

Quality Improvement and Patient Safety in the Pediatric Ambulatory Setting: Current Knowledge and Implications for Residency Training

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KEYWORDS

• Quality • Safety • Ambulatory • Residency training • Pediatrics

The pediatric outpatient environment varies greatly in setting, population served, the presence of trainees, and the types of providers caring for patients. There is also great variability in the quality and effectiveness of care across and within various pediatric ambulatory settings. The knowledge of the extent of this variability is fairly limited, although it is increasing coincident with more attention to quality and the expanded number of measures used by various agencies and entities. The outpatient environment has been the leading edge of improvement work in pediatrics and it has similarly served as an effective locale for the training of pediatric residents in the science of improvement.

This review summarizes what is known about the measurement of quality and patient safety in pediatric ambulatory settings. The current Accreditation Council for Graduate Medical Education (ACGME) requirements for resident training in improvement and their application in these settings are discussed. Some approaches and challenges to meeting these requirements are reviewed. Finally, some future directions that this work may follow are presented; the goal is to strengthen the effectiveness of improvement methods and their linkage to professional education.

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QUALITY IN THE AMBULATORY ENVIRONMENT: WHAT IS KNOWN?

Measurement of quality in ambulatory environments has evolved over the past 15 years since the introduction of the Healthcare Effectiveness Data and Information Set (HEDIS) (see <http://www.ncqa.org/tabid/29/Default.aspx>) by the National Committee for Quality Assurance in 1993.¹ HEDIS provides measurement of the quality of care, primarily in ambulatory settings, and offers comparative performance data between different health plans. Since the introduction of HEDIS, quality measurement has been promoted and implemented by numerous other stakeholders and national organizations to provide information about health providers, ostensibly to inform decision-making by consumers. Although profiling with HEDIS may not be valid for comparison between providers,² these measures are frequently of great benefit for the purpose of quality improvement across ambulatory practices.

The American Academy of Pediatrics (AAP) recently published a review of measurement of quality in pediatric settings.³ The AAP defines appropriate measures by the following criteria:

1. Measures should address issues that are significant for children's health, by severity, prevalence or functional status, and should have the potential to influence improvement.
2. Measures should be scientifically valid and must be found to be reliable after a period of "field testing."
3. Measures should be feasible to collect.

The AAP has endorsed similar recommendations for the "measure" definition outlined by the American Academy of Family Physicians, particularly with respect to measures for use in pay for performance programs. These recommendations reflect support for the patient-physician relationship, and seek to link all measures to clinical guidelines or other evidence-based medicine principles.⁴

The child health field has not received the degree of attention and focus on measurement or pay for performance from government, payers, and other health care stakeholders as adult medicine. While Medicare has, in recent years, introduced an incentive payment system for outpatient providers called "Physician Quality Reporting Initiative" (PQRI) (see <http://www.cms.hhs.gov/pqri/>), Medicaid has no such national program, although some states have implemented local programs to provide incentives for quality performance. In 2003, a study found that children covered by Medicaid were less likely to be fully immunized (69% versus 54%); less likely to have received recommended well-child visits in the first 15 months of life, (53% versus 31%); and far more likely to undergo myringotomy tubes (35 versus two per 1000 members), compared with children on commercial health insurance.⁵

In contrast with adult care, most pediatric quality measurement has focused on the ambulatory environment. Pediatric HEDIS measures (**Box 1**) include such elements of outpatient pediatric care quality as childhood immunization rates and appropriate care of pediatric asthma. Over the past twenty years, other managed care measures have been used by various health plans (eg, rates of lead screening, use of antibiotics for respiratory infections, and adherence to various preventive services like dental care). Some of these measures (**Table 1**) have been included in various national data sets and endorsed by the National Quality Forum and the Ambulatory Quality Alliance.

The seminal study by Mangione-Smith and colleagues⁶ assessing the quality of ambulatory pediatric care was a follow-up to an earlier RAND Corporation study of the quality of adult outpatient care in the United States. Similar to the adult study,⁷ Mangione-Smith and colleagues reported that children received only 46.5% of

Box 1**2009 HEDIS measures pertaining to children's health**

Weight assessment counseling for nutrition and physical activity for children and adolescents
 Childhood immunization status
 Lead screening in children
 Appropriate testing for children with pharyngitis
 Appropriate treatment for children with upper respiratory infection
 Use of appropriate medications for asthma
 Follow-up care for children prescribed ADHD medications
 Access to care (# of visits) as measured at various age ranges
 Annual dental visit
 Cost of care measures/relative resource use
 Guidelines for effectiveness of care measures

recommended care for preventive services, acute illness management, and ongoing care of chronic conditions. The measures considered in the pediatric study included care for: acne, asthma, attention deficit hyperactivity disorder, adolescent preventive health, allergic rhinitis, depression, diarrhea, fever, immunizations, urinary tract infections, vaginitis/sexually transmitted diseases, and routine health care maintenance.

Other landmark studies of quality of care for children were the National Healthcare Quality Report and the National Healthcare Disparities Report issued by the Agency for Healthcare Research and Quality in 2005.⁸ These reports demonstrated both general gaps in care, as well as inequity of care in such critical factors as: infant mortality (4.6 per 1000 live births in Massachusetts as compared with 12.1/1000 in Washington D.C.); overuse of antibiotics (twice as frequent in children as compared with adults); incomplete immunizations (67% of black children fully immunized, compared with a 73% average rate and 75% for white children); and hospitalization for asthma (29.5/10,000 children overall but 59.6 hospitalizations per 10,000 black children).

Many of these gaps had been documented previously in studies examining the quality of pediatric care for asthma, immunizations, and well-child care. Unfortunately, documenting gaps and disparities is easier than demonstrating effective strategies for narrowing them. For example, the National Cooperative Inner City Asthma Study reported that its Inner City Asthma Intervention toolkit was implemented in more than 20 sites. The program was felt to be effective but did not include an evaluative component that could objectively demonstrate the program's impact.⁹ Similarly, Homer and colleagues¹⁰ reported in 2005 that a rigorous assessment of a commonly used quality improvement intervention had not demonstrated significant impact on either process or outcome measures of care for asthma.

Quality in pediatrics has more often been measured in processes rather than outcomes. A "process measure" assesses the performance of the health system itself, as contrasted with an "outcome measure" that illustrates patient health results. For example, asthma measures are often focused on whether children are prescribed appropriate therapy, not whether the child required hospitalization or missed school days. Immunization measures are typically reported as adherence to recommended vaccination schedules and do not necessarily address the outcome measure of effective prevention of vaccine-preventable diseases.

Table 1 National Quality Forum voluntary consensus measures	
Category of Measures	Measures Pertinent for Children
Ambulatory surgery center measures	Prophylactic antibiotics for surgical cases (timing, choice, discontinuation) Falls Never events (Wrong site, side, procedure)
Asthma and respiratory illness	Asthma assessment Management plan Appropriate asthma meds Appropriate treatment for upper respiratory infection Appropriate testing for pharyngitis
Bone and joint disease	(None; osteoporosis, low back pain)
Diabetes	Adult inclusion criteria only (age 18–75 years old)
Eye care	(All adult measures)
Geriatrics	None
Heart disease	None
Hypertension	None
Medication management	Med lists Allergies documented Annual monitoring for selected drugs Drug avoidance in elderly
Mental health and substance use	ADHD diagnosis based on DSM-IV criteria Follow up care for ADHD
Obesity	BMI documented in children 2–18 years
Patient experience with care	None (CAHPS survey-based Medicare pts only)
Prenatal care	
Prevention immunization and screening	Tobacco use or exposure documentation and prevention Childhood immunization status

Data from National Quality Forum, Washington, DC. Available at: <http://www.qualityforum.org>.

Several pediatric subspecialty societies are developing common measure sets, although none have been endorsed to date by NQF or other national entities. The Cystic Fibrosis (CF) Foundation has published clinical quality measures for CF programs across the country (see <http://www.cff.org/LivingWithCF/QualityImprovement/>). These process measures include benchmarked outcome measures for pulmonary status, nutritional status, and adherence to clinical care guidelines. Although other specialty societies have issued outcome-oriented measures (eg, clinical oncology group), most have been research-focused and not publicly available or usable for quality improvement efforts. Recently, a network of pediatric gastroenterologists has initiated an improvement collaborative (“Trailblazer Collaborative”) that aims to improve care and outcomes for children with inflammatory bowel disease.¹¹

Although the principle of equity is one of the six central domains of the definition of quality,¹² there is no national definition for measurement of equity and no NQF-endorsed measure that is specifically evaluated by race and/or ethnicity. Conditions, such as sickle cell disease, which differentially impact children from minority racial and ethnic backgrounds, have been underrepresented in emerging quality efforts and will require systematic advocacy and support for these efforts.¹³

Measurement efforts can be either for comparative reporting and benchmarking, or primarily for improvement.³ Scrutiny of measures used for comparative reporting is essential to ensure validity, risk adjustment, and assurance that differences in performance are caused by differences in care. Studies regarding adults who have diabetes have demonstrated that less than 5% of differences in measured outcomes were attributable to provider decision-making and behavior.² Caution is desirable in the rush to develop and disseminate national measures to assess and compare quality across providers.

PATIENT SAFETY IN THE AMBULATORY ENVIRONMENT: WHAT IS KNOWN?

There is a small but growing body of information available on the types of errors that occur in ambulatory care,^{14–22} Studies on pediatric ambulatory medical errors are also limited.^{23–26} Research suggests that adverse events and near misses are frequent occurrences, but little is known about types of errors, risk factors, or effective interventions.

Most reports of errors in ambulatory pediatric care have centered on medication safety. In one study,²⁷ 21 percent of outpatient prescriptions in a family medicine practice had at least one error. Other investigators found that medication samples were dispensed with inadequate documentation.²⁸ High rates of medication documentation errors were found in another family medicine practice.²⁹ In a pediatric emergency department in Canada, 100 prescribing errors and 39 medication administration errors occurred per 1000 patients.³⁰ In a sample of new prescriptions for 22 common medications in outpatient pediatric clinics, approximately 15% were dispensed with potential dosing errors.²⁴

Several studies have examined antipyretic-dosing errors in children seen in pediatric emergency departments. Li and coworkers³¹ found that over half of surveyed caregivers gave inaccurate doses of acetaminophen or ibuprofen, especially to infants. Another study³² determined that 53% of children received an improper antipyretic dose at home. Goldman (2004)³³ noted that most parents under-dosed their children with acetaminophen, leading to unnecessary emergency visits. Losek and colleagues³⁴ reported that 22% of acetaminophen dose orders were outside accepted recommendations.

Some investigators have reported studies on immunization errors. Feikema and colleagues,³⁵ using data from the United States 1997 National Immunization Survey, found that 21% of children were over-immunized for at least one vaccine, and 31% were under-immunized for at least one vaccine. The costs associated with extra vaccination were estimated conservatively at \$26.5 million. A study by Butte and colleagues³⁶ determined that strict interpretation of immunization guidelines contributed to 35.5% of patients having at least one invalid dose. Petridou and colleagues³⁷ found that there were only 11 reported errors per million immunization doses in Greece in 1999–2000, but the rate of reporting was not noted.

The Learning from Errors in Ambulatory Pediatrics (LEAP) study²⁵ aimed to learn scope, range, potential causes, and possible solutions to medical errors in pediatric ambulatory care. Among 14 pediatric practice sites, there were 147 medical errors reported during the study period. The largest group of errors was related to medical treatment (37%), but errors were also associated with: patient identification (22%); preventive care including immunizations (15%); diagnostic testing (13%); patient communication (8%); and other less frequent causes. Of the medical treatment errors, 85% were medication errors. The investigators determined that among the medication errors, 55% were related to ordering, 30% to failure to order, 11% to administration, 2% to transcribing, and 2% to dispensing.

Kaushal and colleagues²³ reported a prospective cohort study at six office practices in Boston area over 2 months. They discovered 57 preventable adverse drug events (rate 3%, 95% CI 3%–4%) in the care of 1788 patients. None of the events was determined to be life threatening, but eight (14%) were serious. Forty (70%) were related to parental drug administration. The authors determined that improved communication between providers and parents and between pharmacists and parents were the preventive strategies with the most potential benefit to prevent these errors.²⁶ Using the same data, they determined that children with multiple prescriptions were at increased risk of preventable adverse drug events, with an odds ratio of 1.46 (95% CI 1.01–2.11).

Leyva and colleagues³⁸ examined the impact of language barriers on medication errors in New York. They sought to determine how well Bronx Spanish-speaking Latino parents of children 5 years and younger understand written medication instructions. After receiving instructions on administration of ferrous sulfate, only 22% of parents demonstrated correct medication administration (amount and frequency). Subjects who reported comfort when speaking English were more likely to demonstrate correct medication amount to be administered (50% versus 21%, OR 3.8; 95% CI, 1.2–12.2) and correct frequency (93% versus 51%, OR 12.4; 95% CI, 1.5–99.1). Both education (OR 1.22, 95% CI, 1.03–1.45) and comfort speaking English (OR 3.81, 95% CI, 1.13–12.86) independently predicted correct medication dosing.

Neuspiel and colleagues³⁹ describe a voluntary, anonymous, non-punitive, team-based error reporting system, paired with team-based system analysis, rapid redesign, and monitoring of changes in the setting of a pediatric ambulatory department of an academic hospital in New York City. This system was partly modeled on a project implemented in an academic adult primary care setting in Charlottesville, Virginia.²² In the New York study in the first year, 80 errors were reported, compared with only 5 errors reported during the prior year via a traditional incident reporting system. Both medication and non-medication errors were included.

Garbutt and colleagues⁴⁰ report a survey of 439 attending pediatricians and 118 residents about attitudes and experiences in disclosing errors to patients. Only 39% thought current reporting systems were adequate. Residents were more likely than attending physicians to believe that disclosure would be difficult (96% versus 86%, $P = .004$) and to want disclosure training (69% versus 56%, $P = .03$). Attending pediatricians were less likely than residents to be deterred from disclosing an error if the family was unaware of it (12% versus 26%, $P < .001$), if they thought the family would not want to know about it (20% versus 29%, $P = .04$), or if they thought they might get sued (13% versus 21%, $P = .04$).

What can be concluded from current knowledge on medical errors in ambulatory pediatrics? They are frequent events, often related to medication errors. Receiving multiple medications increases the risk of errors. Improving communication with patients and their parents appears to be a ripe opportunity for reducing errors. Language and cultural barriers in communication are particularly important to overcome to reduce the likelihood of medication errors in children. A nonpunitive, team-based reporting system may improve reporting. There appear to be disjointed attitudes about disclosure of errors to patients between pediatric residents and attending physicians, suggesting a training opportunity in this area.

RESIDENCY COMPETENCIES RELEVANT TO QUALITY IMPROVEMENT AND SAFETY

In 2002, in response to the 2001 *Crossing the Quality Chasm* report, the Institute of Medicine (IOM) convened an interdisciplinary summit to reform health professions

education “to enhance patient care quality and safety.”⁴¹ The IOM committee report from this summit stated its “new vision for health professions education”:

All health professionals should be educated to deliver patient-centered care as members of an interdisciplinary team, emphasizing evidence-based practice, quality improvement approaches, and informatics.

The IOM committee proposed a set of five core competencies that all clinicians should possess:

1. Provide patient-centered care
2. Work in interdisciplinary teams
3. Employ evidence-based practice
4. Apply quality improvement
5. Use informatics

The IOM committee called for accreditation bodies to require training programs for health care professionals to educate students in how to deliver patient care using these core competencies. At the time of this report’s publication, evidence for educational activities in quality improvement within the health professions was described as “sparse.”

GRADUATE MEDICAL EDUCATION REQUIREMENTS IN PEDIATRICS

The ACGME pediatric residency program requirements, which became effective July 1, 2007, include several sections relevant to addressing the IOM core competences in quality and patient safety (http://www.acgme.org/acWebsite/downloads/RRC_progReq/320_pediatrics_07,012,007.pdf). In the section on practice-based learning and improvement, the requirements state:

Residents must demonstrate the ability to investigate and evaluate their care of patients, to appraise and assimilate scientific evidence, and to continuously improve patient care based on constant self-evaluation and life-long learning.

To achieve this competency, residents must:

- Identify strengths, deficiencies, and limits in their knowledge and expertise;
- Set learning and improvement goals, identify and perform appropriate learning activities;
- Analyze their practice systematically with quality improvement methodology and implement changes to improve their practice;
- Incorporate formative evaluation feedback into daily practice;
- Locate, appraise, and assimilate evidence from publications related to their patients’ health problems;
- Use information technology to optimize their learning; and
- Participate in the education of others.

Individual or teams of residents may participate in a quality improvement project to meet part of this competency, or they may be active members of a QI committee, under the supervision of experienced faculty.

The ACGME also calls for competency in systems-based practice:

Residents must demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care.

This competency calls for:

- Incorporation of considerations of cost awareness and risk-benefit analysis for patient-and/or population-based care as appropriate;

- Advocacy for quality patient care and optimal patient care systems;
- Working in interprofessional teams to enhance patient safety and improve patient care quality; and
- Participation in identifying system errors and implementing potential system solutions.

The program must ensure that resident education addresses systems approach to examining health care delivery, system errors and system solutions to prevent errors. Each resident must be actively engaged in the identification of system errors and in the development of system solutions, under the guidance of experienced faculty.

ACADEMIC PEDIATRIC ASSOCIATION EDUCATIONAL GUIDELINES

In 2004, the Academic Pediatric Association (APA; formerly the Ambulatory Pediatric Association) published the APA Educational Guidelines for Pediatric Residency. The section of this curriculum on quality improvement defines its goal as: “to understand the importance of and how to use quality improvement methods to monitor and improve the health care that one provides to children.”⁴² Objectives to fulfill this goal include:

- Explaining the role of regulatory or accreditation programs in monitoring quality in hospital and office based settings;
- Discussing tools used to assess quality in pediatric practice;
- Describing role of standards, such as HEDIS in setting benchmarks for pediatric services;
- Identifying and evaluating literature defining best practices;
- Analyzing one’s own practice for factors that promote or inhibit the delivery of high-quality, cost-effective pediatric care;
- Reviewing patient satisfaction results to identify areas for improvement in one’s practice;
- Practicing continuous quality improvement in one’s practice using the PDSA or similar framework;
- Balancing cost and quality in medical decision-making.

The APA Educational Guidelines also include a section on medical errors and patient safety, the goal of which is “to understand the importance of error reduction in medical practice.”⁴² The objectives listed to meet this goal include:

- Discussing the impact of medical errors, including how such errors might occur in one’s own practice;
- Acknowledging the importance of reducing medication errors in pediatric practice and ways to do so;
- Frankly disclosing when an error has occurred, and determine its contributing causes;
- When a preventable medical error occurs in one’s practice, investigate it without assigning blame, distinguish personal from system causes, identify latent conditions that may result in errors and propose interventions to reduce or eliminate such risks, identify how and to whom errors should be reported, and describe methods used to evaluate errors.
- Demonstrating a commitment to systematic error reduction, including self-surveillance to reduce error-prone conditions, such as fatigue.
- Identifying Web sites about patient safety that are useful for physicians.

VALUE OF THE AMBULATORY SETTING FOR LEARNING ABOUT QUALITY AND SAFETY

Pediatric continuity practices present natural opportunities for residents to engage in both practice-based learning and system-based practice while applying quality improvement skills. Residents usually train in the same practice location over a 3-year period. As they are providing continuous care, it is common for them to identify gaps in the delivery of health care at the practice site. Residents are often interested in improvement and the continuity setting may provide both time and real life opportunity to engage in small cycles of change to improve care delivery. While working with a multidisciplinary ambulatory care team, including nursing, medical assistants, registrars, administration and social work, they can create common goals and share ideas for system change. Residents then can participate in real time improvement cycles with members of their continuity practice team. Time may be found during ambulatory block or outpatient rotations to be engaged in long-term design and implementation of ambulatory improvement projects during training.

The ACGME 2007 guidelines call for residents to participate in quality improvement projects, as well as locate, appraise, and assimilate evidence from scientific studies related to their patients' health problems as part of the competency of practice-based learning. During their continuity experience, residents can identify gaps in both knowledge and applied clinical practice, which may be improved by quality improvement methods. Immunization rates, lead screening policies, and asthma management are clinical areas where residents can improve their knowledge about standards of care and work on eliminating the gaps in care delivery.

Because residents spend 10%–20% of their training during residency in their continuity site and in ambulatory block rotations, these are important opportunities to apply quality improvement skills. Gaps in care identified in continuity practices often stimulate the resident's desire to act as a patient advocate and improve the system of health care in which they practice. Their quality improvement work may require that they interface with schools, health insurance administrators, and practice managers, further meeting ACGME competencies.

The American Board of Pediatrics (ABP) has recognized the importance of quality improvement for patient care and safety, reflected in current and future board recertification requirements. They note that pediatricians can be knowledgeable, and yet still have gaps in quality of care. Part four of the "Maintenance of Certification" (see <https://www.abp.org/ABPWebSite/>) provides activities that allow pediatricians to demonstrate that they can assess, reduce variation, and systematically improve the quality of care they deliver. Physicians can demonstrate competency either by participating in an ongoing ABP-approved structured quality improvement project or by completing internet-based quality improvement activities. Because all residents will be required to participate in quality improvement learning and practice to maintain certification, they will benefit from learning how to improve care delivery and incorporate team strategies in the ambulatory setting.

EXPERIENCE WITH RESIDENT TRAINING IN QUALITY IMPROVEMENT

In 2007, Boonyasai and colleagues⁴³ reported a systematic review on the effectiveness of educating clinicians on quality improvement. They also sought to determine whether the effectiveness of such curricula is influenced by teaching methodology. Among 39 studies meeting eligibility criteria, 31 were team-based projects, and 37 were combinations of didactic with experiential learning.

The studies evaluated by Boonyasai and colleagues⁴³ included a range of two to eight out of nine adult learning principles (median = seven). These principles include the following characteristics:

1. enabling learners to be active participants;
2. providing content relating to learners' current experiences;
3. assessing learners' needs and tailoring teaching to their past experiences;
4. allowing learners to identify and pursue their own learning goals;
5. allowing learners to practice their learning;
6. supporting learners during self-directed learning;
7. providing feedback to learners;
8. facilitating learner self-reflection;
9. role-modeling behaviors.

Evaluations of effectiveness included 22 controlled trials (eight randomized; 14 not randomized), and 17 pre/post- or time series measurements. Educational outcomes were described in 14 studies, and 28 studies described clinical process or patient outcomes. Of 10 studies that evaluated knowledge, nine studies reported only positive effects, but most of the assessment tools were not validated. There were mixed results among the six assessments of attitudes. Skill or behavior outcomes were measured in six studies, four of which reported only positive results. Among the 28 studies of clinical outcomes, eight reported only beneficial effects. Mixed or no effects were more frequent in the controlled studies. There were only four studies reporting both educational and clinical outcomes. Boonyasai and colleagues⁴³ conclude that most published QI curricula employ appropriate adult learning principles and show improvement in the knowledge or confidence of learners to perform QI.

Seven of the 39 studies evaluated by Boonyasai and colleagues⁴³ involved resident physicians.^{44–50} All were in ambulatory sites, combining didactic instruction with participation in QI activities. Five of these were integrated into 4-week rotations, and two had regular weekly or biweekly meetings over a year. Boonyasai and colleagues⁴³ found that QI curricula among trainees with clinical outcomes reported mostly beneficial improvement in documentation and disease management, but that their study designs were weak, because they were mainly uncontrolled.

EXPERIENCE WITH RESIDENT TRAINING IN PATIENT SAFETY

Battles and Shea report that resident physicians are involved in many medical errors, and that their deficient education in patient safety contributes to the potential harm of patients.⁵¹ These authors called for the use of root-cause analysis with a near-miss reporting system in teaching hospitals to guide needed changes in graduate medical education programs. In a subsequent publication, Sachdeva and colleagues⁵² suggested the use of standardized patients in an objective structured clinical examination (OSCE) as a teaching tool in patient safety, using cases derived from actual events. They present the results of a national consensus conference on patient safety curricula for surgical residency programs.⁵³

Specific experiences with resident patient-safety curricula with relevance to pediatrics have been reported by two family medicine residency programs. Coyle and colleagues⁵⁴ evaluated the effectiveness of an educational program to improve medical event reporting attitude and behavior in ambulatory care. They found that attendance at six monthly patient-safety educational conferences was significantly correlated with medical event-reporting attitude and behavior change. Barriers to reporting included lack of time, extra paper work, and concerns about career and

personal reputation. Another patient safety curriculum⁵⁵ includes introductory workshops for faculty and residents, several didactic courses, individual portfolios, and a series of small group exercises including chart reviews, case presentations and a long-term quality improvement project. These activities are coordinated by a multi-disciplinary team. Evaluation of the curriculum includes ongoing assessment of resident performance in the included activities and in an annual OSCE. The program was successfully introduced, although OSCE results were not included in this publication.

EXPERIENCE WITH QUALITY IMPROVEMENT TRAINING IN PEDIATRIC AMBULATORY SETTINGS

Since 2004, the pediatric residency training program at New York Presbyterian Hospital (NYPH) has instituted annual longitudinal quality improvement projects based in the continuity clinic setting. This program trains 60 pediatric residents based at four community-based practice locations. Under the guidance of a faculty mentor, residents select a gap in care and then design and implement improvements using the methodology of the model for improvement.⁵⁶ Residents participate in their clinic site-based improvement project during their ambulatory block rotation and hand-off the work to the next resident participating in the longitudinal project.

Projects are driven by ideas for change generated by the pediatric residents, who identify gaps in their knowledge and/or practice and then as a group determine which gap they plan to improve over the course of the academic year. The curriculum includes an overall presentation about quality improvement and the model for improvement as well as four team meetings over the course of the year to discuss AIM statements, “Plan, Do, Study and Act” (PDSA) cycles, measurement and sustaining change as they apply to their current improvement work. In the spring of each academic year, the four projects are presented and evaluated for adherence to the model for improvement, reaching stated goals and potential for sustaining the system changes, which have been incorporated into the practice. This work is unique in that it moves from the hypothetical model of writing a proposal for system changes to actually embedding this work into the clinic setting, performing PDSA cycles, and achieving results with actual system changes.

During their projects, residents are change agents but learn the value of a team model to initiate and sustain change. Faculty mentors oversee participation in the improvement work, while residents choose the gap in care studied and direct the change process. Each resident team reviews and presents the evidence supporting their improvement. Following the dimensions of quality outlined by the IOM, gaps in care have fallen into the categories of effective, safe, patient-centered, efficient, timely and equitable. For example, residents have chosen to improve care in the following areas:

- *Screening*- anemia, lead, tuberculosis, hypertension and asthma
- *Mental Health* – domestic violence and postpartum depression
- *Safety* – home medications and over the counter medications, improving communication between subspecialists and primary care providers
- *System* – redesigning flow of vision and hearing screening
- *Anticipatory Guidance* – dental health, obesity and screen time, and development screening.

Residents have real time opportunities during the rotation to plan and implement a PDSA cycle and suggest the next cycle for the following resident.

An evaluation program has been instituted to assess the quality of the training program. Residents complete knowledge, skills and attitude surveys at the end of their rotations; and faculty mentors also reflect on resident skill and attitude development. Skills recorded include defining the gap in care, developing AIM statements, project measures, conducting tests of change, developing system tools, engaging other members of the improvement team, obtaining feedback from the population of interest, and preparing either a didactic or the final presentation. At the conclusion of this process, all residents are required to complete an email sign-out, which allows the residents to summarize the work completed during their block rotation, and suggest a PDSA cycle for the next resident. In addition, it allows all team members to be informed of the status of their improvement work.

When surveyed, the majority of the residents felt their work on the QI project helped them understand how to evaluate patient care practices, improve quality of care, and develop the ability to effectively use system resources to provide quality care. Of graduating third year residents, 88.5% thought that they were at least somewhat prepared to initiate and implement a quality improvement program using the model for improvement at their next clinical setting. In addition, at the summative presentations of the four longitudinal projects, QI mentors evaluate each project for adherence to the model for improvement, success of improvement work, involvement of team members, and the ability to sustain and spread results. The projects have generally scored high with challenges identified in the area of spreading and sustaining change.⁵⁷ Test scores on a knowledge survey demonstrate that, by their third year, residents have obtained a greater QI knowledge than untrained general pediatric faculty members, reinforcing the success for resident training in the combination of curriculum about QI and the practical application of QI skills in the ambulatory setting.⁵⁸

The effectiveness of resident training in quality improvement in a pediatric ambulatory environment has also been reported by Mohr and colleagues⁴⁷ This pre-through-post-observational study examined the impact of faculty facilitated improvement team meetings on improving immunization completion by two years of age. The residents' team successfully implemented five changes in clinic processes, associated with an increase in immunization completion from 60% to 86% ($P = .04$).

CHALLENGES TO TEACHING QI AND PATIENT SAFETY IN AMBULATORY PEDIATRICS

Irrespective of the model chosen as a training methodology and improvement tool, the challenges of incorporating a QI curriculum into residency training stem, first, from time constraints. The nearly saturated schedules of residents in programs that strain to meet training requirements while also satisfying clinical care needs may distract from educational programming. New curricular elements may be equally challenged to receive adequate focus and attention.

Furthermore, the training of residents in QI is hampered by the limited number of faculty who understand how to teach these methods and approaches. Although all faculty are able to teach the differential diagnosis of signs and symptoms in their area of clinical expertise, few have received formal instruction in improvement methodologies or have participated in structured improvement efforts that would make them comfortable with teaching these methods to house staff.⁵⁸

In 2008, the Institute for Healthcare Improvement initiated an "Open School" to foster education of health professions students in improvement methods and principles of quality and safety (<http://www.ihl.org/IHI/Programs/IHIOpenSchool>). This

initiative may prove to be an important cross-cutting effort to enhance the education available to current medical, nursing and other health professions students.

In addition, many programs identify needs for data support, curricula, online resources and evaluation. In a survey of 77 New York City⁵⁹ primary care residency programs, 69% identified a need for statistical support for data analysis; 62% noted a need for a curriculum guide; and only 10% were resident led projects.⁵⁹ The majority of programs reported some resident participation or were faculty-led with resident involvement. Other typical challenges that are reported include: how to engage team members around development and planning cycles of change and the sustainability of work when the champions (ie, residents) are no longer engaged in their QI work.

A key issue for hospital leaders in quality and safety is identifying strategies to align operational improvement needs with faculty members' priorities both in clinical care and academic research or scholarly activity. Quality improvement research has traditionally been viewed differently than other investigational efforts, but in recent years it has become increasingly rigorous; this may lead to greater recognition by promotions committees in universities and academic medical centers. To the extent that clinical improvement work is fostered by physician participation, it is essential that improvement leaders facilitate the opportunity for collaborating faculty to pose investigational questions that are publishable and can contribute to academic advancement, while also improving systems, processes, and outcomes of care.

FUTURE DIRECTIONS

The pediatric ambulatory setting continues to be ripe for improvement in care, as well as a key location for training future pediatricians in quality and safety. The ambulatory setting is also undergoing significant transformation as information technology continues its accelerating penetration into the health care delivery system. The interface between electronic health record implementation and advancing quality and patient safety in ambulatory settings will have a great impact on pediatric care.

Some future goals that are likely to facilitate improvement in both measurement and clinical outcomes include:

- Development of better measures of quality of care by individual providers
- Improved methodology of studies examining the effectiveness of QI interventions
- Further development and more widespread use of common measure sets for pediatric conditions
- Better recognition and measurement of the impact of equity on child health outcomes
- More knowledge of the types of medical errors occurring in ambulatory pediatric settings and effective strategies to prevent them
- Provider training on disclosure of medical errors
- Full integration of training in safety and quality in pediatric residency, particularly in the ambulatory setting, with prioritization of time for this effort
- Evaluation studies of models for teaching quality and safety to pediatric residents
- Faculty development in QI methodology and effective methods to teach it
- Recognition of QI scholarship in the faculty promotions process

The achievement of these goals will bring pediatrics closer to the quality of care that children deserve.

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