

# The Neonatal Early Onset Sepsis Calculator

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## Assess Need for Change

Early-onset sepsis (EOS) remains a large contributor of morbidity and mortality within the fragile neonatal population, which has led to antibiotics being the most prescribed medications in the Neonatal Intensive Care Unit (NICU) across the United States. EOS of the newborn is defined as positive blood and cerebral spinal fluid cultures for a bacterial organism within the first 48-72 hours of life. The most common risk factors for EOS are maternal fever  $\geq 38$  C/100.4 F, prolonged rupture of membranes ( $> 18$ hrs.), prematurity, and chorioamnionitis. The routine evaluation for EOS includes a thorough physical exam, obtaining a serum blood culture, complete blood count with differential, and C-reactive protein in some practices.

A habitual culture in the NICU has led to the development of accepting unnecessary antibiotic use in treating "culture-negative" sepsis. The practice of unwarranted antibiotic administration in the newborn population must be thoroughly evaluated due to the low incidence of newborns with verifiable diagnosis of EOS. These practices have resulted in adverse outcomes in the newborn population which include: alteration of the microbiome, childhood obesity, atopy, bronchopulmonary dysplasia, increased length of stay, necrotizing enterocolitis, multi-resistant drug organisms, and death. The development of the evidence-based neonatal early-onset sepsis (NEOS) calculator has reduced the use of unwarranted antibiotics and decreased the frequency of ancillary laboratory blood testing in the newborn population.

The purpose of this strategy was to examine the effects of the NEOS Calculator on empiric antibiotic use and overall EOS evaluations for newborns  $> 34$  weeks gestation. This quality improvement project was implemented in relation to this unit's documented overuse of empiric antibiotics and the trajectory of an antibiotic stewardship program.

## Gather Evidence

A pre/post interventional design was used, to include a retrospective baseline and post-interventional chart review on 642 newborns  $> 34$  weeks gestation. The setting was a level III regional transport NICU in Southwest LA, with approximately 700 newborns admitted annually. The sample encompassed all newborns  $> 34$  weeks who met the inclusion criteria during the data collection period. Interventions included the 2018 EOS guidelines, the application of NEOS calculator, discontinuation of routine CRP, and the collection of a CBC at 6-12 hours of life instead of upon admission. Primary outcome measures incorporated the mean number of empiric antibiotic treatment days and antibiotic utilization rate (AUR), number of laboratory tests ordered (CBC, CRP, and blood culture), antibiotic use  $> 48$  hours with negative blood cultures, and a record of provider adherence/utilization of the calculator.

Figure 1: Antibiotic Therapy  $>34$  weeks gestation

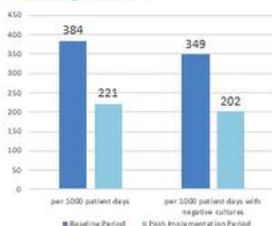


Figure 3: Mean Empiric Antibiotic Treatment Days  $>34$  weeks gestation

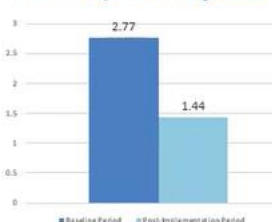


Figure 2: Antibiotic Therapy  $>48$  hours  $>34$  weeks gestation

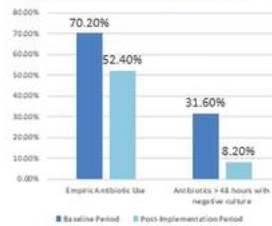


Figure 4: Antibiotic Treatment  $>3$  days Ranking Compared to 74 High-Volume Mednax NICUs

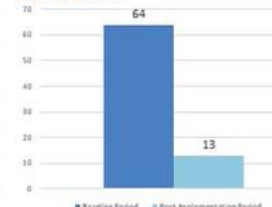
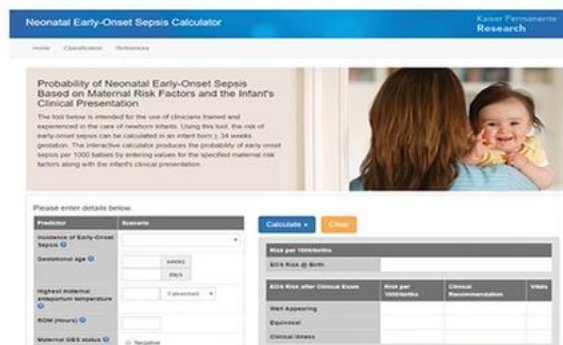


Figure 5: Kaiser Permanente Early Onset Sepsis Calculator



<https://neonatalespsiscalculator.kaiserpermanente.org/>  
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## Translate into Practice

During the project prospective period, empiric antibiotic use among newborns  $>34$  weeks gestation was reduced by 25.4%; the antibiotic utilization rate decreased by 42.5% days of therapy per 1000 patient days. The unwarranted antibiotic therapy beyond 48 hours was decreased by 74.1% and provider neonatologist adherence to the calculator averaged 83.5%. During the post-implementation period, there were an additional 57 opportunities to reserve empiric antibiotic use per NEOS calculator.



## Evaluate and Maintain

The evidence-based approach of using the NEOS calculator to evaluate susceptible newborns before initiating or continuing antibiotics in the NICU setting has multiple benefits. It is a simple way to reduce antibiotic usage and decrease ancillary lab tests. Use of the NEOS calculator in vulnerable newborn populations worldwide has the potential to reduce healthcare expenditures and improve the overall health of these fragile newborns. The NEOS calculator can be applied to the EOS guidelines at the local hospital level. The need for sustainability of this project beyond the initial implementation includes re-education of NICU staff, survey of all advanced practice nurses and physicians, as well as a recommitment of medical and nursing healthcare providers, and installation of the NEOS calculator into the EMR. It is morally imperative as stakeholders in healthcare to help ensure evidence-based practices are applied to those under our care.

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