Minnesota Partnership for Biotechnology and Medical Genomics
University of Minnesota
Mayo Clinic
facts

Rapid Diagnosis and Treatment of Tuberculosis:

Medical Genomics Applied to an Ancient Disease: Real-time PCR for the Diagnosis and Direct Drug Susceptibility Testing of Tuberculosis

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Tuberculosis (TB) is an infectious disease that impacts the entire world. One-third of the world's population — more than two billion people — are infected with TB, making it the second leading infectious cause of death. Minnesota's diverse population includes immigrants from affected countries and puts the state in a particularly vulnerable position for this disease. TB spreads through the air like the common cold, making it exceptionally contagious. It can lie dormant in an infected person for years, but when the immune system is weakened, the chances of becoming sick with TB increase. While TB does not have the high profile of HIV, it poses great risk to the world, and to Minnesotans.

Diagnosis

The two current diagnostic techniques for TB are inadequate: the smear test often misses the disease and the culture test can often take several weeks. Both the smear and culture tests require a sputum sample which can be difficult to obtain and carries a high risk of infection to health care workers. Finally, both these tests can produce false negatives.

Treatment

TB is treatable if diagnosed accurately, but current therapies require a long course of treatment — up to two years. Furthermore, with the continued emergence of drug resistance, the treatment may fail.

Drs. Wengenack and Tsukayama

Drs. Wengenack and Tsukayama recognized this serious shortfall in our public health system, and developed a rapid and specific test that detects TB in less than one day from a stool specimen. The test also provides direct information regarding potential resistance to isoniazid, one of the primary TB treatment drugs. Building on this as a Partnership team, they are taking the test a step further. They are testing three hypotheses:

- that TB is present and can be isolated from the stools of TB patients
- that this method to detect the disease is superior to the current culture methods
- that the stool testing is as effective but faster than culture testing in detecting resistance.

Determining resistance using this real time test will allow physicians to quickly choose effective therapies and also prevent development of drug resistance.

Samples will be collected from patients being evaluated for TB at Mayo Clinic and at the Hennepin County Medical Center (HCMC) Health Assessment and Promotion Clinic (HAP). HAP diagnoses and treats TB patients and conducts screening tests for high-risk individuals and refugees. More than 100 cases of TB are diagnosed in Hennepin County every year.

"The high-risk patients we see in the HAP Clinic is an ideal population for this study. Their compelling situation makes the potential of this work all the more meaningful and important in changing their lives and the lives of millions," notes Dr. Tsukayama.

The samples will be analyzed at Mayo's Clinical Microbiology Laboratory, an internationally renowned reference and development lab with six subspecialty labs where cutting-edge diagnostic tests for infectious disease agents are developed.

"Our ability to rapidly detect TB in stool samples with a state-of-the-art molecular test fills a currently unmet need for the diagnosis of TB," says Dr. Wenganack. "Using a stool sample has multiple advantages—it's non-invasive, potentially more accurate, easier for children and staff, carries little risk for infection and gives rapid results."

The team offers a unique mix of expertise in infectious disease. Lead researchers Wengenack and Tsukayama bring together the best of two complementary worlds: hands-on clinical care in the HAP clinic and intense analysis in the Mayo Clinic labs. Other team members include Irene Sia, M.D., from Mayo Clinic, Bryan Rock, M.D., from the University and Todd Kowalski, M.D. and Cristina Baker, M.D., both medical fellows at the University. Jayawant Mandrekar, Ph.D., a Mayo biostatistician rounds out the necessary expertise.