

Bloodstream infections in preemies may originate from their gut microbiomes

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Dangerous bacterial bloodstream infections in preemies may originate from the infants' gut microbiomes, according to researchers at Washington University School of Medicine in St. Louis. Such infections

are of substantial concern, as about half of infants who are extremely preterm or have very low birth weights experience at least one episode of the life-threatening infection after 72 hours of life. The findings are published May 3 in the journal *Science Translational Medicine*.

Preterm infants are at high risk of infections due to underdeveloped organs, coupled with considerable antimicrobial exposure. Until recently, virtually every prematurely born baby was treated with antibiotics as a preventive measure. While the antibiotics are intended to target disease-causing pathogens, this treatment also can lead to disruption of the [gut microbiome](#) in a way that could allow virulent strains of antibiotic-resistant bacteria to increase in numbers.

"This is a vulnerable population," said senior author Gautam Dantas, Ph.D., the Conan Professor of Laboratory and Genomic Medicine and a professor of pathology & immunology. "This is also a time when the composition of the gut [microbiome](#) is first developing. These early exposures to bacteria shape the gut microbiome in ways that will probably stay with these babies for the rest of their lives. We also have studied the gut microbiomes of infants born at full term, and we know that such babies do not have as many problems, but it's clear that the type of bugs that colonize the gut in the first few months to three years of life will determine what the microbiome looks like later on. Our study also suggests that an early look at the gut microbiome in preemies may allow us to identify those at high risk of dangerous [bloodstream](#) infections."

After birth, a baby's microbiome develops by acquiring microbes from the environment and the infant's primary caregivers. Such microbes help in a multitude of functions, including digestion and absorption of nutrients. In addition, in a more diverse gut microbiome, beneficial microbes outcompete disease-causing microbes, thereby protecting the infant from disease. In some instances, antibiotics can kill beneficial

microbes, giving more dangerous and potentially antibiotic-resistant strains the opportunity to multiply and cause disease.

The most common bacteria in bloodstream infections are also commonly found to colonize the gut without initially causing disease. The researchers, including first author Drew J. Schwartz, MD, Ph.D., an assistant professor of pediatrics and an infectious diseases physician, aimed to test whether such bloodstream infections come from inside the gut or from external transmission. The study included newborns admitted to the neonatal intensive care units (NICU) at St. Louis Children's Hospital, Children's Hospital at Oklahoma University Medical Center and Norton Children's Hospital in Louisville, Ky.

The researchers performed whole genome sequencing on the bacterial strain causing the bloodstream infection and used computational profiling to precisely track the identical strain within feces to identify the strains of bacteria that had colonized the infants' guts prior to bloodstream infection.

In 58% of these cases, the researchers found the gut-origin hypothesis to be true: They found a nearly identical disease-causing bacterial strain in the guts right before a bloodstream infection was diagnosed. In about 79% of cases, they found the disease-causing strain in the gut after a bloodstream infection was diagnosed.

The data also demonstrated that some of the strains of bacteria that caused bloodstream infections were shared among infants within the NICU. This indicates that even in controlled environments, there still could be microbes exchanged between infants, shared by hospital staff or transferred from NICU surfaces. However, relative to other newborns in the NICU who did not experience bloodstream infections, those who did had dramatically more of the causative species in their guts in the two weeks prior to bloodstream [infection](#).

Moving forward, Dantas said, responsible antibiotic use is key, meaning they should only be given to infants who have confirmed bacterial infections. The study suggests that it may be possible to develop a risk assessment tool to help physicians quantify the risk of future bloodstream infections by identifying whether disease-causing bacteria already have colonized an infant's gut and to what degree, a focus of Schwartz's independent research laboratory at Washington University. Ongoing studies could add additional microbiome data over time to show which infants received antimicrobials and what their impact was on potential pathogens lurking in the gut microbiome. This potentially could empower physicians to perform rapid microbiome sequencing to determine best treatment strategies

"From this study, as well as in our lab's past studies, it's clear that we need to be better stewards of how antimicrobials are given," Dantas said. "Antimicrobials are critical; we are going to need them to treat infections, but we need to carefully weigh whether and when to use antimicrobials in specific situations. We need to make sure that when those antimicrobials are given, we have a very good reason."

More information: Drew Schwartz et al, Gut Pathogen Colonization Precedes Bloodstream Infection in the Neonatal Intensive Care Unit, *Science Translational Medicine* (2023). [DOI: 10.1126/scitranslmed.adg5562](https://doi.org/10.1126/scitranslmed.adg5562).
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