Decreasing Unplanned Extubations in the Neonatal ICU

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BACKGROUND: Unplanned extubation (UE) is a preventable adverse event and may lead to additional complications such as cardiovascular resuscitation or respiratory compromise in a critically ill neonate during an emergent re-intubation. A quality improvement project to reduce unplanned endotracheal tube dislodgement would reduce these morbidities. We aimed to reduce UEs in the NICU to 1 UE/100 ventilator days by October 2018. METHODS: As of the baseline period (March 2017 to November 2017), our level 4 NICU had 950 annual admissions and a baseline rate of 9.9 UEs/100 ventilator days. We formed an inter-professional task force consisting of a neonatologist, 2 respiratory therapists, and the NICU nurse educator. We tracked all of our UE events and required the staff involved to file an electronic safety report. PDSA (plan-do-study-act) cycles consisted of staff attitude survey, development of a data collection tool, protocol of 2 staff members for all transfers of intubated patients, staff education around securement device, and daily retaping of endotracheal tubes to securement device. UE events and ventilator days were extracted from a respiratory database and the electornic medical record. RESULTS: A special cause variation was noted via control chart rules for the mean UE rate from a baseline of 9.9 UEs/100 ventilator days in the baseline period compared to a post-intervention mean of 1.6 UEs/100 ventilator days for the period of August 2018 to March 2019). During the intervention phase of the project (December 2017 to July 2018), a special cause variation was noted with a UE rate of 5/100 ventilator days. CONCLUSIONS: Development of a quality improvement project by a multidisciplinary taskforce, along with several PDSA cycles including education and staff awareness, reduced the UE rate by 84% in a level 4 NICU. Ongoing surveillance, education, and review of UE cases will be key to maintaining UE events at a goal of 1 UE/100 ventilator days. *Key words: neonatal; intensive care; mechanical ventilation; unplanned extubation.* [Respir Care 2021;66 (7):1059–1062. © 2021 Daedalus Enterprises]

Introduction

Unplanned extubations (UEs) in ICUs are a common occurrence, with some studies noting a rate of 1–20 UEs/100 ventilator days.[1,2] UE events can lead to short-term complications such as hypoxemia, the need for cardiovascular resuscitation, or the need for emergent re-intubation and long-term complications such as longer duration of mechanical ventilation, longer ICU stay, nosocomial pneumonia, and overall prolonged hospital stay.[2-5] In the NICU, frequent re-intubations can lead to long-term complications such as subglottic stenosis, palatal grooves, and local airway trauma.[6,7]

Potential causes of UE in neonates differ from adults due to smaller airways and fewer options for securing tubes, and, when combined with prolonged ventilator duration in

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very low birthweight and extremely low birthweight neonates, these factors create multiple opportunities for UE. Current strategies to reduce UE events include improved teamwork, increased awareness of UE, and methods of securement include taping or neonate specific securement devices, all of which have been reported to reduce UE events.[8,9]

The respiratory care providers working in the NICU at the Barbara Bush Children's Hospital at Maine Medical Center in Portland, Maine, had noted that UE events in the NICU were a common phenomenon that were not seen in other units in the hospital that cared for intubated patients. In these other units, UE events were treated as never-events due to the lack of on-site providers that could easily re-intubate a patient whose endotracheal tube was dislodged. Conversely, due to continuous on-site presence of neonatologists and neonatal nurse practitioners in the NICU, the process of re-intubating an infant with an UE did not involve locating a practitioner with airway skills to replace the endotracheal tube. These observations led to the development of a multidisciplinary team composed of respiratory therapists, neonatal nurses, and neonatologists to explore the incidence and potential causes of unplanned extubations in the NICU.

QUICK LOOK

Current knowledge

Unplanned extubations contribute to both short-term and long-term complications for premature infants. Quality improvement projects in newborn medicine have decreased many preventable conditions, and the use of quality improvement tools and methods can yield successful improvement projects.

What this paper contributes to our knowledge

A quality improvement project comprised of a multidisciplinary NICU-based team, using rapid-cycle plan-do-study-act changes led to a reduction in unplanned extubations in a level 4 NICU. Interventions such as staff awareness, data tracking, staff education, and small tests of changes at the bedside all contributed to a rapid reduction in unplanned extubation events.

Methods

After the creation of a multidisciplinary team, an intensive literature review was performed, along with a systematic review of all unplanned extubations over a 9-month period (March 2017 to November 2017). Previously, the NICU respiratory therapists tracked UEs via a data-collection sheet that evaluated time and date of the UE, birthweight, gestational age, method of endotracheal tube securement at the time of UE, infant position, and other potential factors contributing to UE. In addition to the manual NICU tracking system, a review of the hospital online reporting system was made to cross-check if other UE were not recorded on the NICU tracking system. As part of the UE data collection process, the NICU respiratory therapists and staff were encouraged to report all UEs on the hospital-wide online tracking system, along with collecting data for the NICU manual data collection.

A survey was developed and distributed to all NICU staff members to assess knowledge, attitude, and potential prevention strategies to reduce UE in the NICU. There were 75 respondents, and results of this survey informed the quality improvement taskforce of local culture surrounding UE, as 52% of staff members responding to the survey did not view UE as a problem in our NICU. The survey results provided the taskforce with the ability to develop guidelines and potentially improve practices to reduce UE.

Following the creation of the taskforce, monthly meetings were held to review all UE events from the previous month while standardizing current practices and creating new policies to address safe securement of endotracheal tubes. During the development of this quality improvement project, a goal statement was created to reduce the current UE rate to a target of 1 UE/100 ventilator days The potentially better practices included increased awareness of UE with the last date of UE added to the huddle board where the entire NICU team meets twice daily for safety huddles, use of a singular securement device to be used in all infants with intensive training provided to all staff, two-person care for intubated infants during any transfer off their patient bed (eg, for weighing, changing position, to be held by parents), placement of mittens for infants $>$ 34 weeks gestation, and daily retaping of the endotracheal tube to the securement device. Clinical specialists and taskforce team members provided re-education around placement and maintenance of the securement device. The respiratory therapists provided 1:1 hands-on instruction on choosing the correct device size and standardized taping of the endotracheal tube to the securement device, while reinforcing monitoring of device integrity and positioning that was mandatory for all NICU staff.

All UE events were extracted from the respiratory care database and cross-referenced with extubations that were collected in the hospital-based online reporting system. Ventilator days were extracted from the electronic medical record via development of an automated monthly report that could be readily accessed by team members. Rates of UE were compiled using statistical process control u-charts using QI Macros (version 2019.03, KnowWare International, Denver, Colorado), and control chart rules[10] were used to determine special cause variations. Special cause variations are data signals or non-random outcomes that can result

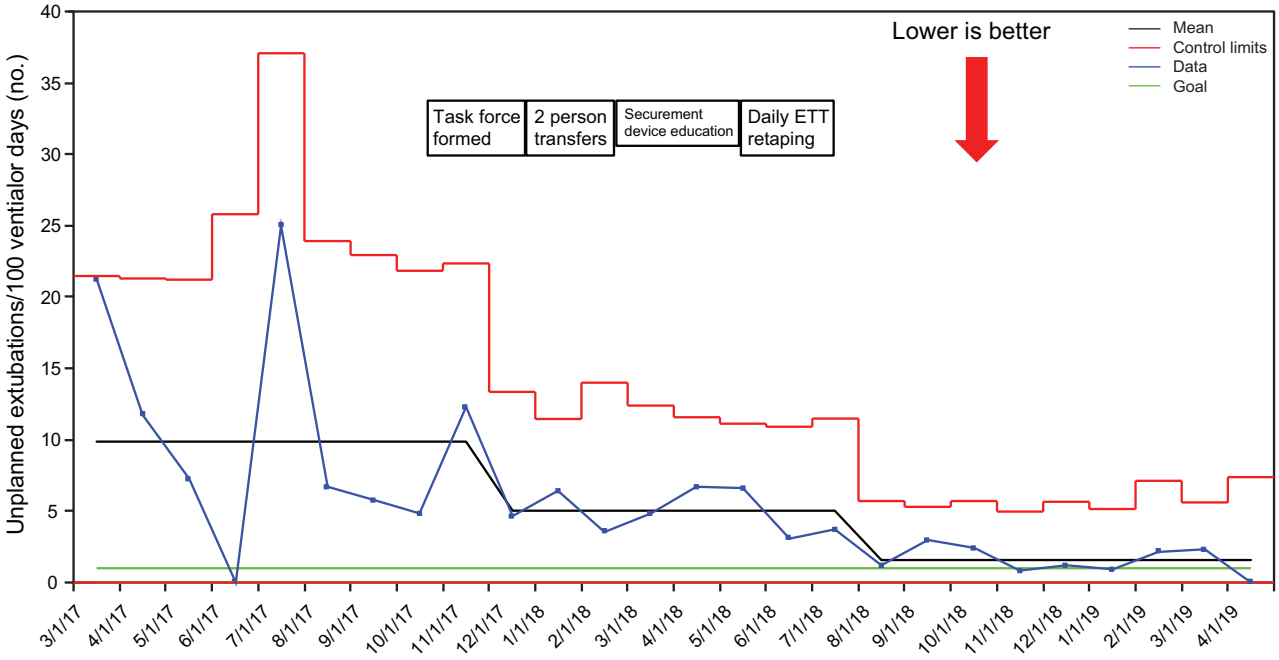

Fig. 1. Control chart (u-chart) showing number of unplanned extubations per 100 ventilator days. Special cause variations are noted by process shifts. Centerlines are 9.9, 5.0, and 1.6. ETT = endotracheal tube.

from a change in process and are governed by statistical rules that differentiate these data points from common cause variation, which are normal variations of data points, often referred to as data noise. Control charts help quality improvement teams identify special cause variation in a process, such as early signs of success, and monitor that process to ensure it is holding the gains of a quality improvement effort. The Maine Medical Center Institutional Review Board determined that this was quality improvement and did not qualify as research.

Results

Over the 9-month baseline period (March 2017 to November 2017), there were 46 UEs with 466 ventilator days (9.9 UE/100 ventilator days). During the intervention phase (December 2017 to July 2018), when the potentially better practices were tested and implemented, there was a 50% reduction with 35 UEs over 777 ventilator days (5 UE/100 ventilator days), which satisfied control chart rules for a special cause variation. In the post-implementation phase (August 2018 to March 2019), there was a further 68% reduction from the implementation period, with 12 UEs over 720 ventilator days (1.6 UEs/100 ventilator days), which again demonstrated a special cause variation by control chart rules (Figure 1). Overall, there was an 84% reduction (9.9 vs 1.6 UEs/100 ventilator days) in rate of UE events from baseline data to the post-implementation phase of this quality improvement project.

Discussion

Reduction of harm to hospitalized patients is an important job for all health care providers as medical errors account for a significant proportion of mortality and morbidity in hospitalized adults and children.[11] UE events in the NICU have previously not carried the same significance as UE events in other critical care areas in our facility due to the constant presence of experienced neonatal providers who can easily re-intubate an infant, compared to other care units that may not have providers skilled in airways readily available when a UE occurs. In addition to potential short-term and long-term consequences of UE events, there are also profound impacts on families at the bedside who experience such an event.

This quality improvement project was developed by a multidisciplinary taskforce and used several plan-do-study-act cycles, including education and staff awareness, to reduce the UE rate by 84% in a level 4 NICU. Although this was a single-center quality improvement project and certain specific factors may not be replicable in other NICUs, we feel that there are enough generalizable processes that can be adopted by facilities that undertake efforts to decrease UE events. This project relied on multidisciplinary development of potentially better practices, development of standard work processes with daily retaping of the endotracheal tube to the securement device, along with weekly assessments of data that allowed for continuous refinement of our processes to decrease UE events.

Similar to other studies, standardized processes were developed and daily compliance with these processes was ensured by team members. While it is not clear in the literature that any one endotracheal tube securement device is superior to another, our previous practice was to let the individual care team decide on the securement method. This quality improvement project standardized the use of a single securement device to reduce variability and improve all team members' comfort with a single method.

Conclusions

While the quality improvement project did not reach its stated goal of 1 UE/100 ventilator days, it made a significant impact on the unacceptably high incidence of UE in our NICU. Similar to other quality improvement projects, measurement and ensuring of compliance with standardized practices and procedures, coupled with ongoing surveillance of UE, will ensure that our UE rates do not change significantly over time and will be key to maintaining UE at a goal of 1 UE/100 ventilator days.

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