The Problem
- NICU infants are subjected to many devices with alarms: CR monitors, IV and feeding pumps, ventilators & incubators
- Preterm infants are at risk for apnea, bradycardia and desaturation events and remain on CR monitors for their entire admission (mean LOS 19 days)
- Meticulous attention to tight oxygen parameters improves long outcomes, but dramatically increase number of alarms
- Opportunity: TJC identified Alarm Safety as one of its National Patient Safety Goals
- Opportunity: BIDMC participated in an alarm safety collaborative hosted by the Vermont Oxford Network (VON) in 2015

Aim / Goal
Two competing goals:
1) Reduce audible CR alarm burden by 20% between September 2015 and September 2016
2) Increase percentage of infants in target saturation range 80% of the time by 20% by September 2016

Interventions
Understanding the Problem
- Gathered our team, explored the extent and depth of the problem & evaluated availability of data
- Participated in the VON NICU series on Alarm Safety to learn about improving oxygen saturation targeting using histograms, adjusting SPO₂ alarm limits and measuring hypoxic events
- Performed bedside and unit-wide audits and identified areas for improvement:
  - CR alarm limits did not match unit policy (or a specific order) 31% of the time
  - Alarm limits were not accurately documented in Metavision 42% of the time
  - Bedside cards to prompt staff of proper limits utilized sporadically
  - Identified need to standardize our alarm response and improve multidisciplinary approach

The Team
Rosanne Buck—NP, Nicole Flaherty—NP, Munish Gupta—QI Director, Nina Koyama—RRT, Dave Medema—Data Engineer, Jamie Perkins—RN, Brenda Sheridan—RN/UBE, Jane Smallcomb—Director Perinatal Services, Jeff Smith—Clinical Engineering Supervisor, Jessica Smith—RN, Wendy Timpse—MD, Kathy Tolland—Nursing Director, Karen Waldo—RN, Molly Wylie—Family Rep, Susan Young—CNS

Results / Progress to Date

Our MIT Team Elucidated the Epidemiology of Alarms in the Neonatal Population:
- MIMIC II: Retrospective database of Philips Monitor download 02/2008-06/2013
- 884 patients ~ 12,000 patient days
- 2,312,885 alarms analyzed
- 200 alarms/patient day
- 1 alarm every 7 minutes per baby
- 41% are device alerts
- 54% of alarms are yellow * 72% of which are SPO₂
- Alarm frequency is highest at early gestational ages, trends down with time and rises again at later gestational ages

Our Clinical Engineering Team Designed Systems for Ongoing Measurement:
- Similar rates to MIT cohort
- On average, 140 alarms/patient day
- 1 alarm every 11 minutes per baby
- On average, 28% of alarms are in-Ops
- On average 82% are silenced
- Pause function used 20,000-

Lessons Learned / Next Steps
What we have learned: Our staff, families and babies are exposed to a plethora of alarms!
- Many of the alarms are clinically actionable, yet a large portion are due to technical issues
- We silence most alarms (though we likely have significant auditory exposure prior to silencing)
- We do not use the pause alarm function often relative to our overall alarm rate

What we plan do about it: Next PDSA: In-Op alarm reduction & quieting when able
- Institute routine lead ‘checks’ and replace all leads for integrity issues
- Encourage staff to silence alarms as they respond and pause alarms when at the bedside
- Develop Alarm Response Algorithm to empower all clinical staff to respond to alarms

Future Work: utilize histograms, develop alarm barometer to inform assignments, address accuracy of alarm limits (bedside O₂ target sign) & documentation, evaluate effect of increasing tachycardia limits

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