

# 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 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 immunizations, lead screening, and use of screening tools among underserved patients under 2 years old.

**Methods:** A quality improvement 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 (PDSA) cycles to optimize 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% to 77% following implementation of the quality improvement 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-centered strategies for visit completion are effective at ensuring timely delivery of comprehensive preventative care to an underserved pediatric population.

**Keywords:** Preventative services; Infant health; Bundled measure; Population management; Underserved populations

## INTRODUCTION

Over 20 immunizations and screenings are recommended for pediatric 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]. Immunization rates are especially low among patients of low socioeconomic status in urban settings [2]. A 2007 study that recruited a nationally representative sample of pediatric 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 and colleagues developed a bundled measure of key evidence-based preventative care services required in the first year of life and used quality improvement methods to increase receipt of these services at the visit level [3,4]. Utilizing similar methods, we conducted a quality improvement (QI) initiative aimed at improving 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 located in a low-income Boston neighbourhood. As a community health centre, the clinic serves

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nearly 5700 patients, where 90% of patients which are insured through Medicaid and The patient population are also unique in that it is largely made up of immigrant families, with 76% self-identifying as Hispanic and 58% with a primary language other than English. The clinic serves nearly 5700 unique patients, over 400 of which of these patients are under 14 months of age. Approximately 2,000 well-child visits are completed by the sub 14-month-old patient population per year. 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 Centres for Disease Control and Prevention (CDC) recommended schedule of immunizations [5]. These included: three diphtheria, tetanus, and acellular pertussis (DTaP) vaccines, three pneumococcal vaccines (PCV), three haemophilus influenza (Hib) vaccines, three inactivated polio vaccines (IPV), 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].

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 utilized 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 immunizations 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 new-born discharge summary and a pre-visit questionnaire scanned in the electronic medical record 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 new-born.

Our pre-visit questionnaire served as psychosocial risk factor screening tool. It included a section on caregiver mental health that utilized the PHQ-2, a validated post-partum 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 et al., 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 quality improvement assessment [8].

In our study, data was collected daily using the hospital's data warehouse and extraction system. The data warehouse stores information from the appointment scheduling system and the electronic medical record. Customized reports are producible through the extraction platform, called Boston Children's Hospital 360, which allows for the retrieval of subpopulation-specific information from the electronic medical record. Reports These reports retrieved from the data warehouse consisted of a combination of standard attributes/metrics and custom-built metrics. At the beginning of our study, we built a report that pulled each of the bundle elements from patients turning 14 months old on the day of the pull. We automated the report to run each day, and from there, created a growing registry of patients and their bundle data. 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 analyze the data monthly. We tracked bundle outcome rates using a p-type Statistical Process Control (SPC) chart. We defined a shift occurrence to be 6 or more data points falling above or below the mean [9].

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

Sl. No.	Component
1	3 doses of diphtheria, tetanus, and pertussis vaccine
2	3 doses of hepatitis B vaccine
3	3 doses of <i>Haemophilus influenzae</i> type b vaccine
4	3 doses of polio vaccine
5	3 doses of rotavirus vaccine
6	3 doses of pneumococcal conjugate vaccine
7	1 dose of measles, mumps, and rubella vaccine
8	1 dose of varicella vaccine
9	Seasonal influenza vaccine
10	Newborn Summary
11	Pre-visit questionnaire
12	Screen for developmental delay (Parents' Evaluation of Developmental Status or PEDS)
13	Screen for lead exposure

## Interventions

We used a Plan, Do, Study; Act (PDSA) cycles model to implement strategies towards improving the bundle passing rate improvement. The interventions were data-driven and focused on improvement of delivery systems and processes. Our PDSAs were grouped into three main strategies:

**Strategy 1-Staff education:** The education and awareness of staff was the first step to initiate the quality improvement 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 quality improvement project and heightened staff awareness, the role of a pre-existing new-born 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 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.

## 12-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 immunization. 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 quality improvement project, there was a noticeable decline in the completion rate, which we attributed to delays in receiving the new-born summary, a component required for the bundle. This was confirmed through measurement of new-born summary completion rate at 67% during this time (Table 1).

In the three 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. 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/

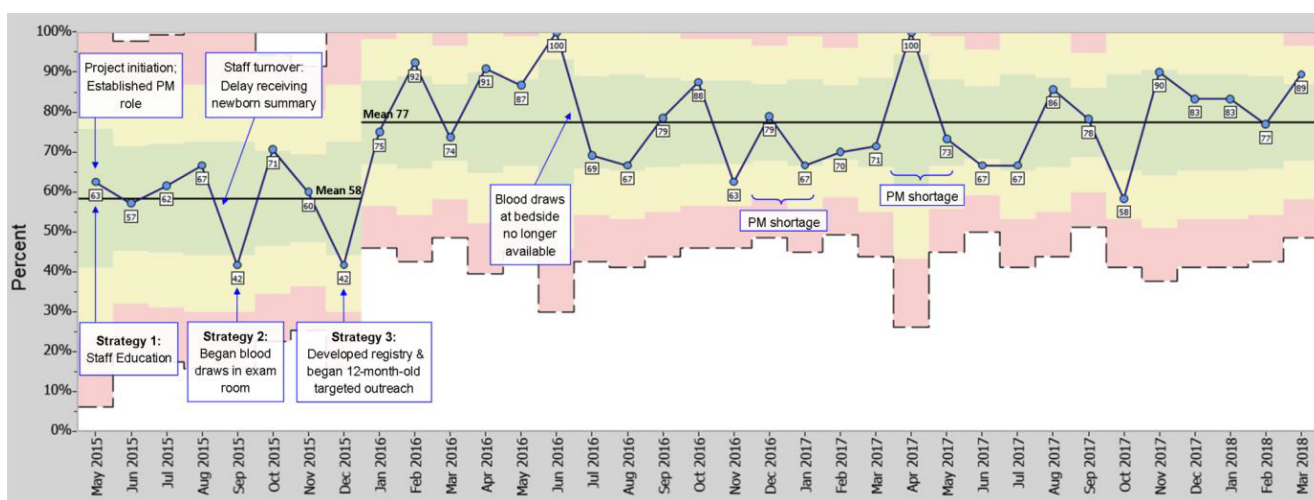


Figure 1: Trends in monthly baby bundle completion rate.

**Table 2:** Individual component completion *vs.* 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 Pcv 13	88%	91%	90%
Total MMR	48%	42%	87%
Total VZV	45%	42%	87%
Flu	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%

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. 12-month targeted outreach and the subsequent increase in attendance at the 12-month visit also functioned as a safety net for missed lead screenings as it could also take place during the 12-month visit, serving as a more sustainable approach than exam room phlebotomy.

## DISCUSSION

In this quality improvement 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 immunization schedule. In terms of sustainability, incorporating the oversight of this

cohort into the role of a pre-existing employee proved both efficient and cost-effective. Population management strategies were achievable in our population size, though these efforts may not be generalizable 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 utilized an all-or-nothing bundle approach to measuring preventative care delivery, as previously used by others [3], 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 electronic medical record 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 patients for whom the vaccinations were contraindicated. For new-born patients who transferred from out of state, the new-born summary was frequently listed under a generic label, rather than a “new-born 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 underreporting of our completion rates.

## CONCLUSION

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 pediatric primary care clinics should utilize 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 generalizability of these findings.

## CONFLICT OF INTEREST

The author(s) disclosed no conflicts of interest.

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