



# Improving time to treatment of neonatal seizures

Steven Papas, MD<sup>1</sup>; Casey Olm-Shipman, MD<sup>1</sup>; Amy Brown, PharmD<sup>2</sup>; Andrea Trembath, MD<sup>3</sup>; Senvene Hunter, MD<sup>1</sup>; Varina Boerwinkle, MD<sup>1</sup>; Jordan Broman-Fulks, MD<sup>1</sup>  
<sup>1</sup>Department of Neurology, University of North Carolina; <sup>2</sup>Department of Pharmacy, University of North Carolina; <sup>3</sup>Department of Pediatrics, University of North Carolina



## Background

Neonates are the most common age group to develop seizures, often with status epilepticus. Even with standardized pathways for treatment of neonatal seizures, treatment delays can occur. Untreated status epilepticus may contribute to neurologic injury and is associated with worse neurodevelopmental outcomes [1,2]. Faster treatment of neonatal seizures is associated with improved response to antiseizure medication. A published quality improvement project has shown the ability to improve time to treatment of neonatal seizures [3].

## Objective

This quality improvement project is intended to improve time to treatment of neonatal seizures, specifically between the time the antiseizure medication is ordered and administered.

## Methods

Primary and secondary drivers of treatment delays were identified. Primary drivers included miscommunication and absence of a shared mental model regarding urgency. Secondary drivers included ordering medication "routine" instead of "STAT". Specific interventions were developed based on these drivers, which included staff education, and communication standardization, and order set development. Data were analyzed for phenobarbital, fosphenytoin, and levetiracetam loading doses, with baseline data from January 2021-January 2023, and post-intervention time starting in February 2023.

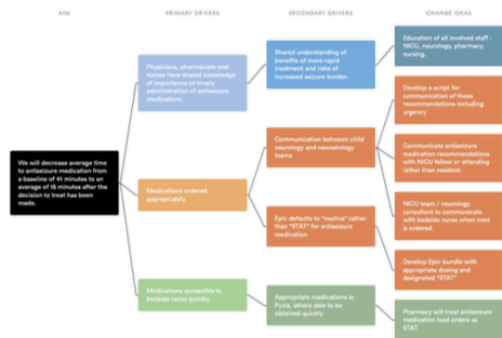


Figure 1: Driver diagram demonstrating primary and secondary drivers in treatment delays and interventions

## Results

Mean time from order to administration of antiseizure medications

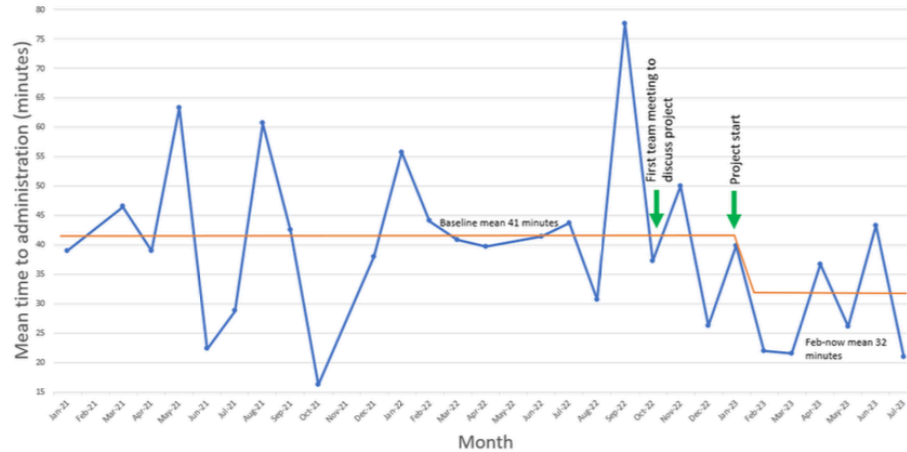


Figure 2: Mean time from anti-seizure medication order to administration, demonstrating improvement from a baseline mean of 41 minutes to 32 minutes.

Standard deviation of time from order to administration of antiseizure medications

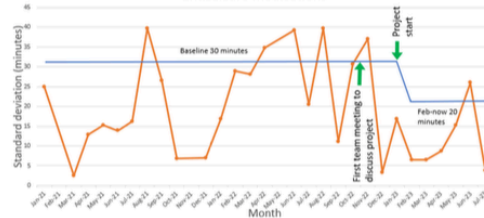


Figure 3: Standard deviation in time to treatment, demonstrating improvement from a baseline standard deviation of 30 minutes to 20 minutes

## Results

Time from order to administration of antiseizure medications has decreased from a baseline average of 41 minutes to 32 minutes. Standard deviation has decreased from a baseline of 30 minutes to 20 minutes. Breaking the process down into its components, time from ordering the medication to pharmacy verification has remained around 5 minutes. Time from order verification to dispensing the medication (from the Pyxis for phenobarbital, and from pharmacy to the neonatal ICU for levetiracetam and fosphenytoin) has decreased from a mean of 16 minutes to a mean of 12 minutes. Time between when the medication is dispensed and administered has decreased from 19 minutes to 14 minutes on average.

## Conclusions

In this quality improvement project, implementing simple interventions has, so far, led to some improvement in time to treatment of neonatal seizures. However, we have not yet met our goal of 15 minutes from order to administration of antiseizure medications. Root cause analysis of recent delays has shown that limitations include having antiseizure medication load orders default to "Routine" rather than "STAT" in our EMR, breakdowns in communication, and frequent staff turnover, which makes ensuring education of all staff on the importance of rapid treatment of seizures difficult. Next steps to further our improvement include implementing a NICU-specific antiseizure medication order set, having multiple providers responsible for contacting nursing when an antiseizure medication load has been ordered, and further education sessions. This has the potential to have significant impact on the immediate and long-term health of the treated neonates.



Figure 4: Process map with mean time, in minutes, of specific steps in the process from order to administration of antiseizure medication, showing improvement in time from verification of the order to dispense of the medication, and in time from dispense of the medication to administration of the medication.

## References

1. Pavel AM, Rennie JM, de Vries LS, et al. Neonatal Seizure Management: Is the Timing of Treatment Critical? *J Pediatr.* 2022 Apr;243:61-68.e2.
2. Wusthoff CJ, Sundaram V, Abend NS, et al. Neonatal Seizure Registry Group. Seizure Control in Neonates Undergoing Screening vs Confirmatory EEG Monitoring. *Neurology.* 2021 Aug 10;97(6):e587-e596.
3. Kramer K, Bekmezian A, Nash K, et al. Expediting Treatment of Seizures in the Intensive Care Nursery. *Pediatrics.* 2021;148(3):e2020013730.