The TB test you can do at home

Latest fluorescent probe can detect tuberculosis bacteria using a homemade light box and a mobile-phone camera.

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A highly specific and sensitive fluorescent molecule can rapidly detect tuberculosis (TB) bacteria in sputum samples, according to work published this week in *Nature Chemistry*[1]. Scientists hope that it will soon lead to a quick and cheap diagnostic tool for the disease.

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Some diagnostic tests for tuberculosis, such as chest X-rays, are difficult to use in remote locations where the disease is rife.

TB has a devastating effect. The disease killed almost 4,000 people per day in 2010, predominantly in the developing world. Although there are treatments available, diagnosis can take several weeks, during which time patients can transmit the infection to others. If a person with active TB goes untreated, the World Health Organization estimates that they will infect an average of 10 to 15 people a year.

“Transmission as a result of delays in seeking treatment — or prolonged ineffectual treatment — is a substantial cost to society, so a method that will resolve inaccuracies in the testing method is a breakthrough,” says microbiologist Bill Jacobs of the Howard Hughes Medical Institute and Albert Einstein College of Medicine in New York.

The most common test for active TB is known as sputum smear microscopy, in which coughed-up sputum is examined under a microscope for the presence of TB bacteria. However, this method requires trained laboratory staff and can fail to diagnose TB in those who are not producing large numbers of bacteria, as is the case for children. Although other methods can diagnose TB, such as chest X-rays and blood tests, these are expensive and difficult to use in remote locations that lack clinical infrastructure.

To address this, scientists at Stanford University in Palo Alto, California, led by chemist Jianghong Rao, have taken advantage of a naturally produced TB protein known as BlaC to create an efficient detection method that uses a simple fluorescent molecule. BlaC is a secreted β-lactamase enzyme that breaks down β-lactams, a class of chemicals that include antibiotics such as penicillin. The researchers designed the molecule to resemble a β-lactam so that it is cut in half by BlaC. Normally the probe remains colourless, but when cleaved, it releases a green fluorescent product that can be detected using a homemade box containing a light-emitting diode and a couple of filters. The faint light emitted can be captured by a mobile-phone camera, making it easy to share with clinicians — no complex lab equipment required.

Previous probes using a similar technique had the disadvantage of being activated by other bacteria that produce β-lactamases, so they were not specific to TB. Rao and his team modified their probe to prevent it from being cleaved by anything except BlaC from TB bacteria. The resulting test proved to be extremely sensitive and can detect fewer than ten TB bacteria in unprocessed human sputum.

Jacobs, who was not involved in the study, says: “This method is powerful because it does not rely on access to a microscope and lab facilities. And it is much more sensitive than the other tests currently available."

A prototype test is currently being developed by Global BioDiagnostics in Temple, Texas, with the product expected to be available by 2015.

Eric Rubin, a microbiologist at Harvard School of Public Health in Boston, Massachusetts, says that although the probe still requires clinical testing, "a diagnostic based on this principle could make a big impact both in drug development and in controlling disease, especially in areas with limited access to technology".

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Corrections

Corrected: This story originally stated that the fluorescent molecule produced blue light. In fact it produces green light. The text has been changed to reflect this.

References

1. Xie, H. *et al*. *Nature Chem.* http://dx.doi.org/10.1038/nchem.1435 (2012).

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