

# nature medicine

## Course correction

**The international response to the ongoing Ebola epidemic has in many respects been more reactive than proactive. But there are changes that, if made, may shift the balance toward future readiness.**

**T**he projections are appalling. At the time of this writing, the World Health Organization (WHO) stated that the number of new Ebola virus disease cases could reach 10,000 per week before the end of the year. The three most heavily afflicted nations—Guinea, Liberia and Sierra Leone—remain woefully underequipped to stem the tide of infection. Severe shortages in medical personnel, protective gear, treatment beds and burial teams hinder almost every aspect of the effort. Cases of transmission were also reported in the US and Spain.

One thing is clear: the international community was not prepared to respond to this outbreak. Less clear is how, with limited resources, to stop the current epidemic. But several broad areas stand out as particularly important for efforts to stem Ebola's spread and improve preparedness for future outbreaks.

One is our sense of urgency. In hindsight, the inability of the world to put forward an agile response to this particular outbreak is not surprising. The first infections occurred in a region unfamiliar with Ebola, at the junction of three nations suffering from civil unrest, crippling poverty and deficient healthcare systems. These and other factors enabled the initiation of multiple chains of transmission, allowing this pathogen to reach, for the first time, densely populated areas. In terms of dynamics and scale, this outbreak may be outside anything ever modeled or anticipated by any relief agency. That said, the Ebola virus is a known pathogen. Unlike the viruses that caused the first outbreaks of sudden acute respiratory syndrome (SARS) or Middle East respiratory syndrome (MERS), the world has been aware of the existence of the Ebola virus and its lethality since its first detection in 1976. So, the fact that no country had a large stockpile of clinically tested vaccine or therapy for Ebola may be interpreted to indicate a lack of a sense of urgency. At the very least, it suggests a lack of prioritization of this pathogen, which is not endemic outside of Africa. If this outbreak teaches us one thing, it's that our assumptions regarding which pathogens the world needs to worry most about need to change.

But changing assumptions is only a start. Acting on them requires coordination and money. Governments around the world have dedicated funds to tackle the Ebola challenge, but funding remains far short of what is needed now—the UN estimated \$1 billion will be necessary to contain the current epidemic—and in the future. In terms of the current outbreak, on 16 October the UN announced that though it has received \$20 million in pledges from various governments for its Ebola trust fund, only \$100,000 has come in thus far. Encouragingly, there has been an outpouring of financial contributions from wealthy individuals and private organizations, the most recent being \$25 million from Mark Zuckerberg and his wife Priscilla Chan to the Centers for Disease Control and Prevention (CDC) Foundation. But whether money will arrive as fast as is needed to quell the still escalating epidemic is unclear.

And where should we allocate funds? In terms of responding to the current outbreak, money should flow towards efforts to mobilize the expertise and equipment to build clinics, administer treatment and safely bury the dead. More complicated are decisions about where to spend to enable preparedness for future outbreaks. Some experts, including Francis Collins, director of the US National Institutes of Health (NIH), have blamed cuts in research funding for the lack of clinically tested Ebola vaccines and therapeutics. Yet prior to this outbreak, US and Canadian government research agencies had discovered candidate Ebola vaccines, and US and Canadian biotechnology companies had formed around candidate Ebola therapeutics. The bottleneck in each case was clinical testing, approval and stockpiling rather than the basic discovery research. Although agencies such as the US Biomedical Advanced Research and Development Authority (BARDA) were set up for the purpose of efficiently taking candidate vaccines and drugs relevant to public health through advanced development and stockpiling, by many accounts BARDA is underfunded, forcing prioritization of pathogens such as influenza over those that were perceived in the past to be more distant threats, such as Ebola. The first BARDA funding for a medical countermeasure against any viral hemorrhagic fever was awarded only in September 2014, to Mapp Biopharmaceutical for advanced development of their antibody-based Ebola therapy. Encouragingly, agencies such as the NIH Vaccine Research Center—with the mission of taking vaccines all the way through advanced development—have initiated clinical testing of candidate Ebola vaccines. And in August 2014, the Wellcome Trust created the Ebola research funding initiative, which commits some funds specifically to clinical studies that could be conducted during the current epidemic. But greater throughput in clinical testing may be one thing needed to stop belated prioritization of infectious agents. So, in a setting of limited funding, allocating more towards advanced development and stockpiling may be advisable.

Another area demanding committed spending is regular and rigorous training of healthcare workers in the use of personal protective gear. Encouragingly, the CDC set up a training course for clinicians on their way to West Africa to treat infected patients, but the transmission of the Ebola virus between infected patients and nurses in hospitals in Dallas and Madrid indicate that even healthcare workers working in 'routine' settings need a deeper understanding of up-to-date guidelines for protecting themselves and others while treating patients with various infectious diseases. Right now it is unclear which institutions will ensure the implementation of such preparedness procedures, at least in the US, as the CDC lacks authority over local and state health agencies in this regard.

Global efforts must be engaged to halt the Ebola epidemic. But when it is over, it is essential that the international community take stock of what this horrific crisis taught us and prioritize these lessons in the long term.