Improving delivery of preventative care services using population management strategies

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ABSTRACT

Background Consistent and timely delivery of comprehensive preventative care services is a challenge, particularly in underserved patient populations. Previous quality improvement (QI) research has focused on the development of bundled measures of preventative services delivery, but these bundles have not been studied on a population level. We aimed to improve preventative care service delivery on a clinic population level through the use of a bundled measure that includes immunisations, lead screening and use of screening tools among underserved patients under 2 years old.

Methods A QI study was conducted at a community-based academic primary care clinic. A population-level bundled measure was adapted from an existing tool. We used plan–do–study–act cycles to optimise results and tracked bundle outcome rates using a p-type statistical process control chart. Interventions included (1) staff education on measure components, (2) introduction of exam room-based phlebotomy to address lead screening completion rates and (3) population management strategies, including development of a patient registry and use of reminders and visit tracking to increase attendance at well-child visits.

Results The percent of bundle completion by 14 months of age increased from a baseline of 58%–77% following implementation of the QI initiatives. A mean shift was identified after the population manager began proactive targeted outreach for the 12-month visit.

Conclusion Targeted systems for outreach aimed at bringing patients into the clinic and patient-centred strategies for visit completion are effective at ensuring timely delivery of comprehensive preventative care to an underserved paediatric population.

INTRODUCTION

Over 20 immunisations and screenings are recommended for paediatric patients within the first year of life.1 Each component is necessary for holistic preventative care. Consistent and timely delivery of these preventative care services is a challenge, particularly in high-risk patient populations.2 Immunisation rates are especially low among patients of low socioeconomic status in urban settings.3 A 2007 study that recruited a nationally representative sample of paediatric patients demonstrated that less than half of children actually received all preventative services.2 Furthermore, measures of completion of any one recommended preventative care component do not consider which patients received comprehensive preventative care services. Bundled measures, on the other hand, have been used as a way to reflect receipt of all recommended preventative care services.3 Brown et al developed a bundled measure of key evidence-based preventative care services required in the first year of life and used quality improvement (QI) methods to increase receipt of these services at the visit level.4 Using similar methods, we conducted a QI initiative aimed at improving to a mean of 80% population-level delivery of a bundle of evidenced-based preventative care services in the first year of life in an underserved low-income population.

METHODS

Boston Children’s Primary Care at Martha Eliot is an urban academic primary care clinic, where 90% of patients are insured through Medicaid, and 76% identify as Hispanic. The clinic serves nearly 5700 unique patients, over 400 of which are under 14 months of age. This study was granted exemption by our hospital’s institutional review board.

Baby bundle components

Bundle elements were primarily adapted from a previously published tool.4 Our bundled measure components are listed in table 1.

Vaccinations included were based on the Centers for Disease Control and Prevention recommended schedule of immunisations.5 These included: three diphtheria, tetanus and acellular pertussis vaccines, three pneumococcal vaccines, three haemophilus influenza vaccines, three inactivated polio vaccines, two additional hepatitis B vaccines following administration of first hepatitis B vaccine dose in birth hospital, two rotavirus vaccines, one measles, mumps and rubella (MMR) vaccine and one varicella (VZV) vaccine.5

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Seasonal influenza vaccination was also required. Although our electronic medical record (EMR) did not allow us to reliably document when an influenza vaccination was offered and declined, we opted to make seasonal influenza vaccination a requirement to complete the bundle, in order to keep the measure comprehensive.

We used the standard state of Massachusetts lead screening approach, which recommends serum lead testing between 9 and 12 months of age.6

In addition to recommended immunisations and screenings, we included other requirements to the bundle to ensure all the necessary elements to provide holistic preventative care to our patients were available.

These included a newborn discharge summary and a previsit questionnaire scanned in the EMR system. The rationale for including the birth record was that it contains essential information on maternal history, pregnancy history and health risk information for the newborn.

Our previsit questionnaire served as psychosocial risk factor screening tool. It included a section on caregiver mental health that used the Patient Health Questionnaire (PHQ) 2, a validated postpartum depression screening tool. Social needs were assessed through questions regarding housing insecurity, food insecurity and trauma exposure.

### Measures

We adopted an all-or-nothing approach to measuring preventative service delivery, which previous studies have shown to be effective in different patient populations, such as in the care of diabetic patients.7 All-or-nothing measures have shown to have several benefits. As determined by Nolan and Berwick, an all-or-nothing measurement reflects systematic processes and identifies gaps in the sequence of care.8 It allows clinics to assess patients more holistically, giving a broader picture of care. An all-or-nothing measurement also sets a higher bar for QI assessment.8

In our study, data were collected daily using the hospital’s data warehouse and extraction system. Reports retrieved from the data warehouse consisted of a combination of standard attributes/metrics and custom-built metrics. Our primary measure of baby bundle completion was the proportion of active patients who had completed all bundle components at the time they turned 14 months old. An active patient was defined as having had at least one appointment in our clinic before 6 months of age and as not having definitively transferred care elsewhere. We excluded those who transferred their care to another facility and patients who had their first visit in our clinic after the age of 6 months due to our inability to catch them up in time to complete the bundle (related to completion of the rotavirus vaccine). Descriptive statistics were used to analyse the data monthly. We tracked bundle outcome rates using a p-type statistical process control chart. We defined a shift occurrence to be six or more data points falling above or below the mean.9

### Interventions

We used plan–do–study–act (PDSA) cycles to implement strategies towards bundle passing rate improvement. Our PDSAs were grouped into the following three main strategies.

**Strategy 1: staff education**

The education and awareness of staff was the first step to initiate the QI study. Multidisciplinary staff education began in May 2015 and continued once a quarter throughout the study period to ensure continued staff awareness of baby bundle requirements, related workflow adjustments and monthly performance.

**Strategy 2: exam room-based phlebotomy**

The initial workflow for lead screening required patients to visit the on-site lab following a scheduled visit. Unfortunately, many patients left the clinic after their visit without visiting the lab. In September 2015, exam room-based phlebotomy was initiated in hopes of capturing patients for phlebotomy during the allotted scheduled visit time, and in turn, increasing the lead screening rate. The effort was discontinued during June 2016 due to staff shortage.

**Strategy 3: population management to promote visit completion**

With the initiation of the QI project and heightened staff awareness, the role of a pre-existing newborn coordination position was expanded from scheduling and gathering documentation to include management of the baby bundle registry the ≤14-month-old cohort, which was developed in a later stage of the initiative. This

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**Table 1** Overall and individual bundle component completion at key time periods*

| n   | Component                                                                 |
|-----|---------------------------------------------------------------------------|
| 1   | Three doses of diphtheria, tetanus and pertussis vaccine                   |
| 2   | Three doses of hepatitis B vaccine                                        |
| 3   | Three doses of Haemophilus influenzae type b vaccine                      |
| 4   | Three doses of polio vaccine                                             |
| 5   | Three doses of rotavirus vaccine                                         |
| 6   | Three doses of pneumococcal conjugate vaccine                            |
| 7   | One dose of measles, mumps and rubella vaccine                           |
| 8   | One dose of varicella vaccine                                            |
| 9   | Seasonal influenza vaccine                                                |
| 10  | Newborn Summary                                                          |
| 11  | Previsit questionnaire                                                    |
| 12  | Screen for developmental delay (Parents’ Evaluation of Developmental Status) |
| 13  | Screen for lead exposure                                                  |

*Protocol adapted from Cincinnati Children’s Hospital Medical Center: Brown CM, Samaan ZM, Morehous JF, et al. Development of a bundle measure for preventive service delivery to infants in primary care. J Eval Clin Pract 2015.
population manager role was instrumental in driving the intervention efforts and will be referred to as ‘population manager’ from this point forward.

Patient registry development
In December 2015, a patient registry was created to keep track of bundle elements and scheduled visits for the <14-month-old cohort of patients.

Twelve-month targeted outreach
Following initial introduction of the staff education and phlebotomy changes, no change was identified in the average monthly bundle completion rate. Data review revealed that bundle failure was often related to missed MMR and VZV immunisation. Furthermore, these were missed most frequently due to failure to keep the 12-month well-child visit prior to the 14-month birthday. Therefore, the team focused on strategies to promote completion of the 12-month well child care visit. Using the newly developed registry, our population manager ensured that each patient who was not scheduled for a 12-month visit received an outreach call outlining the importance of the visit by age 14 months. Next, reminder calls were made to those with upcoming 12-month well-child visits. Calls were also made to those who had missed their 12-month appointments to reschedule in a timely fashion to ensure on-time delivery of services. Internal clinic communications were also sent to the primary care provider when an appointment was missed or if any vaccinations were late prior to an upcoming appointment.

RESULTS
A total of 512 patients turned 14 months during the 3-year study period. Baseline data showed the mean monthly rate of patients who completed the baby bundle to be 58% (figure 1). Following the implementation of our initial staff education (strategy 1), we saw a slight increase in the rate of completion. However, with staff turnover in the third month following the initiation of the QI project, there was a noticeable decline in the completion rate, which we attributed to delays in receiving the newborn summary, a component required for the bundle. This was confirmed through measurement of newborn summary completion rate at 67% during this time (see table 1).

In the 3 months prior to the initiation of our room-based phlebotomy initiative (strategy 2), the rate of missing lead screening was 43% (57% completion rate). Following our exam room-based phlebotomy intervention, the rate of completed lead screens increased to 78%, demonstrating an effective intervention. However, no shift in the overall bundle completion mean was identified.

Prior to our population management strategies, the rate of MMR/VZV completion remained low at baseline (48% and 45%, respectively) and through phlebotomy intervention (42%). Individual component analyses of the incomplete baby bundles revealed that 41% of failures were attributed exclusively to these missing vaccinations (see table 2).

Following targeted outreach and population management strategies, there was an upward shift in the rate of the all-or-nothing measure from 58% to 77% (figure 1). Month-to-month variation was mostly attributed to patients’ poor attendance at the 12-month visit, leading to low rates of MMR/VZV vaccination completion. There were two time periods of population manager shortage, which were accompanied by a decline in bundle completion rate in both cases.

Of our three strategies, population management was the most impactful. Specifically, interventions targeting successful completion of the 12-month visit and successful VZV/MMR vaccinations led to a sustainable increase in overall bundle completion rates. Twelve-month targeted outreach and the subsequent increase in attendance at the twelve-month visit also functioned as a safety net for missed lead screenings as it could also take place during
the twelve-month visit, serving as a more sustainable approach than exam room phlebotomy.

**DISCUSSION**

In this QI study, a series of strategies were implemented to improve the delivery of preventative care services to an underserved population. An all-or-nothing bundled measure was adapted in order to incorporate physical, developmental and social domains of care. Use of a bundled measure allowed for the determination of whether patients were receiving all required services every time.

This study demonstrated that population management strategies are essential for sustainable improvement in the bundled measure. The use of a population-based registry allowed the population manager to keep track of our population, including determination of transfer status, and provide outreach as needed. A positive shift in the mean was identified following population management strategies, specifically strategies focused on promoting completion of the 12-month visit. The effect of the population manager efforts demonstrated the need for dedicated staff in comprehensive preventative care service delivery. Aside from increasing the bundle completion rate, other potential benefits in healthcare delivery were also achievable through the use of population management strategies. Patients' increased attendance at well-child visits led to an increased opportunity for medical advice and anticipatory guidance delivery, and to an increased opportunity to address other needs. With the constant monitoring by the population manager, awareness and proactive intervention became routine and patients were less susceptible to getting behind on their immunisation schedule. In terms of sustainability, incorporating the oversight of this cohort into the role of a preexisting employee proved both efficient and cost-effective. Population management strategies were achievable in our population size, though these efforts may not be generalisable to primary care clinics with a much larger ≤2-year-old population, without greater staffing.

Exam room-based phlebotomy was effective in the short term resulting in increased lead screening rates, but was unsustainable due to staff shortage.

Our study used an all-or-nothing bundle approach to measuring preventative care delivery, as previously used by others, but we were able to incorporate innovative improvement strategies to further improve our care delivery in a sustainable manner.

**Limitations**

There were several limitations in our study. The first was the lack of a visit-based measure. This made the effect of small tests of change not easily identifiable. Real-time efforts to provide visit-based feedback to providers following missed vaccinations were attempted for a short period of time, but were not sustainable in our workflow. However, overall we found that missed visits were a larger contributor to not receiving vaccines that missed opportunities at visits.

Several other limitations were related to our EMR system and to the limited capabilities of our data warehouse extraction. Our EMR did not allow us to document vaccination refusals in a way that could be quantified automatically. Therefore, we were unable to exclude

| Table 2 | Individual component completion versus bundle completion percentages |
|---------|---------------------------------------------------------------|
|         | Baseline (n=67) | Post phlebotomy (n=64) | Post 12-month outreach (n=62) |
| Total DTaP | 90% | 94% | 90% |
| Total Hepb | 88% | 91% | 90% |
| Total Hib | 90% | 94% | 90% |
| Total IPV | 91% | 92% | 87% |
| Total Rotarix | 78% | 84% | 82% |
| Total PCV13 | 88% | 91% | 90% |
| Total MMR | 48% | 42% | 87% |
| Total VZV | 45% | 42% | 87% |
| Influenza | 88% | 91% | 94% |
| Newborn Summary | 67% | 83% | 84% |
| Pre-visit Questionnaire | 88% | 95% | 97% |
| PEDS Screen | 78% | 97% | 95% |
| Pb Screen | 57% | 78% | 85% |
| Bundle Completion | 57% | 58% | 80% |

*All measurement includes 3-month interval averages following launch of the quality improvement initiative (baseline) or intervention (post phlebotomy and post 12-month outreach).

DTaP, diphtheria, tetanus and acellular pertussis; Hepb, hepatitis B; Hib, haemophilus influenza; IPV, inactivated polio vaccines; MMR, measles, mumps and rubella; PCV, pneumococcal vaccines; VZV, varicella.
patients for whom the vaccinations were contraindicated. For newborn patients who transferred from out of state, the newborn summary was frequently listed under a generic label, rather than a ‘newborn summary’ label in our EMR, making identification harder. Our population manager attempted to resolve this issue via chart review, but our data system still identified it as missing. Many of the limitations in this study resulted in a potential under-reporting of our completion rates.

Conclusions
Through use of a bundled measure, we were able to effectively track preventative services and improve the quality of care given to a high-risk patient population. Staff dedicated to targeted population management strategies was essential to improve the delivery of preventative services. Specifically, the population manager outreach efforts around scheduling the 12-month visit had the most impact in shifting the mean rate of bundle completion. In-room phlebotomy demonstrated improvement in lead screening completion rates, but had to be stopped due to staffing limitations, highlighting the importance of sustainable efforts.

More urban paediatric primary care clinics should use holistic care delivery methods using bundled all-or-nothing measures and implement population management strategies for preventative service delivery improvement. Additional studies involving larger and different populations should be undertaken to understand the generalisability of these findings.

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