

One year into the Ebola epidemic: a deadly, tenacious and unforgiving virus

One year into the Ebola epidemic. January 2015

One year after the first Ebola cases started to surface in Guinea, WHO is publishing this series of 14 papers that take an in-depth look at West Africa's first epidemic of Ebola virus disease.



UNMEER/Martine Perret

INTRODUCTION - This assessment looks at how West Africa's epidemic of Ebola virus disease has evolved over the past year, giving special attention to the situation in Guinea, Liberia, and Sierra Leone. The success stories in Senegal, Nigeria, and likely Mali are also described to show what has worked best to limit onward transmission of Ebola following an imported case and bring the outbreak to a rapid end. The fact that a densely populated city like Lagos was successful in containing Ebola offers encouragement that other developing countries can do the same.

An overview of how the outbreak in the Democratic Republic of Congo evolved and was brought under control underscores the many differences between the outbreaks in West Africa and in equatorial Africa, where all previous outbreaks since the first two in 1976 have occurred.

Key events in the WHO response are outlined to show how initial control efforts were eventually overwhelmed by the wide geographical dispersion of transmission, the unprecedented operational complexity of the outbreaks, and the many factors that undermined the power of traditional containment measures to disrupt transmission chains. These factors are also described.

In efforts coordinated by WHO, scientists and the pharmaceutical industry have geared up to develop, test, license, and introduce the first Ebola vaccines, therapies, and point-of-care diagnostic tests. As a strong expression of solidarity with the people of West Africa, these groups are attempting to compress work that normally takes two to four years into a matter of months.

Finally, the assessment takes a look at the potential future evolution of the Ebola epidemic. Based on what has been learned during this first year, what critical strategies and interventions will give countries and their partners the best chance of bringing the outbreaks under control?

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Origins of the 2014 Ebola epidemic

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A "mysterious" disease began silently spreading in a small village in Guinea on 26 December 2013 but was not identified as Ebola until 21 March 2014.



WHO/Saffee Gborie

CHAPTER 2 - Retrospective studies conducted by WHO staff and Guinean health officials identified the index case in West Africa's Ebola epidemic as an 18-month-old boy who lived in Meliandou, Guinea. The boy developed an illness characterized by fever, black stools, and vomiting on 26 December 2013 and died two days later. The exact source of his infection has not been identified but likely involved contact with wild animals.

The remote and sparsely populated village of Meliandou, with only 31 households, is located in Gueckedou District in what is known as the Forest Region. Much of the surrounding forest area has, however, been destroyed by foreign mining and timber operations.

Some evidence suggests that the resulting forest loss, estimated at more than 80%, brought potentially infected wild animals, and the bat species thought to be the virus' natural reservoir, into closer contact with human settlements. Prior to symptom onset, the child was seen playing in his backyard near a hollow tree heavily infested with bats.

By the second week of January 2014, several members of the boy's immediate family had developed a similar illness followed by rapid death. The same was true for several midwives, traditional healers, and staff at a hospital in the city of Gueckedou who treated them.

"You have to know Ebola to fight Ebola. Mobilize your people."

Dr Clement, WHO, Liberia

During the following week, members of the boy's extended family, who attended funerals or took care of ill relatives, also fell sick and died. By then, the virus had spread to four sub-districts via additional transmission chains. A pattern of unprotected exposure, more cases and deaths, more funerals, and further spread had been established.

The first investigations: cholera?

The first alert was raised on 24 January, when the head of the Meliandou health post informed district health officials of five cases of severe diarrhoea with a rapidly fatal outcome. That alert prompted an investigation the next day in Meliandou by a small team of local health officials. The reported symptoms, including diarrhoea, vomiting

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team of local health workers. The reported symptoms, including diarrhoea, vomiting, and severe dehydration, appeared similar to those of cholera, one of the area's many endemic infectious diseases. However, no firm conclusions could be reached.

A second larger team, including staff from Médecins Sans Frontières (MSF) travelled to Meliandou on 27 January. Microscopic examination of patient samples showed bacteria, again supporting the conclusion that the unknown disease was likely cholera. Following the team's visit, other deaths occurred but were neither reported nor investigated.

On 1 February, the virus was carried into the capital, Conakry, by an infected member of the boy's extended family. He died four days later at a hospital where, as doctors had no reason to suspect Ebola, no measures were taken to protect staff and other patients. As the month progressed, cases spread to the prefectures of Macenta, Baladou, Nzerekore, and Farako as well as to several villages and cities along the routes to these destinations.

Alert, investigation and identification of the Ebola virus

The Ministry of Health issued its first alert to the unidentified disease on 13 March 2014. On that same day, staff at WHO's Regional Office for Africa (AFRO) formally opened an Emergency Management System event for a disease suspected to be Lassa fever.

A major investigation, involving staff from the Ministry of Health, WHO AFRO, and MSF, took place from 14 to 25 March, involving site visits to Kissidougou, Macenta, Gueckedou City and Nzerekore. That investigation found epidemiological links among outbreaks previously not known to be connected and identified Gueckedou City as the epicentre for transmission of a disease that still had no known cause.

On 21 March, the Institut Pasteur in Lyon, France, a WHO Collaborating Centre, confirmed that the causative agent was a filovirus, narrowing the diagnosis down to either Ebola virus disease or Marburg haemorrhagic fever.

The next day, the laboratory confirmed that the causative agent was the Zaire species, the most lethal virus in the Ebola family. That same day, the government alerted WHO to what was described as a "rapidly evolving" outbreak of Ebola virus disease. When WHO publicly announced the outbreak on its website on 23 March, 49 cases and 29 deaths were officially reported.

– [Stories from the field: Communities organize Ebola response](#)

Factors that contributed to undetected spread of the Ebola virus and impeded rapid containment

One year into the Ebola epidemic. January 2015

Several factors, including some that are unique to West Africa, helped the virus stay hidden and elude containment measures.



WHO/S. Gborie

CHAPTER 3 - In Guinea, it took nearly three months for health officials and their international partners to identify the Ebola virus as the causative agent. By that time, the virus was firmly entrenched and spread was primed to explode.

By 23 March 2014, a few scattered cases had already been imported from Guinea into Liberia and Sierra Leone, but these cases were not detected, investigated, or formally reported to WHO. The outbreaks in these two countries likewise smouldered for weeks, eventually becoming visible as chains of transmission multiplied, spilled into capital cities, and became so numerous they could no longer be traced.

Countries in equatorial Africa have experienced Ebola outbreaks for nearly four decades. Though they also have weak health systems, they know this disease well. All previous outbreaks, which remained largely confined to remote rural areas, were controlled, with support from WHO and other international partners, in periods ranging from three weeks to three months. In those outbreaks, geography aided containment.

Clinicians in equatorial Africa have good reasons to suspect Ebola when a "mysterious" disease occurs, and this favours early detection. Laboratory capacity is in place. Staff know where to send patient samples for rapid and reliable diagnosis. Health systems are familiar with Ebola and much better prepared. For example, hospitals in Kinshasa, the capital of the Democratic Republic of Congo, have isolation wards, and staff are trained in procedures for infection prevention and control. Governments know the importance of treating a confirmed Ebola case as a national emergency.

An old disease in a new context

In contrast, West African countries, which had never experienced an Ebola outbreak, were poorly prepared for this unfamiliar and unexpected disease at every level, from early detection of the first cases to orchestrating an appropriate response. Clinicians had never managed cases. No laboratory had ever diagnosed a patient specimen. No government had ever witnessed the social and economic upheaval that can accompany an outbreak of this disease. Populations could not understand what hit them or why.

Ebola was thus an old disease in a new context that favoured rapid and initially

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invisible spread. As a result of these and other factors, the Ebola virus has behaved differently in West Africa than in equatorial Africa, challenging a number of previous assumptions.

In past outbreaks, amplification of infections in health care facilities was the principal cause of initial explosive spread. Transmission within communities played a lesser role, with the notable exception of unsafe burials. In West Africa, entire villages have been abandoned after community-wide spread killed or infected many residents and fear caused others to flee.

Also in past outbreaks, Ebola was largely confined to remote rural areas, with just a few scattered cases detected in cities. In West Africa, cities – including the capitals of all three countries – have been epicentres of intense virus transmission. The West African outbreaks demonstrated how swiftly the virus could move once it reached urban settings and densely populated slums.

In past outbreaks, the primary aim of rapid patient isolation was to interrupt chains of transmission. Today, with so many people infected, the primary aim must also include aggressive supportive care, especially rehydration and correction of electrolyte imbalances, which improves the chances of survival. Life-saving supportive care is



difficult to provide in a typical West African health care setting but is improving as more treatment facilities are built by MSF, the UK and US governments, WHO, and other partners.

Damaged public health infrastructures

Guinea, Liberia, and Sierra Leone, which are among the poorest countries in the world, had only recently emerged from years of civil war and unrest that left basic health infrastructures severely damaged or destroyed and created a cohort of young adults with little or no education.

Road systems, transportation services, and telecommunications are weak in all three countries, especially in rural settings. These weaknesses greatly delayed the transportation of patients to treatment centres and of samples to laboratories, the communication of alerts, reports, and calls for help, and public information campaigns.

High population mobility across porous borders

West Africa is characterized by a high degree of population movement across exceptionally porous borders. Recent studies estimate that population mobility in these countries is seven times higher than elsewhere in the world. To a large extent, poverty drives this mobility as people travel daily looking for work or food. Many extended West African families have relatives living in different countries.

Population mobility created two significant impediments to control. First, as noted early on, cross-border contact tracing is difficult. Populations readily cross porous borders but outbreak responders do not. Second, as the situation in one country began to improve, it attracted patients from neighbouring countries seeking unoccupied treatment beds, thus reigniting transmission chains. In other words, as long as one country experienced intense transmission other countries remained at risk, no matter how strong their own response measures had been.

The traditional custom of returning, often over long distances, to a native village to die and be buried near ancestors is another dimension of population movement that carries an especially high transmission risk

carries an especially high transmission risk.

Severe shortage of health care workers

Prior to the outbreaks, the three countries had a ratio of only one to two doctors per nearly 100,000 population. That meagre workforce has now been further diminished by the unprecedented number of health care workers infected during the outbreaks. Nearly 700 were infected by year end and more than half of them had died.

Though the number of infected health care workers was highest at the start of the outbreaks, infections in doctors and nurses began to spike again in the last quarter of the year. The reasons for this spike are currently being investigated.

In Liberia, some evidence suggests that, as cases began to decline and the risk was perceived to be lower, stringent measures for personal protection lapsed. Protective measures in the community, such as frequent hand hygiene and keeping a safe distance from others, visibly declined. In Sierra Leone, which now has 5 times as many new cases per week when compared with Liberia, exhaustion among staff may help explain the increase.

As experience has shown, when a city experiences intense and widespread transmission, as happened first in Monrovia and then later in Freetown, the distinctions between "hot" and "low-risk" zones become blurred. Infections in at least some health care workers, who rigorously followed safe procedures while caring for Ebola patients in a hospital or clinic, are known to have acquired their infection in the community.

As of mid-December, MSF had more than 3,400 staff working in the affected countries. Of these staff, 27 became infected with Ebola and 13 of them died. Investigations by MSF found that the vast majority of these infections occurred in the community, and not in its treatment facilities, which have an outstanding reputation for safety.

Cultural beliefs and behavioural practices

High-risk behaviours in the three countries have been similar to what has been seen during previous Ebola outbreaks in equatorial Africa, with adherence to ancestral funeral and burial rites singled out as fuelling large explosions of new cases. Medical anthropologists have, however, noted that funeral and burial practices in West Africa are exceptionally high-risk.

Data available in August, as reported by Guinea's Ministry of Health, indicated that 60% of cases in that country could be linked to traditional burial and funeral practices. In November, WHO staff in Sierra Leone estimated that 80% of cases in that country were linked to these practices.

In Liberia and Sierra Leone, where burial rites are reinforced by a number of secret societies, some mourners bathe in or anoint others with rinse water from the washing of corpses. Understudies of socially prominent members of these secret societies have been known to sleep near a highly infectious corpse for several nights, believing that doing so allows the transfer of powers.

Ebola has preyed on another deep-seated cultural trait: compassion. In West Africa, the virus spread through the networks that bind societies together in a culture that stresses compassionate care for the ill and ceremonial care for their bodies if they die. Some doctors are thought to have become infected when they rushed, unprotected, to aid patients who collapsed in waiting rooms or on the grounds outside a hospital.

As several experts have noted, when technical interventions cross purposes with entrenched cultural practices, culture always wins. Control efforts must work within the culture, not against it.

Reliance on traditional healers

Traditional medicine has a long history in Africa. Even prior to the outbreaks, poor access to government-run health facilities made care by traditional healers or self-medication through pharmacies the preferred health care option for many, especially the poor. Many surges in new cases have been traced to contact with a traditional healer or herbalist or attendance at their funerals.

After the outbreaks began, the high fatality rate encouraged the perception that hospitals were places of contagion and death, further reinforcing the lack of compliance with advice to seek early medical care. Moreover, many treatment facilities, hidden behind high fences and sometimes draped with barbed wire, looked more like prisons than places for health care and healing.

Community resistance, strikes by health care workers

Control efforts in all three countries have been disrupted by community resistance, which has multiple causes. Fear and misperceptions about an unfamiliar disease have been well documented by medical anthropologists, who have also addressed the reasons why many refused to believe that Ebola was real.

People and their ancestors had been living in the same ecological environment for centuries, hunting the same wild animals in the same forest areas, and had never before seen a disease like Ebola. Equally unfamiliar were the response measures, like disinfecting houses, setting up barriers and fever checks, and the invasion by foreigners dressed in what looked like spacesuits, who took people to hospitals or barricaded tent-like wards from which few returned.

A second source of community resistance arose from the inability of ambulance and burial teams to respond quickly to calls for help, with bodies sometimes left in the community for as long as 8 days. The communities will comply with official advice if it benefits them. They are far less likely to comply if the result, like uncollected bodies, causes visible harm.

Burials performed by military personnel have been safe and efficient but not always dignified, especially in a culture that observes ancestral mourning rites and is accustomed to touching bodies of loved ones before they are buried in their finest clothes, in graves that are marked.

Strikes by hospital staff and burial teams have further impeded control efforts. Most strikes occurred after staff were not paid for weeks or months, did not receive promised hazard pay, or were asked to work under unsafe conditions associated with the deaths of many colleagues.

Public health messages that fuelled hopelessness and despair

In the face of early and persistent denial that Ebola was real, health messages issued to the public repeatedly emphasized that the disease was extremely serious and deadly, and had no vaccine, treatment, or cure. While intended to promote protective behaviours, these messages had the opposite effect.

If hospitals and "Western" medicine offered no treatments, therapies, or cures, families preferred to care for their loved ones at home. In their view, if death is almost inevitable, let this happen as comfortably as possible at home, amid familiar and well-loved faces. Moreover, when patients were taken to treatment or transit centres, anxious families often received little information about the patient's condition, outcome, or even the place of burial.

With time, and as entire households died of the disease, communities began to understand that keeping patients in homes carried a high risk for care-givers. However, the severe shortage of treatment beds, first in Monrovia and later in the western part of Sierra Leone, left families with few other options.

For unknown reasons that may include the stigma that surrounds this disease, the practice of hiding patients in homes continued in some areas, even after abundant

treatment beds became available. The great stigma attached to Ebola explains why suspicious deaths are routinely tested for Ebola. Bodies that test negative can be buried in the traditional way, and families are freed from ostracism by the community.

Spread by international air travel

The importation of Ebola into Lagos, Nigeria on 20 July and Dallas, Texas on 30 September marked the first times that the virus entered a new country via air travellers. These events theoretically placed every city with an international airport at risk of an imported case.

The imported cases, which provoked intense media coverage and public anxiety, brought home the reality that all countries are at some degree of risk as long as intense virus transmission is occurring anywhere in the world – especially given the radically increased interdependence and interconnectedness that characterize this century.

Background noise from endemic infectious diseases

All previous Ebola outbreaks occurred in countries with a number of long-tenured infectious diseases that mimic the early symptoms of Ebola and help keep the disease hidden. The initial symptoms of malaria, for example, are indistinguishable from those of Ebola. Cholera is likewise endemic in the area and caused a large outbreak in Guinea and Sierra Leone in 2012 that lasted most of that year.

As a further complicating factor, the incidence of Lassa fever – which, like Ebola, is a viral haemorrhagic fever – is uniquely high in this West African region, with Sierra Leone recording the world's highest incidence of cases.

A virus with different clinical and epidemiological features

Recent virological analyses have determined that the virus circulating in West Africa is genetically distinct from Zaire viruses seen in past outbreaks and in the 2014 outbreak in the Democratic Republic of Congo. As scientists have noted, the virus in West Africa takes a different clinical course with different epidemiological consequences, although these differences do not affect the infectious period, case fatality rate, or modes of transmission.

As noted in a major study and commentary published in Science Magazine on 29 August, the virus' genome – its genetic "identity card" – is changing "fairly quickly" in fixed ways. As the authors of the report concluded, "continued progression of this epidemic could afford an opportunity for viral adaptation, underscoring the need for rapid containment."

A fire in a peat bog

In past outbreaks of Ebola virus disease and the related Marburg haemorrhagic fever, cases were concentrated in a small number of geographical foci, which simplified logistical demands. Under such circumstances, the principal responders, WHO, MSF, and the US CDC, could flood affected areas with staff and materials, hunt the virus down, and uproot it within several weeks to three months.

The situation in West Africa has been far more challenging, with cases reported in all or most parts of the three countries, including their capital cities. The demands of addressing this broad geographical dispersion of cases outstripped international response capacity at nearly every level, ranging from worldwide supplies of personal protective equipment to the number of foreign medical teams able to staff newly built treatment centres.

During 2014, the outbreaks in West Africa behaved like a fire in a peat bog that flares up on the surface and is stamped out, but continues to smoulder underground, flaring up again in the same place or somewhere else. Unlike other humanitarian crises, like an earthquake or a flood, which are static, the Ebola virus was constantly – and often invisibly – on the move.

The long duration of the outbreaks

The Ebola outbreak demonstrated the lack of international capacity to respond to a severe, sustained, and geographically dispersed public health crisis. Governments and their partners, including WHO, were overwhelmed by unprecedented demands driven by culture and geography as well as logistical challenges. Together, these and other factors, including the behaviour of the virus, created a volatile situation that evaded conventional control measures and constantly delivered surprises.

Faced with so much suffering and so many unmet needs, many partners in the outbreak response courageously took on responsibilities that went beyond their traditional areas of work and expertise. Some, including MSF, the US CDC, the International Federation of Red Cross and Red Crescent Societies (IFRC), the World Food Programme, and UNICEF built upon their well-established roles during health and humanitarian crises to expand their areas of engagement.

MSF, which provided the bulk of clinical care since the beginning of the outbreaks, used its treatment centres to collaborate in clinical trials of experimental therapies and also provided funding. The World Food Programme extended its unparalleled logistical capacities to support response operations that went well beyond the delivery of food. Its helicopters were used to get rapid response teams to remote rural areas. Its engineering teams supported the rapid construction of treatment facilities by WHO and others and the clearing of ground for cemeteries.

Hundreds of CDC staff, including epidemiologists with extensive experience in outbreak containment, were deployed to support surveillance, contact tracing, data management, laboratory testing, and health education. UNICEF worked to promote child health and safe childbirth in addition to taking the lead on social mobilization.

IFRC used its vast network of volunteers to take on primary responsibility for safe and dignified burials. As WHO field staff observed, some operations encountered less community resistance when local staff were part of the response team, as is often the case with IFRC volunteers. However, given the cultural and religious sensitivities surrounding burials, the work of several teams was disrupted by violent community resistance, resulting in serious injuries to some team members.

The International Medical Corps, International Rescue Committee, and International Organization for Migration played major roles in staffing and managing treatment facilities, in Liberia and Sierra Leone, designed to meet all isolation, care, safety, and waste management needs. Staff provided by the International Medical Corps included mental health and psychosocial specialists.

Doing unfamiliar work

Many organizations and agencies took on technical work normally handled by public health experts. UNFPA, for example, undertook contact tracing. The charity Save the Children assumed responsibility for managing a treatment centre built by the UK government in Kerry Town, Sierra Leone.

As the year drew to a close, several charities were struggling to care for Ebola orphans, estimated by some to number more than 30,000 in the three countries. Poverty, the heavy stigma attached to this disease, and the speed with which it can devastate a village made it difficult to find homes for orphaned children.

Manufacturers of essential supplies, like personal protective equipment, were also stretched to the limits of their production capacity, while WHO was left to ensure that donated supplies from existing stockpiles were of the right quality to protect staff during an outbreak caused by an especially contagious and lethal virus. Unfortunately, when the outbreak started, no gear specifically designed to protect against Ebola virus infection existed, and this problem raised some uncertainties throughout the year.

In a new role for WHO, the Organization supervised and funded the construction of

in a new role for WHO, the organization supervised and funded the construction of treatment centres, as requested by ministries of health, and developed floor plans for safe facilities constructed by others.

Despite all this support from multiple sources, capacity was insufficient for most of the year or not available where it was needed most. The problem of insufficient capacity was greatest for foreign medical teams needed to run treatment centres. Many WHO staff sent to the field to serve as coordinators ended up donning protective gear and treating patients as well.

With response teams overwhelmed and resources stretched so thin, these laudable efforts to fill in the gaps raised some important questions. Who is responsible for coordinating all these efforts? Who is responsible for ensuring that unfamiliar jobs taken on by some are properly done?

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- [Stories of Ebola survivors](#)
 - [Story from Guinea: Busting the myths about Ebola is crucial to stop the transmission of the disease](#)
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Guinea: The Ebola virus shows its tenacity

One year into the Ebola epidemic. January 2015

As the first country affected, Guinea illustrates – sometimes to an extreme – some of the many problems that compromised control efforts elsewhere.



WHO/T. Jasarevic

CHAPTER 4 - Since the outbreak was officially declared in mid-March 2014, Guinea has experienced three cyclical patterns of intense transmission followed by an apparent decline in cases and then a return to intense transmission. The first dip in the number of probable and confirmed cases occurred in the week starting 28 April. Cases subsequently increased then dropped again in mid-June. A sudden flare-up occurred during the week starting 11 August, initiating a pattern of high-level transmission that continued for the rest of the year.

The first cycle led to early optimism that the outbreak was under control. As early as 15 April, the outbreak was being publicly described by staff in the Ministry of Health as “nearly under control”. By 25 April, the government had begun the countdown of passing through 21 days, the recognized incubation period, with no cases in the affected prefectures. At that time, Gueckedou was the epicentre of the outbreak, with Macenta also showing a slow rise in new cases.

Early optimism – and calls for caution

Guinea illustrates key issues that have compromised control efforts both within and beyond its borders.

On 1 May, the country’s President visited WHO headquarters in Geneva to discuss the outbreak with Director-General Dr Margaret Chan. He cited several signals that the outbreak had peaked and expressed his hope that WHO could soon declare an end to the event. Dr Chan argued for caution and continued high vigilance. As she stressed, the outbreak could be declared over only after 42 days (twice the incubation period) had passed with no new cases detected under conditions of intense surveillance.

Indications of an apparent decline in cases were noted by others, including Médecins Sans Frontières (MSF) and staff from the US Centers for Disease Control and Prevention (CDC). In early May, MSF put its team in Macenta on standby, while likewise calling for continued vigilance.

As events would prove, these early signals were false.

Other WHO staff, including its leading Ebola expert, also called for caution

“When we got the results from Conakry confirming that Ebola had reached our place, we were

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...also called for caution, arguing that the outbreak had most likely moved underground, as families hid their sick in homes and buried bodies in secret ceremonies after dark. In other words, the outbreak had moved underground, invisible in the statistics. That warning was supported by two phenomena never before observed during previous Ebola outbreaks.

scared. But we knew that we, health workers, have the responsibility to fight it.”

Dr Beuvogui, District Hospital, Telimele, Guinea

First, as new treatment beds became available, they were filled – virtually overnight – by a hidden caseload largely made up of previously unidentified patients.

Second, zones of intense transmission were kept in the shadows by the refusal of communities to accept investigations by foreign medical staff, including WHO teams. In these “shadow zones”, WHO epidemiologists were often forced to use proxy indicators, such as the number of fresh graves, to produce crude maps of areas with intense transmission. Almost from the beginning, WHO epidemiologists working in Guinea recognized that the true scale of the outbreak was being underestimated by officially reported data, though the magnitude of underreporting could not be accurately measured.

With each cyclical rise in the number of cases, the outbreak demonstrated the virus’ remarkable tenacity, repeatedly returning in ways that were impossible to hide either intentionally or – more likely – because of gaps in the surveillance system and the difficulty of uncovering what was happening in the many shadow zones.

Community resistance to an extreme: mobs and murders

Community resistance has been a major barrier to control in all three countries but took on extreme dimensions in Guinea.

The first recorded incident occurred on 4 April, when an angry mob attacked an MSF treatment facility in Macenta, claiming that staff had introduced the disease into the community. Fear spread faster than the virus. In early June, when an MSF emergency coordinator reported a resurgence of Ebola in West Africa, she attributed the rise in cases to community resistance and the challenges of conducting cross-border contact tracing.

By mid-June, incidents of violence against response teams were being reported in communities across the country. In some incidents, response teams were forced to hide in the bush, fearing for their lives. Facilities, equipment, and vehicles were vandalized. Some riots followed disinfection campaigns, as communities believed that the spraying of chlorine was actually disseminating contagion, not stopping it. That impression was further enforced by the fact that spray teams wore equipment that protected themselves from head to toe. People in other communities believed that foreign teams were causing deaths in order to harvest organs.

In the worst incident of violence, an 8-member team of outbreak responders was found murdered in a village on 18 September. A second severe incident followed on 23 September, when Red Cross volunteers who had safely buried a body in the town of Forecariah were attacked by an armed mob. They seriously injured two volunteers, uncovered the grave, removed the highly infectious corpse from its body bag, and hid it somewhere in the village.

At that time, Forecariah, a mining town in western Guinea, had a case fatality rate among Ebola patients of at least 80% and had experienced a serious incident of spread among patients and staff in a large regional hospital. Moreover, cases in this hotspot had established two chains of transmission in Conakry and a third in Sierra Leone.

As the mob in Forecariah grew to more than 3,000 heavily armed youths, the focus of anger shifted to a WHO-led team of epidemiologists. They fled for their lives.

Meanwhile, all equipment and vehicles at the treatment centre were either stolen or

meanwhile, all equipment and vehicles at the treatment centre were either stolen or vandalized by the mob. Weeks of persistent and effective efforts to slow the outbreak down were undone on that day. As the event also underscored, working with patients infected by a deadly and highly contagious virus was not the only life-threatening risk faced by outbreak responders.

Why community resistance persists

Many analysts have attempted to explain why community resistance is persisting in parts of all three severely affected countries.

Traditional belief systems that attribute adverse events, including diseases, to non-medical causes having magical or mystical dimensions, such as a curse or a payback for past sins, have been important factors in some areas.

A December report from the Assessment Capacities Project, or ACAPS, which assesses humanitarian needs, cited ignorance among a cohort of young adults, including some former child soldiers, who received little or no education during the years of civil war and unrest that disrupted progress in all three countries.

Still others look to shortcomings in the response, including delays – sometimes for days – in answering calls for an ambulance or burial team, especially in remote areas in Guinea. In Liberia and Sierra Leone, bodies were left on city streets; some communities waited more than a week for burial teams to arrive. Such failures undermine community trust in the response effort.

Lack of logistical support further fed this community resistance and unwillingness to cooperate with response teams. In parts of Guinea, for example, bad road conditions, lack of properly maintained vehicles and fuel, and fear on the part of ambulance crews have meant that patients may need to undergo an ambulance ride of 8 to 10 hours, sometimes with no food or water, to reach a treatment centre. Many died along the way. Relatives were understandably reluctant to submit loved ones to such an ordeal.

Different challenges in urban and rural areas

The outbreak in Guinea also demonstrated the different challenges faced in rural and urban areas. Whereas health services are more accessible in cities, contact tracing is harder and requires more staff given the numerous opportunities for close contact to occur.

In rural areas, the two biggest problems have been community resistance to safe burials and refusal to cooperate with contact tracing teams. As anthropologists learned, contact tracing was impeded by public interpretations of contact lists as “death” lists indicating who would be next to die. Again, people were understandably reluctant to add the names of a spouse, child, or neighbour to such lists, fearing that doing so condemned them to die.

The outbreak in Guinea further revealed the consequences of both the area’s exceptionally high population mobility and the cyclical pattern of a decline in new cases, followed by a return to intense transmission. When cases in Guinea declined, ill people from neighbouring countries with no available treatment beds flocked to the country seeking treatment after hearing stories that the outbreak there was under control. In all three countries, cross-border movements, especially of patients seeking treatment beds, introduced new chains of transmission, sometimes re-infecting areas that had been coming under control.

Plans versus the realities on the ground

As in Liberia and Sierra Leone, efforts to bring Guinea’s outbreak under control faced multiple barriers, including logistical problems linked to the country’s weak public health infrastructures.

The construction and opening of badly needed Ebola treatment centres took longer than planned. At least 20 of 40 planned treatment centres were operational

than planned. At year end, only 5 of 10 planned treatment centres were operational, leaving far too many patients without a treatment option.

For a long time, the country had only two treatment centres, in Conakry and Gueckedou, both run by MSF. In mid-November, a treatment centre opened in Macenta, run by the French Red Cross. In December, another centre became operational in Nzerekore, run by Alima, a French aid agency. Construction of a fifth centre, in Kankan, to be run by MSF, is nearing completion.

Likewise, plans to construct 62 community transit centres, where suspected patients could be held pending the results of diagnostic tests, were delayed as funding was available to construct and run only 10 of these centres.

WHO's 31 December situation report singled out community resistance to response measures and an exceptionally mobile population as two major barriers to outbreak containment. To counter resistance to control measures, the concept of village "watch committees" had been put forward as a way to engage community leaders and secure public cooperation in case detection, contact tracing, and safe burials. Again, at year end, only half of planned committees were established and functioning.

Case management in several prefectures was impaired by a shortage of vehicles, lack of fuel, and poor road conditions which slowed the transportation of samples to laboratories and of patients to treatment or transit centres. For example, in the Siguiri area near the border with Mali, only one ambulance was available to transport patients and samples to facilities in Gueckedou, a distance which takes a day-long drive over rough roads each way. WHO secured a second ambulance, but transportation capacity still fell well below the need. Every delay that leaves a potentially infectious person in the community feeds opportunities for further virus transmission.

Continuing infections in health care workers

The continuing high number of newly infected health care workers in West Africa's outbreaks is unprecedented. In previous Ebola outbreaks in equatorial Africa, infections among health care workers rapidly diminished soon after the causative agent was identified and measures for infection prevention and control were introduced. In contrast, the concluding months of 2014 saw a surge of infections in doctors and nurses in all three countries.

Of the total of 153 infected health care workers in Guinea, of whom 90 died, 60 national staff became infected from the start of October to end-December, representing nearly 40% of the total.

Initial investigations indicate that most of these recent infections occurred in non-Ebola health care facilities, both privately run and government funded. Insufficient supplies of personal protective equipment in these facilities may help explain the continuing high level of infections in health care workers. As long as case detection and contact tracing remain weak, the risk is high that patients receiving health services for other conditions, including such high-risk events as childbirth, may be infected with Ebola yet not diagnosed.

Finally, all three outbreaks have demonstrated the dangers of using growth in GDP as the sole measure of a nation's socioeconomic progress as it conceals vast social inequalities and hides the vulnerability to national security created by large numbers of desperately poor populations. The economies in all three countries were on the upswing following years of civil war and unrest, yet crumbled under the severe shock delivered by Ebola.

Supportive care reduces case fatality

As the outbreak in Guinea evolved, evidence emerged that good supportive care saves lives. Following confirmation of the outbreak in March, WHO deployed clinicians to Conakry to treat the first patients there. A retrospective clinical study,

coordinated by WHO, examined data on 37 laboratory-confirmed cases treated at a hospital during the first month of the outbreak. Fourteen of the patients were health care workers, and 12 of them acquired their infection in a health care setting. These figures demonstrate the role that hospitals can play in amplifying transmission once cases begin occurring in an urban setting.

[Clinical presentation of patients with Ebola virus disease in Conakry, Guinea](#) 
N Engl J Med 2015; 372:40-47 January 1, 2015

The study benefitted from careful and thorough daily data collection, laboratory records, and case histories compiled by clinicians from the Ministry of Health, MSF, and WHO. To replace fluids lost through severe diarrhoea, 36 patients (97%) received oral rehydration solution. Additional intravenous fluid resuscitation was given to 28 (76%) patients. The case fatality rate, at 43%, was lower than that recorded at other outbreak sites, also in Guinea, and in previous outbreaks caused by the Zaire species of the Ebola virus.

Good supportive care, especially to correct substantial fluid loss from copious diarrhoea, is thought to have contributed to the larger number of survivors. However, two limitations compromised the quality of bedside care: staff were too few in number, and the duration of time spent providing care at the bedside was too short, as heat exposure and dehydration in staff wearing personal protective equipment limited the amount of time they could spend on the ward.

Despite these encouraging results, the case fatality rate in all three countries has remained high, at around 71%. As experiences during 2014 revealed, communities will not seek early testing and treatment – even when laboratory results are rapid and sufficient treatment beds are available – if they have no trust in the outbreak response. In Guinea, a WHO staff member who spent several months in the Forest Zone in the last quarter of the year noted a strong sense of resignation among residents: having lived with this deadly and poorly understood disease for so long, they see no end in sight and little reason for hope.

An upsurge in cases

By late November, Guinea was reporting more new cases, over a broader geographical area, than ever before. Areas that had been reporting no new cases were once again affected. In December, Forecariah again experienced an upsurge in the number of cases, as did the capital, Conakry, and the Dubreka prefecture, north of the capital. Newly affected areas included villages near the borders with Mali and Cote d'Ivoire, increasing the risk that more cases would be exported across exceptionally porous borders. In early December, Telimele reported its first new cases since June.

These areas of resurgence point to the need to tailor responses to the situation in individual prefectures and sub-prefectures. They also call for the deployment of staff and the channelling of funds from the central to the local level.

Control efforts continued to face a high level of community resistance, especially to contact tracing and safe burials. In early December, the opening of a new 50-bed treatment centre in Conakry was initially delayed by a rioting mob. Geographical expansion of the outbreak continued as December progressed. WHO epidemiologists estimated that more cases in recognized hot spots likely meant more cases elsewhere, given the increase in population movements with the start of the dry season.

To date, Conakry has not witnessed, on a large scale, the horrific scenes that unfolded in Monrovia in September and in Freetown in November and December – of uncollected bodies on the streets, patients dying on the grounds of overflowing treatment facilities, and orphans shunned by the community and left to die. However, the country's sheer geographical size, coupled with the persistence of extreme and often violent community resistance, continue to impede control efforts.

Whereas only 7 prefectures reported cases in October, that number had grown to 17 by mid-December. During the third week in December, Guinea reported 156 confirmed cases, the highest weekly case incidence recorded during the year-long outbreak.

On 31 December, WHO recorded 25 sub-prefectures where response efforts encountered community resistance. These sub-prefectures are located in prefectures adjacent to Conakry (Dubreka, Forecariah, Coyah and Kindia), in the Forest Region (Bela, Kissidougou, Gueckedou, Lola, Macenta, Nzerekore), in Upper Guinea (Dabola), and in Western Guinea (Telimele and Labe).

At year end, it looked like Guinea – where the outbreak started, simmered, and then resurged time and time again, nationwide and in individual areas – could present an especially hard challenge in bringing the Ebola epidemic under control.

– [Story from the field: The Guinean town that overcame Ebola](#)

Liberia: a country – and its capital – are overwhelmed with Ebola cases

One year into the Ebola epidemic. January 2015

When the virus entered Monrovia, the outbreak's calm start turned into an illusion.



WHO/P. Desloovere

CHAPTER 5 - Liberia's first two cases of Ebola, in the Foya district of Lofa county near the border with Guinea, were confirmed on 30 March 2014. On 2 April, an infected traveller from Lofa passed through Monrovia, the country's capital, but was not known to have transmitted the virus to others.

On 7 April, the country reported 21 confirmed, probable, and suspected cases and 10 deaths. All five laboratory-confirmed cases died, including one in Monrovia. In a pattern that would become a striking feature of the outbreak, those numbers included three cases in health care workers, all fatal.

The situation in Liberia then stabilized throughout the rest of April and most of May, with cases still largely concentrated in Lofa county. For weeks on end, WHO's Disease Outbreak News about the Ebola situation in West Africa reported "no new confirmed cases in Liberia" or described the situation as "stable". By the end of May, Liberia had reported no new cases since 9 April.

Further cases were detected in early June, mainly in Lofa county, but the trend still looked calm, especially when compared with the situation elsewhere. At the end of June, Liberia reported 51 cases, compared with 390 in Guinea and 158 in Sierra Leone.

Monrovia turns a calm start into an illusion

That appearance of calm turned out to be an illusion. The first additional cases in Monrovia were reported in mid-June. The city was ill-prepared to cope with the onslaught of infections that rapidly followed.

Monrovia was home to the country's only large referral hospital, the John F Kennedy Medical Center, but that facility had been heavily damaged during the civil war and never fully repaired. Frequent floods and electrical fires were hazards for patients and staff alike. Several prominent doctors working there became infected and died

"This morning, I went into my community, searched house to house and interviewed a few people. It is something I love to do because it will save my community."

Robbin George, student, an active Ebola case finder

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working there became infected and died.

By the end of September, Liberia would have the highest number of infections in health care workers – at nearly 200 – among the three countries.

No hospital anywhere in the country had an isolation ward. Few medical staff had been trained in the basic principles of infection prevention and control. Facilities had little or no personal protective equipment – not even gloves – and virtually no knowledge about how to use this equipment properly.

Under such conditions, treatment of the first hospitalized patients ignited multiple chains of transmission, among staff, patients, and visitors, in ambulance and taxi drivers who ferried the sick to care, in relatives, neighbours, and eventually entire neighbourhoods. Case numbers that had multiplied quickly began to grow exponentially.

On 6 August, President Sirleaf declared a three-month state of emergency and announced a string of new regulations, which included the closing of markets, curfews, and restrictions on the movement of patients and their contacts, to be enforced by the country's military. In her view, such restrictions were justified as the disease threatened to undermine the nation's "economic and social fabric".

In August, Liberia made the cremation of people who died from Ebola mandatory in Monrovia. That decree followed the refusal of several Monrovia neighbourhoods to allow burials near their homes, leaving hundreds of highly infectious bodies unattended.

A WHO emergency team begins its investigation

In mid-August, a WHO team of emergency experts, working alongside staff from the Ministry of Health and other key partners, began a three-week long investigation of the situation in Liberia. That investigation revealed that an outbreak had been simmering in the country for at least several weeks before the first cases in Monrovia were detected, giving the virus a huge head-start on control measures.

All agreed that the demands of the Ebola outbreak had outstripped the government's and partners' capacity to respond. By that time, 14 of the country's 15 counties had reported confirmed cases. Some 152 health care workers had been infected and 79 of them had died, representing a significant loss of talented and dedicated doctors and nurses at a time of immense need.

By 8 September, Liberia had the highest cumulative number of reported cases, reaching nearly two thousand cases and more than one thousand deaths.

In Monrovia, bed capacity could not keep up with the growing number of very ill Ebola patients. New treatment centres were opened by MSF and others, but were rapidly filled to overflowing. The WHO team estimated that 1000 beds were needed just for the treatment of currently infected patients. Only 240 beds were available. Although another 260 beds were planned, the shortage meant that only around half of patients could be admitted to treatment facilities over the next several weeks and months.

One treatment facility, quickly set up by WHO at the Ministry of Health's request, was equipped and staffed to manage 30 patients but had 70 as soon as it opened.

At the end of August, the government quarantined the city's West Point slum, home to at least 75,000 people crowded together under unsanitary conditions, as part of efforts to slow the explosive spread. Violence broke out and one teenager was killed as armed forces struggled to contain the event.

Overwhelmed by a runaway virus

As the first week of September ended, data indicated that that exponential growth of cases had overwhelmed response capacity in the capital city. Taxis filled with entire families, of whom some members were almost certainly infected with Ebola, constantly crisscrossed and circled the city, searching for a treatment bed. They

found none. MSF announced that its facilities were overstretched and began to turn patients away.

WHO sent one of its most experienced emergency responders to Monrovia to head its office there. More logisticians arrived from Geneva to address urgent material needs, while field epidemiologists were deployed to undertake case finding and contact tracing. Nonetheless, the outbreak still ran ahead of all these stepped-up efforts.

The lack of adequate numbers of treatment beds provided the most dramatic evidence of a runaway virus. It also jeopardized key control measures, such as the isolation of confirmed and suspected cases, and ensured that the virus would continue to race through families and neighbourhoods. The country's President pushed partners hard to build more treatment centres.

In September, WHO began construction of a new treatment centre in Monrovia, using teams of 100 construction workers labouring in round-the-clock shifts. On 21 September, the Island Clinic was formally handed over by WHO to Liberia's Ministry of Health. The clinic added 150 Ebola treatment beds to the city's existing 240 beds. However, within 24 hours after opening, the clinic was overflowing with patients, again demonstrating the desperate need for more treatment beds.

Epidemiological trends were difficult to assess. Accurate monitoring of the situation suffered from the weak surveillance and reporting systems in place prior to the start of the outbreak. The onslaught of cases strained those mechanisms further. At times, the overwhelmed systems were unable to confirm or discard probable and suspected cases, as laboratory backlogs delayed testing and confirmation of positive cases – sometimes for weeks.

The first drop in cases: a model of success

The first encouraging trend was detected during the last days of September, when reports of new cases in Lofa County, the initial epicentre of intense transmission, began showing an apparent decline. WHO watched that encouraging trend with hope but also caution, given the well-known problems with under-reporting.

By the end of October, WHO could conclude that the decline of cases in Lofa was persistent, consistent, and likely real. The trickle of cases then dried up in November, with no new cases reported for four consecutive weeks. Confidence that Lofa had indeed beaten back the virus increased throughout December. No new cases were reported.

In one of the most encouraging investigations in all three countries during 2014, WHO was able to find a direct link between implementation of the full package of control interventions, including community engagement, acceptance, and ownership of the response, and the decline and then end of new cases. Those findings were all the more impressive given Lofa's proximity to Guinea, where transmission was still ongoing and intense.

The situation in Lofa underscored the value of stratifying the response to this extremely complex and challenging outbreak to meet the unique context and challenges at the district level in all affected countries. This was not an epidemic with three different national patterns, but likely hundreds of distinct patterns, with their own transmission dynamics, playing out within individual districts and sub-districts.

Fortunately, that observation coincided with better reporting at the district level as WHO deployed more experienced epidemiologists to the field. The US CDC likewise sent more staff to help correct deficiencies in the surveillance and reporting systems.

Support escalates in Monrovia

At the start of October, WHO estimated that 1,500 treatment beds were needed in addition to those already in place or planned. Support escalated, as commitments,

made by the US government and others following the September emergency meeting of the UN Security Council on Ebola, began to materialize. Two US Navy mobile laboratories arrived and began processing samples in Bong and Monrovia on 5 October.

More treatment facilities were built by US military personnel. They used WHO master plans for a treatment centre that strictly separated "hot" and "safe" zones, allowed no contaminated wastes to leave the patient ward, and provided space for safe triage. Safe triage reduced the risk that people suffering from another illness or entirely healthy contacts would be placed near confirmed cases, increasing the risk of infection.

The number of trained and supervised staff conducting case finding and contact tracing, and the daily monitoring of contacts increased considerably in Monrovia, but was still insufficient elsewhere in the country. Laboratory capacity improved, but WHO concerns about the quality of data and the under-reporting of cases continued.

The first signals that the situation in Monrovia had stabilized began in late October, with a slow decline detected in the early weeks of November. As a precaution, WHO staff conducted a study of data collected from funeral homes, crematoria, and coffin makers to assess the likelihood that hidden burials might account for the decline in reported mortality. The results of that study supported the conclusion that the decline in cases and deaths in Monrovia was real and robust. In mid-November, the government set a target of no new Ebola cases by 25 December.

As the year concluded, the main risks in Liberia were two-fold: complacency as a traumatized population began to feel safe and vigilance relaxed, and the move of the virus from cities to remote rural areas.

Exchanging one set of problems for another?

During the second week of December, only 6 of the country's 15 counties reported new cases. That situation contrasted sharply with the one reported by WHO on 22 October, when all counties had recorded at least one case and Monrovia was reporting more than 300 new cases each week.

During late November and early December, rural outbreaks were seeded as people who had been working in the cities returned to their rural homes, sometimes to die. By mid-December, the virus had largely moved from cities to remote rural areas that lie well beyond the places where the road system ends.

Apart from continuing – though declining – cases in Monrovia, the districts of greatest concern included Grand Bassa, Bong, Grand Cape Mount, and Margibi. In a Ping-Pong effect, the genuine successes recorded in Monrovia and Lofa risked coming unravelling: travellers from affected rural areas could re-ignite infections in the cities. Based on available evidence, WHO viewed that risk as greater than the risk that new cases would be imported, especially from Sierra Leone.

Given the very different challenges seen in urban and rural areas, the virus' retreat from the cities might turn out to mean that one set of problems has been exchanged for another. As experience has shown, especially in Guinea, areas that come under control remain at risk of re-infection as long as virus circulation continues anywhere in the country or its neighbours.

In Grand Bassa and Grand Cape Mount, health officials struggled to cope with almost no staff properly trained in case detection, patient management, contact tracing, and the safe collection of patient samples. Personal protective equipment was in short supply, as were essential medicines. Almost no villages had ambulances or trained ambulance crews and burial teams. The few vehicles available were poorly maintained and fuel was scarce.

These problems were vastly amplified by the absence of transportation and telecommunications networks. Some villages can be reached only after an eight-hour

hike across rough terrain. Prompt reporting of cases and responses to calls for help have been further impaired by patchy and sporadic telecommunication services. Health staff in these remote counties were lucky to have brief internet access once or twice per week.

In yet another complication, patients in rural areas did not want to be sent for treatment to Monrovia, where abundant beds were available, as they knew that bodies in the capital city would be cremated, in line with the President's August decree. In Liberia, "Decoration Days" – holidays when the graves of relatives are cleaned and decorated – are a deep-seated cultural tradition.

At year-end, Liberia had 10 beds available for each Ebola patient in Monrovia, but faced an urgent need to shift this capacity to rural areas. As experience has shown, moving testing and treatment facilities closer to where cases are occurring is a far better strategy than moving patients, often over long distances, to treatment facilities. Such movements are hard on patients, poorly accepted by families, and fraught with risks of further transmission en route.

WHO has shifted its strategy to the use of rapid response teams sent to rural areas. In the best-case scenario, these teams will catch flare-ups early enough to stamp them out – before entire villages are paralyzed by illness and deaths and the virus inevitably spreads to new areas. However, the difficulty of reaching these remote areas and the absence of so many essential services, personnel, vehicles, and other material support work against the kind of speed that is so badly needed.

Getting an upper hand on the virus?

As the year concluded, four important lessons could be drawn from Liberia's experiences with the Ebola virus.

First, Lofa county, which reported no new cases since early November, demonstrated the feasibility of "bending the curve" and defeating the virus – even in heavily affected areas with intense transmission.

Second, intensification of technical interventions, like increased laboratory capacity, more treatment beds, and a larger number of contact tracing and burial teams, will not bend the curve in the absence of community engagement and ownership.

Third, with the right support, a country can permanently improve its capacity to collect and report health-related data, even under the demanding pressures of a severe outbreak. At year-end, laboratory capacity had improved, in less than three months, to the point where all probable and suspected cases were being tested, with the results promptly reported.

Finally, strong, hands-on, and frequently courageous support from the country's President helped match the severity of the disease with forceful – though sometimes controversial – control measures. President Sirleaf also undertook numerous field visits to severely affected areas to show citizens the level of her engagement and concern.

This leadership helped coordinate the activities of a large number of partners, including US government agencies and military personnel, supporting the response effort.

A Presidential Task Force on the Ebola response, which brought partners and donors together with senior government officials and civil society leaders, was established on 26 July and functioned through the end of September, when it was replaced by a Presidential Advisory Committee on Ebola, or PACE, again chaired by the President. Additional task forces operated in each county to tailor the response to local needs and keep partners working in tandem.

In a worrisome trend, six health care workers were infected nationwide during the first week of December, of whom three died. An investigation was launched to determine

how staff were getting infected and what additional protective measures were needed.

At year-end, despite imperfections in the surveillance and reporting systems, evidence indicated that Liberia – which long showed the most explosive transmission – was getting an upper hand on the virus.

Stories from Liberia

- [Local students become active Ebola case finders](#)
- [Working with communities is the key to stopping Ebola](#)
- [Austin Jallah, an Ebola survivor, sharing his experience fighting the disease](#)
- [New Ebola mobile lab speeds up diagnosis and improves care](#)

Sierra Leone: A slow start to an outbreak that eventually outpaced all others

One year into the Ebola epidemic. January 2015

The funeral of a faith healer ignited an outbreak characterized by innovative response measures, including the Western Area Surge that began in mid-December 2014.



WHO/IC: Black

CHAPTER 6 - In Sierra Leone, the outbreak began slowly and silently, gradually building up to a burst of cases in late May and early June. Cases then increased exponentially in the last quarter of the year, with November seeing the most dramatic jump.

A retrospective investigation by WHO revealed that the country's first case was a woman who was a guest at the home of the index case in Meliandou, Guinea. When the host family became ill, she travelled back to her home in Sierra Leone and died there shortly after her return in early January. However, that death was neither investigated nor reported at the time.

On 1 April the country stepped up vigilance for imported cases when two members of the same family who had died from Ebola virus disease in Guinea were repatriated to Sierra Leone for burial. Though heightened vigilance yielded a number of suspected cases, all tested negative.

Death of a faith healer: the first two hot spots in Kailahun and Kenema

The burst of new cases seen in early June has been traced to the 10 May funeral of a respected traditional healer held in Sokoma, a remote village in Kailahun district, near the border with Guinea. The healer became infected while treating Ebola patients who crossed the border from Guinea, seeking her healing powers.

That funeral sparked a chain reaction of more cases, more deaths, more funerals, and more cases in multiple transmission chains. Local epidemiologists eventually traced 365 Ebola-related deaths to that single funeral, which also seeded cases reported in Liberia.

On 12 June, a state of emergency was

"This is a medical war my country is fighting and I believe that the only way to stop this disease is for us, health practitioners, to come on board. We need to identify all sick

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On 12 June, a state of emergency was declared in Kailahun, calling for the closing of schools, cinemas, and places for night-time gatherings and the screening of vehicles at checkpoints along the borders with Guinea and Liberia.

people and take them out of the community as soon as possible."

Stephen Kamara, medical student

Kailahun and, to its south, the larger city of Kenema, formed the early epicentre of the outbreak. WHO and other partners concentrated their response teams in that area.

Kenema benefitted from a laboratory and ageing isolation ward set up to manage cases of Lassa fever. That laboratory diagnosed the city's first Ebola cases, but the poorly-maintained isolation ward was soon overwhelmed with Ebola patients and services collapsed.

At Kenema's government-run hospital, two wards were converted to serve as an Ebola-designated treatment facility. Unfortunately, eight nurses working there became infected in July, adding to the problem of finding sufficient staff willing to work under life-threatening conditions. As the year progressed, that number grew to more than 40 deaths among doctors and nurses at the single district hospital, dealing a huge blow to the country's already overstretched health system.

On 24 June, MSF opened an Ebola treatment centre in Kailahun. As an emergency coordinator with the charity noted, "We came too late when villages already had dozens of cases. We don't know where all chains of transmission are taking place." By mid-July, so many people were dying of the disease that teams trained by WHO buried more than 50 bodies over a 12-day period.

The MSF 50-bed treatment centre in Kailahun managed more than 90 confirmed cases in the first four weeks after it opened. To meet diagnostic needs, WHO helped establish a mobile laboratory provided by Public Health Canada. However, the number of new cases continued to outstrip both treatment and laboratory capacity.

In both Kailahun and Kenema, the greatest need was for more treatment facilities backed by greater and faster laboratory support. Pending the availability of those facilities, WHO worked, in collaboration with UNFPA, to reduce the number of new cases by training and equipping hundreds of local volunteers to search for cases, use mobile phones to send alerts to health authorities, and conduct contact tracing.

However, a shortage of experienced staff meant that much of this work was not supervised. In particular, the quality of contact tracing suffered. Too many people with a history of high-risk exposure were missed, cases were not detected and managed early, and chains of transmission continued to multiply.

In July, partners working in Kenema and Kailahun agreed that containment would require an enormous and robust scaling up of response capacity. Much stronger basic health infrastructures had to be quickly put in place and made to function well. As the WHO emergency coordinator in Kailahun noted at that time, "We need to step up the response and we need to do it fast." Partners further recognized the need for far greater engagement of community leaders, especially paramount chiefs and religious leaders, to promote local acceptance of control interventions.

Death of a national hero: safety issues raised

Tragedy struck on 29 July, when Sheik Humarr Khan, the country's only expert on viral haemorrhagic fevers, who had been leading the Ebola response in Kenema, died of the disease at the treatment facility in Kailahun. The death of Dr Khan, who was regarded as a national hero, and surrounding publicity removed many public doubts about whether Ebola was "real", but it also introduced questions about the safety of the area's treatment facilities.

In August, WHO urged governments and the international community to make available in all these Ebola-affected countries innovative prevention and treatment

available, in all three Ebola-affected countries, incentives, protection, and treatment for health personnel to improve their safety and provide the motivation needed to ensure uninterrupted health care services.

Confidence in the safety of medical staff was further eroded in the last week of August when a WHO-deployed epidemiologist working in Kailahun became infected. Just a few days later, three staff at a hotel where foreign medical teams were staying became infected.

Following those events, most foreign medical staff, included those deployed by WHO, suspended operations in Kailahun. A team of logisticians and experts in infection prevention and control was deployed by WHO to investigate exactly how health care workers were being infected and to ensure working conditions were safe. Confidence was gradually restored and operations resumed in early September.

In Kenema, more evidence that capacities were overwhelmed came on 30 August, when health care workers at the government-run hospital went on strike over unpaid salaries and poor and dangerous working conditions. Nurses and burial teams complained that they had not been paid for several weeks, had insufficient personal protective equipment, and were forced to use a single broken stretcher to transport bodies as well as patients. WHO made arrangements to pay their back salaries, but not enough could be immediately done to improve the safety of working conditions.

As the number of patients, doctors, and nurses dying at the Kenema government hospital continued to escalate, rumours grew that something other than a disease was responsible for the deaths. More deaths began occurring in the community as patients fled or avoided the hospital, again undermining the effectiveness of treatment in isolation as a control measure.

The "Kenema tent": isolation in reverse

Residents of villages near Kenema witnessed how quickly the virus could sweep through crowded households, but saw few alternatives to home care. Weak response capacity meant that people with suspected Ebola were often not moved to a treatment centre until positive test results became available, which could take up to four days. By that time, many more in the household would be infected. Spread within households, where five to six children might share the same mattress, was ruthlessly swift.

In discussions with village leaders, the WHO field coordinator in Kenema learned that what people wanted was a place where uninfected members of a household could go to "self-isolate". They wanted a low-risk environment to stay in while waiting for the results of diagnostic tests. They had observed the high risk of being infected when people were trapped in a quarantined and crowded household with at least one confirmed Ebola case. The idea of providing a tent, offering sufficient space to keep a safe distance from others, was born.

The WHO office in Freetown provided the first tent. The International Federation of Red Cross and Red Crescent Societies supplied others, while UNICEF took care of sleeping mats, bednets, and cooking equipment.

This community-initiated innovation proved popular and effective. In the village of Mondema, for example, household contacts of confirmed cases able to self-isolate in the tents experienced no new cases. Though the impact on the overall outbreak was small, that innovation demonstrated one of the most important lessons to emerge during the first year: listen to the community. Communities know what they need. If that need is met in an acceptable way, it will be used.

Freetown: the new epicentre

The first confirmed case in Freetown was reported to WHO on 23 June. Cases in Freetown and the adjacent district of Port Loko initially rose slowly, with patients transferred to Kenema for treatment. Throughout July and August, Kailahun and Kenema remained the districts with the most intense virus transmission, and cases

there continued to occur at an alarming rate.

On 6 August, the President declared a national state of emergency, with quarantines, enforced by the military, imposed on the areas and households hardest hit. Also in August, the government passed a law imposing a jail sentence of up to two years on anyone found to be hiding a patient. At the end of that month, the country reported a cumulative total of 1,026 cases, compared with 648 in Guinea and 1,378 in Liberia.

But the real surge in cases began in September as the virus gained a foothold in Freetown. Teams were soon struggling to bury as many as 30 bodies per day. As the situation rapidly worsened, South Africa deployed a mobile laboratory to Freetown and work began to construct Ebola treatment centres, as Kenema's treatment capacity was quickly overwhelmed.

By the third week of September, the situation had begun to stabilize in Kailahun and Kenema, but Freetown, Port Loko, Bombali, and Tonkolili districts showed a sharp and alarming spike in a situation described by WHO as "continuing to deteriorate". Nationwide, WHO estimated that more than 530 additional treatment beds were needed.

The biggest challenges in the densely populated capital were limited treatment and diagnostic facilities and the difficulty of undertaking contact tracing. In parts of Freetown, as many as three families occupied the same household in shifts, increasing even further the risks of disease spread within these families.

In early October in Port Loko, no treatment beds were available in any health care facilities. At one health facility, nurses had no personal protective equipment, no food, and no rehydration fluid. WHO organized the transportation of suspected cases to treatment facilities and provided a supply of essential medicines and equipment, but these did not last long as cases continued to mount and the demand continued to overwhelm existing capacities.

By mid-October, WHO described virus transmission in Freetown and the western districts as "rampant", with more than 400 new suspected cases being reported each week. All administrative districts nationwide had reported at least one case. The impression of stability in Kailahun and Kenema was temporarily lost as cases once again began to rise.

In Freetown, the government and its partners recognized an increasingly urgent, almost desperate situation. On 21 October, the World Food Programme used its unparalleled logistical capacities, supported by funding from the World Bank, to airlift 20 ambulances and 10 mortuary pickup trucks to Freetown to support the government's efforts to shorten response times. An additional 44 vehicles followed a few weeks later by sea. This support was in addition to the delivery, by that date, of food to more than 300,000 Ebola-affected people nationwide.

Community care centres: invention born of necessity

Although the UK government and other partners were rapidly building new treatment centres, especially in Freetown and the adjacent western districts, inadequate bed capacity remained the outstanding problem for patients and their families. It was also a major problem for outbreak responders, as case detection and contact tracing have little impact in the absence of facilities where infectious patients can be removed from the community and safely treated. As field coordinators in all three countries noted, the different control measures were closely interlinked; the failure of one jeopardized the success of others.

Staff from the WHO country office worked closely with government officials, community leaders, and multiple partners active in the country to find immediate solutions that matched the emergency situation. Although a telephone hotline had been set up, those answering the calls had little to offer – not enough ambulances to collect suspected cases, too few treatment beds, and insufficient burial teams to collect all bodies promptly. People needed at least some form of treatment and care

close to their families and homes.

As a first step, WHO staff worked with four communities to construct safe isolation units with eight to twelve beds. These were not hospitals, but community care centres – facilities that could be quickly and flexibly set up in areas with the greatest unmet needs. Strong support from UNICEF and from the UK's Department for International Development made an immediate large-scale difference in the country's capacity to care for many more patients close to their homes. In this way, Sierra Leone became the pathfinder in establishing these centres and making them work.

WHO consulted experts in infection prevention and control to establish floor plans that provided space for patient triage and separated high-risk from low-risk areas. To staff them, also safely, WHO trained village volunteers and teams of local nurses in the basics of infection prevention and control and patient care. WHO was assisted in these tasks by medics from the country's armed forces. WHO also brought in ten experienced health care workers from Kenema, where cases had again declined to almost zero, to take on coordination and supervisory roles.

Though the level of care was not the same as in specialized treatment facilities, patients did receive essential first-line treatments delivered by trained staff – care that was far safer than that provided by family members in a home. The community care centres also responded to the reality of logistical constraints, including poor road systems and a shortage of ambulances to transport patients to distant facilities. Equally important, the centres allowed patients to stay near their homes. For families, low fences let them interact with patients from a safe distance, thus increasing the transparency of care and removing much anxiety about the fate of loved ones.

The Western Area Surge: listen to the community

In the first week of December, Sierra Leone surpassed Liberia as the country reporting the largest cumulative number of cases. The number of new cases reported that week, at nearly 400, was three times as many as in Guinea and Liberia combined. Though cases in Kailahun and Kenema had dwindled to only one or two each month, the country was still reporting new cases from 10 of its 14 districts.

As in Guinea and Liberia, the outbreak in Sierra Leone showed how quickly the dynamics of an outbreak could worsen once cases reached the capital cities. Freetown consistently accounted for around a third of the country's cases. Other areas experiencing intense transmission were the neighbouring districts of Port Loko and Western Rural and, in the eastern part of the country, Kono district on the border with Guinea.

Against this backdrop, the government responded with a massive Operation Western Area Surge initiative, which was launched in mid-December and ran through the end of the year. As the government explained to populations in and around Freetown, the strategy aimed at correcting past deficiencies in the response and regaining the public's confidence and cooperation, especially in the early reporting of cases.

Planning was meticulous. A malaria campaign, supported by the Bill and Melinda Gates Foundation, the UK government, MSF, and WHO, was conducted in targeted areas prior to launch of the surge. It involved distribution of antimalarial medicines, for preventive purposes, to tens of thousands of households in areas where fear of Ebola was causing people to avoid all contact with health services. Among infectious diseases, malaria is one of the biggest killers in Sierra Leone, especially of young children, and the campaign was well-received by the public.

On the technical side, preparations urgently increased bed and laboratory capacities, stepped-up the number of staff trained by WHO and CDC to undertake contact tracing, and made on-site assessments of treatment facilities to improve their safety for staff and patients alike. To support the anticipated surge in requests for testing, WHO added three strategically placed laboratories.

Considerable groundwork also reflected the lesson learned earlier: listen to the

Considerable groundwork also reflected the lesson learned earlier: listen to the community. Well-known religious and traditional leaders were consulted to get a sense of community concerns and expectations. Well-known entertainment personalities were recruited to communicate messages, emphasizing how early detection and treatment greatly improved the prospects of survival.

Thousands of community volunteers came forward for training. This time the government made sure that calls to the Ebola hotline would be answered, with callers referred to local people, local services, local help, and local success stories.

The results of the campaign will be analyzed in January 2015. In a 19 December report, the Ministry of Health and Sanitation could already record a surge in the number of suspected cases being tested in the Western Area. As WHO staff present in Freetown and Port Loko observed, the fundamental systems and capacities for a stepped up response were now in place. Full community cooperation, however, remained a problem and contact tracing suffered as a result.

At year end, that view was shared by the country's health officials, who noted that denial, traditional burials, and fear were still driving spread of the disease in Freetown and adjacent districts, where transmission remained intense.

The persistence of fear and denial was easy to understand. At the end of December, Sierra Leone – with its population of only 6.2 million – had recorded more than 9,000 cases of what all will agree is a terrible and terrifying disease.

Stories from Sierra Leone

- [How Kailahun district kicked Ebola out](#)
- [Communities organize Ebola response](#)
- [Western Area Surge combats Ebola pro-actively](#)

Key events in the WHO response to the Ebola outbreak

One year into the Ebola epidemic. January 2015

This account of the WHO response gives a timeline and explanation of actions taken, including why the outbreaks were declared an international public health emergency in August 2014.



WHO/N. Alexander

CHAPTER 7 - The first report on the Ebola outbreak in Guinea was published on 23 March on the website of WHO's Regional Office for Africa (AFRO). It described measures taken by the Ministry of Health, together with WHO and other partners, to control the outbreak and prevent further spread. Those measures included multidisciplinary teams deployed to the field to detect and manage cases and trace their contacts. As the report noted, "WHO and other partners are mobilizing and deploying additional experts to provide support to the Ministry."

WHO immediately mobilized its collaborating laboratory in Lyon, France, together with West African laboratories located in Donka, Guinea, Dakar, Senegal, and Kenema, Sierra Leone, to prepare for the diagnosis of more cases. MSF, which had a well-established presence in the region, rapidly set up isolation facilities.

The first team drawn from institutional partners in the WHO Global Outbreak Alert and Response Network, or GOARN, travelled to Guinea on 28 March. The team was headed by a senior WHO field epidemiologist. As a reporter covering early events in Guinea for *Vanity Fair* later noted, the international response was "rapid and comprehensive – exactly what you would hope."

Findings from the investigation were reported on 8 April during a Geneva press conference, where WHO officials alerted reporters to "one of the most challenging Ebola outbreaks that we have ever faced". The challenges observed included the wide geographical dispersion of cases in both Guinea and Liberia, cases in the capital city, Conakry, and a high level of public fear, anxiety, rumours, and misperceptions.

By mid-April, the cumulative totals in Guinea had risen to 168 cases and 108 deaths in six prefectures. More cases were being reported in Liberia, largely concentrated in Lofa county.

At a meeting jointly convened by the African Union and WHO on 16 April in Angola, WHO Regional Director for Africa, Dr Luis Sambo, summarized the situation as follows: "WHO has issued an alert on the importance of epidemiological surveillance, public information and biosafety measures including strengthening of the quality of support to laboratories. Although the epidemic is still rife, we are hopeful that it will be

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contained and overcome shortly and that we will be able to mitigate its adverse impact on human lives, travel, economies and international trade.”

Dr Sambo encouraged all health ministers “to strengthen their alert systems and implement the relevant provisions of the International Health Regulations.”

During the third week of April, WHO, in collaboration with GOARN partners, mobilized a new medical team of physicians with expertise in infection prevention and control and in intensive care to support clinicians at Donka Hospital, Guinea’s principal hospital, located in Conakry.

In that same week, Guinea reported 218 clinically compatible cases and 141 deaths. Liberia reported 35 clinically compatible cases. Symptom onset of Liberia’s first confirmed case was retrospectively dated back to 13 March. Sierra Leone was investigating 3 cases that might be either Ebola virus disease or Lassa fever, a disease endemic in large parts of West Africa.



By 5 May, WHO had deployed 112 experts to West Africa to assist in the response, including 68 experts deployed through its global surge mechanism, 10 external experts, and 33 international experts from GOARN partner institutions. Of these, 87 went to Guinea, 20 to Liberia, and 4 to AFRO. Although Sierra Leone had not yet reported a confirmed case, vigilance was high and one expert was sent to support surveillance efforts there.

The expertise among deployed staff had been broadened beyond the traditional areas of epidemiology, laboratory services, infection prevention and control, clinical case management, and logistics to include expertise in medical anthropology, risk communication, and social mobilization. The reason was clear: community resistance had joined inadequate treatment facilities and insufficient human resources as a major barrier to control.

WHO again expressed its heightened level of concern on 6 May, when it convened a high-level meeting in Conakry, attended by governmental health officials and staff from WHO headquarters and AFRO. The purpose of the meeting was twofold: to identify the most important weaknesses standing in the way of a stronger strategic response, and to define the precise support needed from WHO and other partners.

Very encouraging results

On 19 May, Guinea’s Minister of Health briefed the World Health Assembly on the Ebola situation in his country. He referred to field investigations that were “yielding very encouraging results”. As he reported, five of the country’s six foci of intense transmission were coming under control, with Gueckedou remaining the epicentre of transmission.

He credited much of this success to the permanent field presence of more than 70 WHO staff and the rapid deployment by WHO of two mobile laboratories. He also noted the need to combine efforts to control the outbreak with efforts to strengthen the country’s health system.

Later in May, Sierra Leone reported its first 16 cases and 5 deaths, all concentrated in Kailahun district. Within days, that number more than doubled.

By early June, it was clear that large and fluid population movements over exceptionally porous borders were interfering with control measures, most notably

contact tracing and monitoring during the 21-day incubation period. To address this problem, WHO introduced a system of cross-border surveillance in the designated “hot zone”, a triangle-shaped forested area where the borders of the three countries converged. Additional epidemiologists were sent to support that effort.

The sense of urgency increased on 23 June, when a second high-level meeting was held in Conakry. Participants included Guinea’s President, a special representative of AFRO’s Regional Director, the head of the WHO country office, the US Ambassador in Guinea, and staff from the US Centers for Disease Control and Prevention (CDC).

A call for WHO leadership

On that same day, a turning point occurred when the GOARN steering committee, which included several MSF staff, held a session to discuss the Ebola situation. Its members expressed a desire for WHO to lead the response more strongly as the only agency with the experience, seasoned senior staff, constitutional mandate, and country presence to do so. A message and report conveying the need for more forceful leadership were sent to Dr Chan on 27 June. She immediately took personal responsibility for the WHO response.

Among her first steps, she declared a level 3 emergency – the highest level – and set in motion plans to hold an urgent high-level ministerial meeting with senior health officials from African countries, partners, Ebola survivors, representatives of airline and mining companies and financial donors, including executives from the African Development Bank.

The broadened range of participants reflected yet another set of problems: the political dimensions of the outbreaks, the impact of restrictions on air travel and trade, fears that companies critically important to national economies might leave, and widespread public perceptions that Ebola virus disease was invariably fatal.

That meeting was held in Ghana from 2 to 3 July and resulted in both significant commitments of financial support and new strategies to accelerate the operational response. Key priorities identified included mobilizing community and religious leaders to improve Ebola awareness and understanding, as well as strengthening surveillance, case finding and contact tracing.

By that time, the areas of intense virus transmission were well known. Participants agreed to deploy additional staff to these areas and to commit additional country funding to the response. The meeting further recommended the establishment of a WHO sub-regional Ebola outbreak coordination centre in Conakry, which became operational on 25 July.

Also in early July, WHO issued the results of an analysis of the situation in the three countries and risk factors for the continuing spread of the disease. The main risk factors amplifying the outbreaks were identified as high-risk cultural practices and traditional beliefs, extensive population movements within countries and across borders, and inadequate coverage with effective containment measures. The magnitude of the task ahead was also recognized: the unprecedented expansion of the outbreaks demanded “enormous and robust response capacity and structures in terms of human capital, financial, operational and logistical requirements.”

Overwhelming demands

Some of these “enormous” needs were addressed in the third week of July, when WHO organized a conference with potential donors of financial and in-kind support. Dr Chan described the overwhelming demands created by the outbreaks and clearly stated that WHO, acting alone, could not meet all response needs for a disease of this scale and complexity.

In reviewing the situation, she noted that all three outbreaks were experiencing a second major wave of transmission, with a third wave of even more intense transmission expected to emerge soon. That wave arrived in September.

On 1 August, Dr Chan attended a meeting in Conakry where the presidents of the three countries had gathered to discuss what they increasingly believed was a public health emergency of unusual severity. In hours of face-to-face discussions with these leaders, she explained why WHO was so deeply concerned and stressed the need for them to take high-level responsibility for the response.

As she argued, WHO could provide technical guidance and scale up its material support but these measures could never substitute for decisive government action. She also spelled out the consequences of allowing the outbreaks to continue, including more bans on travel and trade, isolation from the international community, and severe shocks to their struggling economies.

The meeting resulted in a Joint Declaration of Heads of State and Government of the Mano River Union, which included Cote d'Ivoire as well as the three countries. Commitments set out in the Joint Declaration included the isolation of areas in the cross-border region by police and military forces, with material support provided to citizens in these areas.

The Declaration further recognized the need for international support to build capacity for surveillance, contact tracing, case management, and laboratory services. In parallel, WHO launched an appeal to donors for \$100 million needed to support its own plan for stepped up action in the three countries.

The emergency committee meets

On 20 July, an airline passenger from Liberia introduced the virus into Lagos, Nigeria, marking the first time that Ebola entered a new country via international air travel. His Ebola infection was confirmed on 23 July. That event rocked public health communities around the world, leading some to anticipate an "apocalyptic" urban outbreak. It also triggered urgent plans to organize an Emergency Committee to assess the Ebola situation under the provisions in the International Health Regulations. The committee met on 8 August.

The use of emergency committees was introduced in 2005 when the IHR were revised. The committee's job was to make a recommendation as to whether the event constituted a public health emergency of international concern and what "temporary recommendations" (a special term for official IHR advice) should be issued by Dr Chan to limit further spread of the disease.

The Emergency Committee was chaired by Dr Sam Zaramba, former Director-General of Health Services at Uganda's Ministry of Health, who played a leading role in responding to that country's large Ebola outbreak in 2000. He noted several serious challenges confronting the three countries: fragile health systems, lack of experience in dealing with Ebola virus disease, highly mobile populations, and wide-ranging public misperceptions about the disease and its modes of transmission. The experts further assessed the implications for control of active transmission in the three capital cities, the large number of infections and deaths among health care workers, and the likelihood that more cases would be exported.

The Committee reached unanimous agreement that the Ebola outbreaks constituted a public health emergency of international concern and transmitted that decision, together with its temporary recommendations, to the WHO Director-General. WHO declared the outbreaks a public health emergency of international concern on 9 August.

Such declarations, which are rare at WHO, are intended to alert all countries to the likelihood of further international spread. Given West Africa's mobile populations and porous borders, the outbreaks in Guinea, Liberia, and Sierra Leone behaved like a single epidemiological geography, with little indication of a potential to spread internationally beyond the area. That view changed when the air traveller from Liberia imported the virus into Lagos.

The IHR emergency committee mechanism was set up in 2005 for a second purpose: to ensure that a system of checks and balances was in place to protect against recommended measures, issued solely by the Director-General, that can have severe economic consequences for affected countries, as happened during the SARS outbreak of 2003. The emergency committee on Ebola that met in August recommended exit screening of people travelling from the affected countries, but took a strong position against trade and travel bans, which have no evidence of effectiveness in preventing further international spread. That recommendation was important given the number of travel bans and restrictions in place that were crippling the response and increasing the hardship faced by populations.

The declaration that the Ebola outbreaks constituted a public health emergency of international concern served these purposes, but it was neither the start of the WHO response nor the first warning by WHO to the international community about the severity of the situation, both of which had started months before. As noted previously, the first WHO-deployed GOARN team travelled to Guinea on 28 March. The team's findings led to stern warnings about the severity of the situation communicated on 8 April. From those early days on, WHO carried the lion's share of the burden for providing logistical as well as technical support.

The "Roadmap" is issued

On 27 August, WHO launched its "Roadmap" for responding to the epidemic, setting out strategies, categories of risk levels in countries, and time-bound objectives. Since then, the presence of WHO staff in the field has been considerably strengthened, with staff staying to work in areas of high transmission for two to three months to ensure that efforts, also among the many nongovernmental agencies contributing to the response, were coordinated and focused on the most urgent needs.

These staff worked shoulder-to-shoulder with national staff and community leaders in tasks ranging from the treatment of patients to the construction of facilities.

Growing international concern

On 2 September, Dr Chan travelled to Washington, DC and New York City to warn government agencies and health officials that cases were increasing exponentially as the unprecedented scale and complexity of the outbreak continued to escalate.

WHO Assistant Director-General for Global Health Security, Keiji Fukuda, who had just returned from West Africa, warned reporters at a 3 September briefing in Washington that WHO did not have "enough health workers, doctors, nurses, drivers, and contact tracers" to handle the increasing number of cases. As he added, "Most of the infections are happening in the community, and many people are unwilling to identify themselves as ill. And if they do, we don't have enough ambulances to transport them or beds to treat them yet," he said.

On 8 September, the US and UK governments announced plans to construct treatment centres in Liberia and Sierra Leone.

On 18 September, an emergency session of the United Nations Security Council was convened to assess the implications of the epidemic as a threat to international peace and security. The event marked the first time that a disease provoked an emergency session of the Security Council.

On that same day, the UN Secretary-General announced the first-ever UN public health mission, with the formation of the UN Mission for Emergency Ebola Response, or UNMEER. The objective was to greatly increase the scale and coordination of the international response and to facilitate its logistics. WHO welcomed the move, especially in view of the heavy logistical burdens that were impeding the response.

UNMEER quickly established an air bridge to facilitate the flow of staff and materials, including badly needed vehicles as well as essential medicines. In some areas, though, demand continued to outstrip supply, especially for kits of personal protective equipment. Even a small treatment centre needed hundreds of these kits per day.

Heightened international concern was accompanied by heightened preparedness measures in a large number of countries, especially after cases occurred in the US and Spain. That, too, placed a strain on limited supplies of critically important material support.

UNMEER also devised response plans for each of the three countries, modelled on the WHO Roadmap. Projections of precise needs, such as for treatment beds, foreign medical teams, and burial teams, helped channel the high-level of international concern into equally precise support, especially for the construction of new treatment centres.

However, the staffing of those centres with either national or foreign medical teams lagged behind. Given the unprecedented number of doctors and nurses infected during the outbreaks, many governments were reluctant to send their nationals into such high-risk environments, especially as state-of-the-art treatment for those who fell ill could not be guaranteed. Getting well-maintained vehicles and adequate fuel into remote areas of intense transmission also remained a pressing need.

A year-end commitment

Looking back at WHO's response, its Director-General said in Washington, DC on 17 December, "We will continue to work with the governments affected by the Ebola outbreak and with development partners in the international community, and international responders to get cases down to zero."

As she noted, sectors well beyond health had been affected in what had become a humanitarian, social, economic, and security crisis. She issued an urgent call for more field epidemiologists on the ground to undertake aggressive case identification and contact tracing. Above all, she stressed the need for all responders to recognize the importance of community engagement. Without community engagement and cooperation, she noted, technical interventions were doomed to fail.

As the year ended, WHO had already started to work with the three most affected countries to support the rebuilding of resilient health systems based on primary health care. In the view of WHO, such systems needed built-in – not separate – capacity to do disease surveillance, to be able to detect early and respond early to outbreaks caused by any pathogen.

At the same time, countries needed systems designed to provide a suite of essential services, including maternal and child health care, immunizations, the prevention and treatment of endemic infectious diseases, like HIV, TB, and malaria, and management of the rising problem of chronic noncommunicable diseases.

If vulnerable countries were supported in doing both – that is, strengthening primary health care together with essential capacities to detect and respond to health emergencies – they would gain greater social stability and resilience to withstand shocks, also from a changing climate, as well as better health. As she had stated before, "Universal health coverage is one of the most powerful social equalizers among all policy options."

– [WHO's contribution to the Ebola response](#)

– [Ebola response roadmap](#)

Modernizing the arsenal of control tools: Ebola vaccines

One year into the Ebola epidemic. January 2015

Accelerated work on new medical products for preventing, diagnosing, and treating Ebola virus disease shows how scientists and the pharmaceutical industry are compressing into a matter of months work that normally takes 2 to 4 years.

CHAPTER 9 - In mid-August 2014, the WHO response moved into a new phase aimed at quickly taking the steps needed to safely add experimental vaccines and therapies to the meagre arsenal of response tools. New tools were urgently needed to reduce the risk of infection, especially among health care workers, and get the high fatality rate, at 71% across all three countries, down. In stepping up these efforts, WHO drew on decades of collaboration with the pharmaceutical industry to make good quality medical products available, at affordable prices, in the developing world.



WHO/M. Missionheiro

The first step occurred on 11 August, when a group of experts convened by WHO reached consensus that the use of experimental vaccines and therapies under the exceptional circumstances of the Ebola epidemic was ethically acceptable.

That consensus opened the way for a large international consultation, convened by WHO from 4 to 5 September, to assess potential Ebola vaccines and therapies and prioritize the most promising products for further investigation. The experts also assessed the likely role of these experimental medical products in containing the outbreak and mapped out the most urgent next steps to take.

Two candidate vaccines move ahead

The next consultation, held from 29 to 30 September, brought together more than 70 experts from all regions of the world, including Africa, to assess the state-of-the-art of work to test and eventually license two candidate Ebola vaccines. The expertise among participants ranged from the virology of emerging infections, to regulatory requirements that must be met, to medical ethics and the clinical management of Ebola patients. Corporate executive officers and other officials from the pharmaceutical industry also presented their views.

The objective was to take stock of the many efforts currently under way to rapidly evaluate Ebola vaccines for safety and efficacy. The next step, if the vaccines are proven safe, is to make them available as soon as possible – and in sufficient quantities – to protect critical frontline workers and also, if possible, to make a difference in the epidemic's future evolution.

The consultation reached 11 conclusions that will shape how WHO, industry, and the scientific, medical, and public health communities take this work forward with the fastest possible speed. The ambition was clear: to give the African people and their health authorities the best product that the world's scientists, working collectively, can offer.

The timeframe was equally ambitious: to accomplish, within a matter of months, work that normally takes from two to four years. without compromising international

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standards for safety and efficacy. As was later recognized, the speed of work to develop, test, and license Ebola vaccines was historically unprecedented.

Vaccines: a significant impact on all scenarios

As the next step, a high-level emergency meeting was convened on 23 October at the request of several governments and representatives of the pharmaceutical industry to explore the many complex policy issues that surround eventual access to Ebola vaccines. More than 90 participants came on short notice to discuss ways to ensure the fair distribution and financing of these vaccines.

Again, a high sense of urgency was readily apparent as participants discussed plans for the different phases of clinical trials to be performed concurrently rather than consecutively, the formation of innovative partnerships to expedite clinical trials, and proposals for getting all partners moving in tandem at the same accelerated pace.

The meeting concluded that vaccines will have a significant impact on the further evolution of the epidemic in any scenario, from best-case to worst-case. All efforts to develop, test, and approve Ebola vaccines must be followed through to completion at the current accelerated pace, even if dramatic changes in the epidemic's transmission dynamics reduce the perceived need for vaccines.

Clinical trials have moved forward quickly to test for safety and immunogenicity. If all goes as planned, phase 2 efficacy trials of GlaxoSmithKline's vaccine could start during the second half of January 2015 in affected and neighbouring countries. While early results are encouraging, public expectations need to be carefully managed. Even if proven safe and effective, vaccines may confer only partial or short-term protection. A second booster dose, possibly with a different vaccine, may be needed to improve efficacy or prolong the duration of protection.

Depending on the results of efficacy trials, millions of doses of the Merck vaccine could be available in early 2015. As long as supplies are limited, experts agree that first priority should go to frontline health care workers, who have placed their lives at risk. The logistical demands are formidable. For example, both vaccines need to be stored at minus 80°C. The severe deterioration of health services and interruption of routine immunization programmes present further challenges. Finally, populations who have been suspicious of foreign medical teams and medicines may likewise be reluctant to accept new vaccines.

Convalescent blood therapies

Experimental therapies were also assessed by WHO. On 26 September, WHO issued a state-of-the-art report on experimental therapies, including convalescent blood therapies involving the transfusion of whole blood or plasma from recovered patients.

The first clinical trials of convalescent therapies began in Guinea and Liberia in December. WHO and its country offices have supported these trials, which required sophisticated blood machines that were rapidly moved through customs. Convalescent blood therapies were undertaken in Sierra Leone, but not in the context of clinical trials.

WHO has provided a system for blood typing of Ebola positive patient blood and coordinated the training of staff in safety procedures and personal protection. The training, equipment, and facilities needed to conduct these trials will upgrade country capacities to provide a safe and good-quality blood service to manage multiple diseases and emergencies, including blood transfusions needed during complications of childbirth and following accidents.

Drug therapies

On 11 November, WHO convened a meeting of its newly created Scientific and Technical Advisory Group on Ebola Experimental Interventions. The group reviewed clinical trial protocols and data for blood products and medicines. Based on test-tube

clinical trial protocols and data for these products and medicines. Based on test tube evidence of activity against the virus, a number of pre-existing medicines were evaluated for their possible use as drug therapies for Ebola.

In the view of the experts, only two of these – favipiravir and brincidofovir – demonstrated sufficient activity in non-human primates infected with the Ebola virus to warrant further investigation. Favipiravir entered clinical trials in early December in Guinea. Clinical evaluation of brincidofovir is planned to start in early 2015 in Liberia.

A new generation of diagnostic tests

As the goal of interrupting chains of Ebola virus transmission depends heavily on laboratory support, WHO has stimulated the development of rapid, safe, and reliable point-of-care diagnostic tests. Containment efforts have been slowed by cumbersome, time-consuming, and complex diagnostic tests that, while highly accurate, impose a number of additional logistical challenges, including transportation needs and requirements for a high level of laboratory biosafety and staff expertise in using sophisticated machines.

Delays in receiving test results are especially detrimental to outbreak control. Apart from posing a severe risk to families and communities, undiagnosed and unmanaged patients contribute to the cyclical transmission pattern currently being seen, whereby cases begin to fall as control measures take effect, only to spike again as new chains of transmission are ignited. The inability to get rapid diagnostic results can mean that uninfected people are placed together with confirmed cases in transit centres, where the risk of infection is high. Better diagnostic tests would make patient triage quicker, safer, and most efficient.

Equally important, a recent study of more than 700 Ebola patients treated in Monrovia strongly suggests that clinical decisions guided by results from rapid point-of-care diagnostic tests could significantly improve patient outcomes.

On 12 December, WHO, MSF, and the Foundation for Innovative New Diagnostics, or FIND, held a consultation to evaluate the status of new point-of-care diagnostic tests that can deliver results within 15 minutes to one hour. Manufacturers have submitted 19 diagnostics which are undergoing laboratory evaluations, coordinated by WHO, to validate claims about test performance and suitability for use in resource-constrained settings. No technical obstacles stand in the way of making these tests rapidly available. WHO has made arrangements to make patient samples available for use during performance evaluation.

Field trials of one of the most promising tests are expected to begin in February 2015 in either Sierra Leone or Guinea. Trials, which should take only two to four weeks, will look at ease of use, training requirements, and feasibility of implementation outside the environment of a high biosafety-level laboratory.

Rapid point-of-care-diagnostic tests will boost the Ebola response considerably, both now and later as the number of cases declines and the strategy shifts to detecting and breaking the last chains of transmission.

– [Questions and answers: Ebola vaccines, therapies, and diagnostics](#)

Classical Ebola virus disease in the Democratic Republic of Congo

One year into the Ebola epidemic. January 2015

In a typical pattern for equatorial Africa, the outbreak in DRC began on 24 August 2014, the last case was confirmed on 4 October, and the outbreak was declared over on 21 November 2014.



WHO DRC/Eugene Kabambi

CHAPTER 10 - On 24 August, health officials in the Democratic Republic of Congo notified WHO of an outbreak of Ebola virus disease in the Boende district, Equateur province, immediately raising fears that the outbreaks in West Africa had spread eastwards. The results of virological studies dissolved those fears. Though the DRC outbreak was also caused by Ebola Zaire, the lineage was most closely related to a virus from the country's 1995 Ebola outbreak in Kikwit. As the laboratory report concluded, "the virus in the Boende district is definitely not derived from the variant currently circulating in West Africa."

The outbreak in DRC followed a classical pattern, with the index case occurring in the pregnant wife of a bushmeat hunter. Subsequent spread was from person-to-person. The health workers who cared for her were among the first of 66 cases and 49 deaths recorded during the outbreak. The virus remain confined to the remote rural Boende district, located more than 1200 km from the capital Kinshasa and not connected by roads or other forms of easy transportation with other large cities or trade hubs. Motorcycles, canoes, and satellite phones were made available to facilitate outbreak investigation and contact tracing.

The country's seventh Ebola outbreak

This was the country's seventh Ebola outbreak and health officials knew what to do to contain the outbreak, despite a weak health system and a severe shortage of health care staff. The Minister of Health immediately travelled to Boende, together with the head of the WHO country office, to assess the situation, discuss control measures with local health officials, and demonstrate high-level of leadership and concern to the affected population.

"In DRC there was long experience with Ebola – this was the seventh outbreak of the disease here. The country had the knowledge and the people needed to stop an outbreak – plus strong technical assistance and support from WHO."

Dr Cabore, WHO Representative, DRC

A treatment centre was quickly constructed and a clearing was made that allowed a dedicated helicopter to land, bringing in supplies and carrying the first patient samples to a laboratory in Kinshasa. staffed

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and equipped to perform state-of-the-art genetic testing, with results delivered within hours. Installation of a mobile laboratory at the outbreak site allowed real-time reporting of test results, with quality control performed by a Canadian laboratory.

The country's President personally supervised the response, including the establishment of a national coordinating committee that met daily in Kinshasa. As another advantage, the health ministry could deploy epidemiologists who had gained experience during previous Ebola outbreaks. Past experiences also led the government to provide psychosocial support, provided by clinical psychologists and medical anthropologists, to affected patients and their families. A social mobilization campaign moved village-by-village to ensure that every household had a good supply of facts and disinfectants.

The classical control measures – case detection, isolation, contact tracing, and infection prevention and control, including safe burials – were applied and worked quickly and effectively. In addition, the Djera area was placed under quarantine, further limiting population movement.

The last case was confirmed on 4 October, just 41 days after the outbreak was notified. WHO formally declared the outbreak over on 21 November 2014.

– [Story from Democratic Republic of the Congo: The country that knows how to beat Ebola](#)

Successful Ebola responses in Nigeria, Senegal and Mali

One year into the Ebola epidemic. January 2015

At-risk countries had a distinct advantage by the summer of 2014: they had witnessed the devastation caused by Ebola and were on high alert to respond to an imported case as a national emergency.



WHO/A. Esiebo

CHAPTER 11 - Though no clinicians, laboratories, populations, or governments in West Africa had any experience with Ebola virus disease when the outbreaks started, at-risk countries had a distinct advantage by the summer of 2014. They had witnessed the tenacity of the virus, and the social and economic devastation it caused, and were on high alert to respond to an imported case as a national emergency. This high-level of alert characterized the responses in Nigeria, Senegal, and Mali and contributed to their success.

Nigeria

In an unprecedented event, the virus entered Lagos, Nigeria on 20 July in a symptomatic air traveller whose sister had just died from Ebola in Liberia. He vomited during the flight, on arrival and, yet again, in the car that drove him to a private hospital, where he told staff he had malaria. The protocol officer who escorted him later died of Ebola. As malaria is not transmitted from person to person, no staff at the hospital took protective precautions. Over the coming days, 9 doctors and nurses became infected and 4 of them died. No one who shared a flight with the index case developed the disease.

When confirmation of Ebola virus as the causative agent was announced on 23 July, the news rocked public health communities all around the world. No one believed that effective contact tracing could be undertaken in a chaotic and densely populated city like Lagos, with many poor people living in crowded slums and a population that swelled and ebbed every day as people came to the city looking for work or returned home when unsuccessful. Many envisioned an urban apocalypse, with Nigeria seeding outbreaks in several other countries, as had happened in the past with the poliovirus.

"The Ebola outbreaks and response in Nigeria and Senegal showed the world that the disease can be stopped if a country is adequately prepared from the outset. WHO is now working with all countries at-risk to help them meet the same standards for preparedness."

Isabelle Nuttall, Director, Global Capacities, Alert and Response, WHO

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The second shock came when a close contact of the index case entered the country's oil hub, Port Harcourt, on 1 August. A doctor who treated him developed symptoms on 10 August and died of Ebola on 23 August. An investigation undertaken by Nigerian and WHO epidemiologists revealed an alarming number of high-risk and very high-risk exposures for hundreds of people.

In both cities, all the ingredients for an explosion of new cases were in place. That explosion never happened, thanks to the country's strong leadership and effective coordination of an immediate and aggressive response. As in Senegal, an emergency operations centre was established, supported by the WHO country office. Also like Senegal, Nigeria had a first-rate virology laboratory, affiliated with the Lagos University Teaching Hospital, that was staffed and equipped to promptly diagnose a case of Ebola virus disease.

The government generously allocated funds and dispersed them quickly. Isolation facilities were built in both cities, as were designated Ebola treatment facilities. House-to-house information campaigns and messages on local radio stations, in local dialects, were used to ease public fears. Infrastructures and cutting-edge technologies in place for polio eradication, were repurposed to support the Ebola response, putting GPS systems to work for real-time contact tracing and daily mapping of transmission chains. Contact tracing reached 100% in Lagos and 99.8% in Port Harcourt.

In what WHO described as a "spectacular success story", the country held the number of cases to 19, with 7 deaths. World-class epidemiological detective work eventually linked all cases back to either direct or indirect contact with the air traveller from Liberia. WHO declared Liberia free of Ebola virus transmission on 20 October.

Senegal

The first case in Senegal was confirmed on 29 August in a young man who travelled to Dakar, by road, from his home in Guinea, where he had been in direct contact with an Ebola patient. Both the government and WHO treated that news as an emergency and responded accordingly. WHO despatched three senior epidemiologists with extensive frontline experience in containing some of history's largest Ebola outbreaks. These epidemiologists worked shoulder-to-shoulder with staff from the Ministry of Health, MSF, and CDC to undertake urgent and thorough contact tracing.

Dakar was in a fortunate position as it is home to a world-class Senegalese foundation, the Pasteur Institute and its laboratory, which is fully approved by WHO to test quickly and reliably for viral haemorrhagic fevers, including Ebola. In an important innovation, Senegal set up a separate centre devoted to emergency Ebola measures, thus freeing the health system to continue to deliver routine services. That measure, backed by massive public information campaigns, helped relieve public anxieties and encourage cooperation with control measures.

All contacts were monitored daily and those with symptoms were immediately tested. All test results were negative. No onward transmission occurred. The single case fully recovered. WHO declared Senegal free of virus transmission on 17 October, 42 days after the second test on that single patient came back negative.

Mali

When Mali confirmed its first case on 23 October, in a two-year-old child from Guinea who later died, the country had been on high alert for months. Mali experienced a dress-rehearsal for imported Ebola cases in early April, when six suspected cases were detected and placed under observation. An isolation facility in Bamako, designed for the management of Lassa fever patients, was repurposed to safely receive the suspected cases for close monitoring. Patient samples were tested at the CDC in Atlanta and the Pasteur Institute in Dakar. All test results were negative.

As in Senegal and Nigeria, the country moved quickly in what the government and WHO regarded as an emergency situation. The child, who was symptomatic upon

her arrival, and her family members had travelled extensively throughout the country using public transportation, also spending some hours with relatives in Bamako. Staff from WHO and other partners, already in the country to strengthen preparedness, shifted their work to support outbreak containment. Aggressive contact tracing was undertaken, with several close contacts monitored in a hospital setting. As in Senegal and Nigeria, the country could use its own high-quality laboratory facilities, in Bamako, that had been built, with support from the US National Institutes of Health, to safely handle hazardous samples from tuberculosis and HIV patients.

Days then weeks passed with no contacts showing symptoms. The country looked like it would pass through the event with a single case. Then, on 25 October, a Grand Imam from Siguiri prefecture in Guinea was admitted to Bamako's Pasteur Clinic with a diagnosis of acute kidney failure. He died on 27 October. That single hospital admission ignited a chain of transmission that eventually led to seven additional cases and five deaths, including a doctor and a nurse who had treated the Imam.

The country was well-rehearsed in the emergency measures that needed to be taken swiftly. Hundreds of contacts were identified and placed under daily surveillance. Isolation facilities and an Ebola-designated treatment centre were constructed. In response to public fears and misperceptions, an innovative telephone hotline was established and began receiving around 6,000 calls per day. All calls were meticulously recorded and analysed each day, with information on the caller's precise area of work or residence, occupation, and main concerns. Calls were then mined to uncover where public messages about the disease needed to be adjusted. Some callers reported suspected cases. All such reports were investigated. No further cases were identified.

Altogether, 433 contacts were identified and followed up for the 21-day incubation period. The last patient hospitalized in the Ebola treatment centre fully recovered and was released, following two negative tests, on 6 December. The last 13 contacts ended their monitoring period at midnight on 15 December. Vigilance remains high. If no further cases are detected, WHO will declare Mali free from active Ebola transmission on 18 January 2015.

Shared features of a successful response

The three countries shared a high level of vigilance that led to the rapid detection of an imported case and the rapid introduction of classical control measures. They also benefitted from government support at the highest level that treated the first case as a national emergency. Support from WHO epidemiologists at the start of the investigation was warmly welcomed.

All three countries had their own high-quality laboratories, facilitating the rapid detection or discarding of cases. Contact tracing was rigorous and most identified contacts were monitored in isolation. Local staff and existing infrastructures were used in innovative ways. For example, Mali used medical students with training in epidemiology to increase staff numbers for contact tracing. All three countries established emergency operations centres and recognized the critical importance of public information campaigns that encouraged community cooperation.

Stories from the field

- [Preparing to confront Ebola – just in case](#)
 - [WHO Director-General visits Mali to bolster UN support to the Ebola outbreak](#)
 - [Government of Senegal boosts Ebola awareness through SMS campaign](#)
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The importance of preparedness – everywhere

One year into the Ebola epidemic. January 2015

Although all cities with an international airport are theoretically at risk of an imported case, the need for preparedness is greatest in countries that share borders or have extensive travel and trade relations with the three hardest-hit countries.



WHO/J. Caminade

CHAPTER 12 - The successful experiences in Senegal, Nigeria, and Mali demonstrated the importance of preparedness and having the capacities in place to mount a rapid and comprehensive emergency response. Given the devastation caused by Ebola virus disease in Guinea, Liberia, and Sierra Leone, countries worldwide are on high alert for imported cases and many have elaborate preparedness plans in place.

In addition, experiences in the US and Spain showed that conventional control measures, including isolation and exhaustive tracing and monitoring of contacts, can halt further spread quickly following locally-acquired infections.

Intelligence from rumour-tracking teams: worldwide vigilance is high

Throughout the year, small teams at WHO headquarters systematically gathered intelligence, using a dedicated internet search engine, about possible Ebola cases in non-affected countries. Staff in WHO country offices and partners, including nongovernmental agencies, working in the field provided another source of alerts to possible cases.

The system has a translation facility that lets it pick up rumours and hints suggesting an Ebola case in any language. Staff in WHO country offices and partners, including nongovernmental agencies, working in the field provided another source of alerts to possible cases.

From mid-October to year end, the system picked up more than 183,000 alert signals. These were rapidly screened by epidemiologists, who selected a subset for further examination, risk assessment, or investigation and verification. More than 150 signals required further investigation, with the peak seen in August.

Based on the number of rumours tracked, worldwide vigilance for imported cases was judged high.

While any country with an international airport was theoretically at risk of an imported case, the need for preparedness was considered greatest in countries with weak public health infrastructures and little or no diagnostic capacity to detect cases early. When investigating possible cases, WHO paid especially close attention to rumours

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in countries that share borders or have extensive travel and trade relations with the three hardest-hit countries.

A checklist helps assess preparedness and gaps

In early October, WHO convened a consultation in Brazzaville, Republic of Congo, to assess preparedness needs and identify ways to quickly improve operational readiness to respond to imported cases. The consultation had two main outcomes. The first was a compact preparedness checklist that set out core principles, standards, capacities, and practices that can be used by countries to assess their level of preparedness.

In its second outcome, the consultation identified 14 priority countries in Africa considered to be especially vulnerable and in greatest need of international support to improve preparedness: Benin, Burkina Faso, Cameroon, Central African Republic, Cote d'Ivoire, Ethiopia, Gambia, Ghana, Guinea Bissau, Mali, Mauritania, Niger, Senegal, and Togo.

In Senegal and Mali, preparedness measures were already being put in place when those two countries confirmed their first Ebola cases on 29 August and 23 October.

By the second week of December, assessment missions to all 14 priority countries had been completed. Assessments focused on the capacity of each country to detect, investigate, and report possible Ebola cases. An assessment was also made of each country's capacity to mount a response that could hold onward transmission to a small number of cases.

The resulting national preparedness action plans gave international development partners guidance on specific areas where support was likely to have the greatest impact on preparedness. At the end of each preparedness mission, at least one technical expert remained on site to oversee the continuity and coordination of preparedness measures.

Beyond Africa

Work on preparedness has taken place in all WHO regions. Training courses, workshops, and simulation exercises have been undertaken for groups of countries, while visits have been made to more than 70 countries in all regions to review capacities first-hand, develop action plans, and provide direct support.

All regions have also developed their own Ebola task forces and have regional response plans in place. Emergency operation centres and rapid response teams are likewise in place.

Most experts warn countries to expect additional imported cases as 2015 progresses. Given the high level of worldwide vigilance, chances are good, especially in countries with well-developed health systems, that these cases will be detected early – before they have a chance to spark multiple new chains of transmission.

The warnings the world did not heed

One year into the Ebola epidemic. January 2015

A formal assessment of the response to the 2009 H1N1 influenza pandemic concluded that the world was lucky on that occasion, as the virus was so mild, but ill-prepared to cope with any severe and sustained emergencies in the future, as borne out by the Ebola epidemic.



WHO/R. Sorensen

CHAPTER 13 - In 2010, a review committee was convened under the provisions of the Internal Health Regulations to evaluate the response to the 2009 H1N1 influenza pandemic and assess the level of global preparedness for similar events in the future. As the committee concluded, "The world is ill-prepared to respond to a severe influenza pandemic or to any similarly global and threatening public-health emergency."

Beyond implementation of core public-health capacities called for in the IHR, the committee expressed the view that global preparedness can be advanced through research, reliance on a multisectoral approach, strengthened health-care delivery systems, economic development in low and middle-income countries, and improved health status.

The committee noted that the WHO response to public health emergencies was framed by the Organization's "dual role as a moral voice for health in the world and as a servant of its Member States." It observed the limitation of WHO systems that were designed to respond to a geographically focal, short-term emergency, rather than a global, sustained, long-term event. The Ebola epidemic has been just such an event.

Needs: an army of reinforcements, a war chest, and modern weapons

The committee's recommendations for strengthened preparedness included calls for the establishment of a more extensive global public health reserve workforce that could be mobilized as part of a sustained emergency response, the creation of a contingency fund for public health emergencies to support surge capacity, and pursuit of a comprehensive research and evaluation programme. The committee noted that these needs could not be met by WHO acting alone and required collaboration with the international community.

"As soon as the outbreak was confirmed on March 21, we started to work with the Ministry of Health and other partners to implement necessary measures. It is the first time the country is facing an Ebola outbreak, so WHO expertise in the area is valuable."

Dr Zitsamele-Coddy, WHO

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As the Ebola outbreak has revealed, the world did not respond to these recommendations, with none of these measures fully in place to support a response that could last for many more months to come. Furthermore, in November 2014, an IHR review committee found that only 64 of WHO's 194 Member States had the essential surveillance, laboratory, data management, and other capacities in place to fulfil their obligations under the IHR.

As a result, WHO went into battle against this virus with no army of reinforcements to support a sustained response, no war chest to fund a surge, and weapons that date back to the Middle Ages.

Thanks to the generosity of the international community, the dedication of scientists, and the ingenuity of the pharmaceutical industry, solutions to two of these problems have a good chance of being found. Reinforcements are badly needed. Finding more experienced field epidemiologists and foreign medical teams to manage the newly built and planned treatment centres, and getting those centres and staff closer to where they are needed most, remain major challenges.

What needs to change

On 25 January 2015, the WHO Executive Board will hold a special session to discuss the Ebola epidemic and what needs to be done to bring it under control. To guide these discussions, WHO staff prepared six background papers, including proposals for changing the systems and structures used by WHO when it responds to emergencies.

In connection with a reform process currently under way at WHO, Executive Board members will consider the extent to which WHO is expected to be operational in the field during extended emergencies, with its staff directly coordinating or supervising the response, or whether the WHO role should be confined to technical guidance and advice. Both functions – providing technical assistance and direct aid are constitutionally mandated. The Board will also consider administrative and managerial arrangements between WHO headquarters and its six regional offices.

– [WHO supplies arrive in Guinea to support the Ebola outbreak response](#)

Ebola response: What needs to happen in 2015

One year into the Ebola epidemic. January 2015

As 2014 progressed, the world learned a great deal from the largest and longest Ebola outbreak in history, and these lessons have shaped a more strategic approach going forward.



WHO/C. Banluta

CHAPTER 14 - Much was learned during 2014. The epidemic in West Africa – the largest and longest in the nearly four-decade history of this disease – yielded greater clinical understanding of the pathology of Ebola virus disease and ways to improve survival rates jumped ahead. We have gained much greater understanding at the operational level: what specific packages of control interventions will have the greatest impact on getting transmission down?

Scientific research about the disease escalated dramatically, as has research and development to develop new medical products for prevention, treatment and possibly cure.

The four biggest lessons from 2014

The biggest and most obvious lessons are four-fold.

First, countries with weak health systems and few basic public health infrastructures in place cannot withstand sudden shocks, whether these come from a changing climate or a runaway virus. Under the weight of Ebola, health systems in Guinea, Liberia and Sierra Leone collapsed. People stopped receiving – or stopped seeking – health care for other disease, like malaria, that cause more deaths yearly than Ebola.

In turn, the severity of the disease, compounded by fear within and beyond the affected countries, caused schools, markets, businesses, airline and shipping routes, and borders to close. Tourism shut down, further deepening the blow to struggling economies. What began as a health crisis snowballed into a humanitarian, social, economic and security crisis. In a world of radically increased interdependence, the consequences were felt globally.

The evolution of the crisis underscored a point often made by WHO: fair and inclusive health systems are a bedrock of social stability, resilience and economic health. Failure to invest in these fundamental infrastructures leaves countries with no backbone to stand up under the weight of the shocks that this century is delivering with unprecedented frequency.

Second, preparedness, including a high level of vigilance for imported cases and a readiness to treat the first confirmed case as a national emergency, made a night-and-day difference. Countries like Nigeria, Senegal and Mali that had good

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surveillance and laboratory support in place and took swift action were able to defeat the virus before it gained a foothold.

Third, no single control intervention is, all by itself, sufficiently powerful to bring an Ebola epidemic of this size and complexity under control. All control measures must work together seamlessly and in unison. If one measure is weak, others will suffer.

Aggressive contact tracing will not stop transmission if contacts are left in the community for several days while test results are awaited. Good treatment may encourage more patients to seek medical care, but will not stop community-wide transmission in the absence of rapid case detection and safe burials. In turn, the powers of rapid case detection and rapid diagnostic confirmation are diminished in the absence of facilities for prompt isolation. As long as transmission occurs in the community, medical staff following strict protocols for infection prevention and control in clinics will be only partially protected.

Finally, community engagement is the one factor that underlies the success of all other control measures. It is the linchpin for successful control. Contact tracing, early reporting of symptoms, adherence to recommended protective measures, and safe burials are critically dependent on a cooperative community. Having sufficient facilities and staff in place is not enough. In several areas, communities continued to hide patients in homes and bury bodies secretly even when sufficient treatment beds and burial teams were available. Experience also showed that quarantines will be violated or dissolve into violence if affected communities are given no incentives to comply.

An epidemic with two causes

The persistence of infections throughout 2014 had two causes. The first was a lethal, tenacious and unforgiving virus. The second was the fear and misunderstanding that fuelled high-risk behaviours. As long as these high-risk beliefs and behaviours continue, the virus will have an endless source of opportunities to exploit, blunting the power of control measures and deepening its grip. Like the populations in the three countries, the virus will remain constantly on the move.

Getting to zero means fencing the virus into a shrinking number of places where all transmission chains are known and aggressively attacked until they break. It also means working within the existing context of cultural beliefs and practices and not against them. As culture always wins, it needs to be embraced, not aggravated, as WHO aimed to do with its protocol on safe and dignified burials.

A more strategic emergency response

As the new year began, a revised response that builds on accumulated experiences was mapped out by WHO. This new response plan adopts what has been shown to work but also sets out new strategies designed to seize all opportunities for getting the number of cases down to zero.

Community resistance must be tackled by all outbreak responders with the greatest urgency. Concrete guidance on ways of doing this is likely to emerge from an analysis of Sierra Leone's Western Area Surge, which included several strategies for engaging communities and responding to their concerns. As was learned during 2014, community leaders, including religious leaders as well as tribal chiefs, can play an especially persuasive role in reducing high-risk behaviours.

Apart from low levels of community understanding and cooperation, contact tracing is considered the weakest of all control measures. Its poor performance likewise needs to be addressed with the greatest urgency. For example, in Guinea, which has the most reliable data, only around 30% of newly identified cases appear on contact lists. In all three countries, the number of registered contacts for confirmed cases is too low. In Sierra Leone, some lists of contacts include family members only, and no one from the wider community.

As the year evolved, outbreak responders learned the importance of tailoring

As the year evolved, outbreak responders learned the importance of tailoring response strategies to match distinct needs at district and sub-district levels. An understanding of transmission dynamics at the local level usually reveals which control measures are working effectively and which ones need improvement. Doing so requires better district-level data and, above all, better coordination. The outbreaks will not be contained by a host of vertical programmes operating independently. Again, all control measures must work seamlessly and in unison.

At year end, as cases flared up in new areas or moved from urban to rural settings, a clear need emerged for rapid response teams and for agile and flexible strategies that can change direction – and location – quickly. In WHO's assessment, all three countries now have sufficient numbers of treatment beds and burial teams, but these are not always located where they are most needed. As was also learned during 2014, transporting patients over long distances for treatment does not work, either for families and communities or in terms of its impact on transmission.

As long as logistical problems persist, community confidence in the response will remain low. People cannot be expected to do as they are told if the effort leaves them visibly worse off – quarantined without food, sleeping in the same room with a corpse for days – instead of better off. These problems are compounded by poor road systems and weak telecommunications in all three countries. In Liberia, for example, health officials in rural areas are lucky if they have an hour or two of internet connectivity per week. This weakness defeats rapid communication of suspected cases, test results and calls for help, thus ensuring that response efforts continue to run behind a virus that seizes every opportunity to infect more people.

A decentralized strategy – and an ethical imperative

As the response decentralizes to the subnational level, fully functional emergency operations centres, with local government health teams integrated and playing a leadership role, must be established in each county, district and prefecture in the three countries. These centres will drive the step-change in field epidemiology capacity needed to achieve high-quality surveillance, rapid and complete case-finding, and comprehensive contact tracing – the fundamental requirements for getting to zero.

A decentralized response also demands urgent attention to well-known gaps and failures in collecting, collating, managing and rapidly sharing information on cases, laboratory results and contacts. Understanding and tackling the drivers of transmission in each area call for enhanced case investigation and analytical epidemiology. Tools for collecting and sharing this information need to be standardized and put into routine use by governments and their partners.

Another major problem is the unacceptably large difference in case fatality rates between people who receive care in affected countries (71%) and foreign medical staff (26%) who were evacuated for specialized treatment in well-resourced countries. Getting case fatality down in affected countries is an ethical imperative.

Innovation needs to be encouraged, publicized, tested and funnelled into control strategies whenever appropriate. Mali used medical students with training in epidemiology to rapidly increase the number of contact tracers. Guinea drew on its corps of young and talented doctors to strengthen its outbreak response, with training provided by WHO epidemiologists. These staff know the country and its culture best. They will still be there long after foreign medical teams leave.

In Sierra Leone, the government-run Hastings Ebola Treatment Centre, a 123-bed facility entirely operated by local staff, has defied statistics elsewhere in the country with its survival rates. Six out of every 10 patients treated there make a full recovery. As noted by an infection control specialist working on the wards, the only patients that cannot be saved are those who wait too long to seek care. After noting that Ebola virus disease has some similarities with cholera, staff at the facility made intravenous administration of replacement fluids a mainstay of the routine treatment protocol.

The pattern of transmission seen throughout 2014 makes a final conclusion obvious: cross-border coordination is essential. Given West Africa's exceptionally mobile populations, no country can get cases down to zero as long as transmission is ongoing in its neighbours.

Prevent outbreaks in unaffected countries

With the increasing number of cases and infected prefectures in Guinea, the risk of new importations to neighbouring countries is also growing. In terms of preparedness, the most urgent need is for active surveillance in the areas bordering Mali, Senegal, Guinea-Bissau and Cote d'Ivoire, through the deployment of additional human and material resources, and the introduction of standard performance monitoring and reporting on a weekly basis.

Improvements in contact tracing and monitoring in the second phase of the response provide an opportunity to substantially enhance the efficacy of exit screening. Doing so further reduces the risk of new Ebola exportations from affected areas. As contact tracing improves, lists of active contacts could be systematically shared with border and airport authorities to link this information with exit screening.

Get health systems functioning again – on a more resilient footing

Much debate has focused on the importance of strengthening health systems, which were weak before the outbreaks started and then collapsed under their weight. In large parts of all three countries, health services have disintegrated to the point that essential care is either unavailable or not sought because of fear of Ebola contagion.

As some have argued, cases will decrease fastest when a well-functioning health system is in place. That argument also points to the need to restore public confidence – which was never high – in the public health system. Targeted drug-delivery campaigns that aimed to treat and prevent malaria were well-received by the public and are a step in the right direction, but much more needs to be done.

Although virtually no good systems for civil registration and vital statistics are still functioning in the three countries, indirect evidence suggests that childhood deaths from malaria have eclipsed Ebola deaths. Liberia, for example, had around 3500 malaria cases each month prior to the outbreak, with around half of these cases, mainly young children, dying. An immediate strengthening of health systems could reduce these and many other deaths, while also restoring confidence that health facilities can protect health and heal disease.

Others argue that efforts must stay sharply focused on outbreak containment. As this argument goes, response capacity is limited and must not be distracted. This argument favours a step-wise approach that initially concentrates on strengthening those health system capacities, like surveillance and laboratory services, that can have a direct impact on outbreak containment.

For its part, WHO sees a need to change past thinking about the way health systems are structured. As the Ebola epidemic has shown, capacities to detect emerging and epidemic-prone diseases early and mount an adequate response need to be an integral part of a well-functioning health system. Outbreak-related capacities should not be regarded as a luxury or added as an afterthought. Otherwise, the security of all health services is placed in jeopardy.

Step up research

Research aimed at introducing new medical products needs to continue at its current accelerated pace. Executives in the R&D-based pharmaceutical industry have expressed their view that all candidate vaccines must be pursued "until they fail". They have further agreed that the world must never again be taken by surprise, left to confront a lethal disease with no modern control tools in hand.

New tools will likely be needed to get to zero. For example, vaccines to protect health

care workers may make it easier to increase the numbers of foreign and national medical staff. Better therapies – and improved prospects of survival – may encourage more patients to promptly seek medical care, greatly increasing their prospects of survival.

As cases decline, robust and reliable point-of-care diagnostic tests will boost efforts to break transmission chains. Rapid diagnostic tests can support efficient patient triage and reduce the time that contacts or suspected cases are held in facilities alongside confirmed cases, where they are at risk of infection. Such tests could also facilitate the screening of patients at regular health care facilities, thus reducing the risk of transmission from undiagnosed cases to unprotected medical staff.

However, all new control tools must be introduced carefully and in ways that guard against both unrealistic public expectations and unfounded fears. For example, vaccines may not confer full protection; the duration of protection could be brief; a booster shot may be needed. Not all experimental therapies can be easily and safely administered in resource-constrained settings.

Such tools may also be needed for the future. Researchers have identified at least 22 African countries that have the ecological conditions and social behaviours that put them at risk of future outbreaks of Ebola virus disease.

Mine every success story

Operational research is needed to understand why some areas have stopped or dramatically reduced transmission while others, including some in the same vicinity and with similar population profiles, remain hotspots of intense transmission.

Did the striking and robust declines in Lofa County, Liberia, and Kailahun and Kenema districts in Sierra Leone occur because devastated populations learned first-hand which behaviours carried a high risk and changed them? Or can the declines be attributed to simultaneous and seamless implementation of the full package of control measures, as happened in Lofa country? Answers to these questions will help refine control strategies.

Research is also needed to determine how areas that have achieved zero transmission can be protected from re-infection. Some success stories look real and robust, but these are only pockets of low or zero transmission in a broad cloak of contamination.

At every opportunity, strategies devised for the emergency response should be made to work to build basic health capacities as well. Some success stories can serve as models.

Liberia demonstrated how quickly the quality of data and reporting can improve, thus strongly supporting the strategic targeting of control measures at district and sub-district levels.

Sierra Leone showed how laboratory services can be strengthened and expanded, reducing waiting times for test results close to what is seen in countries with advanced health systems while also supporting the better clinical management of cases.

Each and every survivor is also a success story. In an effort to fight the stigma that so often haunts these people, many treatment centres hold celebratory ceremonies when survivors are released from treatment. Each is given a certificate as proof that they pose no risk to families or communities.

Get the incentives – and support – right

Both foreign and domestic medical staff have worked in the shadows of death, placing their lives at risk to save the lives of others. In many places, these staff also risked losing their standing in communities, given the fear and stigma attached to anything or anyone associated with Ebola.

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These people deserve to be honoured and respected. They also deserve to be paid on time and given safe places to work. Timely and appropriate payment to national staff remains problematic. More studies are currently under way to identify the circumstances under which health care workers continue to get infected.

Special efforts are also needed to improve safety at private health facilities, in pharmacies, and among traditional healers, as evidence suggests the risk of transmission is highest in these settings. The number of hospitals that remain closed or virtually empty supports the conclusion that doctors and nurses are most likely getting infected while treating patients in community settings.

Incentives also need to be in place to ensure that foreign medical teams stay in countries long enough to understand conditions, including political and social as well as operational issues, and pass on this knowledge to replacement staff. Towards the end of the year, WHO ensured that its field coordinators stayed in countries for several months.

The “post-Ebola syndrome”

Given the fear and stigma associated with Ebola, people who survive the disease, especially women and orphaned children, need psychosocial support and counselling services as well as material support. They may need medical support as well. A number of symptoms have been documented in what is increasingly recognized as a “post-Ebola syndrome”.

Efforts are now under way to understand why these symptoms persist, how they can best be managed, whether they are caused by the disease, and whether they might be linked to treatment or the heavy use of disinfectants. WHO staff have developed an assessment tool that is being used to investigate these issues further.

Maintain unwavering commitment at national and international levels

Media coverage of the Ebola crisis peaked in August, when two American missionaries and a British nurse became infected in West Africa and were medically evacuated for treatment in their home countries. Coverage increased dramatically in October, when the USA and Spain confirmed their first locally transmitted cases.

Ominous forecasts from various agencies – including 1.4 million cases by mid-January 2015 – contributed to the deepening of concern. The most accurate forecast, of 20 000 cases, was made in the WHO Ebola response roadmap, issued in late August. WHO later also made dramatic forecasts based on the assumption that control measures were not being scaled up fast enough.

Although the situation in Liberia at year end, especially in Monrovia, looked promising, optimism must remain cautious. As experiences in Guinea made clear, this is a virus that can go into hiding for some weeks, only to return again with a vengeance. In Liberia, as caseloads declined, evidence of complacency and “Ebola fatigue” rapidly appeared in some populations even though transmission continued.

The three countries will continue to need international support for some time to come, whether in the form of direct support for response measures or assistance in rebuilding their health services. Countries and the international community must brace themselves for the long-haul.

One overarching question hangs in the air. The virus has demonstrated its tenacity time and time again. Will national and international control efforts show an equally tenacious staying power?

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- [Sierra Leone: Rebuilding primary health services amid the Ebola crisis](#)
 - [Communities organize Ebola response](#)
 - [About Ebola virus disease outbreak](#)

