Infectious disease experts weigh in on the creation of a human vaccine to protect against Ebola

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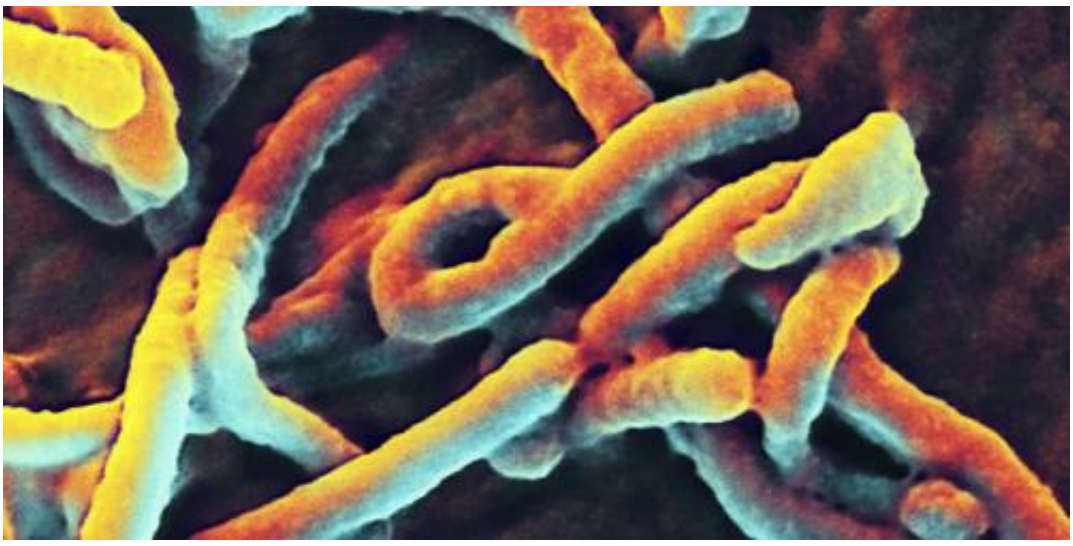

Ebola virus particles budding from an infected cell. Credit: National Institutes of Health

In the past year, the largest and deadliest outbreak of the Ebola virus has spread through West Africa—now with confirmed cases in five countries—and more than half of those who have contracted the virus have perished from it. These frightening statistics have put the development of a vaccine on a fast track, and the National Institutes of Health have announced that trials of one vaccine candidate will begin in September.

To learn more about this outbreak and the creation of new human vaccines, Vermont Medicine, a publication of the University of Vermont's College of Medicine, talked to Dr. Beth Kirkpatrick, UVM Vaccine Testing Center director and professor of medicine, and Dr. Kristen Pierce, associate professor of medicine—both infectious disease specialists at Fletcher Allen Health Care who have led vaccine studies for such global pathogens as cholera, West Nile virus, dengue, typhoid fever and anthrax.

Vermont Medicine: What is Ebola virus and where are Ebola infections most commonly seen?

Vaccine Testing Center: Ebola is a filovirus and causes one of several viral hemorrhagic fevers which are often fatal in humans and non-human primates. The WHO has declared the current Ebola outbreak a Public Health Emergency of International Concern. The first case was documented in Guinea in 2013 but has since spread to Liberia and Sierra Leone. The combined death toll from the epidemic has been 2240 cases with 1229 deaths, with a case fatality rate of 55 percent. There have been over 120 health care workers who have died of Ebola after caring for others with the disease. The fact that there is no convincing evidence that the epidemic is under control, and new cases in Liberia—which shares no common border with the affected countries—have raised further concern.

How does one contract Ebola virus?

According to the Centers for Disease Control and Prevention (CDC), it is hypothesized that the human outbreaks may begin following contact with an infected animal, such as a non-human primate or fruit bat. Once infected, individuals spread infection to others via direct contact with blood and other bodily fluids (urine, saliva, vomitus, semen, and feces).

There are still unanswered questions about human-to-human transmission. In the affected countries of Western Africa, there is concern that spread from infected patients who have died is occurring through the culturally accepted practices of preparing the patient for burial.

What are the challenges of developing an Ebola vaccine?

The development of any vaccine requires a complex understanding of the microorganism and its relationship within the host, especially the immune response. To design a vaccine, researchers will often choose specific components (like surface proteins) of the original pathogen which do not cause disease but will prompt an immune response that will protect the host following future exposure to the real pathogen. Very little is known about the immune response to Ebola, so vaccine development has been challenging. Complicating matters, there may be more than one subtype of Ebola circulating and an effective vaccine would likely need to protect against the various Ebola subtypes.

At present there are two candidate vaccines which have been tested in non-human primates. Both vaccines are recombinant protein vaccines. Phase I (safety) trials of these vaccines are now on a "fast track" and are projected to start within the next few weeks within the United States. These new vaccines will need to be tested carefully for safety and dose schedules (phase I and II trials) in healthy non-infected subjects and then in endemic areas for effectiveness. If these vaccines move quickly through early studies and are found to be safe, there will be intense pressure to move them rapidly into use in West Africa. This creates an ethical dilemma in that unless they are tested against a placebo group (which may be unethical to use in this outbreak), we may not definitively know if the vaccine is actually working.

How does basic science and the development of vaccines for other global pathogens help us better understand how to potentially prevent Ebola?

Scientific advances in the understanding of the pathogens themselves, the immune response to infections, and other vaccine candidates (as studied by UVM faculty in the Department of Microbiology and Molecular Genetics, The Vermont Center for Immunology and Infectious Diseases, and Vaccine Testing Center, respectively) ultimately permit the development of safer and more effective vaccines and therapeutic agents. In 2014, we have a substantially larger toolkit for designing and testing vaccines, including the use of recombinant protein, DNA, and virus-like particle technology, as well as complex immunophenotyping techniques to assess appropriateness of the immune response following vaccination.

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