

No Cause for Alarm: Decreasing Inappropriate Pulse Oximetry Use in Bronchiolitis

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"I need you to come look at the baby in room 8! The monitor keeps alarming for desaturations." I walk to the patient room thinking through the many other tasks on my to-do list. As I enter the room, the smiling but noisy breathing child with bronchiolitis greets me. "We've deep suctioned him and he's breathing more comfortably, but the pulse oximeter keeps dipping into the high 80s." I look at the bedside monitor continuously tracking the patient's heart rate, respiratory rate and oxyhemoglobin saturation, which now reads a perfect 100%. As I complete my assessment, I cannot help but wonder, "Why is this happy, well-appearing patient on a monitor?"

As trainees, we are the frontline clinicians who rotate through different units within the hospital, and we observe situations like this almost every day, if not multiple times a day. Our perspective should make us the ideal stewards for identifying care processes that deviate from standard guidelines, but we are often not empowered to implement changes to improve the system and rather rely on the "higher-ups" to solve systems-based issues. As the call for "bending the value curve" has echoed through hospital systems and training programs, it is essential that we not only teach trainees about health care value but also empower them to identify examples of low-value care and give them tools and resources to be a more effective part of the solution.¹ As part of the *Hospital Pediatrics* Bending the Value Curve series, we describe how low-value patient care stories such as the one above inspired a resident-led quality improvement (QI) initiative.

In 2014, our residency program developed the Healthcare Value Curriculum and, at approximately the same time, initiated the Advanced Skills Track in QI and Patient Safety to train interested residents in the methodology and tools of QI. As both curricula took shape, it became clear that to teach value in a hands-on way and empower trainees to improve quality of care (the important numerator in the value equation),¹ the best approach would be a resident-driven project focused on improving value by using the Model for Improvement and QI methodology. Our group of 3 QI and Patient Safety Advanced Skills residents identified a value-based problem for a capstone project that would also have significant buy-in from fellow trainees: improving quality of care by reducing unnecessary monitoring and alarms for patients with bronchiolitis admitted to the general pediatrics inpatient unit. Anecdotally, we recognized that nurses and residents are often inundated with unnecessary alarms and pages for the well-appearing bronchiolitis patient. Were

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bronchiolitis patients truly inappropriately monitored in our institution, and did this contribute to low-value care? If so, is there anything that we could do to flip the value equation? Previous work has revealed team- or unit-based approaches and QI methodology can have a significant impact on monitor use; thus, we set off on our own QI journey.^{2,3}

While gathering our baseline data, we found that our hospital followed national trends, with bronchiolitis being the second most common diagnosis among general pediatrics admissions with 513 patients seen in fiscal year 2016 (July 2015–June 2016).⁴ The use of pulse oximetry in patients with bronchiolitis remains a hot topic, and although authors within the literature point toward overdiagnosis of hypoxemia leading to increased admission rates and a potential escalation of therapies, physicians continue to rely on pulse oximetry data to guide clinical decision-making.⁵ In 2013, the American Academy of Pediatrics’ Pediatric Hospital Medicine Choosing Wisely Initiative included recommendations against the use of continuous pulse oximetry (CPO) for children not requiring supplemental oxygen.^{6,7} At that time, a panel of multidisciplinary stakeholders at our institution created a pathway to standardize care for children with bronchiolitis by using evidence-based guidelines that included recommendations for continuous monitoring.⁸ In the pathway, it is recommended that patients considered to be on the mild-to-moderate pathway (based on a 5-point clinical classification system) and who do not require supplemental oxygen therapy be placed on intermittent pulse oximetry (Supplemental Fig 2). Despite these recommendations, 27% of patients admitted with mild-to-moderate bronchiolitis were still ordered for CPO in 2016. Thus, our specific smart aim for our QI project was to increase adherence to the bronchiolitis pathway guidelines regarding the use of intermittent pulse oximetry for patients between 29 days and 1 year of age.

For many reasons, unnecessary use of CPO is an example of low-value care. Although continuous monitoring can sometimes alert physicians of potential clinical deterioration, the vast majority of the alarms triggered are nonactionable alarms (ie, either an alarm

that correctly identified a change in the physiologic state of a patient but did not require intervention or an invalid alarm caused by a motion artifact or technical and/or equipment failure).^{9,10} On the basis of data from a recent systematic review, likely only 1% of alarms are considered actionable in an inpatient pediatric ward like ours.¹¹ In addition, the Joint Commission released a sentinel event alert stating that alarm fatigue contributes significantly to patient morbidity and mortality.¹² Excess alarms can lead to harm by delaying response to critical alarms, disrupting process of care, introducing errors, and creating noise pollution, which increases stress levels in patients, families, and employees.^{9,12} Thus, unnecessary monitoring and alarms tip the value equation in the wrong direction, by potentially decreasing safety, effectiveness, efficiency, and perhaps even timeliness.¹

To address this problem, we investigated barriers to following the previously established guidelines for the use of CPO in bronchiolitis patients. Key drivers for inappropriate use of CPO were identified through focus groups with nurses, respiratory therapists, and resident physicians. Recurring themes ranged from a desire to continuously monitor unattended patients to a reluctance to wake patients to attach pulse oximetry for spot checks and a hesitancy to cancel monitoring without involvement of the attending physician. Results from the focus groups were used to inform and test several interventions by using plan-do-study-act (PDSA) methodology. The tests

of change were performed on a 16-bed general pediatrics unit (the Seasonal Stay Unit) open during the high-census months (October–April) and staffed with 1 third-year and 3 second-year pediatric residents. We targeted efforts aimed at (1) providing key stakeholder education about established monitoring guidelines for patients with bronchiolitis and (2) leveraging safety huddles and rounds as a forum for discussion of appropriate CPO use.

Residents rotating through the unit were engaged in each PDSA cycle by incorporating targeted educational sessions and continuous feedback. In addition, to ensure a team-based approach, we held educational sessions for respiratory therapists and provided daily “monitor pearls” during the nursing safety huddles. Throughout the PDSA cycles, faculty mentors conducted real time check-ins and shared data with residents rotating on the unit. Weekly feedback from residents shaped each subsequent PDSA cycle.

As a result of our QI project, CPO orders decreased from a median rate of 20% in the 2015–2016 Seasonal Stay Unit season to 6% in the 2016–2017 season. In comparison, a similar general pediatrics unit’s use of CPO for patients with mild-to-moderate bronchiolitis maintained a rate of 28.6% in the same period. Additionally, over 7 months, we successfully decreased clinical pulse oxygen saturation (SpO₂) alarms for patients with mild-to-moderate bronchiolitis by 50% from a baseline median of 48.6 alarms per patient day (during Season 1 and Season 2 before the intervention

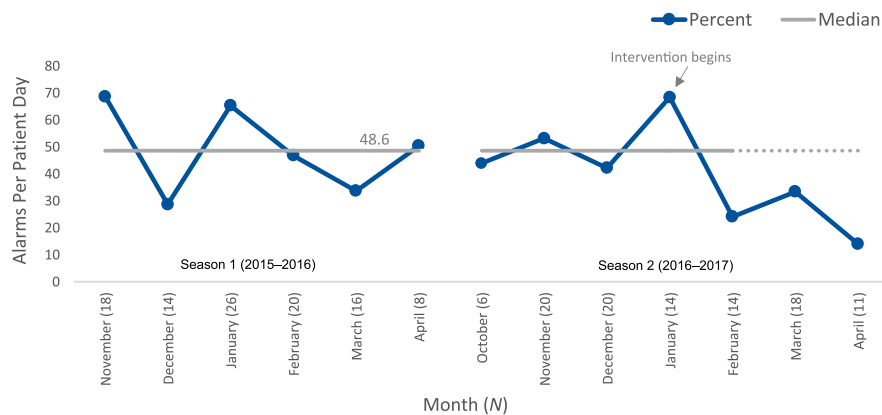


FIGURE 1 SpO₂ alarms for patients to mild-to-moderate bronchiolitis.

period) to a median of 24.1 alarms per patient day post-intervention (Fig 1). As balancing measures to ensure our project did not result in any unintended outcomes, we measured rates of transfer to the ICU and readmissions. Decreasing CPO use did not change rates for either of these measures. As previously described by the authors of previous studies, resource use remained unchanged as measured by length of stay, viral testing, and chest radiograph orders.^{13,14} Cost is an integral part of value (the important denominator in the value equation), and in this study, we were able to improve quality by reducing alarms without increasing cost as measured by resource use.¹

Incorporating a QI project into existing clinical responsibilities with embedded education and feedback led to successful resident engagement and higher value care. Although the authors of previous studies did not show significant reduction in overall alarm counts when targeting CPO alone, our efforts to improve the appropriate use of pulse oximetry in children with mild-to-moderate bronchiolitis resulted in decreased clinical SpO₂ alarms, which, when not indicated, can interrupt care and cause noise pollution and alarm fatigue.^{14,15} Our ability to engage multiple stakeholders, including residents, contributed to the success of the project. Although the project took place on a small unit over a limited period of time, we are encouraged by our experience and anticipate continued resident involvement moving forward to sustain change. We hope our success in carrying out a resident led QI project will inspire others to try their hand at bending the value curve.

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