Implementation of a Preventive Services Bundle in Academic Pediatric Primary Care Centers

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BACKGROUND AND OBJECTIVES: Previous studies have documented poor rates of delivery of preventive services, 1 of the core services provided in the primary care medical home setting. We aimed to increase the reliability of delivering a bundle of preventive services to patients 0 to 14 months of age from 58% of patient visits to 95% of visits. The bundle includes administration of routine vaccinations, offering influenza vaccination, completed lead screening, completed developmental screening tool, screening for maternal depression and food insecurity, and documentation of gestational age.

METHODS: The setting was 3 academic pediatric primary care clinics that serve 31,000 patients (>90% Medicaid). Quality improvement methodology was used and key driver diagram was determined. Patient “Ideal Visit Flow” and the Responsible, Accountable, Support, Consulted, and Informed Matrix were developed to drive accountability for components of the ideal flow. Plan, Do, Study, Act cycles were used to develop successful interventions. The percent of patients seen who received all bundle elements for which they were eligible was plotted weekly on a run chart, and statistical process control methods were used to determine a significant change in performance.

RESULTS: The preintervention percentage of patient visits ages 0 to 14 months receiving all preventive service bundle elements was 58%. The postintervention percentage is 92%.

CONCLUSIONS: Innovative redesign led to improvement in percentage of patients age 0 to 14 months who received the entire preventive services bundle. Key elements for success were multidisciplinary site-specific teams, redesigned visit flow, effective communication, and resources for data and project management.

More than 10 years ago, the Institute of Medicine called attention to the suboptimal performance of the United States health care system, concluding: “Current care systems cannot do the job. Trying harder will not work. Changing care systems will.”1 In pediatrics, a 2007 publication revealed that patients receive only 41% of indicated preventive services.2 Past efforts to improve quality in pediatric primary care have focused mostly on individual services, such as improving immunization rates3 or lead screening.4–6 Yet, pediatric practices continue to struggle with comprehensively delivering preventive services in light of lengthy
health maintenance guidelines and short visits.\textsuperscript{7–12} The challenges of delivering comprehensive well child care underscore the need for true system transformation rather than intense focus on a single measure. In other areas of medicine, “bundle measures” have been used to measure whether every patient receives every service every time.\textsuperscript{13–15}

We identified 1 previous study of a bundle measure in pediatric primary care. This bundle included services related only to physical health (immunization, lead screening, anemia, and tuberculosis) and was implemented in nonacademic practices.\textsuperscript{16} This 2004 study demonstrated that it is possible to improve care across multiple measures through system improvement. However, changes in the scope of well child care in the past decade call for a more broadly defined measure that includes services beyond screening for physical illness and exposures.\textsuperscript{17}

Locally, our medical center was redesigning primary care, with a global aim to improve health promotion, chronic disease outcomes, and patient and family experience, while decreasing cost of care at a population level. The intervention described in this article focuses on our goal to improve health promotion. The scope of this quality improvement (QI) study was to improve delivery of preventive services, including assessment of development and family well-being, during visits at our 3 primary care centers in the first 14 months of life.

We aimed to measure and improve a “preventive service bundle” of 5 indicators of promoting an infant’s physical health, cognitive and social development, and family well-being. We used an all-or-none bundle measure to obtain a more accurate picture of the quality of care that individual patients received\textsuperscript{18} during office visits. We theorized that, by monitoring performance on a bundle measure and using the data to drive small tests of change, we could optimize performance during each stage of an office visit (eg, registration, intake, order entry). We could then clearly define roles, standardize processes, and transform our system to achieve highly reliable preventive service delivery.\textsuperscript{19} We aimed to improve the percentage of visits at which patients received all bundle elements for which they were eligible from 58% to 95% within 1 year.

\section*{METHODS}

\section*{Setting}

Cincinnati Children’s Hospital Medical Center (CCHMC) has 3 primary care centers involved in primary care redesign. Sites 1 and 2 (urban) and site 3 (suburban) are the medical homes for \textasciitilde{}18,000, 7000, and 6000 patients, with \textasciitilde{}37,000, 14,000, and 15,000 visits, respectively, per year. The payer mix is uniform across the centers: 90\% Medicaid, 3\% private insurance, and 7\% self-pay/uninsured. All 3 sites train large number of learners. All sites have been using Epic, an electronic health record (EHR), since May 2011. In 2012, CCHMC and the Division of General and Community Pediatrics invested \$250,000 to conduct a large-scale primary care redesign that aimed to improve health promotion and prevention, outcomes for children with chronic diseases, patient and family experience, and decrease cost of care. This article focuses on 1 phase of the redesign and describes the QI tools and processes used to improve health promotion and prevention for infants in our patient population. This study was granted exemption by the CCHMC Institutional Review Board.

\section*{Study Population and Outcome}

We sought to design a comprehensive, efficient, and effective preventive service delivery system. We focused on the first 14 months of life when opportunities are greatest for engaging families in primary care.\textsuperscript{20}

The following services were selected for inclusion in the bundle of preventive services that all infants should receive during the first 14 months of life: administration of routine immunizations, seasonal influenza vaccination offer, lead screening, standardized developmental screening using Ages and Stages Questionnaire, and screening for bio-psychosocial risk factors including gestational age, parental depression, and food insecurity. These services were chosen by the primary care redesign steering committee, explained below, based on American Academy of Pediatrics recommendations,\textsuperscript{21} with minor modifications.

\section*{Team Structure}

A team structure was developed to support all phases of the primary care redesign. Some of the team’s time focused on preventive services for infants. The team included the following: (1) a steering committee that provided overall guidance and consisted of a project sponsor, project leader, physicians, patient services manager, business director, QI consultant, and advisors; (2) a project manager that guided resources to achieve specific goals; (3) support teams that provided content expertise on family engagement, training, finance, resident education, QI data analysis, information technology (IT), and communication; and (4) site-based teams at each of 3 primary care clinics spearheaded the work while participating in a hands-on QI training program. Participating physicians did not have extra protected time. Nurses and medical assistants (MAs) received payment for the hours they spent in these planning and training activities. At
a staff kick-off meeting, the project vision, mission, and goals were reviewed and feedback was collected. An office system inventory was used to provide a baseline assessment of our preventive services delivery system. Our redesign aligned with the National Committee for Quality Assurance/Patient Centered Medical Home requirements.

**Development of Key Driver Diagram and Interventions**

Improvement work began in June 2012. Preventive service support and site-based teams met throughout the planning and implementation phases to develop a theory of change, plan tests of change, and review data. The Model for Improvement was used. This model is based on 3 fundamental questions: (1) What are we trying to accomplish? (2) How will we know that a change is an improvement? (3) What changes can we make that will result in improvement? The team organized its theory of change by using a key driver diagram (Fig 1). Interventions were tested by using Plan, Do, Study, Act cycles.

Optimizing patient visit flow was expected to improve preventive service bundle delivery. The project manager, consultant, and site-based teams mapped the detailed existing patient visit flow for each clinic. Clinic staff roles and responsibilities were identified by using a Responsible, Accountable, Support, Consulted, and Informed (RASCI) Matrix. RASCI is an acronym derived from the 5 responsibilities most typically used: Responsible, Accountable, Support, Consulted, and Informed. This matrix describes the participation by various roles in completing tasks and allows for prioritization of work. The current process map and RASCI matrix were used to develop ideal patient visit flow with the goal of optimizing each care team member’s role to maximize individuals’ training and skills. Roles were redefined and reassigned, and Plan, Do, Study, Act cycles tested integrating reassignments into visit flow. In addition, the IT team optimized the EHR to display patients’ preventive service needs on the patient schedule. This information was referenced by providers and staff during relevant steps in the ideal flow.

Several key changes were made to visit flow. First, 2 types of “huddles” were implemented. The nurse manager huddled with nurses and MAs in the morning to discuss potential flow challenges that day. In addition, at the beginning of each morning, afternoon, and evening clinic session, each provider huddled with their assigned MA to review the preventive service needs of each scheduled patient. Second, registration staff preassembled standardized, age-specific packets that included developmental and social screening forms. These were distributed at registration for parents to complete before rooming. Third, much of the information-gathering and EHR documentation for well visits was shifted from providers to intake staff. This ensured screening questions were documented and allowed physicians to focus the visit on areas of concern. Fourth, intake staff preordered immunizations and screening tests for providers to review and sign. Finally, the patient discharge process was standardized and included a staff member checking that all appropriate preventive services had been delivered. Clinic start time was not changed, and the number of visit was not reduced during ideal flow implementation.

**Methods of Evaluation**

A measure of the reliability of daily preventive service delivery was created, with the visit as the unit of analysis. This measure calculated the percentage of 0- to 14-month-old visits during which the patient received all elements of the bundle for which they were eligible that day. More details on the measure are provided in a separate publication. Figure 2 summarizes expectations for preventive service delivery at each age. For example, any visit for a 9-month-old patient would require administration of any overdue immunizations, developmental screening, and screening for risk factors (gestational age, food insecurity, parental depression). SMART, Specific Measurable Actionable Relevant Time-bound.
because of acute illness and documented this with an appropriate diagnosis code, this was not counted as a failure.

Performance data on bundle delivery were retrieved directly from clinical documentation in the EHR. Reports on this measure were constructed through an iterative process. An automated data report was initially formulated, then compared with manual chart reviews to ensure interrater reliability and to identify unique situations for which decision rules needed to be created. The automated report was then modified and the process was repeated. In its final form, the report was automated with quality checks done manually by a data manager who followed a list of decision rules.

Daily data were collated into weekly rates and plotted on a run chart. Standard probability-based rules were used for interpretation of run charts. In accordance with these rules, the median was recalculated when a “shift” of 8 consecutive points above or below the median was observed. Initially, chart audits were performed by the data manager for all failures, and appropriate timely feedback was provided to staff and providers. Weekly data were shared with all.

Throughout the QI process, qualitative data were collected from front-line staff regarding barriers to implementing interventions and impact of interventions on clinic flow, patient care, and resident education. QI consultants were on-site during implementation to shadow patients through visits and collect feedback that was used to improve processes. As a balancing measure, patient cycle time (time from patient sign-in to discharge) was collected pre- and postinterventions.

RESULTS

Over an 8-week baseline period (June through July 2012), the entire bundle of preventive services for which patients age 0 to 14 months were eligible was delivered at 58% of visits. Postintervention results revealed a median performance of 92%, achieved by May 2013 and sustained over 1 year (Fig 3). Interventions fell into 2 major categories: structural and functional. Dates of intervention implementation are annotated on the run chart (Fig 3). Structural interventions included team development, shared vision, expert consultation, QI training, divisional support, and project and data management. Functional interventions included prioritization of work, optimizing the EHR, previsit planning, improving communication, and implementation of ideal visit flow. Interventions were temporally associated with shifts on the run chart (Fig 3). Cycle time remained the same pre and postinterventions (average 75 minutes).

Qualitative data collected from front-line staff indicated that early in our testing, a majority of failures were due to family refusal of preventive services or failure to document services that were completed or deferred due to acute patient illnesses. In addition, more failures happened on evenings or weekends, and when transient providers worked in our clinics. There was no difference in failures by age group. Failures were addressed by having QI consultants coach providers on proper documentation, observe and evaluate flow, and provide feedback and recommendations to optimize the ideal flow map.

FIGURE 2
Visit-level measure scoring. *Gestational age and screening for parental depression and food insecurity documented in EHR, if not already in patient chart. *Must get all listed immunizations. If patient did not get vaccine, check the visit date and count as a “yes” if the patient got the vaccines indicated due to the date of the visit and recommended interval from last dose of vaccine. "Rotavirus #1 rule: If patient did not get vaccine but age is ≥ 106 days, score as yes (too old to start the series). "Rotavirus #2 rule: If patient received first rotavirus vaccine but did not get second rotavirus vaccine and age is ≥ 224 days, score as yes (too old to get second dose). The American Academy of Pediatrics recommends screening at 9 months. Given low adherence to well child schedule in this patient population, clinic processes include screening at any well visit occurring between 6 and 14 months of age to ensure developmental delays are detected in a timely way for children who miss a well visit. Measure includes at least 1 completed screen. "Lead screening to be completed once between 9 and 12 months of age. "Refusals count as yes if appropriately documented. ASQ, Ages and Stages Questionnaire; DTaP, diphtheria-tetanus-acellular pertussis; Hib, Haemophilus influenzae type b; IPV, inactivated polio vaccine; MMR, measles, mumps, rubella; PCV, pneumococcal vaccine.
separate in-depth study looked at the
effects of primary care redesign on
residents’ educational experience. It
is presented in a separate publication
currently under review. Overall,
residents had improved perceptions
of patient flow and physician/
nonphysician teamwork.

Our bundle delivery rate was
sustained at a median of 92%
over a 1-year period. We planned
for sustainability by developing a
standardized orientation and training
process for all newly hired staff
and providers. We also performed
frequent assessment and retraining
of existing staff and providers to
ensure the ideal flow protocol was
being followed.

DISCUSSION

Between June 2012 and June
2013, we increased delivery of a
preventive services bundle from
58% of visits to 92% of visits for
patients 0 to 14 months of age, and
we sustained the improvement
for over 1 year. Interventions
that coincided temporally with
improvement in bundle delivery
included prioritization of work,
previsit planning, preclinic huddles,
and implementation of ideal flow.
Through improvement on the bundle
measure, we now reliably address
infants’ physical health, cognitive and
social development, and family well-
being during primary care visits. We
have also transformed our system
to create effective mechanisms
for communication among staff
members and more failsafe processes
for identifying patients’ health
maintenance needs.

Our study was strengthened by
rigorous use of QI methods, with
on-site QI consultants who ensured
fidelity to the interventions. We
maximized the sustainability of our
intervention by studying our system
under various conditions, including
during evening and weekend
hours and clinic sessions staffed by
transient providers (moonlighters
and learners). By collecting
performance data directly from
the EHR, we were able to include
all visits in our data. Because we
audited charts and coached providers
on proper documentation, we are
confident that our data closely reflect
actual preventive service delivery.

Our findings support those of other
studies in which system-based
improvements resulted in improved
preventive service delivery. Shaw
et al6 and Young et al31 showed that
practices who set goals and used
QI methods achieved improvement
in at least 1 preventive service. In
accordance with recommendations
by Solberg et al,32 we used
strategies that considered multiple
characteristics of participating clinics.
Our findings were consistent with
those of Bordley et al33 who achieved
improvement in immunization
rates, anemia, and lead screening
through implementation of previsit
planning, risk assessment forms,
provider prompts, and redistribution
of responsibilities among office staff.

Given findings by Shojania et al33
that point-of-care EHR reminders
alone achieved small effects, and
Lanham et al34 that relationships and
respect among office staff contribute
to primary care quality and success
of improvement initiatives, our
initial structural interventions
(eg, formation of site-based teams
with nonphysician team leaders)
likely played a key role in laying the
groundwork for our success.

To our knowledge, ours was the
second study to measure delivery
of a “bundle” of preventive services
in pediatric primary care. Margolis
et al16 measured a bundle of 4
preventive services (immunizations,
and screening for tuberculosis,
anemia, and lead) at 18 nonacademic
practices and achieved improvement
from 7% to 34%. Because Margolis
et al16 used a patient-level measure
rather than a visit-level measure,
we cannot directly compare our
success. However, our findings build
upon the work by Margolis et al16
by expanding the bundle to include
services related to developmental

FIGURE 3
Percent of primary care patients seen 14 months and younger who have received the entire bundle of preventive services for which they are eligible.
and social well-being and also demonstrate that it is possible to achieve significant sustainable improvement in large academic-affiliated pediatric practices. Expansion to this setting is important in ensuring high quality care for low-income children, given the large percentage of publicly insured patients who are served by academic-affiliated safety net hospitals.\textsuperscript{35}

Our study had some limitations. Because we did not consider decisions to defer immunizations because of illness a failure to deliver indicated services, our data do not capture potential missed opportunities to vaccinate in situations where the patient is ill but immunization deferral is not clinically indicated.\textsuperscript{36} Additionally, because we are no longer performing chart audits on all failures, it is possible that some preventive services are being delivered but not documented; therefore, our actual performance may be better than what is shown.

In considering whether our findings are generalizable to other practices, we acknowledge context-specific factors that may have contributed to our success including the financial support for external consultation, data analysis, a project manager, QI consultants, and QI methodology training for front-line staff. We believe these resources were integral to our success given the size and complexity of our settings. However, because the fund was not entirely used for this particular phase of the redesign and the support staff had multiple other job responsibilities, it is difficult to quantify the exact cost of our preventive service improvement. It is notable that our improvements were achieved without hiring extra staff or reducing patient volume. We believe that small and less complex practices can learn from our experience to implement some changes with minimal project management resources. Universal strategies from our work that may be applied without a lot of further testing include the following: (1) developing EHR-based prompts about services due; (2) creating standardized packets for each patient age with appropriate developmental and social screening forms,\textsuperscript{27,28} which can be distributed by registration staff and completed by parents during waiting time; (3) shifting some history-taking and EHR documentation to intake staff to maximize the time and skills of all clinical team members. Also, new health care models with per-member per-month payment systems may soon incentivize investment in personnel to facilitate improvement work and quality measurement because funding these activities may provide returns on investment by improving outcomes for patients for which the health system is accountable.

Reaching our original goal of 95% would require higher reliability interventions, such as increased automation of tasks.\textsuperscript{32} We will continue to work closely with our IT team to implement these types of changes. Future directions include improving preventive service delivery on a population level and measuring preventive service bundles for other patient age groups.

CONCLUSIONS

Using QI methods, we achieved and sustained a preventive service bundle delivery rate of 92% of primary care visits for patients 0 to 14 months of age. The bundle included administration of all routine immunizations, offering influenza vaccine to eligible infants, and screening for lead, developmental delay, gestational age, food insecurity, and parental depression at appropriate intervals. Our bundle is the first, to our knowledge, to include preventive services in multiple domains of child and family well-being. Our study demonstrates the dramatic increase in reliability that is possible with system transformation, even in complex settings serving low-income populations.

**ABBREVIATIONS**

CCHMC: Cincinnati Children’s Hospital Medical Center  
EHR: electronic health record  
IT: information technology  
MA: medical assistant  
QI: quality improvement  
RASCI: Responsible, Accountable, Support, Consulted, and Informed

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