

Decreasing Unplanned Extubations in the Neonatal ICU

Unplanned extubations (UE) continue to be an undesirable yet common event in neonatal ICUs. Neonates are at a particularly increased risk for UE due to their small size, the use of uncuffed endotracheal tubes (ETTs), and the infrequent use of continuous sedatives and muscle relaxants or paralytics in comparison to older children and adults.¹ Due to the variability of tube stabilization techniques and devices as well as sedation protocols between facilities, UE rates tend to plateau versus decrease despite best efforts. Patients who experience UE during their stay may experience hypoxia and may require airway re-insertion and escalation of care, which may result in an increased cost of care.¹ Additional complications associated with UE in neonates include longer stay and increased hemodynamic instability, airway trauma, infection, intraventricular hemorrhage, cardiopulmonary arrest, and death.²

There is an apparent lack of randomized controlled trials and systematic reviews pertaining to UE in neonates. Over the past 30 years, the literature on UE reduction has remained limited primarily to cohort reviews reporting on incidence at authors' respective facilities. Neonatal UE rates have been reported to range from 0.14 UE/100 intubated days to 5.3 UE/100 intubated days in cohort studies during this timeframe.³ Several institutions have implemented common quality improvement metrics as recommended by Children's Hospitals Solutions for Patient Safety UE collaborative, such as a standardized taping method, use of anatomic reference points, and root-cause analysis or debriefing.⁴ While implementation of the above methods as a whole has been shown to reduce the UE rate and to decrease the rate of harm to neonates and other patient populations, UE continues to remain a largely unresolved issue despite evidence-based practices adopted and case review.

In this issue of *RESPIRATORY CARE*, Morris and colleagues⁵ first implemented a bundled approach to preventing UE that included a focus on the method of endotracheal tube (ETT) securement, its regular assessment as part of nursing cares, and the use of 2 providers for all patient

repositioning maneuvers over a 7-month period. They found an initial decline in UE, but this plateaued at 0.91

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UE/100 ventilator days. Morris and colleagues⁵ then performed an internal retrospective review of UE and found that the odds of UE were 2.9 times higher if the ETT tip was at or above T1 on chest radiograph. Following this internal review, they conducted a prospective study of hospitalized infants admitted within their level-4 referral neonatal ICU with an UE.⁵ For this study, UE was defined as any dislodgement of the ETT from the trachea that was not intentional. The purpose of the study was to evaluate the effectiveness of a single intervention, which involved actively advancing any ETT past the T1 vertebra, in addition to the bundle interventions already in place. Two notifications (ie, "nudges") were added to remind staff of the change in practice. First, they implemented a script change in the twice-daily huddles reminding all staff of the preferred ETT position and current position; second, they required the notation on chest radiograph of the ETT position on nursing morning rounds sheets to ensure that the ETT was below T1 as a means of reducing UE. In the literature, the position of the ETT is recommended by radiology as 1.5 cm above the carina in children and at mid third of the trachea at T2–T4 level (with head in neutral position)⁶; many other studies describe the recommended position as mid-tracheal between the first and second thoracic vertebra,^{7–10} which is consistent with the intervention.

The primary outcome measured was UE rate per 100 invasive ventilator days, excluding tracheostomies. The statistical significance of ETT located at or above T1 was measured before and after the intervention in addition to other risk factors. They found 152 UE (1.23 per 100 ventilator days) in the 16 months prior to intervention, with 40% occurring in the setting of ETT at or above T1. Following the intervention, which maintained the ETT position below T1, UE events decreased to 48 (ie, 0.91 per 100 ventilator days). Prior to implementation of this unique intervention, subjects with ETT at or higher than T1 were significantly associated with UE ($P = .002$); following this intervention, ETT at or higher than T1 was no longer significantly associated with UE ($P = .20$) after both univariate analysis and binary logistic regression.⁵

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It is noteworthy to highlight that, compared with other quality-improvement studies that demonstrate 50–64% improvement,^{2,3,11} a 74% improvement in the UE rate is a higher rate of reduction. The final rate of UE (0.91 per 100 ventilator days) reported by Morris and colleagues⁵ is in the lowest quartile of the range of UE in neonates noted in 2013 by Silva and colleagues³ of 0.14–5.3 per 100 ventilator days (median 1.98). While their rate showed a significant reduction and is within Children’s Hospital Association 2017 reported averages for neonatal ICU of < 1 per 100 ventilator days,¹²⁻¹⁶ it is more than the 2019 Solutions for Patient Safety UE centerline of 0.79 per 100 ventilator days.⁴

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