5, 10, and 15 minutes increased to 47% (P = .07), 61% (P = .04), and 79% (P = .01), respectively (Table 3). There was no statistical difference in delays between different days of the week or between cases scheduled as inpatients or outpatients.

DISCUSSION
Improving efficiency and access to pediatric endoscopic procedures is critical to the care of pediatric patients

TABLE 1
Pediatric Procedure

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure locations</td>
<td></td>
</tr>
<tr>
<td>Pediatric endoscopy suite</td>
<td>1636 (83.5)</td>
</tr>
<tr>
<td>PICU</td>
<td>44 (2.5)</td>
</tr>
<tr>
<td>Operating room</td>
<td>33 (2)</td>
</tr>
<tr>
<td>Adult GI</td>
<td>34 (2)</td>
</tr>
<tr>
<td>Outpatients</td>
<td>986 (73)</td>
</tr>
<tr>
<td>Inpatients</td>
<td>362 (27)</td>
</tr>
<tr>
<td>Intubated</td>
<td>604 (46)</td>
</tr>
<tr>
<td>Deep sedation</td>
<td>708 (54)</td>
</tr>
<tr>
<td>EGD</td>
<td>965 (55.2)</td>
</tr>
<tr>
<td>Colonoscopy</td>
<td>384 (22)</td>
</tr>
<tr>
<td>PEGs</td>
<td>87 (5)</td>
</tr>
<tr>
<td>PEG change</td>
<td>74 (4.2)</td>
</tr>
<tr>
<td>Liver biopsy</td>
<td>62 (3.6)</td>
</tr>
<tr>
<td>Flexible sigmoidoscopy</td>
<td>44 (2.5)</td>
</tr>
<tr>
<td>EGD/dilation</td>
<td>33 (1.9)</td>
</tr>
<tr>
<td>ERCP</td>
<td>32 (1.8)</td>
</tr>
<tr>
<td>Colonoscopy/polypectomy</td>
<td>26 (1.5)</td>
</tr>
<tr>
<td>EGD foreign body</td>
<td>16 (0.9)</td>
</tr>
<tr>
<td>Rectal suction biopsy</td>
<td>10 (0.6)</td>
</tr>
<tr>
<td>Other</td>
<td>15 (0.8)</td>
</tr>
</tbody>
</table>

A total of 1747 procedures in 1348 patients. ERCP, endoscopic retrograde cholangiopancreatography; GI, gastrointestinal; PEG, percutaneous endoscopic gastrostomy.
with gastrointestinal disorders. Moreover, physicians, hospital staff, patients, and families value efficiency and productivity. Failure to begin the first case of the day on time creates an ongoing downstream delay for all subsequent cases and negatively affects the entire day’s schedule. When pediatric procedures run late, patients and their family members are forced to wait while the staff is required to work overtime. These scenarios result in shared frustration and waste of resources. Therefore, it is important to improve efficiency and timeliness of pediatric endoscopic procedures. To date, there are limited data on endoscopy units’ flow and delays in pediatric endoscopy start times. Most of the literature comes from adult endoscopy centers and operating rooms.\textsuperscript{1,2,4,5}

In 2006, adult endoscopy suite efficiency was studied prospectively for 5 months and revealed that physicians’ unavailability caused significant delays in endoscopic procedures.\textsuperscript{2} More recently, Schembre et al\textsuperscript{6} reported (in abstract form) their experience with an improvement model called a rapid process improvement workshop designed around Plan-Do-Study-Act. Two-week workshops examined endoscopy patient travel patterns, nurse and patient walking distances, resource allocation, and equipment standardization. Patient travel patterns, patient cycle times (amount of time patient spent in an office visit), nurse walking distances, and number of procedures performed per room per day were measured before and after the rapid process improvement workshop recommendations were implemented. Using this intervention, they were able to reduce patient waiting time by 25%, turn overtime by 20%, walking time of the nurse by 66%, and admission time by 65%. Their improvement was sustained at 60 days.

To our knowledge, this is the first study that demonstrates the utility of QI methods in improving timeliness of pediatric endoscopic procedures and pediatric endoscopy unit flow. By systematically and prospectively tracking pediatric endoscopy procedures and implementing our process interventions, we have demonstrated a significant improvement in the percentage of procedures starting on time and

TABLE 2 Pediatric Endoscopy Delays

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Average Delay, min</th>
<th>1st Period (6/10–8/11)</th>
<th>2nd Period (9/11–12/12)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st case</td>
<td>17</td>
<td>10</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>2nd case</td>
<td>39</td>
<td>25</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>3rd case</td>
<td>61</td>
<td>45</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>4th case</td>
<td>79</td>
<td>51</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>131</td>
<td>.02</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 3 First Case Start Within 5, 10, and 15 Minutes

<table>
<thead>
<tr>
<th>1st Case Start</th>
<th>1st Period (6/10–8/11), %</th>
<th>2nd Period (9/11–12/12), %</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within 5 min</td>
<td>36</td>
<td>47</td>
<td>.07</td>
</tr>
<tr>
<td>Within 10 min</td>
<td>51</td>
<td>61</td>
<td>.04</td>
</tr>
<tr>
<td>Within 15 min</td>
<td>61</td>
<td>79</td>
<td>.01</td>
</tr>
</tbody>
</table>
a significant decrease in delays. To sustain our QI intervention, we have constructed a measurement system that regularly generates data on the endoscopy suite performance. Physicians and staff are provided with these data. All the physicians, nurses, and technicians are deeply engaged in sustaining our achievements, and we all share pride in our improved performance. Indeed, preliminary analysis of our most recent data showed sustainability of the improvements we achieved in timeliness (first case delays have been further reduced to an average of 7 minutes [data not shown]), and these results will be reported in a follow-up study.

Our QI project identified patient-, equipment-, and physician-related causes for case delays. As a first step, we decided to target the division of pediatric gastroenterology and the patient-related causes for delays. We used a tally sheet to create a Pareto chart and targeted the causes that were most prevalent in our system. Serial interventions were conducted, including education of pediatric gastroenterology faculty staff, e-mail communications to faculty, sharing of individual physician performance data, and monthly faculty meetings. Other interventions focusing on patient-related causes included sending a letter to patients’ caregivers with detailed information about the procedure and preprocedure preparation. Before this project started, reminder telephone calls were done by PACU nurses 12 to 24 hours before the procedure. We then instituted reminder telephone calls by a scheduler 1 week before an endoscopic procedure and again by pediatric endoscopy nurse at 24 to 48 hours before the procedure. This method gave the nurses longer time to get in touch with caregivers and patients and more time for patients to make the necessary arrangements to get ready and be on time for their procedure. Our environment is such that the endoscopy suite is on the same floor as the pediatric operating room but is not part of the operating room. Our patients are admitted to the PACU before each procedure. Our PACU is shared by the general operating rooms, and patients then recover in the same area. This setup can be a limiting factor in our workflow and volume, particularly on days when the operating rooms are busy and complex surgical procedures have priority for anesthesia service and PACU admission and recovery. Our next step will be to invite the pediatric recovery room team and pediatric anesthesia team to join the pediatric endoscopy QI initiative to further improve pediatric endoscopy suite flow and efficiency.

CONCLUSIONS

We found a significant improvement in timeliness of pediatric endoscopic procedures. Our QI efforts have reduced delays and improved care delivery processes. We are confident that our pediatric endoscopy QI experience will allow pediatric endoscopists to assess their own ongoing performance and will encourage similar QI initiatives aimed at improving efficiency throughout the hospital.

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REFERENCES

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