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EDITORIAL

Has the hospital become the place not to be for infants with bronchiolitis?

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Children belong at home with their parents. But what when children become ill? At every pediatric hospital, the duration of hospital admissions decreases steadily and the number of ambulatory services is forever increasing. Especially for children with chronic conditions, home support programs have been developed. These range from home intravenous antibiotic therapy, home total parenteral nutrition, home peritoneal dialysis, home oxygen therapy, home noninvasive ventilation to home support for children on palliative care. But all these conditions have one item in common: they are aimed at supporting children with a chronic disorder. In these situations, the gain for the child and family is large, the caregiver is accustomed with the medical condition, the transfer home can be prepared. For sure, the pioneers who initiated these programs faced resilience from their colleagues. Still, in affluent societies, such pediatric programs are now well embedded in the care landscape.

In the current issue of the *European Journal of Pediatrics*, the authors enter an entirely different arena: they calculate the potential gain of hospital days when infants and toddlers with bronchiolitis, the prototype of an acute and possibly life-threatening disease, are discharged home on oxygen [5]. Is this a bridge too far? Surely, some have prescribed home oxygen therapy for bronchiolitis and claim it can be done safely [3, 6, 8, 12]. And indeed, depending on the cost of hospital admission versus the cost and extent of home care support, some Euros can be saved.

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Is sending infants with an acute respiratory infection home on oxygen therapy because of the perceived need for supplemental oxygen the correct strategy? Several pieces of evidence cast serious doubt. The introduction of routine oximetry has been accompanied by an increase in the rate and duration of hospital admissions for bronchiolitis [10]. Even a small change in oxygen saturation from 94 to 92 % apparently has much more impact on the physicians' decision to admit infants with bronchiolitis, than the degree of respiratory distress [7]. The perceived need for supplemental oxygen is reported as the sole reason for prolongation of hospital admission in about 25 % of infants with bronchiolitis [9]. When all clinical parameters have improved, oxygen supplementation is still continued for an average of 66 h [13]. This leads to the relevant question of which infants require supplemental oxygen during the course of acute bronchiolitis, especially in the convalescent phase. I do not think we always know the answer.

Pulse oximetry allows for a simple, noninvasive, and reasonably accurate estimation of arterial oxygen saturation [4]. But users should be aware of its limitations, which include: motion artifacts, poor perfusion at the site of measurement, irregular rhythms, ambient light or electromagnetic interference, skin pigmentation, nail polish, calibration assumptions, probe positioning, time lag in detecting hypoxic events, venous pulsation, intravenous dyes, and presence of abnormal hemoglobin molecules [4]. The apparatus' accuracy (the closeness of measurement of a quantity to that quantity's true value) is only in the order of ±2 % and the apparatus' precision (the degree to which repeated measurements under unchanged conditions show the same results, also called reproducibility or repeatability) is only in the order of 4 % [4]. In addition, oxygen delivery to tissues also depends on hemoglobin levels and cardiac output. Neither is taken into account in oximetry. It is often forgotten that for the same cardiac output, a hemoglobin level of 8 g/dl and 100 % oxygen saturation, is associated with lower oxygen

delivery to tissues than a hemoglobin level of 12 g/dl with an oxygen saturation of 80 %. Normal values for SP_{O2} (arterial hemoglobin oxygen saturation measured by pulse oximetry) decrease at increasing altitude and the cutoff to start supplemental oxygen should be adjusted for altitude [11]. If already for the doctor and the nurse, the use and interpretation of oximetry requires skill and knowledge, surely one cannot expect the parents and home team to be familiar with its limitations. Unnecessary use of oxygen and oxygen toxicity are likely to occur. In only one study on home oxygen therapy, the degree of respiratory distress was measured via the respiratory distress score (possible range from minimum 0 to maximum 10): the mean score of 2.31 at discharge (SD is not mentioned) makes one wonder if these infants really did need supplemental oxygen [3].

The discussion of oxygen therapy in infants with bronchiolitis is often centered around the cutoff for SP_{O2} to start supplemental oxygen and the limits vary from 88 to 94 %, with 93 % used as mean [10]. The American Academy of Pediatrics guideline advocates <90 % [1]. Rarely, the duration of oxygen desaturation needed to continue or restart supplemental oxygen is discussed. There is no evidence that transient (<1 min) desaturations below 90 % are associated with long-term adverse outcome. This is even unlikely unless—as stated above—one takes into account hemoglobin level and cardiac output. SP_{O2} nadirs of 84 to 86 % can be measured in healthy children [2]. In many institutions, infants with bronchiolitis are monitored by continuous oximetry, even though this is not recommended past the acute phase [1]. From personal experience, I can state that it is difficult to convince junior house staff, nurses and parents alike to discontinue monitoring and focus on the clinical observation of the infant with bronchiolitis. All are more likely to have noticed the very transient desaturation and restart oxygen supplementation rather than the nearly total time spent with normal oxygen saturation. Given all information provided above, to decide on discharge of an infant with bronchiolitis, it seems more reasonable to rely on the global clinical evaluation including the feeding behavior and the degree of respiratory distress rather than just his instantaneous oxygen saturation.

The final discussion point to raise: should economic motives push us so far that we consider sending young infants home during an acute illness, under the care of a worried and inexperienced mother, with the support of a general health care provider who will visit twice a day at most? Will this improve quality of care? On the whole the results of Gauthier's study [5] are convincing: the potential financial gain of home oxygen therapy is limited. In addition, who would finance an adequately powered study to provide evidence that home oxygen therapy is indicated and can be done safely in infants with bronchiolitis? Surely, more important factors can be optimized in the care of infants with bronchiolitis before we continue the debate on home oxygen therapy for an acute respiratory illness [1, 9]. These include: implementing discontinuous oximetry once the acute phase of bronchiolitis has passed, determining the minimal duration of desaturation to restart oxygen therapy (e.g., more than 60 s and/or associated with signs of respiratory distress), bringing the prescription of supplemental oxygen back to the physician rather than leaving it with the nurses and the parents. I rest my case.

References

1. American Academy of Pediatrics, Subcommittee on Diagnosis and Management of Bronchiolitis (2006) Diagnosis and management of bronchiolitis. Pediatrics 118(4):1774–1793
2. American Thoracic Society (1999) Cardiorespiratory sleep studies in children: establishment of normative data and polysomnographic predictors of morbidity. Am J Respir Crit Care Med 160 (4):1381–1387
3. Bajaj L, Turner CG, Bothner J (2006) A randomized trial of home oxygen therapy from the emergency department for acute bronchiolitis. Pediatrics 117(3):633–640
4. Fouzas S, Priftis KN, Anthracopoulos MB (2011) Pulse oximetry in pediatric practice. Pediatrics 128(4):740–752
5. Gauthier M, Vincent M, Morneau S et al. (2012) Possible impact of home oxygen therapy on hospital stay for infants with acute bronchiolitis. Eur J Pediatr. doi:10.1007/s00431-012-1831-4
6. Halstead S, Roosevelt G, Deakyne S et al (2012) Discharged on supplemental oxygen from an emergency department in patients with bronchiolitis. Pediatrics 129(3):e605–e610
7. Mallory MD, Shay DK, Garrett J et al (2003) Bronchiolitis management preferences and the influence of pulse oximetry and respiratory rate on the decision to admit. Pediatrics 111(1):e45–e51
8. Sandweiss DR, Corneli HM, Kadish HA (2010) Barriers to discharge from a 24-h observation unit for children with bronchiolitis. Pediatr Emerg Care 26(12):892–896
9. Schroeder AR, Marmor AK, Pantell RH et al (2004) Impact of pulse oximetry and oxygen therapy on length of stay in bronchiolitis hospitalizations. Arch Pediatr Adolesc Med 158(6):527–530
10. Shay DK, Holman RC, Newman RD et al (1999) Bronchiolitis-associated hospitalizations among US children, 1980–1996. JAMA 282(15):1440–1446
11. Subhi R, Smith K, Duke T (2009) When should oxygen be given to children at high altitude? A systematic review to define altitude-specific hypoxaemia. Arch Dis Child 94(1):6–10
12. Tie SW, Hall GL, Peter S et al (2009) Home oxygen for children with acute bronchiolitis. Arch Dis Child 94(8):641–643
13. Unger S, Cunningham S (2008) Effect of oxygen supplementation on length of stay for infants hospitalized with acute viral bronchiolitis. Pediatrics 121(3):470–475