

Intermittent Pulse Oximetry Use and Length of Stay in Bronchiolitis: Bystander or Primary Driver?

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Bronchiolitis has been a prominent focus for quality improvement (QI) efforts in pediatrics for nearly 2 decades.¹ Bronchiolitis costs the US health care system an estimated \$1.7 billion annually, and numerous efforts from the local institutional to national levels have been undertaken to promote high-value care and reduce unnecessary resource use.^{2,3} Pulse oximetry use in bronchiolitis is a perennial target for improvement efforts based on the impact of its use on the risk of hospitalization and length of stay (LOS) without appreciable improvements in patient outcomes.⁴ Studies of pulse oximetry's impact on LOS have been previously focused on either the widely varying lower acceptable limit of oxygen saturation or the use of continuous versus intermittent pulse oximetry (IPO).⁴⁻⁶

In this issue of *Hospital Pediatrics*, Mittal et al⁷ present results from a QI initiative that both standardized pulse oximetry value interpretation and increased the use of IPO over continuous pulse oximetry (CPO). They demonstrated that their combined approach was associated with a reduction of hospital LOS in a community hospital setting. The retrospective baseline cohort of 180 patients was compared with 2 intervention cohorts of 94 patients and 99 patients in cycles 1 and 2, respectively. In cycle 1, IPO use increased from a baseline of 20% to 75% while clinicians simultaneously standardized pulse oximetry readings sufficient for patient discharge. Unlike most previous studies or QI reports, IPO rather than CPO was recommended for those patients who were classified as nonsevere for at least 4 hours, even if they were still receiving supplemental oxygen of <1.5 L per minute. The combination of those interventions in cycle 1 resulted in a reduction of 8.4 hours in average LOS. Cycle 2 involved the implementation of an adapted bronchiolitis pathway and electronic medical record order set with standardized de-escalation protocols and target oxygen saturations $\geq 90\%$. From cycle 1 to 2, with 85% of patients placed on the pathway, the LOS was decreased by an average of 11.7 hours. There were no known adverse events attributable to the interventions, and 7-day readmission rates increased slightly (3.3%–5.0%).

Although a common limitation in QI studies, multiple improvement interventions were made simultaneously making it difficult to attribute the increased use of IPO as the sole driver of decreased LOS. This difficulty is in part due to the fact that IPO use was not monitored as a process metric in cycle 2. Additionally, the authors failed to account for several factors related to patient severity or complexity, and the trend in decreasing LOS existed

www.hospitalpediatrics.org

DOI:<https://doi.org/10.1542/hpeds.2018-0183>

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HOSPITAL PEDIATRICS (ISSN Numbers: Print, 2154-1663; Online, 2154-1671).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Dr McCulloh receives support from the Office of the Director of the National Institutes of Health under award UG10D024953. The remaining authors did not receive funding. Funded by the National Institutes of Health (NIH).

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

Development of this commentary and the content in this publication was supported by the Office of the Director of the National Institutes of Health under award UG10D024953. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.



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before study initiation suggesting that their findings might have occurred without their intervention. Perhaps most importantly, the implementation of de-escalation protocols and standardized pulse oximetry discharge criteria likely contributed to the decrease in LOS as demonstrated by the 11.7-hour reduction from cycle 1 to 2.

Authors of previous studies do not strongly support targeting CPO use as a means to reduce LOS. Schondelmeyer et al⁸ targeted CPO discontinuation in patients hospitalized with asthma, bronchiolitis, or wheezing. Despite a reduction in CPO use, they did not demonstrate a statistically significant reduction in time for patients to be medically ready for discharge.⁸ Additionally, a randomized clinical trial involving CPO versus IPO published by 1 of the authors of this commentary (R.M.) also did not detect a reduction in LOS with IPO use.⁶ However, unlike the QI initiative by Mittal et al,⁷ IPO was not initiated until children were weaned off supplemental oxygen. Conversely, in the large Bronchiolitis of Infancy Discharge Study, randomized use of “standard” (in this case 94%) pulse oximetry readings versus modified pulse oximeter readings (ie, readings of 90% were changed to display as 94%) did not affect clinicians’ determination of time to resolution of cough.⁹ Finally, authors of a randomized trial that artificially inflated pulse oximetry values by 3% for patients seen in the emergency department found a significantly lower risk of hospitalization.⁵ Together, it is suggested in the evidence to date that perhaps the lower acceptable limit of oxygen saturation and not the means by which it is obtained is the true driver of LOS in bronchiolitis.

Better organized and larger-scale trials of pulse oximetry use in bronchiolitis are on the horizon. A prospective randomized controlled trial is underway at 3 children’s hospitals in Ontario, Canada, to compare IPO versus CPO in those hospitalized with bronchiolitis.¹⁰ Unlike McCulloh et al,⁶ and similar to the QI initiative by Mittal et al,⁷ children who are medically stable and still on supplemental oxygen will be randomly

assigned to IPO. The Eliminating Monitor Overuse study led by Christopher Bonafide and colleagues is expected to provide valuable insight into the state of pulse oximetry monitoring at community hospitals and tertiary pediatric medical centers alike (C.P. Bonafide, MD, MSCE, personal communication, 2018). The results will both enhance our understanding of current practice in the United States as well as inform a future prospective clinical trial.

The use of CPO has presumed disadvantages, including contributing to alarm fatigue and decreased patient mobility. Importantly, we must recognize that no studies to date have been designed and powered to detect adverse outcomes related to IPO versus CPO use. This study by Mittal et al⁷ does, however, reveal the degree of impact QI interventions can have at an institutional level. What remains unanswered is how hypoxemia should be addressed in patients with bronchiolitis. Turning off the oximeter allows providers to ignore values that might otherwise make us uncomfortable and which could affect LOS. Yet would we be better served to answer the real question: What are safe oxygen saturation limits? In the meantime, standardizing lower oxygen saturation limits, promoting the use of IPO in targeted populations, and implementing weaning protocols as institutional QI projects appear to be the most effective methods to reduce LOS and improve resource use in viral bronchiolitis.

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DOI: 10.1542/hpeds.2018-0183 originally published online January 3, 2019;

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