TB: unravelling the secrets of a bacterial killer

UCD researchers are applying powerful new genomic technologies to understand the bacteria that cause TB in cattle and humans in a bid to reduce the burden of disease.

Which infectious disease kills the most people in the world every year? HIV/AIDS? Malaria? Believe it or not, the holder of that dubious honour is tuberculosis, or TB.

A long-time companion of humans and other mammals such as cattle, the bacteria that cause TB are called mycobacteria. They are remarkably successful at evading the host's immune system, and alarmingly, strains are emerging that can also dodge antibiotics.

So, what can we do about it? An ongoing project at UCD is exploring the genetics of mycobacteria in a bid to develop new ways of detecting infection in cattle. Researchers are comparing TB-causing bacteria from humans and cattle, using a 'One Health' approach to unlock some of the mysteries of these socially and economically important microbes.

Widespread infection

Professor Stephen Gordon, who is Professor in

Infection Biology at UCD School of Veterinary Medicine, finds that people tend to be astounded by the massive numbers of humans that live with a mycobacterial infection. "One third of the world's human population is infected

Professor David MacHugh (Left), Professor in Genomics at the UCD School of Agriculture and Food Science; Professor Stephen Gordon (Right), UCD One Health Theme Lead and Professor in Infection Biology at UCD School of Veterinary Sciences

with the bacterium that causes TB," he says. "And the disease kills around 1.7 million people each year."

Most people who are infected have no symptoms of TB, because the bacterium is 'walled off' by the immune system, but if such a person experiences stress such as extreme hunger or another infection such as HIV, the TB can take hold.

TB also exacts a large toll in agriculture, because a mycobacterial strain closely related to the one that causes TB in humans can infect and cause disease in cattle. "Bovine TB costs hundreds of millions of Euro annually worldwide," says Professor Gordon, who explains how in Ireland cows are routinely tested for infection, but many appear to slip through the net.

"Even though we test all animals in Ireland for bovine TB, around 30% of herds having cattle infected with bovine TB are first identified during inspections of animal carcasses at a slaughterhouse," he says. "This tells us we need to be doing more to identify the infected animals earlier."

Towards better diagnosis in cattle

UCD researchers are looking to improve our ability to diagnose infection in cows on the farm. They are exploring how genomic technologies could pinpoint infected cows by examining blood samples, explains Professor David MacHugh, Professor in Genomics and Associate Dean for Research Innovation and
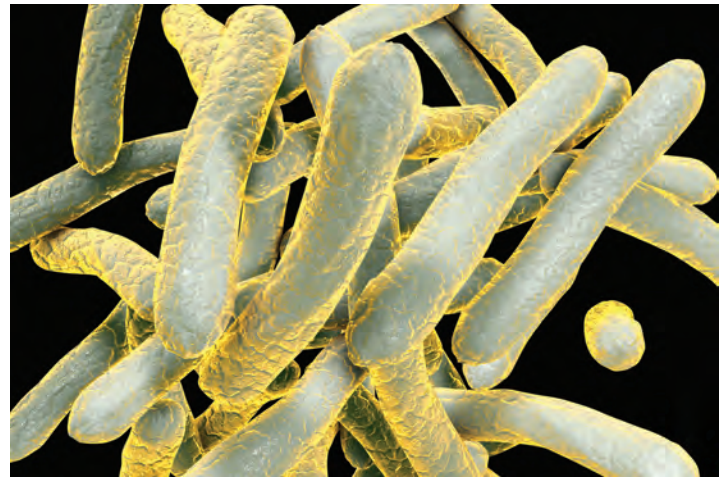
3D illustration of bacterium Mycobacterium tuberculosis

Impact at the UCD School of Agriculture and Food Science.

The technologies we can use to study the genomes of mycobacteria and their mammalian hosts have come on in leaps and bounds in the last 10 years," says Professor MacHugh. "We can now directly study the activity of both mycobacterial and host genes during infection.

"The UCD researchers are working on a project funded by Science Foundation Ireland to develop a new test for TB infection in cows. "We are looking at gene activity in the blood of the host to look for signatures of infection," says Professor MacHugh. "We have been able to see a large perturbation of host gene activity when a mycobacterial infection is present, and we think it will be possible to exploit this to develop a test that can augment the diagnostic techniques that are currently in use."

Common and different

As well as moving towards better diagnosis,

which could reduce the burden of TB on cattle herds and wider economies, the UCD research is also comparing fundamental aspects of the bugs that cause TB in humans and cattle.

"The bacteria that infect humans and cattle and cause TB are genetically very similar and they have both evolved strategies to subvert the immune system in their respective hosts," says Professor MacHugh.

"The commonalities between two bacteria means we can use powerful genomics technologies to compare the bacteria and their effects."

The differences between the two bacteria can also help us to unravel their tactics and better understand how they cause disease.

"We are looking at what makes each bacterium a successful pathogen of cattle or humans," says Professor Gordon. "This is an example of a One Health approach, comparing human and animal disease to advance new ideas into how disease-causing organisms evolve, and then how we can use this information to develop new diagnostic tests."

The TB Research Team pictured outside the UCD School of Veterinary Science. From left to right: Joseph Crispell, Viktor Perets, Sophie Cassidy, Stephen Gordon, Morgane Mitermite, Jose Maria Urtesun Elizari, David MacHugh, Ruoyao Ma, Alicia Smyth, John Browne, and Sarah Faherty O'Donnell