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THE FIRE MARSHALL'S REPORT: A SEARCH THROUGH THE EMBERS

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BIOTECHNOLOGY FOCUS 20TH ANNIVERSARY SPECIAL

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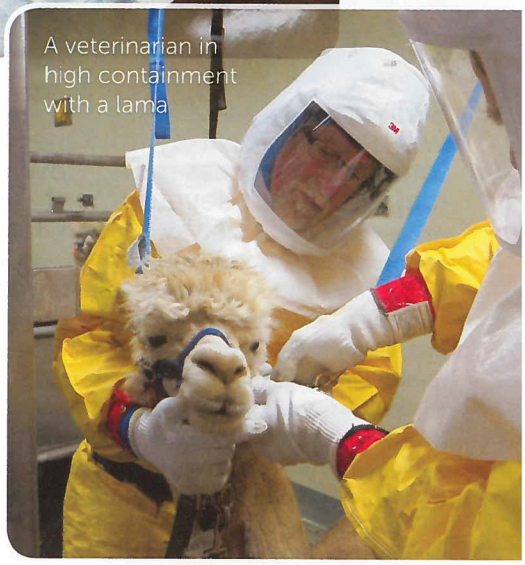
TACKLING INFECTIOUS DISEASES:

Canada's role in the global effort

Every year infectious diseases emerge that threaten the health of people and animals, and impact the global economy.

An animal care technician with a piglet



A veterinarian in high containment with a lama

It is estimated that three diseases emerge annually, and every three years one of them will lead to a larger epidemic.

Outbreaks of pathogens like tuberculosis, Zika virus, and Middle East respiratory syndrome coronavirus (MERS-CoV) regularly make headlines. And the threat of antibiotic-resistant superbugs is so great the World Health Organization has released a list of 12 families of bacteria that urgently need new antibiotics.[1] All of this underlines the need to get ahead of these infectious diseases so that we can limit their impact.

To strengthen Canada's role in responding to infectious diseases worldwide, the Vaccine and Infectious Disease Organization-International Vaccine Centre (VIDO-InterVac) at the University of Saskatchewan works with international partners to study human and animal pathogens and develop solutions.

VIDO-InterVac is home to one of the largest and most advanced containment level 3 (CL3) research laboratories in the world – A clear advantage when you consider that most emerging infectious diseases are classified as risk group 3 or higher. Working with these diseases requires complex containment infrastructure, biosafety practices, and training to ensure the safety of researchers and the surrounding community.

One of VIDO-InterVac's unique assets is the CL3 large-animal research capacity, which has helped them become an international leader in large animal model development for emerging infectious diseases. These models are used to mimic the disease in humans and animals, and are extremely important to infectious disease research. Not only do they allow researchers to better understand how pathogens cause disease, but they are also used to test the safety and effectiveness of new vaccines and drugs.

The development of human and animal vaccines, and other anti-infective medicines such as antibiotics, rely on the use of animal models. Although no single animal model can provide all the information required to advance new vaccines and drugs through preclinical development, research has shown large models have advantages:

- They are ideal for the evaluating the effectiveness of vaccines against pathogens in their natural animal hosts
- Large animal models more accurately predict vaccine outcomes in humans.[2]

As part of the global effort to combat pathogens like MERS-CoV, Zika virus, and tuberculosis, VIDO-InterVac has developed unique large-animal models that will ensure global health innovations can be rapidly developed and tested.

Alpaca model for MERS-CoV makes it easier to test and advance vaccines and anti-infectives in development

First identified in Saudi Arabia in 2012, Middle East respiratory syndrome (MERS) is a zoonotic (spread from animals to humans) viral respiratory disease. It is the second highly pathogenic coronavirus to be spread from animals to humans in recent years—the first was severe acute respiratory syndrome coronavirus (SARS), which was first reported in 2003.

To date, MERS has resulted in 1,936 confirmed cases and 684 deaths.[3] Although the majority of cases have occurred in Saudi Ara-

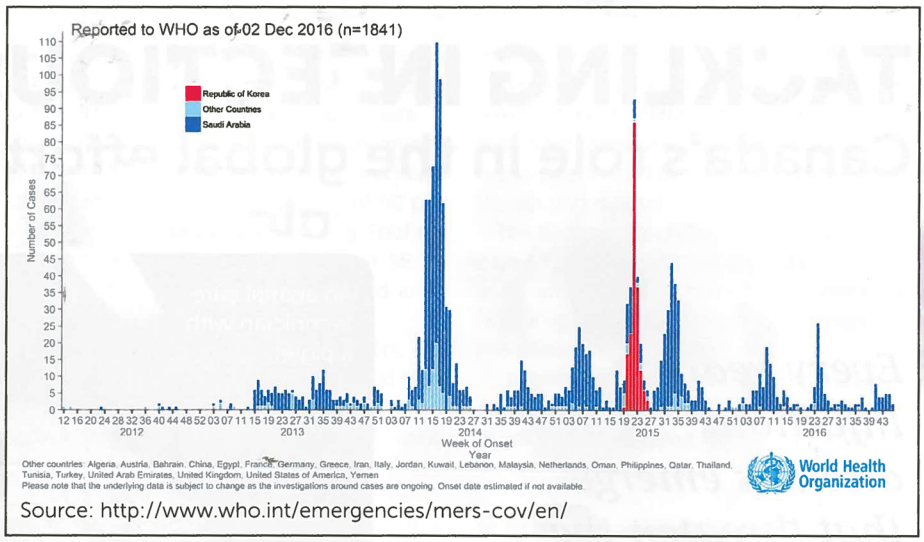
bia, MERS-CoV is considered a global threat. One single case in the Republic of Korea (a male infected in the Middle East), resulted in 186 confirmed cases, more than 16,000 people quarantined, and over 35 deaths.

In an effort to protect against this virus, VIDO-InterVac focused on developing an animal model and a vaccine for MERS. Although camels are the natural host for the virus, they are not ideal animals to work with in a high containment laboratory in the middle of Saskatchewan. Not only are they difficult to come by and expensive to acquire, their size and temperament also make them difficult to handle.

Because of this, VIDO-InterVac focused efforts on establishing an alpaca model. As members of the same animal family as camels, alpacas can be naturally infected with the virus and are more readily attainable in Saskatchewan. This new model makes it easier to test and advance the vaccines and anti-infectives in development.

VIDO-InterVac scientists aim to develop a vaccine for camels and will be testing promising candidates in alpacas this year. This is the first step in determining the safety and efficacy of these vaccines that will ultimately be tested in the field in Saudi Aribia.

CONFIRMED GLOBAL CASES OF MERS-CoV



Source: http://www.who.int/emergencies/mers-cov/en/

Swine model for Zika virus will be used to study how the infection progresses and how it affects brain development

Although Zika virus (ZIKV) was identified in humans in the 1947, the virus only recently became a significant public health concern.

Primarily spread by mosquitos, but also transmitted sexually, ZIKV has been connected to congenital brain abnormalities, including microcephaly, in babies born to infected mothers. Zika has also been linked to Guillain-Barre syndrome, an autoimmune disorder that causes the body's immune system to attack part of the peripheral nervous system and can lead to paralysis.

Currently there is no vaccine or therapy available to combat the infection. As potential new human vaccines are developed, having an effective animal model for preclinical testing will reduce risk and ensure effective solutions reach the market faster. Preliminary research at VIDO-InterVac found that fetal pigs and piglets are susceptible to ZIKV infection, which led to a world-first—the development of a swine model that mimics the infection in humans.

Scientists at VIDO-InterVac will now use this model to study how the infection progresses and how it affects brain development—knowledge that could point to new drug and vaccine targets. Additionally, in support of international efforts, the swine model was made available to partners so that they could assess vaccines and drugs currently in development.

Developing new solutions for human and bovine Tuberculosis

Tuberculosis (TB) is caused by Mycobacterium tuberculosis and is spread through the air from person to person. It is a disease that most Canadians assumed had been eradicated in the 1950s; instead it has become the deadliest infectious disease in the world. In 2015 alone, there were 10.4 million new cases of the disease and 1.8 million deaths.[4]

A similar pathogen in cattle that causes bovine TB (which can also infect humans) is an important trade issue for Canada. Confirmed cases can lead to significant economic losses for the agriculture sector, as was recently witnessed on the prairies. Although the investigation is ongoing, the Canadian Food Inspection Agency quarantined 43 premises in Alberta and Saskatchewan, and destroyed approximately 10,500 animals.[5]

With its partners, VIDO-InterVac is engaged in research to better understand how human and bovine TB cause disease in order to develop new vaccines, drugs and diagnostic tools. VIDO-InterVac's expertise in animal health research make it one of only a few organizations in the world that can conduct this type of research.

Work currently underway includes the development of a novel swine model for human TB infection and transmission that more closely resembles the disease in humans. This model will accelerate the development of new TB vaccines and therapies, which means they will be ready for clinical trials a lot sooner.

Canada's role in the global effort to protect against future epidemics

Infectious diseases are a never-ending threat, especially in an era of growing antimicrobial resistance. International collaboration and diligence will ensure we continue to improve our understanding of how these pathogens cause disease and to develop solutions that will protect health. Canada has an important role to play in this global effort, and exciting research advances are occurring for MERS-CoV, Zika virus, and tuberculosis that can be used to protect against future epidemics.

References

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