Cornell University
College of Veterinary Medicine

Infant immunities live fast and die young

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Forgetful immune systems leave infants particularly prone to infections. Upending the common theory that weak immune cells are to blame, a Cornell study has found that infants' immune systems actually respond to infection with more speed and strength than adults, but the immunities they create fail to last.

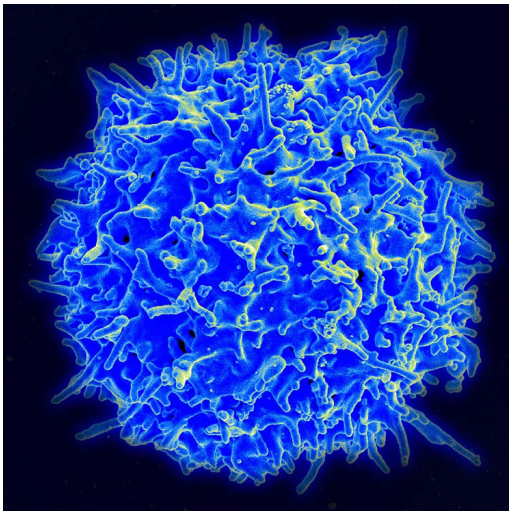
Published in the *Journal of Immunology* in May, 2014, the discovery reveals a new angle immunizations could take in protecting infants and children from infectious diseases.

Infectious disease accounts for more than a third of infant deaths worldwide, according to the World Health Organization. Immunizations protect people against dangerous complications by teaching immune systems to remember pathogens. But infant immunities rapidly wane, often requiring extra booster shots after an initial vaccine.

"The perfect vaccine would be a single dose given at birth that generates long-lasting immunity," said immunologist Dr. Brian Rudd at the College of Veterinary Medicine, the study's lead author. "No such vaccine exists because we haven't understood why infants rapidly lose immunities. Our finding could change the way we immunize infants and ultimately lead to more effective ways of enhancing immunity in early life."

Immunity against most microbes depends on forming memory T cells that remember specific pathogens and can rapidly respond to future infections. Adults almost always generate large numbers of effective memory T cells during infection, around 10% of which stay in a long-lived memory pool to rapidly respond next time.

Rudd found that newborn T cells generated in response to infection met dramatically different fates. When met with the same pathogen, newborn immune systems made T cells that responded more rapidly to infection than adult cells, but quickly became terminally differentiated, never making it into the memory pool. This disproves the common theory that newborn immune cells have a weak or sub-optimal response to infection.



“Surprisingly, we found that newborns’ cells actually responded more vigorously to infection compared to adults,” said Rudd. “We also found that newborns’ cells go through their lifespans more quickly and die off sooner, before they can give rise to memory T cells and remember what they’ve learned. So the immune system is forced to start the learning process over again when infected by the same pathogen later in life.”

Rudd’s lab is adjusting the expression of different proteins in different-aged T cells to determine how developmental variation in these factors influence memory cell behavior and fate. They are also performing genome-wide analyses of different-aged T cells to find the genes that code these differences.

“We hope to find a way to make neonatal cells behave more like adult cells in how they learn from vaccines and respond to infection,” said Rudd. “Knowledge gained from these studies could be used to design more effective therapeutic interventions and vaccines that can be safely administered in early life.”

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