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ASIA EDITION

Singapore developed a first-of-its-kind device to profile the immune function of newborns

May 26, 2025 | News | By Hithaishi C Bhaskar

SMART and KKH develop The BiophysicaLÃ?Â Immune Profiling for Infants (BLIPI) device, which profiles an infant's immune system in under 15 minutes, using just a single drop of blood



Researchers from the Critical Analytics for Manufacturing Personalized-Medicine (CAMP) and Antimicrobial Resistance (AMR) interdisciplinary research groups (IRGs) of Singapore-MIT Alliance for Research and Technology (SMART), MIT's research enterprise in Singapore, and KK Women's and Children's Hospital (KKH), have developed a first-of-its-kind device to profile the immune function of newborns.

Using a single drop of blood, the BiophysicaL Immune Profiling for Infants (BLIPI) system provides real-time insights into newborns' immune responses, enabling the early detection of severe inflammatory conditions and allowing for timely interventions. This critical innovation addresses the urgent and unmet need for rapid and minimally invasive diagnostic tools to protect vulnerable newborns, especially those born prematurely.

Critical unmet need in newborn care:

Premature infants are particularly vulnerable to life-threatening conditions such as sepsis and necrotising enterocolitis (NEC). Newborn sepsis — a bloodstream infection occurring in the first weeks of life — is a major global health challenge. Current diagnostic methods to detect and prevent these serious conditions in newborns rely on large blood samples — up to 1 ml, a significant quantity of blood for a newborn — and lengthy laboratory processes.

BLIPI is a portable device that can give results at the ward or the neonatal intensive care units (NICUs), removing the need for transporting blood samples to the laboratory and making it easily implementable in resource-limited or rural healthcare settings. Significantly, BLIPI needs just one drop of blood, and 20 times less blood volume than what existing methods require. These swift results can help clinicians make timely, life-saving decisions in critical situations such as sepsis or NEC, where early treatment is vital.

“Our goal was to create a diagnostic tool that works within the unique constraints of neonatal care — minimal blood volume, rapid turnaround, and high sensitivity. BLIPI represents a major step forward by providing clinicians with fast, actionable immune health data using a non-invasive method, where it can make a real difference for newborns in critical care,” saidDr Kerwin Kwek, Research Scientist at SMART CAMP and SMART AMR, and co-lead author of the study.

Future research will focus on larger clinical trials to validate BLIPI's diagnostic accuracy across diverse neonatal populations with different age groups and medical conditions. The researchers also plan to refine the device's design for widespread adoption in hospitals globally, bringing a much-needed diagnostic solution for vulnerable infants at their cot side. Beyond hospitals, pharmaceutical companies and researchers may also leverage BLIPI in clinical trials to assess immune responses to neonatal therapies in real-time — a potential game-changer for research and development in paediatric medicine.

(L to R:) Dr Genevieve Llanora, Department of Neonatology, KKH; Dr Kerwin Kwek, Research Scientist, SMART CAMP and SMART AMR, holding BLIPI with Assistant Professor Yeo Kee Thai, Senior Consultant, Department of Neonatology, KKH; and Nicholas Ng, Research Engineer, SMART CAMP. (Photo: KK Women's and Children's Hospital)