Scientists take step toward simple and portable tuberculosis tests for developing world

October 8 2009

Two billion people worldwide carry the pathogen that causes tuberculosis (TB), and most of them do not even know they are infected. This is because some 90 percent of people with TB have "latent" infections. They have no symptoms, they can't spread the disease to others and the bug remains dormant in their lungs -- often for years.

Detecting latent TB infections is an important public health problem because those 10 percent of people who go on to develop full-blown "active" TB will, in turn, infect another 10-15 people per year on average. Such smoldering spread is one of the reasons why TB remains the seventh-leading cause of death worldwide, killing more than 1.5 million people every year.

Now a group of researchers at Colorado State University (CSU) has demonstrated a sensitive new way to use light to detect traces of TB bacteria in fluids. Their work, described by CSU graduate student Barbara Smith at the Optical Society's (OSA) Annual Meeting, Frontiers in Optics (FiO), next week in San Jose, Calif., may one day help health care workers identify people who are latently infected. Moreover, the technology may be amenable for widespread use in the developing world, where most cases of TB occur.

What is missing from the public health tool chest, says CSU professor Diego Krapf, who led the research, is a technique that can be used to

widely detect TB in those places where it is most prevalent.

Krapf, Smith and their colleagues have developed a technique that can sensitively detect different molecular markers indicating a TB infection that would be cheap to use and no harder to administer than a common pregnancy test, making it ideal for use in the developing world. The Colorado researchers envision a device that would simply require someone to smear a drop of blood or urine on a glass slide, insert it into a machine and read a simple display that would indicate whether that person is infected or not.

Such a device could easily be built with existing off-the-shelf technology, says Krapf, adding that it would be no more complicated than the internal workings of a standard DVD player. The device relies on specialized surface chemistry that avoids protein adsorption, except for those molecules that need to be detected. Then, the presence of these molecules is recorded by fluorescence using a red diode laser.

Once detected, TB infections are generally treatable with a long course of antibiotics, and one of the basic strategies behind the World Health Organization's current efforts to curb the spread of the disease worldwide is to simply find the people who are infected and get them the antibiotics they need.

The CSU development could one day play a role in curbing the spread of TB. Currently, finding people who are infected is not so simple. Doctors can spot suspected cases by taking chest X-rays, which may reveal evidence of infection in the lungs. Or they can turn to a century-old technique called a sputum smear, where a sample of coughed fluid is stained and examined under a microscope for indications of the infection. Better yet, if doctors can grow cultures of TB bacteria from lung fluid, they definitively know that a person is infected.

These tests may not detect latent TB infections, however, because people who are latently infected may not have enough bacteria in their lungs to detect. For people with latent infections, other tests exist, but they have their problems as well. A simple skin test exists, but it is only sensitive enough to detect about half of all cases, says Krapf. Other more sophisticated methods that rely upon detecting specific markers in the blood are more sensitive, but they require special facilities and training that would be far too expensive for widespread use in the developing world.

Krapf and his colleagues have been able to demonstrate the feasibility of detecting markers of TB infections at great sensitivity in saline solutions -- they were even able to detect a single molecular marker of a TB infection in solution. They have not yet built a functioning device that can detect hidden TB infections in blood or urine samples, and they have not yet tested the technology on samples collected in the field. Before any such detector is available for use in the field, it would have to be rigorously tested in clinical trials.

Moving in that direction, the team plans to do a survey of blood and urine samples from people infected with TB bacteria. This will help them conclude how sensitive they need to make any detector and which markers are the best to test.

Source: Optical Society of America (news : web)