

Quality Improvement Efforts in Pediatric Oral Health

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ABSTRACT Quality improvement (QI) and measurement are increasingly used in health care to improve patient care and outcomes. Despite current barriers in oral health measurement, there are nascent QI and measurement efforts emerging. This paper describes the role that QI and measurement can play in improving oral health care delivery in clinical practice by presenting a QI initiative that aimed to test and implement a chronic disease management approach to address early childhood caries.

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Measuring quality and using measurement data are increasingly commonplace in health care to promote improvements in care delivery, to influence payment for services and to increase transparency.¹ According to the Institute of Medicine, quality is the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.² Quality improvement has been defined as the combined and unceasing efforts of everyone to make changes that will lead to better patient outcomes (health), system performance (care) and professional development (learning). Quality improvement is a formal approach that uses data measurement to test, implement and spread changes and ideas.³ The U.S. Department of Health and Human Services established the National Strategy for Quality

Improvement in Health Care, which adopted the Triple Aim of improving the patient care experience, improving the health of populations and reducing the cost of health care. Development and implementation of measures is ongoing for program development and to motivate providers and insurance plan purchasers to track higher-risk patients to induce them toward improved health outcomes.

In dentistry, a barrier to adopting quality improvement activities has been the lack of quality measures.⁴ Currently, the dental insurance claims submission process does not require diagnostic codes. As such, claims data provide mostly information pertaining to access, process and health care delivery and provide only limited information on health outcomes and quality of life. Nevertheless, quality improvement has a role in clinical dental practice. Quality improvement can help dental providers ensure that their clinical practice is

conforming to current standards of care and also allow them to be able to critically evaluate the care that their patients receive, to be able to measure what works, what does not and to implement changes to improve patient outcomes.

Despite the barriers to data measurement in oral health care, including the lack of a measurement culture, there are nascent quality improvement and measurement efforts emerging in dentistry. In 2010, the Dental Quality Alliance (DQA), comprised of a diverse group of stakeholders, was established by the American Dental Association to lead the development of evidence-based oral health and health care performance measures on multiple levels. One of the core objectives of the DQA is “to identify and develop evidence-based oral health care performance measures and measurement resources” through consensus-building processes.⁴ The Dental Quality Alliance’s initial measurement efforts have been focused on program-level and plan-level performance measures using administrative data obtained from claims submissions.⁵

The purpose of this paper is to describe the role that data measurement and quality improvement can play in clinical dental practice by reporting on an oral health quality improvement initiative that aimed to facilitate the adoption of a chronic disease management approach to address early childhood caries (ECC).

Chronic Disease Management of Dental Caries

Dentistry’s Current Approach to Caries

The dental profession continues to primarily address dental caries as an acute surgical problem that requires restoration and repair.⁶ While restorative treatment repairs tooth structure, it does not

address the underlying disease process.⁷ Young children with caries who are not cooperative are commonly sedated or treated under general anesthesia in an operating room (OR) setting. However, despite receiving costly treatment under general anesthesia,⁸⁻¹⁰ many children develop new and recurrent caries.¹¹⁻¹⁵ If the responsible risk factors are not adequately addressed, new and recurrent caries will likely develop.¹⁶ A more effective approach may be one that relies on patient-specific prevention and focused management

[Chronic disease management] relies on a close collaboration between an informed and engaged patient and/or parent and a proactive health care provider/team.

of the disease in addition to repairing defective tooth structure.¹⁷ Chronic disease management of dental caries is such an approach, which has been demonstrated in early studies to be effective in improving patient outcomes and may result in reduced costs.¹⁷⁻²⁰

What Is Chronic Disease Management?

Chronic disease management has been defined as a system of coordinated health care interventions in which patient self-management efforts are significant.²¹ Chronic disease management differs from a traditional approach where providers tell patients what changes to make. Instead, it relies on a close collaboration between an informed and engaged patient and/

or parent and a proactive health care provider/team. Because dental caries is a chronic disease that is heavily influenced by social and behavioral factors, effective self-management of etiologic factors is required. An important role for dental practices and oral health care providers is to provide coaching and support to the family to make necessary behavioral changes, such as in oral hygiene, diet and fluoride use.

ECC Collaborative and Chronic Disease Management

Since 2008, DentaQuest Institute has supported multiple phases of the Early Childhood Caries (ECC) Collaborative.²² The ECC Collaborative is a learning collaborative modeled after the Institute for Healthcare Improvement’s Breakthrough Series.²³ The ECC Collaborative has trained more than 40 dental and oral health care teams across the U.S. to use quality improvement strategies to test and implement a chronic disease management approach to addressing ECC.²²

TABLES 1 and 2 show the most recent ECC chronic disease management clinical protocol. The protocol includes seven components:

- Caries risk assessment.
- Effective communication.
- Self-management goal setting.
- Caries charting.
- Fluorides and other remineralizing strategies.
- Restorative treatment as needed and desired by patient/family.
- Recare interval based on risk.

The ECC protocol along with its rationale and promising results from Phases 1 and 2 of the ECC Collaborative will be briefly summarized here as they have been described elsewhere.²⁴⁻²⁶

TABLE 1

Early Childhood Caries (ECC) Chronic Disease Management Clinical Protocol*

Caries risk assessment	<ul style="list-style-type: none"> ■ Performed in full or abbreviated format during each visit ■ A child who has at least one tooth with demineralization or cavitation lesion is an ECC patient
Effective communication	<ul style="list-style-type: none"> ■ With permission, explain the caries process to parent and use structured communication strategies such as: <ul style="list-style-type: none"> • Fixing the cavities does not fix the problem • Without a change in diet and home care, new cavities and broken fillings will result • Change is hard and won't happen over night
Self-management goal setting	<ul style="list-style-type: none"> ■ Engage and coach parent to select one or two goals to work on until the next visit ■ Goals may include more frequent toothbrushing, topical fluoride use and specific diet modification strategies
Caries charting	<ul style="list-style-type: none"> ■ Use a charting system, such as ICDAS or ADA caries charting system to: <ul style="list-style-type: none"> • Document caries by tooth, surface and activity • Monitor disease improvement or progression
Fluorides and other remineralization strategies	<ul style="list-style-type: none"> ■ Topical fluorides, including over-the-counter toothpaste, stannous fluoride, xylitol and/or calcium phosphate products can be offered
Restorative treatment	<ul style="list-style-type: none"> ■ Full range of treatment options can be presented based on each patient's needs and parent's desires, including <ul style="list-style-type: none"> • Conventional treatment (including use of pharmacologic management) • Interim therapeutic restorations for caries control
Risk-based recare intervals	<p>Patients are recommended to return in:</p> <ul style="list-style-type: none"> ■ One to three months (if high risk) ■ Three to six months (if moderate risk) ■ Six to 12 months (if low risk) <p>At the recare visit, perform:</p> <ul style="list-style-type: none"> ■ Caries risk assessment ■ Self-management goal setting ■ Exam and charting ■ X-rays if indicated ■ Fluoride varnish

*DentaQuest Institute.

TABLE 2

Early Childhood Caries Risk-Based Chronic Disease Management Protocol

Existing risk category	New clinical findings	Fluoride varnish interval	Self-management goals	Restorative treatment	DM return interval	Other
Low	No disease indicators of caries Completely remineralized (arrested) carious lesions	Six to 12 months	Twice daily brushing with fluoride toothpaste [†] Stannous fluoride [‡] on cavitated lesions		Six to 12 months	
Medium	No disease indicators,* but has risk factors** and/or inadequate protective factors*** Disease indicators present with some remineralization	Three to six months	Twice or more daily brushing with fluoride toothpaste Stannous fluoride on cavitated lesions Dietary changes	Sealants ITR Conventional restorative	Three to six months	Xylitol gum, candies or wipes Calcium phosphate paste
High	Active caries (disease indicators present) No remineralization occurring Heavy plaque	One to three months	Twice or more daily brushing with fluoride toothpaste Stannous fluoride on cavitated lesions Dietary changes	ITR Sealants Conventional restorative	One to three months	Xylitol gum or candies Calcium phosphate paste

*Examples of disease indicators include demineralization, cavitated lesions, existing restorations, enamel defects, deep pits and fissures.

**Examples of risk factors include patient/maternal/family history of decay, plaque on teeth, frequent snacks of sugars/cooked starch/sugared beverages.

***Examples of protective factors include fluoride exposure (topical and/or systemic), xylitol.

[†]Brush with a smear of 1,000 ppm fluoride toothpaste.[‡]Apply a smear of 1,000 ppm stannous fluoride to cavitated lesions.

TABLE 3

ECC Collaborative Phase 1: Comparison of Rates of New Cavitation, Pain and Referral to the Operating Room (OR) Between ECC Patients and Historical Control Patients

Outcomes	Boston Children’s Hospital, Boston			Saint Joseph Hospital, Providence, R.I.		
	ECC (N=403) %	Historical control (N=129) %	Improvement %	ECC (N=234) %	Historical control (N=80) %	Improvement %
New cavitation	26.1	75.2	▼65.3	41.0	71.3	▼57.5
Pain	13.4	21.7	▼38.2	7.3	31.3	▼23.3
Referral to OR	10.9	20.9	▼47.8	14.9	25.0	▼67.8

Caries Risk Assessment, Effective Communication and Self-Management Goal Setting

Assessing caries risk and supporting the control of risk factors are the cornerstones of the ECC clinical protocol. In practice, a full or abbreviated caries risk assessment is performed at every visit informally or preferably with a structured form. A care team member explains caries etiology to the patient or caregiver, provides coaching to alter the balance of risk and protective factors and provides support with self-management goal setting. Effective self-management support requires a collaborative approach with providers and patients working together to define problems, set priorities, establish goals and create treatment plans to solve problems. Recognizing that change is difficult to achieve, no more than one or two self-management goals are assigned to work on until the next visit. Self-management goals may include more frequent toothbrushing, using topical fluorides at home and diet modification. Visual flip charts and handouts are useful to help guide the conversation.

Caries Charting

A clinical examination and caries charting are important to monitor and document caries presence, progression and activity by tooth and surface. Using a charting system such as those developed by the American Dental Association,²⁷ the International Caries Detection and Assessment (ICDAS)^{28,29} or an alternative system allows for tracking of important information for determining disease diagnosis, caries risk status and clinical treatment planning.¹⁸

Fluorides and Other Remineralization Strategies

The use of fluorides for caries prevention and management is both safe and effective in the office or at home. The frequency of professional fluoride treatments should be based on caries risk. High caries risk children should receive fluoride varnish every three to six months, while the recommended frequency for moderate-risk children is at least once every six months.³⁰ Children with ECC, who have demineralized enamel or cavitated carious lesions may benefit from professional topical fluoride applications more frequently than every three months to assist in controlling the caries process.¹⁹

An adult should assist with toothbrushing beginning with the eruption of the first tooth using a smear of 1,000 ppm fluoride toothpaste, ideally twice each day.³¹ Xylitol and casein phosphate products are also available to assist in controlling the caries process at home.³²

Restorative Treatment, Sealants and Interim Therapeutic Restorations

Tooth surfaces with deep pits and fissures of high caries risk children would benefit from bonded or glass ionomer sealants.³³ If the destruction of tooth structure is minimal, caries arrest might be possible with demineralization strategies. If the decay has progressed into dentin or caries arrest has not been achieved, interim therapeutic restoration (ITR) may be performed to achieve caries control. The ITR procedure

involves removing the decay using hand or rotary instruments with caution to avoid pulp exposure. After preparation, the tooth is restored with a fluoride-releasing glass ionomer restorative material. It is important for parents to understand that ITR is caries control rather than permanent restoration.³³

When significant tooth structure has been destroyed by the caries process, restorative treatment is performed to restore function or improve esthetics. Long-term success of restorative treatment relies upon effective management of the disease, along with appropriate use of restorative techniques and materials.⁶ Conservative restorative treatment may be appropriate for a child whose caries risk has improved. However, a child whose caries risk has not improved and demonstrates progression of caries activity may benefit from a more aggressive approach to reduce new and recurrent decay in susceptible tooth surfaces, such as with use of full-coverage crowns.

When caries arrest is achieved, restorative treatment may be deferred, especially in an uncooperative child. However, close follow-up and preventive care based on caries risk are critical to safeguard from disease relapse.

Recare Intervals

Patients are recommended to return for recare frequency based on their caries risk (one to three months for high risk, three to six months for moderate risk and six to 12 months for low risk) and the desires of their parents. During each recare visit, a clinical examination

TABLE 4

ECC Collaborative Phase 2: Comparison of Rates of New Cavitation, Pain and Referral to the Operating Room (OR) Between ECC Patients and Historical Control Patients

Outcomes	ECC (N=344) %	Historical control (N=316) %	Percentage of improvement %	Improvement range %
New cavitation	33	46	▼28	▲14 - ▼71
Pain	8	11	▼27	▲80 - ▼100
Referral to OR	14	22	▼36	0 - ▼81

is performed and caries risk and self-management goals are reassessed. Seeing a child more frequently for preventive care may be helpful to reduce a child's fears and builds trust with the provider to allow for restorative treatment to be completed more easily at a later time.¹⁹

Evidence Supporting Chronic Disease Management of ECC

Phase 1 of the ECC Collaborative, which took place at two hospital-based dental care practices, found that after 30 months, children with ECC in the intervention group experienced lower rates of new cavitated carious lesions, pain and referrals for restorative treatment in the OR compared to baseline historical controls with ECC (TABLE 3).

A follow-up Phase 2 of the ECC Collaborative continued with five additional sites across the U.S. found that after 18 months, fewer disease management (DM) children experienced new cavitation, pain and referrals to the OR for restorative treatment compared to baseline historical controls (TABLE 4). The Phase 2 sites found that quality improvement strategies facilitated adoption of the chronic disease management approach and resulted in improved care to patients and better outcomes overall.

Barriers to Chronic Disease Management

Chronic disease management is not a new concept. Featherstone reintroduced the Caries Balance in 2000³⁴ and caries-risk assessment (CRA) tools

have been available, such as through caries management by risk assessment (CAMBRA)^{35,36} and the American Academy of Pediatric Dentistry.³⁷ However, while there has been a shift in dentistry toward a preventive approach to caries management, chronic disease management has not yet been systematically adopted into clinical practice. Some reasons for the continuing gap include the time required to translate science into clinical practice, insurance reimbursement favoring surgical management of dental caries, lack of provider training and lack of incentives for patients and providers to adopt new modes of preventive care and disease management. Although providers may be familiar with caries risk assessment and chronic disease management approaches, they may not know how to operationalize them into day-to-day clinical care with patients. In addition, most currently available dental information systems (electronic dental records) do not allow for measuring or tracking of patients' oral health status.

Role of Quality Improvement in Clinical Practice

Quality improvement is based on a system of learning, incremental change and the incorporation of empirically supported best practices from evaluating performance and outcome measures.³ Quality improvement strategies are intended to support care delivery redesign and are opportunities to accelerate the pace of change into clinical practice.

Developed by Associates in Process Improvement, the Model for Improvement,³⁸ has been used in the ECC Collaborative to guide changes made by teams to introduce, test, refine and sustain the ECC protocol in clinical practice. The Model for Improvement, composed of three key questions and the plan-do-study-act cycle, is a framework for testing changes in real work settings and offers guidance in how to learn from experience and how to determine an effective plan of action.

In the ECC Collaborative, participating practices performed many small tests of change (plan-do-study-act cycles), which have served as learning opportunities for how to conduct critical care delivery processes, e.g., how best to conduct CRA or implement self-management goal setting. Only those changes that resulted in measureable improvements in processes and/or outcomes were implemented by the sites and their providers into their clinical practice.

ECC Collaborative and Data Measurement

Driver Diagram

A driver diagram is a theory of change and represents a practice's current hypothesis of cause and effect in the system — what changes will likely result in the desired effects. It depicts the relationship between the aim, the primary drivers that contribute directly to achieving the aim and the secondary drivers that are necessary to achieve the primary drivers. A driver diagram is most useful in planning a quality improvement initiative and also helps in defining which aspects of the system should be measured and monitored, to see if the changes/interventions are effective and if the underlying causal theories are correct.³⁹

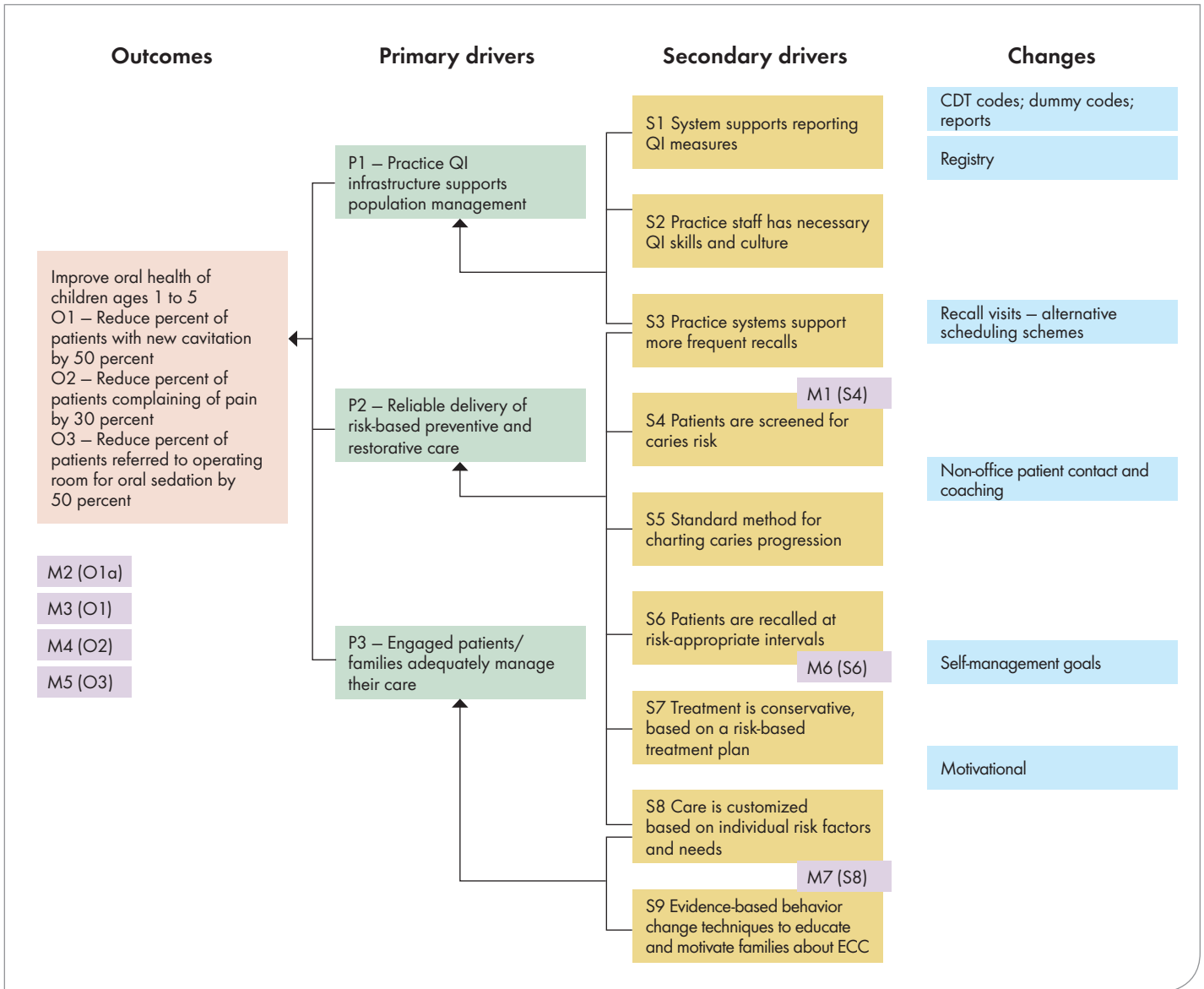


FIGURE 1. Early childhood caries (ECC) collaborative driver diagram. (DentaQuest Institute.)

The current driver diagram for the ECC collaborative is shown in FIGURE 1. The ECC Collaborative’s aim is to reduce the percentage of children under 60 months of age with new cavitated carious lesions, pain from untreated caries and referral to the operating room (OR) or sedation for restorative dental treatment. Among the primary drivers are having a quality improvement infrastructure that supports the oral health management of

a practice’s patient population, having reliable delivery of risk-based preventive and restorative care and having patients/parents who are engaged to manage well their oral health. Secondary drivers include those factors that affect the reliable delivery of risk-based preventive and restorative care. For example, are patients reliably screened for caries risk? Are patients recalled at appropriate intervals based on their caries risk?

Measurement

How does one know if the changes made to a clinical practice or care delivery system are resulting in positive changes? One has to measure the results. FIGURE 2 shows the companion measurement plan to the ECC Collaborative driver diagram. The ECC Collaborative selected seven measurements and developed definitions for the measurements in terms of numerators and denominators. For example, measure 1, the percent of active patients with

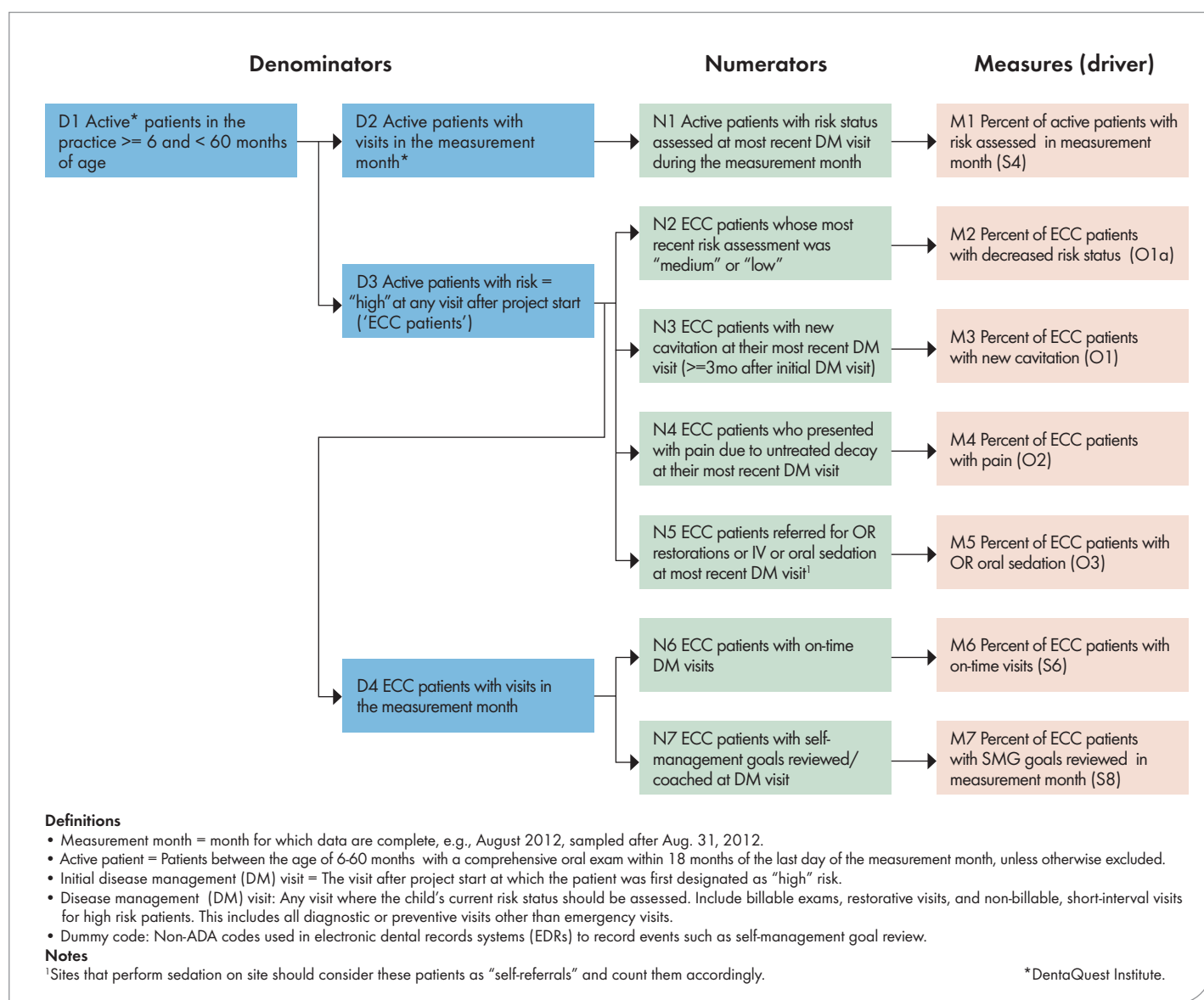


FIGURE 2. Early childhood caries collaborative measurement plan.

caries risk assessed in the measurement month, is determined by dividing the numerator, which is the number of active patients with caries risk assessed at the most recent recall or disease management visit, by the denominator, which is the number of active patients with visits in a measurement month. In the ECC protocol, a disease management visit is a visit that occurs between recall visits, during which CRA and self-management goals are revisited and fluoride varnish is

applied. An active patient is defined as a patient who is between the age of six and 60 months who had a comprehensive exam within 18 months of the last day of the measurement, unless otherwise excluded.

In Phase 3, the ECC Collaborative tested collecting of process and outcome data by having the dental providers enter these data directly into their electronic dental practice management systems during patient encounters. Because most electronic dental billing systems do not easily allow

for entry of diagnostic codes, the teams instead used available dental procedure billing codes and made up "dummy" codes to represent patient diagnoses and outcomes. Testing was required at the local level because the practices had different workflows and used different electronic billing systems. At each patient encounter, providers entered one of the American Dental Association dental procedures and nomenclature (CDT) billing codes D0601 (low risk), D0602 (moderate risk) and

D0603 (high risk). Released for use in 2014, these caries risk CDT codes are procedure codes that are intended to be used to document patient caries risk diagnosis.

After engaging in self-management goal setting with a patient, providers entered a CDT code D3110 (nutritional counseling). If a patient was referred for sedation or OR treatment, CDT codes such as D9248 (non-IV conscious sedation) or D9220 (deep sedation/gen anesthesia CDT 2015 code) were used. Because there were no available codes to represent the presence of new cavitation and pain, the sites used made-up (dummy) codes such as NC001 and PA001 respectively.

FIGURE 3 shows an example of billing and caries charting codes used for a patient with ECC at the author’s hospital-based dental clinic. On the visit date, April 11, 2014, billing codes D0603 (high caries risk) and D1310 (nutritional counseling/SMG) were recorded signifying that the patient received CRA and self-management goal setting. A bundle of codes consisting of 1MoDM (one month DM), D1330 (oral hygiene instructions) and D1206 (fluoride varnish) were entered as charges to represent a recare disease management visit completed one month after the patient’s prior preventive dental visit. An NC0001 (new cavitation) code was also entered. If pain related to untreated caries was identified, a PA0001 code would be entered. If referral for sedation or operating room (OR) was needed, D9220 (deep sedation/gen anesthesia CDT 2015 code) would be entered.

FIGURE 3 also shows dental caries charting by tooth, surface and activity using condition codes that are modeled after the ICDAS²⁹ and has similarities to the new ADA caries classification system.²⁷ For example, D1 and D1.5 were charted to document demineralization and cavitation limited to the enamel respectively on the facial surfaces of the maxillary incisors.

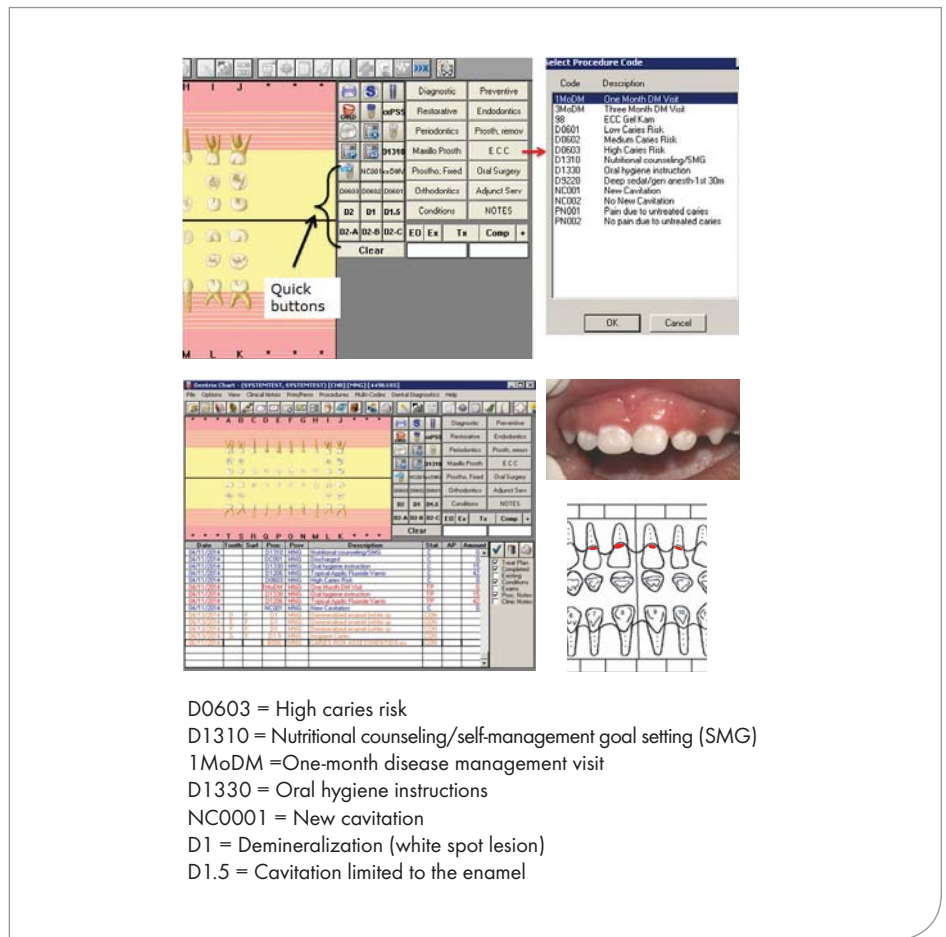


FIGURE 3. Example of dental billing and caries charting codes used for a patient with early childhood caries in the ECC Collaborative.

Other codes, D2 for caries extended into dentin, D2C for very soft decay, D2B for slightly soft decay and D2A for decay that felt hard to the gentle feel of a spoon or explorer are also available for use to track patients’ caries findings from visit to visit and to help inform the patient’s caries risk, which can change from one visit to the next.

The Phase 3 sites installed an Access database, which facilitated submission of de-identified measurement data to the ECC Collaborative. For the sites that used Dentrix Enterprise as their electronic billing system, their data were automatically extracted each month and sent directly to DentaQuest Institute. The remaining sites collected their data into an Excel spreadsheet, which they uploaded into the Access database. DentaQuest

Institute reviewed the data monthly to track the collective progress of the ECC Collaborative. A progress report, consisting of run chart data, along with feedback was sent monthly to each site.

FIGURE 4 shows examples of run charts of the process measures, “percent risk assessed,” “percent self-management goals” and “on-time return visits” for the ECC Collaborative in the aggregate. Among the sites, there was variability in performance. However, most sites quickly achieved and maintained high levels of reliability with caries risk assessment and self-management goal setting. More difficult to achieve in terms of reliable performance was on-time visits based on caries risk. In the ECC Collaborative, high-risk patients were recommended to return in one to three months, but a leeway was given in the

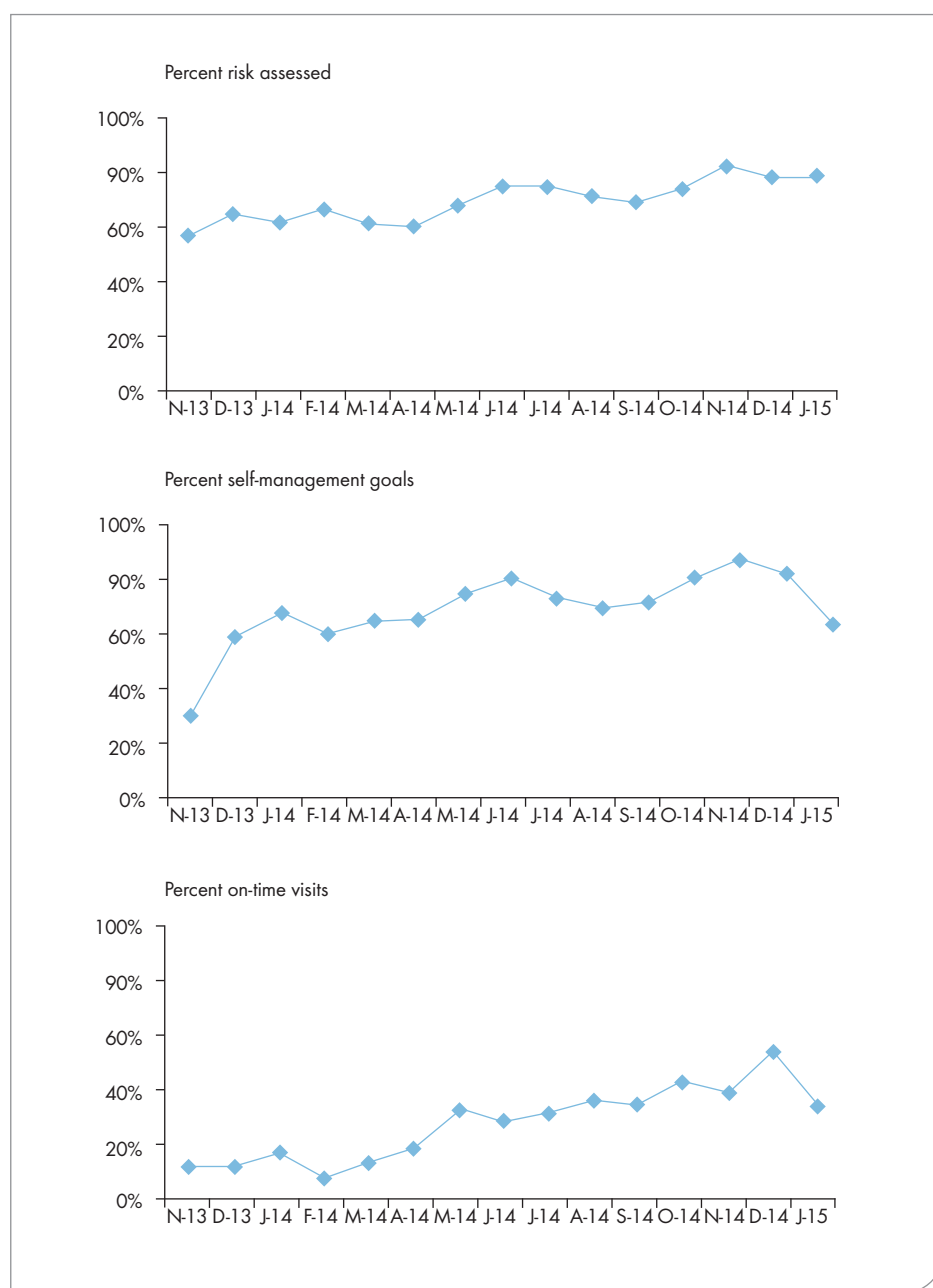


FIGURE 4. ECC Collaborative Phase 3 monthly trends for percent caries risk assessment, self-management goals and on-time visits in the aggregate. (DentaQuest Institute.)

measurement plan, allowing four months for high-risk patients to return for a DM visit. Despite being faced with significant barriers, such as high no-show rates and nonworking contact information for high-risk families in safety-net dental sites, 40-60 percent on-time return rates were achieved by many teams toward the end of the Collaborative. Because clinical outcomes

require a longer time horizon to manifest, the Collaborative is continuing to accept measurement data from Phase 3 teams.

On the local level, the sites were expected to review their individual run chart data in order to be able to track their trends over time and think about how to drive change. In addition, sites were recommended to conduct internal audits in

order to be able to better understand their local trends, such as any variability with caries risk assessment and self-management goal setting completed (and as coded) by their practitioners. To be able to affect consistent behavior change in their providers and staff, the sites were further expected to meet regularly and to share their measurement data in a transparent manner. Open sharing of data to create friendly competition among providers and staff has been found to be helpful to improve overall practice performance.

Challenges and Opportunities

Critical to the success of all quality improvement efforts is having strong leadership to provide guidance, support and encouragement to the improvement work. The role of the senior leader is to prioritize and balance resources to ensure the sustainability of the changes made by the practice. Quality improvement efforts require dedicated time for the team members (providers and staff alike) to do the actual improvement work but also for key staff to meet regularly. It is important to convene regular staff meetings, but the meetings need not be lengthy. In fact, 15 to 20 minute huddles on a regular schedule, such as every week or every month, are valuable to allow staff members to report on measurement data and the results of completed plan-do-study-act cycles and to plan additional plan-do-study-act cycles. The ECC Collaborative has found quality improvement methods, such as testing changes using plan-do-study-act cycles on a small scale, measuring the results and implementing well-tested workflows and ideas into their unique practice settings to be useful to the sites.

Without doubt, there are impediments to using quality improvement strategies and data measurement in dentistry. Some of the more successful participating teams in the ECC Collaborative were hospital-

based and community-health-center-based dental practices that already had a quality improvement infrastructure in place and a culture to support improvement work. Yet other motivated practices also were able to achieve positive practice changes as well. Beyond facilitating the adoption of the chronic disease management approach, many other areas of current clinical dental practice could benefit from using quality improvement strategies to facilitate practice redesign and workflow enhancement, with the goal to improve patient outcomes and treatment costs. At the end of Phase 2 of the ECC Collaborative, team leaders were convened and asked, “What impact did the Collaborative have on you?” One team leader’s response was, “I no longer view children aged 0 to 5 the same way. I do not pick up the handpiece first.”

Conclusions

Measurement is necessary to promote and assess the impact of improvements in the quality of patient care delivery and outcomes. Although quality improvement and data measurement are not yet commonplace in dentistry, these strategies and tools have been found to be valuable to facilitate the adoption of chronic disease management approaches in an ECC Collaborative with more than 40 teams in the U.S. With the current focus on quality and value-based health care, it can be expected that quality improvement will become more familiar to dentistry as greater numbers of validated oral health quality measures become available for use by payers, third-party administrators, clinical practices and care providers. ■

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