Measuring Quality in Pediatric Endoscopy

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KEYWORDS

• Quality • Metrics • Pediatric endoscopy • Pediatric colonoscopy • Training • GiECAT$_{KIDS}$ • Benchmarks • Quality improvement

KEY POINTS

- Quality measurements in pediatric endoscopy can be used to increase transparency about patient care processes and outcomes.
- Although the definition of quality for pediatric endoscopy is yet to be fully developed, it can be promoted by adhering to various established metrics for procedural documentation.
- The Gastrointestinal Endoscopy Competency Assessment Tool for Pediatrics Colonoscopy (GiECAT$_{KIDS}$) is a rigorously developed quality measure of procedural competence.
- Continuous quality improvement initiatives that engage trainees, as well as established pediatric endoscopists, to examine their own procedural processes and outcomes can be considered to be valuable at both the individual provider and endoscopy unit level.

INTRODUCTION

Measuring procedural quality should be expected to become an increasingly standard component of performing gastrointestinal endoscopy in children in the twenty-first century. Quality measurements in endoscopy, as in all aspects of medical practice, are increasingly being used to appraise clinical care processes, as health care in the United States and beyond continues down its current path of reformation.[1] Such metrics are also likely to be used to increase transparency about patient outcomes, as well as to influence payments for the procedure.[2–4] In turn, pediatric gastroenterologists must be open to defining aspects of high-quality endoscopy, as well as to begin to self-identify opportunities for improvement. The risk to not engage in the quality movement is that others (including regulatory boards, administrative agencies, or third-party payers) will define these measures for us.

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Box 1 lists candidate quality metrics for pediatric endoscopy, which can be either process or outcomes oriented.[4,5] Regardless of their origin or intended use, it is reasonable to mandate that all metrics devised to assess quality of pediatric endoscopy be accurate, meaningful, and practical. Measuring quality in endoscopy involves assessing 2 dimensions of care: (1) appropriateness of a procedure and (2) the skill with which the procedure is performed.[6] It also should encompass the 6 domains of quality put forth by the Institute of Medicine, by ensuring that procedures are effective, patient-centered, safe, efficient, timely, and equitable.[7] The definition of pediatric endoscopic quality is still to be fully developed; however, when viewed at the societal level, it is plausible to assume that endoscopy should be recommended and performed, when indicated, in an expeditious, skillful, successful, safe, and comfortable manner. Performance of pediatric endoscopy also should be of high value, providing the best quality for the least cost.

To date, there are limited measures of endoscopic quality that have been universally accepted when treating either adult or pediatric patients. However, a number of high-stake interest groups, including the American Society of Gastrointestinal Endoscopy (ASGE), have put forward individual and multisociety consensus statements on the

Box 1
Elements of pediatric endoscopic quality that reflect individual processes of care, as well as clinical outcomes

Endoscopic Procedures
- Procedure volume by type
- Appropriateness of indications
- Absence of contraindications
- Patient comfort
- Adverse events
- Technical performance (eg, ileal intubation)
- Therapeutic success (eg, esophageal dilation, polyp removal)
- Accuracy of endoscopic diagnosis
- Completeness of documentation

Patient Based
- Waiting room time
- Patient satisfaction (eg, with discharge instructions, procedures, sedation)
- Parental satisfaction
- Family/patient complaints
- Rescheduled or canceled procedures
- Waiting time for transfer, transport, admission

Nursing/Support Staff
- Intravenous access difficulties
- Adequacy of bowel preparation
- Completeness of preprocedure assessments
- Completeness of sedation/anesthesia records
- Mislabeled specimens
- Follow-up care documented
- Room turnover time

Environment and safety
- Universal precautions use
- Emergency equipment readiness
- Safe stretcher use
- Expired drug disposal
- Radiation drug use
- Storage and disposal of chemicals/toxins
- Room turnover time

Infection Control
- Scope disinfection procedure followed
- Accessory reprocessing procedure followed
- Bacteremia following procedures
- Proper specimen handling
- Needle disposal

Other
- Procedure report sent to referring physician
- Specimen loss
- Missing consent forms
- Endoscope repairs (type, frequency, turnover)
- Missing prior authorization
- Billing rejection

Adapted from Brown RD, Goldstein JL. Quality assurance in the endoscopy unit. Gastrointest Endosc Clin N Am 1999;9(4):596; with permission.

topic.[4,8,9] In short, there is good agreement that a quality endoscopic procedure is safe and efficient, is used effectively to make proper diagnoses, can essentially exclude other diagnoses, minimizes adverse events, and is accompanied by appropriate documentation from beginning through the end of the procedure. This includes the documentation of timely communication of all results, including pathologic analysis of tissue sampling.

Common methods for improving quality in health care include the identification of threshold standards, below which care can be considered to be inadequate; benchmarking personal practice with that of peers; the provision of additional training and education; the performance of self-evaluation and reporting; as well as engagement in continuous quality improvement processes. The process of identifying a standard, and then evaluating whether all practice meets that standard, can be considered quality assurance. Although quality assurance is critical to all procedures, it only targets improvement or elimination of performance below the set threshold. In contrast, quality improvement assumes that there is variability in practice that can be used to motivate all performers on a "bell-shaped curve" to improve toward the highest levels.

MEASURING QUALITY THROUGH PROCEDURAL DOCUMENTATION

Quality in endoscopy can be promoted by adhering to various established metrics for procedural documentation.[10] **Box 2** lists recommendations for endoscopic procedure documentation that were proposed by the ASGE in a monograph on quality in 1998

Box 2
Recommendations from the American Society of Gastrointestinal Endoscopy (ASGE) for standard elements of endoscopic procedure documentation

Procedure Report
- Date of procedure
- Patient identification data (eg, Medical record number, account number, encounter number)
- Procedure type
- Indication for procedure
- Patient medical history/comorbidities
- Physical Status (American Society of Anesthesiology)
- Endoscopic instrument identification data
- Medications used (eg, general anesthesia, sedatives, antibiotics)
- Anatomic extent of examination
- Limitations of examination
- Tissue or fluid samples obtained (number, location)
- Findings
- Diagnostic impression
- Results of therapeutic intervention
- Adverse events (immediate vs delayed)
- Disposition
- Recommendations for further care

Endoscopic Unit Record
(In addition to Procedure Report Data)
- Duration of procedure
- Presence of informed consent document
- Evidence of preprocedural and postprocedural evaluation

Procedure Sedation Record
- Evidence of postprocedure recovery (ie, Aldrete score)

Adapted from Brown RD, Goldstein JL. Quality assurance in the endoscopy unit. Gastrointest Endosc Clin N Am 1999;9(4):599; with permission.

that reviewed recommendations of various regulatory bodies, including the Department of Health and Human Services' Agency for Healthcare Research and Quality, as well as the Joint Commission.[5] Many of these key elements of documentation have since been supported by adult and pediatric studies as appropriate for universal application across endoscopic procedures.[9,10] Generally speaking, pediatric procedural documentation of endoscopy is intended to maintain standards upheld in documentation of surgeries, as well as procedures in adults. Whenever possible, such standards should be evidenced-based.

Endoscopic quality should be assessed at each time point of a procedure, including before, during, and after its performance.[9] Strictly speaking, the process of performing endoscopy often begins in the clinic with referral for the procedure, and ends after patients have left the procedural unit. Documentation that reflects the quality of each time point in the procedure is an imperative and must relate to critical elements.

Preprocedural elements that can be used to assess the quality of documentation of pediatric gastrointestinal endoscopy include clear mention of the procedural indication; discussion of informed consent, including discussion of risks, benefits, and alternatives to the procedure; evidence that the endoscopist performed a preprocedure assessment, either by documentation of a physical examination and/or by noting the patient's physical status; as well as evidence that the endoscopist established a plan for how sedation would be achieved, even if that routinely involves an anesthesiologist-administered regimen.

Major intraprocedural elements should include a full description of the procedure performed, delineation of any findings with specific mention of anatomic landmarks, quantification of estimated blood loss, and note of any complications. Ideally, standard language is used to describe findings.[11] Postprocedural elements that should be clearly documented to ensure reflection of procedural quality include cataloging of any patient recommendations postprocedure. There also should be clear documentation of communications that ensued regarding results of the procedure, including immediately after the procedure in terms of endoscopic impressions, and later, after processing and review of tissue samples.

Large multicenter studies of quality of endoscopy reports have shown clear gaps in documentation quality that may benefit from improvement.[12–14] In particular, investigators examining data from the Clinical Outcomes Research Initiative or CORI project of more than 400,000 procedures over a 2-year period found tremendous variation in reporting, with many basic elements of procedural reports found to simply be missing.[14] In similar findings using different methodology, Robertson and colleagues[12] reviewed 122 separate endoscopy centers for adherence to ASGE guidelines for reporting. They set a threshold for adequate performance for any criterion at 70% compliance, and found that colonoscopy reporting practices were widely variable and often suboptimal, even with this low standard.

Endoscopy reports by pediatric gastroenterologists may similarly suffer from inconsistencies and significant provider variation. One recent study by Thakkar and colleagues[10] examined more than 21,000 records from 14 pediatric centers in the pediatric endoscopy database system - clinical outcomes research initiative (PEDS-CORI) network for adherence to key quality indicators and found that more than half of pediatric endoscopy notes analyzed were missing at least one element. Key indicators included documentation of bowel preparation, ileal intubation rate, American Society of Anesthesiologists physical status, and procedure time. This study underscores the importance of focusing on standardizing documentation as a starting point for engaging in discussions of quality, even as we continue to explore best measures for pediatric procedures.

QUALITY AND ENDOSCOPIC TRAINING

Training in pediatric endoscopy may represent the most critical time to teach best practices around not only performing procedures, but also their documentation. The goals of training in endoscopy are to perform procedures, safely, completely, independently, and expeditiously; to accurately interpret and describe findings; to integrate endoscopic findings into the management plan; to recognize and manage complications; and to effectively communicate both the endoscopic and pathologic results of procedures to patients and to other clinical providers.[15] Recent pediatric guidelines stipulate that trainees must aim to know appropriate indications, contraindications, and alternatives to procedures; appearances of both normal and abnormal findings; and how to select and apply appropriate sedation strategies and equipment.[16] High-quality documentation of a procedure from both trainees and experienced endoscopists should routinely reflect attainment of each of these goals.

Of course, beyond learning to document, it is paramount that trainees develop procedural competence during their fellowship years. In this regard, the Gastrointestinal Endoscopy Competency Assessment Tool for Pediatric Colonoscopy ($GiECAT_{KIDS}$) should be recognized as the most rigorously developed quality measure to date for pediatric gastrointestinal procedures.[17,18] The $GiECAT_{KIDS}$ was developed by Dr Catharine Walsh at the University of Toronto to support a competency approach to training and assessment of pediatric colonoscopy. Dr Walsh used a Delphi method involving more than 40 expert endoscopists from a variety of practice settings across North America. Through this process, 3 major domains of colonoscopy competency were developed: (1) technical (psychomotor skill), (2) cognitive (knowledge), and (3) integrative (judgment, clinical reasoning).[17]

A final score on the $GiECAT_{KIDS}$ is calculated from 2 components. The first is an 18-item highly structured checklist, which outlines key steps required to complete the procedure. This checklist is modeled after validated versions used in general surgery and is scored dichotomously, where 1 = done correctly and 0 = not done or done incorrectly. The second component of the $GiECAT_{KIDS}$ score is a 7-domain Global Rating Scale (GRS), which is designed to assess holistic aspects of skill in terms of provider autonomy, including technical skill, strategies for scope advancement, visualization of mucosa, independent procedure completion (vs need for assistance), knowledge of procedure, interpretation and management of findings, and patient safety. Each domain of the GRS is scored on a 5-point Likert scale, with higher scores reflective of better performance (more autonomy demonstrated) by the endoscopist (**Box 3**).

Box 3
Likert anchors used in scoring the Global Rating Scale component of the Gastrointestinal Endoscopy Competency Assessment Tool for Pediatric Colonoscopy, which differentiates between levels of procedural competency, as defined by degree of provider autonomy

1. Unable to achieve tasks despite significant verbal and/or hands-on guidance
2. Achieves some of the tasks but requires significant verbal and/or hands-on guidance
3. Achieves most of the tasks independently, with minimal verbal and/or manual guidance
4. Competent for independent performance of all tasks without the need for any guidance
5. Highly skilled advanced performance of all tasks

The GiECAT$_{KIDS}$ has excellent reliability and validity and should be regarded as a mature quality indicator that can be used in training programs.[17] In particular, it has been shown to have high interrater, as well as test-retest, reliability. Total scores can be used to discriminate among novice, intermediate, and advanced endoscopists. Higher scores are also significantly associated with more procedural experience (**Fig. 1**), as well as higher cecal and ileal intubation rates.[18] In turn, although the GiECAT is currently only recommended for training, it is plausible to assume future studies may find it can be useful in granting procedural privileges or in monitoring continued competence, for practicing clinicians.

QUALITY IMPROVEMENT AND MAINTENANCE OF CERTIFICATION

As endoscopists transition from trainee to faculty, competencies in procedural performance should be maintained. Identifying gaps in procedural quality is critical to improving pediatric endoscopic practices at all levels of expertise. Continuous quality improvement (CQI) initiatives that engage trainees, as well as practicing endoscopists, to examine their own procedural processes and outcomes can be considered to be valuable at the individual and endoscopy unit level.[19] Not only may CQI help in maintenance of competence certification for providers, but it can also help in identifying areas of process vulnerabilities across a clinical practice.[20]

For example, systematic examination of peri-procedural records of multiple providers within a practice may reveal lack of standardized documentation around informed consent. This may leave open the possibility that a patient could undergo endoscopy without clear documentation that consent was obtained, should the consent form be misplaced. It also creates the potential for omission of particular risks, which could be cited later by a patient or a family who could state they were not prepared in the event of a complication. Identifying and mitigating such vulnerabilities could facilitate the determination of a best practice within the unique practice environment engaged in the CQI activity to ensure that consent is obtained by all providers in a standardized manner, and that the process is invariably documented in a specific location in the medical record.

Although the current process for maintaining subspecialty board certification in pediatric gastroenterology is controversial, the American Board of Pediatrics has pledged support for efforts by the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) and other societies to host quality improvement maintenance of certification (MOC) activities.[21] NASPGHAN, specifically, has offered

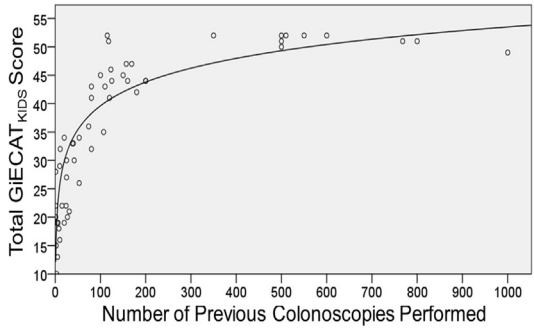

Fig. 1. Total GiECAT$_{KIDS}$ scores increase in line with procedural experience, with a notable plateau after 200 to 400 procedures. (*Adapted from* Walsh CM, Ling SC, Walters TD, et al. Development of the gastrointestinal endoscopy competency assessment tool for pediatric colonoscopy (GiECATKIDS). J Pediatr Gastroenterol Nutr 2014;59(4):482; with permission.)

a mechanism since 2013 for members to gain MOC credit by examining their own endoscopy and colonoscopy documentation practices.[22] **Table 1** shows collective baseline responses from participants electing to participate in the first year of these MOC activities (NASPGHAN MOC Task Force Presentation at the Annual Meeting, 2014). These data not only reveal opportunities for improvements in processes of care, but also begin to provide benchmark data around key indicators, such as ileal intubation rates and typical procedural times. Ultimately, data collected through MOC activities may be useful for quality assurance across the field of pediatric gastroenterology.

PREPROCEDURE ELEMENTS OF QUALITY PEDIATRIC ENDOSCOPY

Indications for performing endoscopy in children can be diagnostic, as well as therapeutic. In either case, the indications for recommending and proceeding with a planned gastrointestinal procedure should be ideally made clear to both patients and other providers *before* it begins.[9] A number of studies in adults have shown higher diagnostic yield when endoscopic procedures are performed for appropriate reasons.[23–25] Another critical element of a high-quality preprocedure phase is evidence of patient assessment by the endoscopist.[13] One way to provide such evidence is to document a patient's physical status according to a classification system designed by the American Society of Anesthesiology (ASA), even if an anesthesiology-colleague has also made note of this in their procedural documentation.

Indeed, one of the most important preoperative assessments is relating patient risk factors for a given procedure to the proposed plan for sedation. The ASA has established suggestions for their nonanesthesiology colleagues to classify patients' physical status.[26,27] This classification system is commonly used as a metric of patient complexity, and serves as a common language among clinicians, as they discuss patients in terms of disease severity. However, the ASA is well known to suffer from

Table 1
Example of baseline data collected from the providers enrolled in the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition endoscopy maintenance of certification (MOC) activity

MOC Upper Endoscopy – Data Entry Period 1 (n = 81)	
1. Average compliance with procedural documentation requirements across 10 charts	84.2%
2. Average % of procedure reports shared with primary care or referring physician	63.8%
3. Average % documentation of discussion of biopsy results with patient/parent	90.4%
4. Average time from procedure to reporting of biopsy results	8.0 d
5. Average % upper endoscopies performed that resulted in change in clinical management	59.6%
MOC Colonoscopy – Data Entry Period 1 (n = 58)	
1. Average compliance with procedural documentation requirements across 10 charts	91.3%
2. Average total colonoscopy time (scope insertion through withdrawal)	35.7 min
3. Average total time to cecum	20.9 min
4. Average % successful terminal ileum intubation[a]	91.8%
5. Average % colonoscopies performed that resulted in change in clinical management	68.0%

[a] Record review restricted by protocol to cases with a priori intention to inspect the ileum.

interobserver agreement.[28] A brief preprocedural discussion with the anesthesiologist about patient ASA is a good way to make sure both anesthesiologist and endoscopist have the same considerations as they assess a patient. It also avoids discordant assessments of the same patient by 2 providers (the endoscopist and the anesthesiologist) treating the same patient during the same encounter, which could be used to signify inadequate coordination of care.

One caveat regarding ASA classification is that anesthesiologists may be inclined to label more children undergoing endoscopy as a higher ASA class when compared with ratings by endoscopists and pediatric endoscopy nurses. This may be because anesthesiologists routinely consider reflux, as well as patient age, in their decision-making. Another drawback to relying on ASA classification to document patient assessment is that the system is one of crude patient categories that cannot adequately capture complex clinical scenarios. For this reason, it may be very appropriate and useful to also document a patient's comorbidities.[13] Asthma, in particular, is a common pediatric comorbidity that could impact a patient receiving procedural sedation. Careful documentation of comorbidities does not only improve procedural outcomes, but also attests to the endoscopist's awareness of risks to a patient's safety and that they are in a position to take steps to mitigate them.

Despite its shortcomings, a patient's ASA class has been shown to be clearly associated with increased risk of adverse events in both adults and children.[29] In turn, ASA classifications may be useful in endoscopic risk stratification, leading to multisociety agreement that its documentation should be considered an important quality indicator for endoscopy.[13]

Informed consent is the final critical element of the preprocedure phase. The ASGE has defined informed consent as "voluntary agreement by a person with the capacity for decision making to make an informed choice about allowing an action proposed by another person."[30] By definition, obtaining informed consent in pediatrics almost always involves parents or legal guardians to provide consent. State laws should be used to determine the age at which pediatric patients can give legal consent or what exact capacity a patient requires for decision making.

There are few contraindications for performing endoscopy in children. New ASGE standards-of-practice for pediatric endoscopy state the only relative "absolute" contraindication may be when bowel perforation suspected, but even this is best recognized to be a relative risk.[31] Nevertheless, endoscopy in situations that may involve risk factors associated with concerns for patient safety during the procedure should involve a clearly documented risk-to-benefit discussion with the patient or the patient's family. These risk factors may include patient size, as very small premature neonates, in particular those weighing less than 2.0 kg, as well as obese children, may be at risk for respiratory compromise; patients with coagulopathies, which may increase their risks from biopsies; those with neutropenia, which may increase their risks of infection; and those with acute cardiac and/or pulmonary disease, who should also be assessed for risks of sedation-related events.[32–34]

To be of high quality, informed consent should include "professional disclosure," defined as what would be expected should a colleague in the same situation give either to another clinician or to a layperson.[35] Information within disclosure should include a patient's medical diagnosis and results, the proposed procedure and the reason, the benefits anticipated by performing the procedure, any risks the endoscopist has considered as he or she prepares for the procedure, as well as possible complications and/or adverse events that a reasonable patient should expect to know might be encountered during the procedure. Finally, patients should be advised as to any alternatives that might exist to doing the procedure, as well as their prognosis if the procedure is declined.

It is possible to directly relate each component of high-quality consent to specific procedures and their indications in children. For example, in the case of a diagnostic esophagogastroduodenoscopy with biopsies to evaluate esophagitis, the goals of the procedure are to obtain information by visualizing and sampling the mucosa of the upper gastrointestinal tract. Risks of the procedure are rare, but do include bleeding, perforation, and exposure to infectious disease. The alternative to not performing the procedure de facto would entail not gaining information unique to visualizing and/or sampling the mucosa.

COMPLICATIONS OF PEDIATRIC ENDOSCOPY

Although the safety of performing upper endoscopy in children has been well established, it is important to recognize that performing endoscopic procedures in children is inherently risky. In data from PEDS-CORI involving more than 10,000 endoscopies, the overall rate of complications was 2.3%, and mostly involved transient hypoxia from sedation (1.5%).[29] The risk of bleeding was second-most common at 0.3%.

Analysis of PEDS-CORI data also has suggested that characteristics of patients who are most at risk for complications during pediatric upper endoscopy include those who are younger, and those with higher ASA classes.[29] In addition, the presence of a trainee during a procedure may be more associated with adverse events. Presence of a trainee has also been shown to add time to procedures,[36,37] which to some extent should be viewed as a "necessary evil" of training the next generation of endoscopists. On the other hand, as procedural efficiency is increasingly rewarded, it may be important to document trainee presence to account for otherwise substandard metrics. Documentation of presence of a trainee during a procedure should be viewed as an element of high-quality endoscopy in gastrointestinal fellowship programs, as it allows both verification of procedural experience by the trainee, as well as clear evidence of their participation in the patient's medical record.

The ASGE has provided a lexicon for complications of endoscopy that is helpful for standardizing definitions.[38] It is fundamentally important to track complications, even though they may occur extremely infrequently. **Fig. 2** depicts an example of how the number of complications adjusted per 10,000 procedures, and analyzed at the provider level using a funnel plot of upper control limits for provider rates, can be used to identify endoscopists with special cause variation in their even rates. This approach rests on the assumption that if providers as a group are uniformly performing safe and competent gastrointestinal procedures, the rate of major complications during endoscopic procedures will be low and no special cause variation in complication rates across providers will be identified.

It also may be appropriate to risk stratify procedures so as to avoid misclassifying endoscopists with particular advanced expertise in procedures that may incur more risk, and/or those who are willing to take on the most difficult cases in a group. Our experience with adjusting procedures by ASA status (I/II vs III or greater), as well as to whether the procedures were diagnostic or therapeutic, has suggested these may be reasonable variables for risk adjustment. Further study is needed to better elucidate measures of complications, as well as best statistical approaches to understanding them appropriately.

INTRAPROCEDURAL ELEMENTS OF QUALITY

For both upper endoscopy and colonoscopy, high-quality procedures are reflected in documentation that attests to complete inspection, and that differentiates between examination by visualization only, and mucosal sampling. The implementation of

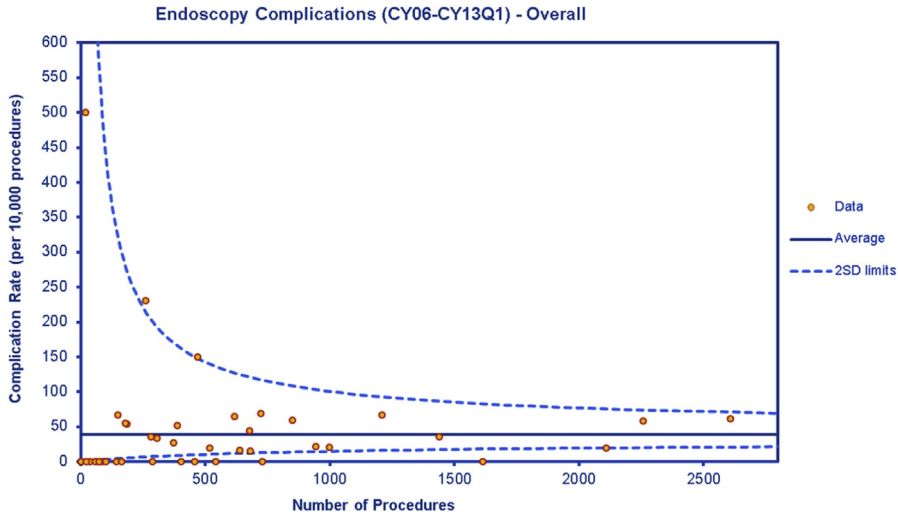

Fig. 2. Example of upper funnel methodology to identify providers (each orange dot represents one provider) with above expected, unadjusted, complication rates for pediatric endoscopy. N = 23,714. Complication Rate = 38.8/10,000 procedures. (*Data Courtesy of* JR Lightdale, MD, Worcester, MA.)

colorectal cancer (CRC) screening in adult medicine has guided development of most intraprocedural quality metrics in endoscopy. The most focus has been placed on cecal intubation rates, as well as adenoma detection rates and indications for procedures (ie, recommended intervals for postpolypectomy surveillance).[9] A multitude of studies have again found variation in care, as well as inconsistencies in documentation, to provide ample opportunities for CQI.[3,8,20,39]

At this time, thresholds for quality of CRC screening are generally considered to be a minimum cecal intubation rate of greater than 90%, a withdrawal time of at least 6 or better 9 minutes, and an adenoma detection rate of greater than 20%.[8] Furthermore, colonoscopy in adults should be completed with a complication rate lower than 1%, including polypectomy. To date, many quality improvement initiatives have focused on processes of care around bowel preparation and withdrawal rates that can help to ensure complete inspection during screening procedures.[40,41] The growing insight into factors that improve complete inspection and thereby CRC detection rates underscores a growing appreciation by adult colonoscopists into processes of care that can affect outcomes.

Colonoscopy in children is fundamental to the diagnosis and management of digestive disease in children, but is rarely performed to screen for CRC. As such, intraprocedural quality metrics for colonoscopy in children must be different from those in adults. Most indications for colonoscopy in children are lower gastrointestinal bleeding, abdominal pain, and diarrhea.[42] Colonoscopy is most commonly performed in infants and children when entertaining a diagnosis of inflammatory bowel disease,[43] but also may be used to identify common sources of rectal bleeding, including juvenile polyps.[42,44]

With respect to common indications, most pediatric colonoscopies require ileocecal intubation to screen for inflammatory bowel disease.[43] Thakkar and colleagues[10] recently proposed candidate quality metrics for pediatric colonoscopy to include ileal intubation, as well as procedure duration and bowel preparation quality. In a study of

quality indicators for pediatric colonoscopy conducted through the PEDS-CORI network, they also reviewed preprocedural documentation of indications, as well as postprocedure unplanned events. In addition to wide variation in documentation, the investigators found approximately 30% of procedures to have no documentation of ileal inspection, and more than 50% to lack documentation of bowel preparation quality. A growing emphasis on improving processes of care, such as bowel preparation, while focusing on quality of documentation, is likely to improve diagnostic yield and help avoid need for repeat procedures.

Upper endoscopy is far more commonly performed in children as compared with colonoscopy, and may be specifically useful to evaluate for the possibility of common pediatric conditions, such as allergic, infectious, or peptic esophagitis; infectious or inflammatory gastritis; and celiac disease.[45] Again, complete inspection is key to diagnosis, and a typical upper gastrointestinal endoscopy should involve direct visualization of the esophagus, stomach, duodenal bulb, and the duodenum.

The preferred method of pediatric endoscope insertion when performing quality endoscopy, with or without endotracheal intubation, is direct visualization of structures in the pharynx, including the palate, epiglottis, arytenoids, and vocal cords. The esophagus should be partially distended to look for abnormalities and to also identify anatomic landmarks, such as the aortic notch and the gastroesophageal junction. The stomach should be considered as 3 areas: the fundus, corpus, and antrum. Most quality upper endoscopic procedures advance to the third part of the duodenum, past the major papilla.

According to new ASGE guidelines, biopsies should be obtained during endoscopic procedures if patients have an underlying immunocompromised state; if irregular or deep ulcerations of the mucosa are seen; or if there is proximal distribution of esophagitis, a mass lesion, or an irregular-appearing stricture.[46] Biopsies during colonoscopy should be obtained if there are irregularities of the mucosa. Generally speaking, obtaining biopsies should be considered a very safe practice, but inherently to involve increased risks, especially of bleeding or perforation.[47] Biopsies also should be recognized to add significant cost to endoscopic procedures. In turn, appropriate sampling may be key to ensuring endoscopic value.[48]

Regarding biopsies and pediatric endoscopy, the standard of care is to obtain them routinely, even in the absence of specific findings.[31] The resulting emphasis on obtaining nonfocal biopsies is based in large part on a consensus “risk-benefit calculation” that the downsides of performing repeat procedures in the pediatric population outweighs the downsides of obtaining biopsies from normal-appearing mucosa, on the off chance it might show disease. Evidence to support this practice has been limited, but impactful. For example, Khakoo and colleagues[49] examined the correlation between endoscopic and histologic findings in 167 children undergoing endoscopy for peptic symptoms, and found that only erosive disease was associated with high endoscopic-histologic correlation. In those patients with no findings endoscopically, 60% had evidence of gastritis on histology.

The likelihood that there may be pathologic findings if the mucosa appears normal to an endoscopist is considerably less during colonoscopy.[48] Nevertheless, it remains common practice during pediatric colonoscopy to obtain multiple nonfocal biopsies at multiple colonic segments, even if there is the appearance of normal colonic mucosa throughout. Recently, a few studies have suggested that current strategies of taking multiple biopsy specimens during pediatric colonoscopies add little to no benefit compared with strategies taking fewer biopsies, and may incur significant cost.[48,50] Future quality studies of pediatric colonoscopy are needed to evaluate biopsy strategies in pediatric colonoscopy in terms of diagnostic yield, patient safety, and procedural value.

Regardless, biopsy protocols during all pediatric procedures may benefit from standardization. For example, it is important to recognize that certain conditions common in children (eg, gastritis, celiac disease) may be patchy in distribution. One proposed method that has been shown consistently to increase diagnostic yield in the case of suspected gastritis is to use the Sydney system, which suggests 5 locations in the stomach[49,51] (**Fig. 3**).

Evidence-based guidelines may be critical to developing high-value biopsy protocols. In the case of celiac disease, the American College of Gastroenterology recommends 4 to 6 proximal small bowel biopsies, from parts 1 to 4 of the duodenum.[52] There has been growing evidence that diagnostic yield of pediatric celiac disease may be increased if the duodenal bulb is biopsied.[53] Eosinophilic esophagitis may be a patchy disease that also requires biopsies for diagnosis. There may be increased diagnostic yield if at least 5 biopsies are obtained from the distal, mid, and proximal esophagus.[54]

POSTPROCEDURAL ELEMENTS OF QUALITY

In the postprocedure period, there are several critical elements to ensuring high endoscopic quality. In particular, ensuring and documenting clear communication on the day of the procedure is important. In addition to communication of endoscopic findings, it is also important to convey that pathology has been sent and is pending. Documentation that the patient has been advised to await results of tissue sampling can attest to this communication.

Communication later of pathology findings is a fundamental responsibility associated with performing endoscopy in children.[55] As with all pathology, this is particularly true if the biopsies suggest disease or an unfavorable diagnosis; however, this responsibility is just as important when the biopsies do not show pathology. Either result is helpful for providing guidance regarding appropriate postprocedural follow-up. Failure to communicate pathology findings is often the result of poorly designed systems for ensuring communication practices.[56]

Role clarity is key, and it should be decided a priori in a practice as to who will communicate the findings. Candidates for this role include the providers themselves, a colleague who referred the patient for endoscopy, as well as nursing or administrative staff. It also should be determined ahead of time what form the communication will

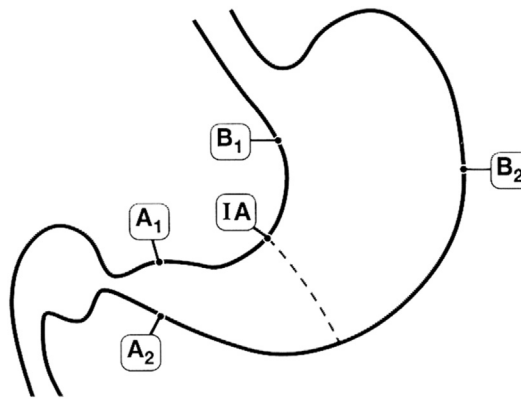

Fig. 3. The Sydney system for rigorously classifying each section of the stomach. (*From* Dixon MF, Genta RM, Yardley JH, et al. Classification and grading of gastritis. The updated Sydney System. International Workshop on the Histopathology of Gastritis, Houston 1994. Am J Surg Pathol 1996;20(10):1161–81; with permission.)

take, and the timing for notification. Finally, role clarity is also key in terms of documenting that communication about pathology results occurred, as well as follow-up plans that were made, in accordance.

Designing good systems for documenting communication of pathology findings requires a careful understanding of individual work-flow.[55] The ideal system for communicating results is meticulous, standardized, and sets clear expectations for everyone, including patients. For example, a practice may opt to provide a written handout during discharge from a procedural unit that gives a timeline for expecting notifications from the endoscopist regarding biopsies, who will call the patient, and how to reach the office if the communication appears to have broken down.

Clear documentation of communicating results should include information about how (eg, via phone call, letter, e-mail) and when patients were contacted, whether or not they appeared to understand the discussion, and what follow-up plan was recommended. It also may be appropriate to document the provider's impression of the patient's understanding and plan for next steps.

SUMMARY

In conclusion, gastrointestinal endoscopy is a fundamental tool for diagnosing gastrointestinal disease in children that is generally safe, but inherently risky. High-quality pediatric endoscopy should be recognized to involve technical, cognitive, and integrative skills. Quality of pediatric procedures should be reflected in documentation of key indicators, which are yet to be fully developed. Nevertheless, a plausible framework for CQI in pediatric endoscopy likely begins with standardization and consistency in documentation throughout all phases of a procedure.

Patient assessment preprocedure is critical and increasingly a nationally recognized quality metric. Likewise, a national emphasis on quality informed consent mandates that physicians explain the nature and purpose of the procedure, the probable risks and benefits, and any rare or unusual risks of which a reasonable person would want to be aware and any alternatives to performing the procedure or refusing care. Intraprocedural quality can be assured by allowing the indication for the procedure to a priori guide evidence-based strategies to ensure complete visualization of the anatomy and to obtain biopsies appropriately. Finally, postprocedural communication of results occurs both on the day of the procedure and subsequently, when pathology results are returned.

In short, ensuring quality in pediatric gastrointestinal procedures requires meticulous, carefully designed systems designed to capture key measures that endoscopists must be open to evaluating, at all stages of their careers.

REFERENCES

1. Bjorkman DJ, Popp JW Jr. Measuring the quality of endoscopy. Am J Gastroenterol 2006;101(4):864–5.
2. Chassin MR, Loeb JM, Schmaltz SP, et al. Accountability measures–using measurement to promote quality improvement. N Engl J Med 2010;363(7):683–8.
3. Hewett DG, Rex DK. Improving colonoscopy quality through health-care payment reform. Am J Gastroenterol 2010;105(9):1925–33.
4. Cotton PB, Hawes RH, Barkun A, et al. Excellence in endoscopy: toward practical metrics. Gastrointest Endosc 2006;63(2):286–91.
5. Brown RD, Goldstein JL. Quality assurance in the endoscopy unit: an emphasis on outcomes. Gastrointest Endosc Clin N Am 1999;9(4):595–607, vi.

6. Johanson JF, Schmitt CM, Deas TM Jr, et al. Quality and outcomes assessment in gastrointestinal endoscopy. Gastrointest Endosc 2000;52(6 Pt 1):827–30.
7. Institute of Medicine Committee on Quality of Health Care in America. To err is human: building a safer health system. In: Kohn L, Corrigan J, Donaldson M, editors. Washington, DC: National Academy Press; 2000. p. 287.
8. Pullens HJ, Siersema PD. Quality indicators for colonoscopy: current insights and caveats. World J Gastrointest Endosc 2014;6(12):571–83.
9. Rex DK, Petrini JL, Baron TH, et al. Quality indicators for colonoscopy. Am J Gastroenterol 2006;101(4):873–85.
10. Thakkar K, Holub JL, Gilger MA, et al. Quality indicators for pediatric colonoscopy: results from a multicenter consortium. Gastrointest Endosc 2015. [Epub ahead of print].
11. Aabakken L, Rembacken B, LeMoine O, et al. Minimal standard terminology for gastrointestinal endoscopy—MST 3.0. Endoscopy 2009;41(8):727–8.
12. Robertson DJ, Lawrence LB, Shaheen NJ, et al. Quality of colonoscopy reporting: a process of care study. Am J Gastroenterol 2002;97(10):2651–6.
13. Lieberman D, Nadel M, Smith RA, et al. Standardized colonoscopy reporting and data system: report of the quality assurance task group of the national colorectal cancer roundtable. Gastrointest Endosc 2007;65(6):757–66.
14. Lieberman DA, Faigel DO, Logan JR, et al. Assessment of the quality of colonoscopy reports: results from a multicenter consortium. Gastrointest Endosc 2009; 69(3 Pt 2):645–53.
15. Walsh CM, Ling SC, Khanna N, et al. Gastrointestinal endoscopy competency assessment tool: development of a procedure-specific assessment tool for colonoscopy. Gastrointest Endosc 2014;79(5):798–807.e5.
16. Leichtner AM, Gillis LA, Gupta S, et al. NASPGHAN guidelines for training in pediatric gastroenterology. J Pediatr Gastroenterol Nutr 2013;56(Suppl 1):S1–8.
17. Walsh CM, Ling SC, Walters TD, et al. Development of the gastrointestinal endoscopy competency assessment tool for pediatric colonoscopy (GiECATKIDS). J Pediatr Gastroenterol Nutr 2014;59(4):480–6.
18. Walsh CM, Ling SC, Mamula P, et al. The gastrointestinal endoscopy competency assessment tool for pediatric colonoscopy. J Pediatr Gastroenterol Nutr 2015; 60(4):474–80.
19. Rex DK, Bond JH, Winawer S, et al. Quality in the technical performance of colonoscopy and the continuous quality improvement process for colonoscopy: recommendations of the US Multi-Society Task Force on Colorectal Cancer. Am J Gastroenterol 2002;97(6):1296–308.
20. de Jonge V, Sint Nicolaas J, Cahen DL, et al. Quality evaluation of colonoscopy reporting and colonoscopy performance in daily clinical practice. Gastrointest Endosc 2012;75(1):98–106.
21. Available at: http://mocportfolioprogram.org/. Accessed August 30, 2015.
22. NASPGHAN. 2015. Available at: http://naspghan.org. Accessed August 30, 2015.
23. Balaguer F, Llach J, Castells A, et al. The European panel on the appropriateness of gastrointestinal endoscopy guidelines colonoscopy in an open-access endoscopy unit: a prospective study. Aliment Pharmacol Ther 2005;21(5):609–13.
24. Froehlich F, Repond C, Mullhaupt B, et al. Is the diagnostic yield of upper GI endoscopy improved by the use of explicit panel-based appropriateness criteria? Gastrointest Endosc 2000;52(3):333–41.
25. de Bosset V, Froehlich F, Rey JP, et al. Do explicit appropriateness criteria enhance the diagnostic yield of colonoscopy? Endoscopy 2002;34(5):360–8.

26. Practice guidelines for sedation and analgesia by non-anesthesiologists. Anesthesiology 2002;96(4):1004–17.
27. Anesthesiology ASo. ASA physical status classification system. 2014. Available at: http://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system. Accessed April 19, 2015.
28. Mak PH, Campbell RC, Irwin MG. The ASA Physical Status Classification: inter-observer consistency. American Society of Anesthesiologists. Anaesth Intensive Care 2002;30(5):633–40.
29. Thakkar K, El-Serag HB, Mattek N, et al. Complications of pediatric EGD: a 4-year experience in PEDS-CORI. Gastrointest Endosc 2007;65(2):213–21.
30. Committee ASoP, Chandrasekhara V, Eloubeidi MA, Bruining DH, et al. Open-access endoscopy. Gastrointest Endosc 2015;81(6):1326–9.
31. Committee ASoP, Lightdale JR, Acosta R, Shergill AK, et al. Modifications in endoscopic practice for pediatric patients. Gastrointest Endosc 2014;79(5):699–710.
32. Buderus S, Sonderkotter H, Fleischhack G, et al. Diagnostic and therapeutic endoscopy in children and adolescents with cancer. Pediatr Hematol Oncol 2012;29(5):450–60.
33. Seefelder C, Elango S, Rosbe KW, et al. Oesophageal perforation presenting as oesophageal atresia in a premature neonate following difficult intubation. Paediatr Anaesth 2001;11(1):112–8.
34. Long Y, Liu HH, Yu C, et al. Pre-existing diseases of patients increase susceptibility to hypoxemia during gastrointestinal endoscopy. PLoS One 2012;7(5):e37614.
35. Lofft AL. Informed consent for endoscopy. Gastrointest Endosc Clin N Am 1995;5(2):457–70.
36. Lightdale J, Valim C, Newburg A, et al. Efficiency of propofol sedation versus conscious sedation with midazolam and fentanyl in a pediatric endoscopy unit. Gastrointest Endosc 2005;61(5):AB92.
37. McCashland T, Brand R, Lyden E, et al. The time and financial impact of training fellows in endoscopy. CORI Research Project. Clinical Outcomes Research Initiative. Am J Gastroenterol 2000;95(11):3129–32.
38. Cotton PB, Eisen GM, Aabakken L, et al. A lexicon for endoscopic adverse events: report of an ASGE workshop. Gastrointest Endosc 2010;71(3):446–54.
39. Kaminski MF, Regula J, Kraszewska E, et al. Quality indicators for colonoscopy and the risk of interval cancer. N Engl J Med 2010;362(19):1795–803.
40. Lee TJ, Blanks RG, Rees CJ, et al. Longer mean colonoscopy withdrawal time is associated with increased adenoma detection: evidence from the Bowel Cancer Screening Programme in England. Endoscopy 2013;45(1):20–6.
41. Belderbos TD, Grobbee EJ, van Oijen MG, et al. Comparison of cecal intubation and adenoma detection between hospitals can provide incentives to improve quality of colonoscopy. Endoscopy 2015;47(8):703–9.
42. Thakkar K, Alsarraj A, Fong E, et al. Prevalence of colorectal polyps in pediatric colonoscopy. Dig Dis Sci 2012;57(4):1050–5.
43. Rufo PA, Denson LA, Sylvester FA, et al. Health supervision in the management of children and adolescents with IBD: NASPGHAN recommendations. J Pediatr Gastroenterol Nutr 2012;55(1):93–108.
44. Lee HJ, Lee JH, Lee JS, et al. Is colonoscopy necessary in children suspected of having colonic polyps? Gut Liver 2010;4(3):326–31.
45. Vandenplas Y, Rudolph CD, Di Lorenzo C, et al. Pediatric gastroesophageal reflux clinical practice guidelines: joint recommendations of the North American

Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN). J Pediatr Gastroenterol Nutr 2009;49(4):498–547.
46. Committee ASoP, Sharaf RN, Shergill AK, Krinsky ML, et al. Endoscopic mucosal tissue sampling. Gastrointest Endosc 2013;78(2):216–24.
47. Yao MD, von Rosenvinge EC, Groden C, et al. Multiple endoscopic biopsies in research subjects: safety results from a National Institutes of Health series. Gastrointest Endosc 2009;69(4):906–10.
48. Badizadegan K, Thompson KM. Value of information in nonfocal colonic biopsies. J Pediatr Gastroenterol Nutr 2011;53(6):679–83.
49. Khakoo SI, Lobo AJ, Shepherd NA, et al. Histological assessment of the Sydney classification of endoscopic gastritis. Gut 1994;35(9):1172–5.
50. Manfredi MA, Jiang H, Borges LF, et al. Good agreement between endoscopic findings and biopsy reports supports limited tissue sampling during pediatric colonoscopy. J Pediatr Gastroenterol Nutr 2014;58(6):773–8.
51. Lash JG, Genta RM. Adherence to the Sydney System guidelines increases the detection of Helicobacter gastritis and intestinal metaplasia in 400738 sets of gastric biopsies. Aliment Pharmacol Ther 2013;38(4):424–31.
52. Rubio-Tapia A, Hill ID, Kelly CP, et al, American College of Gastroenterology. ACG clinical guidelines: diagnosis and management of celiac disease. Am J Gastroenterol 2013;108(5):656–76 [quiz: 677].
53. Weir DC, Glickman JN, Roiff T, et al. Variability of histopathological changes in childhood celiac disease. Am J Gastroenterol 2010;105(1):207–12.
54. Dellon ES, Gonsalves N, Hirano I, et al. ACG clinical guideline: evidenced based approach to the diagnosis and management of esophageal eosinophilia and eosinophilic esophagitis (EoE). Am J Gastroenterol 2013;108(5):679–92 [quiz: 693].
55. Coffin CM. Pediatric surgical pathology: pitfalls and strategies for error prevention. Arch Pathol Lab Med 2006;130(5):610–2.
56. Nakhleh RE. Quality in surgical pathology communication and reporting. Arch Pathol Lab Med 2011;135(11):1394–7.