Researchers discover strategy for predicting the immunity of vaccines

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In the first study of its kind, researchers at the Yerkes National Primate Research Center and Emory Vaccine Center, Emory University, have developed a multidisciplinary approach involving immunology, genomics and bioinformatics to predict the immunity of a vaccine without exposing individuals to infection. This approach addresses a long-standing challenge in the development of vaccines--that of only being able to determine immunity or effectiveness long after vaccination and, often, only after being exposed to infection.

The study, which used the yellow fever vaccine (YF-17D) as a model, is available in the online edition of *Nature Immunology* and represents a long awaited step forward in vaccine immunology and predictive health.

YF-17D is one of the most successful vaccines ever developed and has been administered to nearly half a billion people over the last 70 years.

"A single shot of the vaccine induces immunity in many people for nearly 30 years," says Bali Pulendran, PhD, lead Yerkes researcher of the study and professor in the Department of Pathology and Laboratory Medicine at Emory University School of Medicine. "Despite the great success of the yellow fever vaccine, little has been known about the immunological mechanisms that make it effective," he continues.

Pulendran's team, including graduate student Troy Querec, PhD, in collaboration with Rafi Ahmed, PhD, director of the Emory Vaccine Center, Eva Lee, PhD, Georgia Institute of Technology, and Alan

Aderem, PhD, Institute for Systems Biology in Seattle, sought to determine what makes such a vaccine effective so researchers can design new vaccines against global pandemics and emerging infections that repeat the success of this model vaccine.

The researchers used YF-17D to predict the body's ability shortly after immunization to stimulate a strong and enduring immunity. Researchers vaccinated 15 healthy individuals with YF-17D and studied the T cell and antibody responses in their blood. There was a striking variation in these responses between individuals. Analysis of gene expression patterns in white blood cells revealed in the majority of the individuals the vaccine induced a network of genes involved in the early innate immune response against viruses.

"Using a bioinformatics approach, we were able to identify distinct gene signatures that correlated with the T cell response and the antibody response induced by the vaccine," says Pulendran. "To determine whether these gene signatures could predict immune response, we vaccinated a second group of individuals and were able to predict with up to 90 percent accuracy which of the vaccinated individuals would develop a strong T or B cell immunity to yellow fever," continues Pulendran.

Pulendran and his colleagues are now working to determine whether this approach can be used to predict the effectiveness of other vaccines, including flu vaccines. The ability to successfully predict the immunity and effectiveness of vaccines would facilitate the rapid evaluation of new and emerging vaccines, and the identification of individuals who are unlikely to be protected by a vaccine.

"This type of research is essential to answer fundamental questions that can lead to better vaccinations and prevention of disease. Yerkes, as one of only eight National Institutes of Health–designated national primate

research centers, is uniquely positioned to carry out such diverse research," says Stuart Zola, PhD, director, Yerkes Research Center.

Source: Emory University