Researchers propose rapid Ebola test using nanotechnology

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Just as Ebola was finally fading from the headlines, it came back in the

news with shocking reports: a Scottish nurse rehospitalized nine months after beating Ebola is now suffering from meningitis caused by the virus. A recent study also confirms the virus can live in semen for up to nine months, maybe more.

These stories, added to the continuing trickle of new cases out of Guinea, remind us of the persistence of the deadly virus and the need for quick diagnosis and treatment.

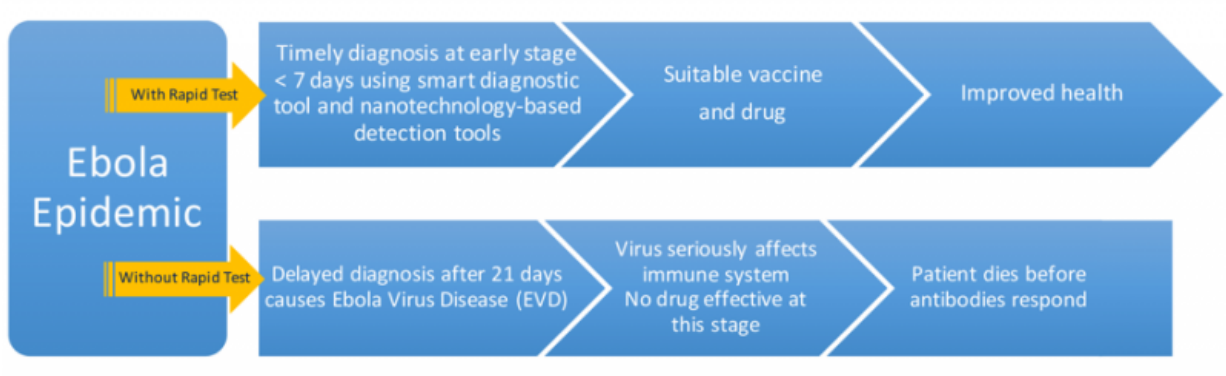
"Recent Ebola virus infection has taken more than 11,000 lives globally and there is still no way to target the virus and kill the disease," says Ajeet Kaushik, assistant professor in the Center for Personalized Nanomedicine in the Institute of Neuroimmune Pharmacology at the Herbert Wertheim College of Medicine (HWCOM).

aushik decided to undertake an extensive review of the Ebola literature to see where and how there may be an improvement in the diagnosis and or treatment of the disease. Ebola Virus Disease (EVD) is lethal. When a patient gets infected with Ebola, the right diagnosis is not, unfortunately, a guarantee that the person will be saved. But recognizing the virus early greatly increases the chance the person will live, and catching it at later stages skyrockets the likelihood they will die.

Kaushik was aided in the review by colleagues Sneham Tiwari, Rahul Dev Jayant, and Center director Madhavan Nair, as well as by Dr. Aileen Marty. The paper, titled "Toward detection and diagnosis of Ebola virus disease at point-of-care," was recently published in the journal *Biosensors and Bioelectronics*: 75, 2016, 254–272.

Marty, a professor of Infectious Diseases in the Department of Medicine, Family Medicine and Community Health at the HWCOM, specializes in tropical medicine, infectious disease pathology and disaster medicine. She took two trips to Africa in 2014 and 2015 to offer

aid and expertise in containing and treating the virus and offered a front-line perspective to the review.



The team's conclusions after summarizing these articles: Early detection of the disease would be a critical tool in helping control the virus and save lives.

"Yes, recent vaccine trials have demonstrated effectiveness in preventing clinical disease, but only with fast detection and equally fast distribution of the vaccine to all those exposed, and the vaccines being tested only exist in limited supplies and have not yet been licensed," Marty says.

It currently takes six to eight hours to perform the diagnostic testing that will prove or disprove that a patient has Ebola. This must be performed in a laboratory. In the meantime, the caregivers are facing shortages of resources, such as IV fluids and hospital beds, to help the sick while they await their fate.

"Conventional methods of detection are good but slow and should be

performed at Biosafety Standard Level 3 laboratories which are expensive to maintain and require skilled personnel," Kaushik says.

Marty, who was recently appointed to the Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria, also noted that the lack of appropriate safety, work stations and effective selective rapid diagnostics methodologies will continue to be significant challenges in the fight against EBOV. But a cost-effective, rapid, sensitive and selective sensor that can detect Ebola at point-of-care could literally be lifesaving.

"It is important to devise more rapid, more sensitive, but also more specific and appropriate diagnostic assays for Ebola because there are grave social, economic and medical – even lethal consequences –to a misdiagnosis," Marty says. "This requires that only diagnostics tests that have undergone independent, comprehensive assessment of quality, safety and performance be used in confirming the diagnosis of infection with Ebola virus. While this new nano-technology is extremely promising, we must be very careful to assure that a definitive diagnosis is given only if the specificity is extremely high – a criteria that becomes even more important as the incidence and prevalence of Ebola disease continues to decrease. This nanotechnology is currently likely to be a good screening test but it should still be backed up with nucleic acid testing using technologies such as polymerase chain reaction (PCR)."

Kaushik's lab has been working on miniaturized sensing technology and integrating that into devices that are capable of detecting virus levels for quite some time. Combining the collaborative strengths of a biologist, nanotechnologist and engineers to develop smart compartments to integrate point-of-care (POC) Ebola sensing devices in a BSL-4 environment should be the aim of future research approach in this area.

"We believe that if we explore this option, the length of time it will take

to detect the Ebola virus will be reduced to 40 minutes instead of multiple hours," Kaushik says.

That's time well-spent.

More information: Ajeet Kaushik et al. Towards detection and diagnosis of Ebola virus disease at point-of-care, *Biosensors and Bioelectronics* (2016). DOI: 10.1016/j.bios.2015.08.040

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