Fighting tuberculosis with better diagnostics

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Around the world, tuberculosis (TB) is making a comeback, owing to the increased incidence of HIV/AIDS and several other factors. According to the World Health Organization (WHO), between 1900 and 2015, the incidence of new TB cases increased nearly 40 percent—from an estimated 7.5 million to 10.4 million. Furthermore, the untreatable drug-resistant strains of the bacterium are rapidly increasing, causing grave concern. Drug resistance is a widespread global challenge today and could result in a post-antibiotic era, if unchecked.

That and the global health concern of TB are two reasons why a team at Los Alamos National Laboratory, in collaboration with several institutions, is working to develop an innovative tool set for early and accurate diagnosis of the disease.

One of the greatest challenges of TB is that not everyone exposed to the bacterium that causes the disease will get sick. A third of the world can harbor the bacterium, and never present with the disease: a condition called latent infection. Only under certain conditions such as when the immune system is compromised, as with autoimmune conditions or HIV/AIDS, do these individuals present with active TB.

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Harshini Mukundan explains how her team developed the diagnostic tool

Early, accurate diagnosis is vital in defeating TB and other deadly bacterial infections. Unfortunately, current diagnostics are either inaccurate or require extensive laboratory expertise, are time consuming, and do not discriminate between latent and active infection. This problem is especially compounded when diagnosing pediatric TB.

“Several years ago, my mentor at Los Alamos National Laboratory, Dr. Basil Swanson, and I, along with our collaborators, obtained a grant from the National Institutes of Health to develop a tool that could diagnose the disease early in infection and accurately distinguish between active and latent TB,” says Laboratory researcher Harshini Mukundan.

The team developed an extremely sensitive optical waveguide biosensor for measuring low concentrations of relevant signatures in complex biological samples such as blood. But having a sensitive platform is not the only key to efficient diagnosis. Understanding the interaction between the bacterium and the patient, and designing efficient methods of measuring that interaction directly in clinical samples are also required for success.

“We wondered if we could develop a rapid diagnostic tool by mimicking the way the human immune system recognizes ***any*** infection by recognizing biomarkers—bits of a disease-causing microbe’s cells that are sloughed off in our bloodstream during active disease immune recognition,” Mukundan says. “If we could do this in the laboratory it would likely provide a universal strategy for diagnosis of all infectious diseases.”

Pursuing this line of thought, her team developed a test to detect these bacterial biomarkers directly in patient blood. Their work opened the door to creating a rapid diagnostic tool, which they have begun testing in clinical samples.

“The results are exciting and, so far, extremely promising. We’ve realized that this approach can be used not just for TB, but for other pathogens as well,” Mukundan says.

“Our goal is to create one easy-to-use tool to diagnose *all* infections. Indeed, we have applied our universal approach to other bacterial infections with excellent results. I envision a day when we have a very cheap, hand-held, easy-to-use, point-of-care sensor helping patients everywhere.”

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