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PREFACE to “**The 2013-16 Ebola epidemic: Data, decision-making and disease control**”

Peter Piot, Cordelia Coltart, Katherine E Atkins

Ebola's history

Until 2013, there had been 24 naturally occurring reported outbreaks of Ebolavirus affecting humans. All but one of these outbreaks were confined to four central African countries: Democratic Republic of the Congo (DRC, formerly Zaire), South Sudan (formerly Sudan), Gabon and Uganda. In total, approximately 2300 people had been known to have contracted the infection, around 1500 of whom had died. The only reported human infection in West Africa was a single case of Taï Forest Ebolavirus infection in Côte d'Ivoire in 1994.

Ebola was first discovered following an outbreak near the Ebola River in Zaire in 1976. Analysis from this first reported outbreak identified two key modes of transmission: i) healthcare workers and family members were becoming infected after close contact with a patient, and ii) patient-to-patient transmission was occurring through reuse of contaminated needles for injections at the local hospital. This outbreak was rapidly controlled as quarantine measures were instigated by village-leaders, and nosocomial transmission was eliminated when the hospital was forced to close after most healthcare workers were infected. The absence of sustained transmission and the small number of individuals infected did not pose a wider public health threat outside the affected communities. Ebola, therefore, did not hit the headlines. It did, however, generate some scientific interest in vaccine development and pathogenesis, triggered mainly by biosecurity concerns given its high case fatality risk.

Awareness of Ebola

Prior to 2013, public knowledge around Ebola was limited to the descriptions in graphic novels and Hollywood blockbusters, largely inspired by the 1995 Ebola outbreak in Kikwit, DRC. These productions generally depicted a catastrophic, worst case scenario, highlighting the potential apocalyptic qualities of Ebola—not only could it spread like wildfire, destroying communities, regions and continents, but it also held significant potential as a bioterrorism weapon. However, outside of Africa, indeed outside of central Africa, Ebola was considered more of fascination than a concern. It was a tropical disease, limited to central Africa and the most rural and poorest regions. That was soon to change.

Ebola 2013–2016

In December 2013, in Gueckedou prefecture in the Forestière region of Guinea, near the tripoint of Guinea, Sierra Leone and Liberia, a 2-year old boy would later be identified as the index case of this outbreak. During the following 28 months, there was sustained transmission across Guinea, Liberia and Sierra Leone, as well as spillover cases and connected outbreaks in a further three West African countries, three European countries and the US. There was a sense of shock, not least because none of these ten affected countries had previously experienced an Ebola case (except for one laboratory worker

accidentally infected in the UK in the 1970s). This outbreak heralded a new era for Ebola—a multi-country epidemic of global significance. It was the result of a perfect storm of a slow response, the legacy of civil war and corrupt dictatorships, poorly functional health and governmental systems commanding little public trust, and highly mobile populations. In its wake, the epidemic has left us with a list, albeit incomplete, of what went wrong in our attempts to control the disaster, and of what the lessons are for future outbreaks of Ebola and other highly lethal pathogens.

What have we learned?

After it became clear that much of the devastation could have been prevented, four different panels were formed to review the international response—the *World Health Organization (WHO) Ebola Interim Assessment Panel*, the *Harvard University and the London School of Hygiene & Tropical Medicine's Independent Panel on the Global Response to Ebola*, the US National Academy of Medicine's *Commission on a Global Health Risk Framework for the Future*, and the United Nations High-Level Panel on the *Global Response to Health Crises*. These panels aimed to identify the reasons that contributed to poor outbreak control, and to provide recommendations on how to strengthen future response. They were unanimous in implicating the WHO's failings to avert the disaster. The WHO has since responded by restructuring its epidemic response capacity. This restructuring can, in principle, tackle several recommendations by the Harvard/LSHTM Panel which state the need for the WHO to scale back its broad remit and instead refocus on: providing technical assistance to nations to strengthen their public health system capacity and epidemic preparedness and response; providing emergency response and declarations; establishing best-practice guidance; and convening the global community. Other organisations have reacted to other Panel recommendations; most notably, the World Bank has launched a pandemic financing facility to underpin national response initiatives, and the Coalition for Epidemic Preparedness Innovation (CEPI) has been launched to incentivise vaccine development for pathogens where there is market failure. A priority for CEPI is to complete full testing and registration of at least two Ebola vaccines so that they can be used in future Ebolavirus outbreaks and to protect health care workers and other vulnerable populations. Despite some improvement in global epidemic preparedness, implementation of most recommendations is still patchy and will require continued strong leadership—at political, scientific and public health levels.

Many of the recommendations centred around global governance and leadership, with little attention to the role of the individual nations. However, for infectious disease outbreaks, acting effectively is often synonymous with acting rapidly. Without strengthening local core capacity to rapidly detect and respond to outbreaks, weeks will be lost prior to international mobilization of resources occurring. With an exponentially increasing number of cases, a delay of weeks can be the difference between effective outbreak control and a public health emergency.

Was the response different to that during previous epidemics?

This outbreak was unlike all previous outbreaks in many respects: it was unique in terms of its magnitude—being over 90 times larger than any previous outbreak; in terms of its timespan—with transmission continuing over two years; in terms of its geography—occurring in West Africa where no human-to-human Ebola transmission had been

reported; and in terms of its spatial distribution—with intense transmission spanning three entire countries, and significant urban spread. This is in contrast to previous outbreaks that were localised to specific rural areas or small towns that were geographically isolated. In previous outbreaks control effects (led by Médecins sans frontières (MSF), The Centers for Disease Control (CDC), and WHO alongside national authorities) were implemented prior to early cases seeding transmission in new areas. This was again displayed by the rapid control of an Ebola outbreak in Boende, DRC in 2014, led mostly by Congolese experts, authorities, and MSF.

In comparison to historical outbreaks, this West African outbreak at times seemed “out of control” and evolved into a major humanitarian crisis, resulting in an unprecedented global health response. It is the first time key players in an Ebola response have included international military and governmental organisations from the UK, USA, China, France, Cuba and the African Union, along with many other countries. Public health strategies were complemented by military and military-style coordination and logistics that helped implement preventative interventions and enforced curfews to try to limit further transmission.

Media coverage significantly affects how a disease is perceived. The 1995 Kikwit outbreak was the first epidemic to generate global media coverage, largely due to technological advancements making it possible to broadcast and send images in real time. This media attention played a major role in mobilizing public engagement. This attention led to increased resources during the epidemic and generated the development of several documentaries, books and films, producing a new global wave of public information about Ebola. Worldwide media attention exploded during this recent epidemic, and oscillated between helpful public information to almost hysterical fear-mongering.

Ebola as a game-changer

The unprecedented size and duration of the West African Ebola epidemic tested the limits of medical knowledge, health system infrastructure and capacity, and the international global health response. The epidemic uncovered fatal weaknesses in these systems that set back Ebola response, and if left unchanged, will hamper future disease control across all emergent diseases. With Western, Middle and Central Africa increasingly hosting dangerous ecological risk factors for zoonotic spillover events, this recent Ebola epidemic must be a game-changer for how we, as a global community, deal with this ever-present health threat. Great leaps forward have sometimes followed great tragedy, as was the case with the ongoing HIV/AIDS epidemic. Achieving a political and social movement, AIDS activism allowed health to be placed on the top of global agendas. New health priorities allowed access to pharmaceuticals under patent to low income countries, and the field of “global health” emerged with its own research agenda.

This Ebola epidemic highlighted the inadequacy of scientific and medical advancements in preventing global spread of emerging infections. Making progress will rely on higher-level governance to improve economic incentives in pharmaceutical development and timely financial decisions. In addition, there is a great need for innovation—from diagnostics to vaccines, better data collection and management, improved detection and surveillance protocols, and sober consideration of the socio-economic drivers for many ecological risk factors for disease spillover.

