Clinical Pearl: The Low Prevalence of Targeted Clinical Decision Support Imperils Nutritional Calculations

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In the first few weeks, preterm infants in the neonatal intensive care unit (NICU) accumulate a deficit in calories and protein contributing to infant malnutrition. (1) There are pathophysiologic reasons for this deficit, including early intolerance to fluid and macronutrients. (2) Variation in nutrition delivery across neonatal intensive care units (NICU), however, also exists and is associated with poor postnatal growth even after adjusting for co-morbid conditions. (3) This variation suggests that the structure of the healthcare system also contributes to these deficits. One source of structural variation includes the data available to clinicians to monitor nutrition delivery in infants.

There is a low prevalence of clinical decision support (CDS), or clinical support tools, to calculate nutrition intake for critically ill infants across the Children's Hospital Neonatal Consortium, a collection of 34 US and Canadian children's hospital NICUs. (4) Clinicians still rely on manual calculations to retrospectively determine the quantity of calories and macronutrients (e.g., protein) that an infant received in the past. Of the NICUs that had CDS to calculate these values, few were automated and most required additional work from the clinician. In some cases, clinicians transcribed data from the intake and output report of the electronic health record (EHR) into another section of the EHR.

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Clinicians also lacked comprehensive CDS to prospectively determine the nutrition intake that an infant would be projected to receive in the future based on current orders. Though many NICUs had reports to summarize projected caloric and macronutrient intake from parenteral nutrition orders, there were few examples of CDS to calculate these values from enteral feeding orders. (4) This may be because feeding orders rely on logic that is not discretely captured by the EHR. For example, in situations where an infant is permitted to receive either breast milk or formula, clinicians would order both "30mL of breast milk every three hours" and "30mL of formula every three hours." Logically, this is interpreted by clinicians as "OR" though may appear to the EHR as "AND."

Though the calculations for caloric and macronutrient intake do not require calculus, they are error-prone. In a study of pediatric burn patients, clinicians produced fewer errors when electronic methods were used to calculate the volume of fluid resuscitation compared to manual calculations. (5) Calculation by hand resulted in small and large errors in a half and a fifth of the calculations, respectively. In addition, such determinations suffer from a lack of standardization in clinical practice regarding approaches to using variables critical to these calculations. In the survey of 34 NICUs, dosing weight was used to calculate fluid intake in 40% of NICUs versus daily weight in the other 60% of NICUs.(4)

Another risk of relying on manual calculations in a busy NICU is that the calculations may not be performed, leaving clinicians to focus on data that are readily available, above all fluid. It is not surprising that there are more CDS to retrospectively calculate fluid intake because these calculations are simpler than calculating caloric or macronutrient intake. (4) Therefore, clinicians may heuristically use fluid intake to approximate nutrition intake. This strategy may work well for infants exclusively receiving enteral nutrition; however, it may result in inadequate nutrition delivery in two scenarios. During the transition phase of nutrition, when enteral feeds are increased, and parenteral nutrition is decreased, the relationship between the intake of fluid and nutrition is not constant. Advancing enteral feeds while keeping total fluids constant may result in inconsistent nutrition delivery. A decline in protein intake has been demonstrated in infants during this transition phase. (6) Furthermore, when clinicians employ fluid restriction in critically ill infants without immediate feedback of implications on nutrition, they may be susceptible to availability bias. (7) The risk-benefit ratio of fluid restriction may appear more favorable if there is no readily available data on nutrition. Therefore, a fluid restriction may inadvertently result in nutrient restriction.

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Whether the absence of nutrition data contributes to the decline in protein delivery during the transition phase or clinicians in the NICU are susceptible to availability bias with fluid restriction

remains to be proven. Regardless, clinicians' time would be better spent assessing how various orders balance adequate nutrition while minimizing central line days or addressing a fluid-sensitive cardiopulmonary status. Comprehensive, automated, and real-time CDS to prospectively summarize projected nutrition intake would support clinicians in managing this balance by providing an opportunity to revise orders that would otherwise deliver inadequate nutrition.

The immediate and tangible benefits of increased and enhanced CDS for nutrition intake may be realized through its support of quality improvement initiatives directed at growth and nutrition in the NICU. Initiatives may be directed at improving the nutrient content of orders and ensuring that orders are executed effectively. The benefits of the EHR should include assisting the clinician with the management of patient data; however, current CDS that require recopying data are an example of the clinician working for the EHR rather than the EHR working for the clinician. Delivering adequate nutrition and optimizing the growth of critically ill infants is a goal for every clinician in the NICU. Therefore, the data should exist to support these goals. We should measure what we value rather than value what we measure.

References

1. *Embleton NE, Pang N, Cooke RJ. Postnatal malnutrition and growth retardation: an inevitable consequence of current recommendations in preterm infants? Pediatrics [Internet]. 2001 Feb 1 [cited 2014 Jul 9];107(2):270–3. Available from: http://pediatrics.aappublications.org/cgi/doi/10.1542/peds.107.2.270*
2. *Bell EF, Acarregui MJ. Restricted versus liberal water intake for preventing morbidity and mortality in preterm infants. Cochrane Database Syst Rev [Internet]. 2014;12(6):CD000503. Available from: http://www.ncbi.nlm.nih.gov/pubmed/25473815*
3. *Olsen IE, Richardson DK, Schmid CH, Ausman LM, Dwyer JT. Intersite differences in weight growth velocity of extremely premature infants. Pediatrics. 2002;110(6):1125–32.*
4. *Falciglia GH, Murthy K, Holl JL, Palac HL, Woods DM, Robinson DT. Low prevalence of clinical decision support to calculate caloric and fluid intake for infants in the neonatal intensive care unit. J Perinatol [Internet]. 2019 Dec 9; Available from: http://dx.doi.org/10.1038/s41372-019-0546-z*
5. *Dingley J, Cromey C, Bodger O, Williams D. Evaluation of 2 novel devices for calculation of fluid requirements in pediatric burns. Ann Plast Surg. 2015;74(6):658–64.*
6. *Miller M, Vaidya R, Rastogi D, Bhutada A, Rastogi S. From parenteral to enteral nutrition: a nutrition-based approach for evaluating postnatal growth failure in preterm infants. JPEN J Parenter Enteral Nutr [Internet]. 2014 May;38(4):489–97. Available from: http://journals.sagepub.com/doi/10.1177/0148607113487926*
7. *Kahneman D. Ch. 12: The Science of Availability; Ch. 13: Availability, Emotion, and Risk. In: Thinking, Fast, and Slow. Farrar, Straus, and Giroux; 2011.*

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