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Impact of Location of Sepsis Evaluation on Time to Antibiotic Administration within a Neonatal Intensive Care Unit

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Abstract

Timely antibiotic administration is crucial for decreasing morbidity and mortality in sepsis, including in neonates. We explored how location and type of sepsis workup affected time to initiation of antibiotics at an academic level IV NICU. Location of the sepsis evaluation was shown to have a larger impact on time to antibiotic administration, suggesting that environmental factors can play a larger role in efficiency than the task itself.

Keywords: Sepsis; Antibiotics; NICU

Abbreviations: NICU: Neonatal Intensive Care Unit; EOS: Early Onset Sepsis; LOS: Late Onset Sepsis; CSF: Cerebrospinal Fluid.

Introduction

Delayed antibiotic administration has been linked to poor survival in adult patients with sepsis [1]. It is recommended that patients with suspected sepsis receive antibiotics within 1-hour of diagnosis [2]. Though limitedly studied in neonates, prolonged time to antibiotic administration has also been associated with increased morbidity and mortality in the neonatal intensive care unit (NICU) [3].

However, giving antibiotics to neonates within the 1-hour window can be difficult. One study found that the majority of first dose antibiotics ordered for neonatal early onset sepsis evaluations were given more than 1-hour after physicians' orders and more than 2-hours after birth [4].

A quality improvement project at the Oregon Health and Science University Doernbecher Children's Hospital NICU, a 42-bed level IV unit, focused on expediting antibiotic administration in patients with suspected sepsis. The type of sepsis evaluation and location of the evaluation were assessed to determine the relationship between these factors and time to antibiotic administration.

Methods

This project is a quality improvement initiative for the Division of Neonatology (2018-2019), as well as part of the Vermont Oxford Network *Choosing Antibiotics Wisely* Collaborative (2016-2018), a national multi-center collaboration. We performed a retrospective chart review of all antibiotic initiation at the Doernbecher Children's Hospital NICU from October 2018 to September 2019 (N=667). Time to antibiotic administration was calculated by assessing the difference between time of antibiotic order to the time of documented administration in the electronic medical record. Sepsis evaluations are separated into two groups – early onset and late onset. Early onset sepsis (EOS)

workups occur within the first 72 hours of life and involve obtaining blood cultures before antibiotic administration. Late onset sepsis (LOS) evaluations typically require blood, urine, and cerebrospinal fluid (CSF) cultures before antibiotic administration. Location of sepsis evaluation was determined by documented location of the patient at the time of obtaining cultures and other labs. EOS workups can occur in the NICU or in the resuscitation ("resus") suite, which is adjacent to the NICU in Labor and Delivery and is used for stabilization of neonates after delivery. LOS workups only occur in the NICU. Median time to antibiotic administration was calculated monthly, and a two-tailed non-parametric Wilcoxon rank sum test was used to compare groups.

Results

The median time to first dose of antibiotic administration was 74 minutes (interquartile range IQR 63-85). There was a difference in median time to first dose of antibiotic administration based on type of sepsis workup and location (Figure 1). Median EOS workup in the resus suite was 60 (57-69) minutes, compared to 74 (69-83) minutes for EOS in the NICU (p=0.01). LOS workup in the NICU was 83 (75-95) minutes, which was not statistically different from EOS workup in the NICU (p=0.16).

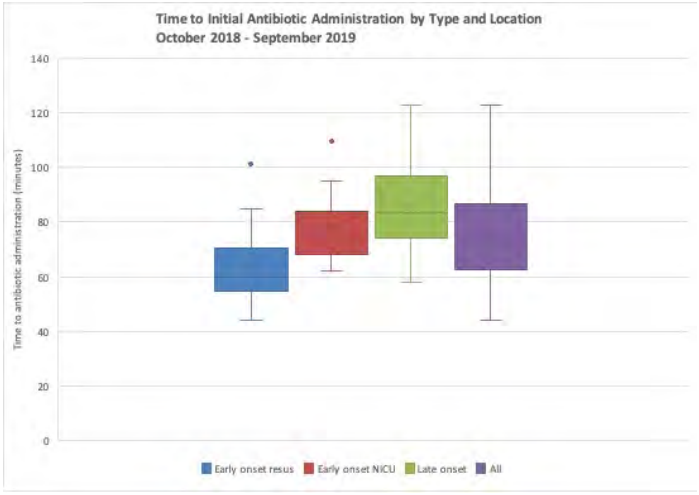

Figure 1: Box and whisker plot representing time to antibiotic administration in minutes, from October 2018 to September 2019. The line inside each box represents the middle quartile or median value. The X inside the boxes represent the mean. Bottom and top bars ("whiskers") or dots represent minimum and maximum times to administration, respectively. Bottom and top edges of each box represent the upper and lower quartile, respectively. The top bracket and asterix represent significant values at $p<0.05$ between the two group.

Discussion

There is a statistically significant difference between median time to first doses of antibiotic administration for early onset sepsis evaluation in the resuscitation suite compared to in the NICU, suggesting there are location specific characteristics that impacted efficiency in our project. Some differences between our resus suite and the NICU include the closer proximity of supplies within the resus suite, increased staff availability with at least 1 dedicated resuscitation nurse who does not have other patient assignments, and potentially increased preparedness for a sepsis workup in the resus suite, particularly for anticipated deliveries. There was not a statistically significant difference between EOS and LOS workup in the NICU, surprising given the difference in tasks involved between the two.

Our findings are limited to information obtainable from the medical record. For example, we're unable to quantify the time when sepsis was suspected and are using the time when antibiotics are ordered as a correlate. There are also differences in the type of patient whose rule out is started in the resus suite vs in the NICU. However, patients whose rule out starts in the resus suite are generally more clinically ill compared to those in whom providers opt for a "wait and see" approach, and one would suspect there to be more competing priorities in the initial minutes and hours of stabilization after birth. Both of these factors would tend to cause delays in antibiotic administration and diminish the difference that we observed.

Different strategies have proven to be successful in improving time to antibiotic administration, such as policies, educational

programs, optimization of electronic medical records and order sets, and improvement in communication [4-6]. Some studies have shown differences in administration timing based on the time of day of sepsis evaluation [5], which we did not observe (data not shown).

While our data reflects our particular institution's practices, similar differences in processes exist in other practice settings. For example, IV therapy teams may be available only certain hours or to certain locations; some institutions may use a procedural room for obtaining labs or starting IVs in certain subsets of patients; ***. Our findings suggest that these external conditions may be more impactful on the efficiency of a process than the intrinsic task itself, and these unique factors at each facility should be considered in quality improvement efforts.

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