

Increasing Length of Stay in the NICU for Premature Newborns: Good or Bad?

Cody Arnold, MD, MSc,^a Alexis S. Davis, MD, MS Epi^b

In this issue of *Pediatrics*, Edwards et al¹ present convincing evidence that the postmenstrual age (PMA), weight, and weight z score at discharge for preterm newborns increased between 2005 and 2018. It would be reasonable to speculate that the longer length of stay (LOS) might be attributed to rising survival rates and increasingly fragile survivors. However, the researchers' analyses suggest the opposite: the burdens of morbidities associated with prematurity appear to have decreased over time. The researchers did not have data that allowed the investigation of alternative causes of longer LOS or potential benefits that could justify longer LOS (decreasing rates of readmission, for example). The authors make the noncontroversial observation that there was a substantial monetary cost associated with the increased PMA at discharge: crude increase in median PMA of 8 days (estimated cost: \$28 576) and 12 days (95% confidence interval: 11–12) when adjusted for exposure to surgery, mechanical ventilation, and morbidities associated with prematurity (estimated cost: \$42 864). The increase in PMA at discharge was inversely related to gestational age at birth, a pattern consistent with the resolution of apnea of prematurity (AOP). Increased weight at discharge would be expected with longer LOS, whereas the modest increase in weight z score suggests that some of the increased weight was due to improved nutritional practices.

The authors raise the possibility that financial motivations might have played a role in this story. It is widely

understood that NICUs are an important source of income for hospitals, physicians, publicly traded group practices, and departments of pediatrics in academic centers. However, given that the misaligned incentives that characterize the US health care system were relatively stable from 2005 to 2018, financial motivations cannot be the sole explanation for increasing discharge PMA. But something, or things, must have been changing, even if misaligned financial incentives were a permissive factor.

Given the magnitude of increase in LOS, and that the data source represents the majority of US NICUs, researchers should feel obliged to confirm the findings using other databases, seek to understand the variables driving the changes, and determine if longer LOS has been associated with benefits. It has been reported that variation in the diagnosis and management of AOP and use of continuous pulse oximetry (CPO) contribute to inter-NICU variation in PMA at discharge.^{2,3} We believe that the same variables might also explain much of the temporal trend in PMA at discharge reported by Edwards et al.¹

In regard to AOP management, practices have been standardized in many NICUs such that the variation in duration of discharge countdowns reported in the 1990s and early 2000s has likely decreased, with countdowns of <5 days more likely to be deemed inadequate.^{4,5} In regard to diagnosis, it may be that increasing the use of CPO as a component of routine cardiorespiratory monitoring resulted in slower resolution of AOP. It is also

^aDivision of Neonatology, Department of Pediatrics, The University of Texas Health Sciences Center at Houston McGovern Medical School, Houston, Texas; and ^bDivision of Neonatal and Developmental Medicine, Department of Pediatrics, Stanford University School of Medicine, Stanford, California

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Address correspondence to Cody Arnold, MD, MSc, 6413 Fannin St, University of Texas Health Sciences Center at Houston McGovern Medical School, Houston, TX 77030. E-mail: cody.c.arnold@uth.tmc.edu

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possible that there has been a deemphasis on AOP as the cause of bradycardia and desaturation events. Anecdotal observations supported by published reports suggest that in many NICUs it is not necessary to classify bradycardia or desaturation events as secondary to AOP to initiate a discharge countdown.⁶ It is widely accepted that establishing cardiorespiratory stability is key in determining that a preterm infant can be discharged safely, but perhaps we have become overly reliant on monitors.⁷

In another recently published US study, on the basis of data from 48 US tertiary care children's hospitals, researchers report numerous NICU days without medical services beyond cardiorespiratory monitoring, consistent with the findings reported by Edwards et al.^{1,8,9} These studies serve as a reminder that the evidence supporting current discharge countdown practices consists of retrospective observational studies that did not include specific interventions or meaningful clinical outcomes. And there is no evidence supporting routine use of CPO until discharge. Nevertheless, it must be acknowledged that premature patients and parents might be benefitting from the longer LOS reported by Edwards et al.¹ But to assume that they are benefitting would be presumptuous and self-serving.¹⁰ Prospective research comparing alternative countdown strategies on the basis of readmissions rates and other outpatient outcomes is overdue. Topics that warrant investigation include operational definitions of countdown events, countdown duration, indications for CPO, outpatient use of caffeine, and shared decision-making with parents.¹¹⁻¹⁵

We have focused on AOP and discharge countdowns in this commentary because we believe that changes in related practices are likely the most important drivers of the increases in PMA at discharge

reported by Edwards et al.¹ Other factors, such as increasing availability of NICU beds or decreasing availability of home support services, may have contributed to longer LOS.^{16,17} But these questions should be answered by research, not by speculation.

ABBREVIATIONS

AOP: apnea of prematurity
CPO: continuous pulse oximetry
LOS: length of stay
PMA: postmenstrual age

REFERENCES

1. Edwards EM, Greenberg LT, Ehret DEY, Lorch SA, Horbar JD. Increases in discharge age and weight for very preterm infants, 2005-2018. *Pediatrics*. 2021;147(2):e202016006
2. Eichenwald EC, Blackwell M, Lloyd JS, Tran T, Wilker RE, Richardson DK. Interneonatal intensive care unit variation in discharge timing: influence of apnea and feeding management. *Pediatrics*. 2001;108(4):928-933
3. Eichenwald EC, Zupancic JA, Mao WY, Richardson DK, McCormick MC, Escobar GJ. Variation in diagnosis of apnea in moderately preterm infants predicts length of stay. *Pediatrics*. 2011;127(1). Available at: www.pediatrics.org/cgi/content/full/127/1/e53
4. Darnall RA, Kattwinkel J, Nattie C, Robinson M. Margin of safety for discharge after apnea in preterm infants. *Pediatrics*. 1997;100(5):795-801
5. Eichenwald EC; Committee on Fetus and Newborn, American Academy of Pediatrics. Apnea of prematurity. *Pediatrics*. 2016;137(1):e20153757
6. Chandrasekharan P, Rawat M, Reynolds AM, Phillips K, Lakshminrusimha S. Apnea, bradycardia and desaturation spells in premature infants: impact of a protocol for the duration of 'spell-free' observation on interprovider variability and readmission rates. *J Perinatol*. 2018;38(1):86-91
7. American Academy of Pediatrics Committee on Fetus and Newborn. Hospital discharge of the high-risk neonate. *Pediatrics*. 2008;122(5):1119-1126
8. Goldin AB, Raval MV, Thurm CW, et al. The resource use inflection point for safe NICU discharge. *Pediatrics*. 2020; 146(2):e20193708
9. Zupancic JAF, Kunz SN, Pursley DM. Quantifying the where and how long of newborn care. *Pediatrics*. 2020;146(2): e2020006213
10. Silber JH, Lorch SA, Rosenbaum PR, et al. Time to send the preemie home? Additional maturity at discharge and subsequent health care costs and outcomes. *Health Serv Res*. 2009;44(2 pt 1):444-463
11. Lorch SA, Srinivasan L, Escobar GJ. Epidemiology of apnea and bradycardia resolution in premature infants. *Pediatrics*. 2011;128(2). Available at: www.pediatrics.org/cgi/content/full/128/2/e366
12. Quinonez RA, Coon ER, Schroeder AR, Moyer VA. When technology creates uncertainty: pulse oximetry and overdiagnosis of hypoxaemia in bronchiolitis. *BMJ*. 2017;358:j3850
13. Cheston CC, Vinci RJ. Overuse of continuous pulse oximetry for bronchiolitis: the need for deimplementation science. *JAMA*. 2020; 323(15):1449-1450
14. ClinicalTrials.gov. IdentifierNCT03340727, Moderately Preterm Infants With Caffeine at Home for Apnea Trial (MoCHA). Bethesda, MD: National Library of Medicine. 2020. Available at: <https://clinicaltrials.gov/ct2/show/NCT03340727>. Accessed September 14, 2020
15. Soltys F, Philpott-Streiff SE, Fuzzell L, Politi MC. The importance of shared decision-making in the neonatal intensive care unit. *J Perinatol*. 2020;40(3):504-509
16. Profit J, McCormick MC, Escobar GJ, et al. Neonatal intensive care unit census influences discharge of moderately preterm infants. *Pediatrics*. 2007;119(2):314-319
17. Hintz SR, Kendrick DE, Vohr BR, Poole WK, Higgins RD; National Institute of Child Health and Human Development (NICHD) Neonatal Research Network. Community supports after surviving extremely low-birth-weight, extremely preterm birth: special outpatient services in early childhood. *Arch Pediatr Adolesc Med*. 2008;162(8): 748-755

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