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How Nigeria Defeated Ebola

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Ada Igonoh was the physician who pronounced 40-year-old Patrick Sawyer dead. Four days after he was admitted to First Consultants Medical Centre, a hospital in Lagos, Nigeria, she found him collapsed and unresponsive in his private bathroom. That day, no one was allowed near the door until World Health Organization (WHO) officials removed the body. On the day he died, July 24, 2014, an evaluated blood sample confirmed everyone's worst fears. Ebola Virus Disease (EVD) had arrived in the largest city on the African continent.

At that time, Ebola infections had dispersed for eight months across countries of the Mano River countries – Liberia, Sierra Leone and Guinea – where the Ebola outbreak began in December 2013. None of these countries' heads of state had yet declared a medical crisis. Neither had the WHO. Yet, the death of a visitor travelling from Liberia led Nigerian officials to immediately declare a national state of emergency. They began managing a potentially catastrophic situation, one that would catch by surprise those at the forefront of infectious disease management.

In Nigeria, there is a critical mass of scientific, medical and public health expertize – founded on decades of experience managing medical crises, natural disasters and the health-related fallouts of economic breakdown driven by policies of international financial institutions. Bypassing a highly underfunded health care system and a global racial divide when it comes to accessing medical treatment, Nigerian personnel set up an emergency response unlike any other in the past. Their efforts resulted in one of the highest survival rates in the history of Ebola outbreaks.

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Sawyer, a naturalized U.S. citizen living in Coon Rapids, Minnesota was in his former home country of Liberia working for ArcelorMittal, a Luxembourg-headquartered, multinational steel manufacturer. There were about 100 people infected with Ebola in Liberia including his younger sister, Princess Christina Nyennetue. Sawyer was with her at St. Joseph Catholic Hospital the day before she died on July 8. After insisting that an autopsy be performed, he became aware of the cause of her death. ArcelorMittal got word that Sawyer was in contact with a family member infected with Ebola and insisted that he turn himself over to the Ministry of Health for screening. The virus has a 21-day incubation period and he was relieved from work and placed on "clinical watch."

On Sunday, July 20, 11 days into isolation, Sawyer flew from Monrovia, Liberia to Lagos, Nigeria. His intention was to travel onward to the eastern city of Calabar, where he would attend a conference of the Economic Community of West African States (ECOWAS). Although reports vary, it appears he was representing the Liberian Ministry of Finance as a consultant. On his Asky Airlines flight, Sawyer became severely ill. When he arrived at the Murtala Muhammed International Airport in Lagos, he collapsed in the terminal. Two ECOWAS officials, Mr. Jatto Abdulqudir and Mr. Koye Olu-Ibukun, were there to meet him and quickly got sought medical attention for Sawyer. As it turned out, Nigerian physicians working in public hospitals were knee-deep in a national strike and all public health facilities were closed to patients. The private hospital, First Consultants Medical Centre, remained open and was Sawyer's best option.

Sawyer told the intake physician that he had just flown in from Monrovia. But he denied being exposed to Ebola. He was feverish and so the physician ordered a full blood count and tested for malaria, which is endemic to West African countries. That night, all blood work came back normal. By the next morning his condition was significantly worse. HIV and hepatitis tests were conducted and both turned out to be negative. After two days of no definitive medical explanation, Dr. Stella Ameyo Adadevoh, the attending physician in charge, decided it was time to screen for Ebola and notify health authorities.

Ebola is not endemic to Nigeria and therefore it is not common for a hospital to have clinical tests for EVD in stock. And so Dr. Adadevoh contacted Professor Abdulsalami Nasidi, the Director of the Nigeria Centre for Disease Control, located in the country's capital, Abuja. Nasidi referred her to the Department of Virology at the Lagos University Teaching Hospital (LUTH). It had recently received testing kits for Ebola from research colleagues in Germany. Coincidently, when Dr. Adadevoh called, Professor Nasidi was preparing to fly to Lagos in order to chair an already-

scheduled academic meeting on Ebola at the West African College of Physicians. Little did he realize that he would be staying in Lagos for the next six weeks in full crisis-mode.

Before she prepared blood and urine samples to be sent to LUTH that day, Dr. Adadevoh searched for Ebola information online. She created information packets that contained transmission and prevention measures and distributed them to all the staff – First Consultant's self-taught crash course training on EVD management. Faced with no access to Ebola-specific personal protective equipment, which covers clothing, skin and provides a barrier to body fluids, they used what they had on hand: gloves, shoe covers, facemasks. The staff erected a wooden barricade at the entrance of Sawyer's room because they had no other way to isolate the patient.

On the third day of his hospitalization, Sawyer asked to see a physician. Dr. Ada Igonoh gowned up and went to him. She discovered he was experiencing very severe dysentery. She found his IV bag on the floor, which she picked up and hung back on its stand. After instructing the nurse, Justina Ejelonu, to attend to the patient, she updated her supervisor, Dr. Adadevoh, on his condition. Jatto Abdulqudir, the ECOWAS official, was at the hospital and approached the two physicians, reminding them that Sawyer needed to be on a morning flight to Calabar. Adadevoh was adamant that he was not fit to travel.

It was never clear why there was such an urgency to get Sawyer to the conference. Liberian journalists were perhaps the first to raise questions. They obtained security footage from the Payne International Airport in Monrovia, where they observed Sawyer at his departure gate. Their reports indicated that he avoided coming in contact with anyone, and at one point, laid belly-down on the floor in a corridor. He seemed to be in excruciating pain. The urgency to get on the plane to Lagos was met with equal pressure to move him on to Calabar: the hospital received several calls from ECOWAS and Liberian government authorities, who insisted that Sawyer be discharged. Journalists would later press government officials on their own behavior. A clear response never materialized, but ultimately a dead man was accused of dishonest communication with government representatives.

Adadevoh was the lead physician responsible for resisting Sawyer's hostility to hospitalization and outside pressures to release him. She was also responsible for confining the outbreak mainly to First Consultants Medical Centre. Her efforts averted a significant spread of the disease into the Lagos metropolis (home to 21 million people), which could have resulted in an entirely different and catastrophic outcome.

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On July 23, the day before Sawyer died, Nigerian scientists gathered at the West African College of Physicians for the Ebola academic meeting. To their shock, Professor Sunday Aremu Omilabu, the head of the Virology Department at LUTH and Professor Nasidi announced that a foreigner currently in Nigeria had tested positive for Ebola. With the outbreak scaling up in Liberia, Sierra Leone and Guinea, the scientists in the room knew it was only a matter of time, given the fluidity of West Africa's borders, before the outbreak spread. As a citizen of an ECOWAS country, one can legally cross the vast rural state boundaries without visas and passports. Along the 350-mile border between Liberia and Guinea, for example, there are countless points of free passage. People circulate daily for trade, work and family gatherings – a dense network of cross-border, often unregulated, movement.

Some of Nigeria's rural borders are also unregulated. If Ebola were to enter Nigeria through one of these, it could take weeks to detect. In the past, other disease outbreaks in the country, such as cholera, polio, meningitis and even the endemic hemorrhagic Lassa fever, were only discovered in remote areas once they become a crisis. Another huge concern for scientists and government health officials was the urban border of Lagos. The ancient slave port of Badagry, a town at the edge of Lagos State, is a major transport depot to cities all over West Africa. Everyday, thousands, if not tens of thousands of people travel to and from this place. The fear that Ebola would arrive overland in this manner had everyone worried. But, for the most part, the 2013 Ebola outbreak was not spread by those traveling on foot or by bus. Rather the disease accompanied elites – wealthy business people and international health emergency workers – on international flights. Characterizing the sheer luck of this hypervisibility, a health official told us, "Ebola arrived to Lagos screaming."

In April 2014, three months before Patrick Sawyer landed in Lagos, clinicians and research scientists affiliated with the National Institute for Medical Research and the Lagos State Ministry of Health began preemptively to educate and train government health officials at the Lagos port and rural borders. They also trained doctors and medical workers on case definitions, as well as lab preparation. According to Dr. Jide Idris, the Lagos State Health Minister, they held public meetings and disseminated information to "every nook and cranny of Lagos State and eventually the whole of Nigeria."

"We still had to come to people's level – at least to listen to them about their fears and challenges on Ebola," said Dr. Francisca Nwaokorie, a medical laboratory scientist specializing in microbiology and parasitology at the University of Lagos. The biggest question at public meetings was whether Ebola could be cured. Since it could not be treated with medication, the focus was on prevention. The public meetings were particularly beneficial to parents concerned about their children's safety at school.

"There was one school where I gave a lecture," Nwaokorie explained, "When I came around a second time, school administrators had already mounted a massive water system, where everyone can go to wash their hands. And actually some parents volunteered to get that done."

Once the outbreak was officially declared, the teams utilized the skills of small-town announcers who, in very charismatic ways, disseminate information. Multimedia campaigns were launched, such as the series, *Lens on Ebola*, produced collaboratively by Lagos-based health-media organizations, U.S. Centers for Disease Control and Prevention, and 'Nollywood' film companies that featured popular movie stars. Eventually, community development organizations, mosques, churches, traditional leaders and schools were involved in many Ebola campaigns.

At the July 23 meeting at the West African College of Physicians meeting, Omilabu and Nasidi were expected to lead an academic discussion about Ebola. Armed with the information of Sawyer's positive Ebola test, they launched the beginnings of a nation-wide emergency response. Some of the scientists and clinicians in attendance were the first to volunteer to help contain the outbreak.

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On the morning of July 25, First Consultants Medical Centre went into emergency-mode. The hospital was decontaminated after every patient was discharged and put on an Ebola clinical watch. According to Dr. Ada Igonoh all hospital workers began to retrace not just their contact with Sawyer, but all their interactions including handling patients and lab materials, as well as contact with each other and with family members during the period leading up to his death.

On Saturday, July 26, all hospital staff met with Nasidi, Omilabu, Idris and other key health officials. They were grouped into high and low risk categories based upon their exposure to Sawyer, who came to be known as the "index patient."

"Each person received a temperature chart and a thermometer to record temperatures in the morning and night for the next 21 days," Igonoh explained in her own written account of the ordeal. "We were all officially under surveillance. We were asked to report to them at the first sign of a fever. We were reassured that we would all be given adequate care. The anxiety in the air was palpable."

Igonoh was exhausted from the week's events and decided to take a break from the intensity of Lagos – a city whose frenetic tempo makes New York feel like a sleepy village. She stayed with her parents just outside the city where, on Tuesday July 29, she developed joint and muscle pains and a

sore throat. She decided these were due to stress and anxiety. She took medication for suspected malaria and antibiotics for the sore throat.

"Every day I would attempt to recall the period Patrick Sawyer was on admission – just how much direct and indirect contact did I have with him? I reassured myself that the contact with him was quite minimal." After she completed the three-day anti-malarial treatment, the aches and pains persisted. She lost her appetite and was extremely fatigued.

On Friday, August 1, Igonoh woke up, greeted her parents and took her temperature. It was one of those slow motion moments that heightened her anxiety beyond anything that she experienced in the previous two weeks. She informed her mother that she had a fever and isolated herself from the family. The next morning, August 2, her sore throat persisted and the fever was even worse. She immediately called the Ebola helpline and an ambulance was sent with WHO doctors on board who took blood samples. Later in the day, dysentery and vomiting began. She remained isolated from her family members, who were convinced that she did not have Ebola.

On Sunday, August 3, Igonoh got a telephone call from one of the WHO doctors who had taken her blood. Another sample was needed. An ambulance arrived but the clinicians on board did not draw blood as they did the day before. Instead they asked her to go back with them to a temporary isolation center that had been set up by the Lagos State Government. It was located at the public Mainland Hospital in the Yaba neighborhood of Lagos. There, she was told, someone with more skills would draw her blood.

"Will you bring me back home?" she asked. They agreed to bring her back that night. She recalled over and over the times that she had contact with Sawyer. She reassured herself that every interaction was minimal, including when she felt for his pulse, through double-gloved fingers, at the time of his death.

Dr. Igonoh told her parents that she was going to Yaba and would be back in the evening. The 26 year-old physician put on her jeans and placed her iPad and three mobile phones in her purse. From the bedroom window, her mother watched the ambulance drive off to the city. Upon arriving at Yaba, Igonoh was instructed to stay in the ambulance; she was offered food but couldn't eat anything. After four hours, the ambulance door opened. An unfamiliar white man appeared and said to her, "I have to inform you that your blood tested positive for Ebola. I'm sorry."

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Dr. Patrick Nguku is a surgeon and medical epidemiologist by training. He has previous experience combatting disease outbreaks in East Africa including Ebola in Northern Uganda. As

the Resident Advisor of the Nigeria Field Epidemiology and Laboratory Training Programme in Abuja, he is responsible for training public health experts in conducting disease surveillance and responding to disease outbreaks. In the past, this agency tracked and coordinated responses to cholera, meningitis, Lassa Fever and other diseases. He recalled the week leading up to the outbreak: "We had gone to Obudu on a trip for our polio program. That was the week of July 13th. We came back [a week later] on the 21st; and on the 22nd was when we started hearing rumors. Ebola was confirmed the next day on 23rd. And on the 24th, it was panic."

The first task for Nguku's team was to tediously comb through the records at First Consultants. After examining the files, inpatients and outpatients were categorized into high and low risk categories as the hospital staff had been. The list of people to follow up rose from 9 to 40, then to 70. Doctors feared that those under clinical watch would go underground.

Physicians can see more than 100 patients a day. They are often cared for by family members who secure medication and provide food when medical personnel are stretched to capacity to deliver care. So, Nguku's team had to also consider the fact that there are just as many, if not more, visitors than patients inside hospitals at any given time. Essentially it was the team's job to identify and determine the status of *every single person* – patient, visitor, worker – who entered the hospital during Patrick Sawyer's hospitalization.

The enormity of this undertaking was only the first stage of what public health officials commonly refer to as "contact tracing" – finding everyone who was in contact with an Ebola patient. The parallel task was to coordinate tracing everyone who had come into contact with Sawyer from the moment he landed up until his arrival at First Consultants. Dr. Nasir Sani-Gwarzo, a medical epidemiologist and the director of the Port Health Services Division of the Ministry of Health, headed a team that evaluated airline passenger lists. They had to identify whom Sawyer may have been in contact with on the plane, at the airport, and even those who flew out of Nigeria that day. They decontaminated the airport and established entry and exit screening at all ports of entry throughout the country.

In retracing events, Nguku and Sani-Gwarzo's teams had to imagine Sawyer's every move. Detailing the path of contact, they considered that after deplaning, Sawyer stood in a long immigration line. Eventually he handed his passport back and forth to at least two government officials. He then waited with other passengers from different flights at the baggage claim. When he met his ECOWAS contacts, Abdulqudir and Olu-Ibukun, they walked past the hundreds of passengers and visitors moving up and down the terminal. After exiting the airport, they made their way through numerous currency sellers wanting to change their money. Then they walked among the multitudes of taxi-drivers attempting to secure the lucrative deal of driving them to

another part of the city. At some point, someone had to pick Sawyer up off the floor after he collapsed.

At least an hour ride by car, Sawyer, Abdulqudir, and Olu-Ibukun traversed the constantly pumping streets of Lagos. Once outside the airport, they drove along Airport Road and passed the Ikeja General Hospital, where workers were on strike. More than likely they got stuck in a "go-slow" (traffic jam) that usually forms in front of Computer Village, West Africa's largest secondhand market of imported electronic goods. In this highly-commercialized section of Ikeja, dense foot traffic moved alongside as well as between the vehicle lanes.

Making their way out of Ikeja, they more than likely encountered another hold up at the Maryland Roundabout, one that was punctuated with melodic car horns navigating the congestion. At all hours, a mobile market literally appears and disappears with the traffic itself. Young men and women eking out a living move up and down the go-slow. They repetitively call out "pure water!" and other items they're selling. Nguku's team had to imagine whether the usual exchange between street sellers and vehicle passengers could have taken place.

If Abdulqudir did not continue driving down the eight lane Ikorodu Road past the neighborhoods of Ilupeju, Palmgrove, Ojuelegba, and Surulere, then most likely they took the 7.3 mile long Third Mainland Bridge, the second longest in Africa. Driving high above the west side of the Lagos Lagoon they passed over Makoko – a desperate, floating neighborhood where nearly 100,000 residents live in small wooden homes that sit just above watery thoroughfares.

As the three continued, they approached skyscrapers towering above elite Lagos neighborhoods. When Third Mainland Bridge emptied into the island city, Sawyer, Abdulqudir, and Olu-Ibukun passed through the hustle and bustle of widespread commercial activity that moves effortlessly between wholesale businesses and the streets; where impromptu church services are performed; where snazzily-dressed elite professionals and the working class cue up to eat delicious regional specialties at small food joints, and where many unreachable dreams are put to test.

Exiting off the island's main Ring Road, they arrived at the Obalende roundabout, one of the city's largest transport depots, where buses vie for lucrative parking, as well as customers travelling to every corner of the city. Folks mingle and sell food and other goods in a market that draws would-be passengers. There, the three men parked and stepped down from the vehicle. Together they moved through some of the island's densest foot traffic to the entrance of First Consultants Medical Centre.

The vitality of Lagos made the emergency response teams' contact tracing mission all the more poignant. After Sawyer died, the teams had to consider the possibilities of an Ebola-infected

traveler making a drive like this from the northern edge of the Lagos metropolitan area to its southern-most tip before receiving medical care. The ride, the airport passengers, the visitors to the hospital, and the numerous people with whom they all had contact along the way had to be considered on that first day of Nigeria's national emergency response.

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Dr. David Brett-Major, the WHO physician who met Dr. Igonoh in the ambulance, instructed her to open her mouth wide. She recalled: "He said it was a typical Ebola tongue. I took out my mirror from my bag and took a look and was shocked at what I saw. My whole tongue had a white coating, looked furry, and had a long, deep ridge right in the middle. I then started to look at my whole body, searching for Ebola rashes and other signs, as we had been recently instructed. I called my mother immediately and said, 'Mummy, they said I have Ebola. But don't worry, I will survive it. Please go and lock my room now; don't let anyone inside and don't touch anything.' She was silent. I cut the line."

Igonoh was then taken to the female ward of the temporary isolation center. To her, it looked like an abandoned building that had not been used in a while. There was one other patient in the ward – a nurse assistant from First Consultants, Mrs. Ukoh – whose symptoms were worse than her own. She got settled and began what would be weeks of getting used to the stench of feces and vomit, and also what she would think of as the "Ebola smell" that lingered in the air. The two women were served rice and tomato-based stew that night but neither of them ate.

Brett-Major came in wearing goggles and a full protective hazardous-materials (hazmat) suit. He brought her several bottles of water as well as oral rehydration fluid therapy (ORS), which he dropped by her bedside. He informed Igonoh that she had to drink at least 4.5 litres of oral rehydration fluid daily to replace fluids lost to diarrhea and vomiting. After they finished talking about her treatment, he said good night and left.

"My parents called. My uncle called. My husband called crying. He could not believe the news. My parents had informed him, as I didn't even know how to break the news to him. As I lay on my bed in that isolation ward, strangely, I did not fear for my life. There was an inner sense of calm. I did not for a second think that I would be consumed by the disease."

But that evening, the symptoms fully kicked in. She had diarrhea every two hours. She would run to the toilet with a bottle of ORS, so that when she was stooling, she was also drinking. The toilet in the makeshift isolation center did not flush and had to be cleared by pouring a bucket of water

through it. She placed another bucket next to her bed for vomiting. The next morning, August 4, she noticed red rashes on her skin. She had developed sores on the inside of her mouth. Her throat was so sore that she could not eat; she could only drink ORS. She took paracetamol (aspirin) and nothing else for the pain. Mrs. Ukoh, lying across from her, had stopped speaking.

Nine days after Sawyer died, public health officials were still frantically organizing the emergency response. Inside the isolation ward, there was a desperate need to change bed sheets and mop the floor. At this early stage, no one but Brett-Major entered the ward to see the patients, chat and clean up. Meals were prepared and left outside the door of the ward.

Later that evening, Brett-Major brought another patient onto the ward, Justina Ejelonu, a nurse who had only started working at First Consultants the week before. The night that Sawyer's worst symptoms kicked in, Ejelonu was on duty and had attended to him. In a fit of resistance, Sawyer had snatched off his IV drip and blood flowed onto her bare hands like water out of a faucet. She developed symptoms at home. When she arrived at the isolation ward, she was bleeding from an in-progress miscarriage. The following day Ejelonu tested positive for Ebola. She was devastated. Not only did she lose the baby but she also contracted Ebola on the first day at her new job.

Igonah's pastor called her to offer spiritual support. He is also a physician and "encouraged me to monitor how many times I stooled and vomited each day and how many bottles of ORS I consumed. We would then discuss the disease and pray together. He asked me to do my research on Ebola since I had my iPad with me, and told me that he was also doing his study. He wanted us to use all relevant information on Ebola to our advantage. So, I researched and found out all I could about the strange disease that had been in existence for 38 years."

Igonah and her pastor discovered that there are five viral strains of EBV. Igonoh had the deadliest of them – the Zaire strain. Patients who die of Ebola usually do so anywhere between six and 16 days after the onset of symptoms that lead to multiple organ failure and system shock caused by dehydration.

"I read that as soon as the virus gets into the body, it begins to replicate really fast. It enters the blood cells, destroys them and uses those same blood cells to aggressively invade other organs where they further multiply. Ideally, the body's immune system should immediately mount up a response by producing antibodies to fight the virus. If the person is strong enough, and that strength is sustained long enough for the immune system to kill off the viruses, the patient is likely to survive. If the virus replicates faster than the antibodies can handle, however, further damage is done to the organs."

Igonoh was past the first stage of symptoms – headache, fever, muscle soreness – which usually occurs within the 10 days of initial infection. She was experiencing symptoms that are typical of "second stage" Ebola. The third stage includes bruising, brain damage, and bleeding from the nose and mouth. At the fourth and final stage, one loses consciousness, experiences seizures and eventually dies from mass internal bleeding. Moving from one stage to the next can take place within days or within a matter of hours. "I had no intention of letting the deadly virus destroy my system. I drank more ORS. I remember saying to myself repeatedly, 'I am a survivor, I am a survivor'."

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The day that Sawyer tested positive for Ebola, Federal and Lagos State health ministries activated the Federal Emergency Operations Center (EOC). It was made up of an interagency team including the Nigeria Institute of Medical Research, National Primary Health Care Development Agency, the Nigeria CDC, Lagos State Government (which also had its own EOC), Federal Tertiary Hospitals, the Red Cross of Nigeria and some foreign partners.

Dr. Faisal Shuaib, a physician and public health expert, was in charge of the EOC, which uses a hierarchically coordinated Incident Management System. The Minister of Health was the most senior official. He communicated with Dr. Shuaib, the Incident Manager, the Nigerian Centers for Disease Control, and importantly, the national media, which was harnessed extensively for daily updates. Feeding up the chain were six components of the emergency response: epidemiology and surveillance, case management and infection control, social mobilization, lab services and diagnostics, and borders and management coordination.

Built into the EOC was a platform to interface with the medical community within and outside of Nigeria so that hour-to-hour regional Ebola updates were immediately available to the staff. Foreign partners, such as Médecins Sans Frontières (Doctors Without Borders), WHO, U.S. CDC and UNICEF were assigned to different response teams based on experience and know-how. They worked under the direction of Nigerian officials and alongside their Nigerian counterparts.

The EOC had been in place since 2012 and was set up in response to a polio epidemic in a country with a national health system long in decline due to the effects of the International Monetary Fund's (IMF) 1986 structural adjustment program. Structural adjustment was meant to abate national debt and other macroeconomic problems, but it severely weakened the national economy, which negatively impacted all aspects of Nigerian life. The health care system became difficult to access because privatization measures led to expensive care, supply shortages, low salaries and the

exodus of qualified health professionals from the state system. In protest, millions of Nigerians took to the streets across the country. In response, the IMF and the World Bank worked closely with successive military dictatorships, to brutally suppress protest and force through highly unpopular policies.

Structural adjustment was not only wrecking havoc in Nigeria. In Sierra Leone and Liberia – two of the countries hardest hit by Ebola – such policies were directly connected to the onset or exacerbation of horrifying civil wars. Aftermaths of these wars left collapsed health care systems and medical workers fleeing for their lives in what amounted to massive brain drains. When Ebola broke out in Sierra Leone, there were only about 250 doctors left in the country.

By the mid-1990s, Nigeria was in the throes of a severe economic crisis coupled with a severe health crisis. The national delivery of vaccines was especially impacted. The Federal Ministry of Health devolved responsibility for vaccination programs to state governments, which did not have the budgets to carry out this mandate. By 2003, official estimates indicate that only 30% of the child population was routinely vaccinated. Preventable diseases, such as polio, were rapidly resurfacing as a direct result of economic austerity programs. While southern Nigeria had all but eliminated polio by the early 2000s, the North – a vast region that is home to extreme wealth inequality and severe underfunding of the health system – still experiences many polio infections.

The north was fertile ground for public suspicion and widespread boycott of health care initiatives driven by government. In 2003, for example, rumors began to circulate that vaccinations contained HIV, cancer stimulators and anti-fertility drugs aimed at wiping out the majority Muslim population. These rumors were fueled by political struggles between northern political and religious leaders and a newly elected federal civilian government in the southwest. When the boycott disrupted the polio campaign, there were large areas that went unvaccinated. Immunity depends upon high vaccination rates and the low number of polio immunizations led to a vaccine-induced outbreak. For much of the public, the outbreak confirmed the rumors that the vaccines were trouble.

Moreover, the north was the site of a scandalous clinical trial orchestrated by the world's largest pharmaceutical company, Pfizer. In 1998, a widespread meningitis outbreak appeared in the northern city of Kano, where more than 100,000 people piled into hospitals seeking treatment. Alongside Médecins Sans Frontières, which was administering emergency care, Pfizer set up a clinical trial to see if its existing marketed drug, Trovan, could be extended to treat children with meningitis. Emergency medicine and experimental research bled into each other, which caused confusion among those seeking medical relief. The trial was never registered with Nigeria's national drug regulatory agency, making it illegal. A total of eleven children died and many more

were maimed. At the same time that rumors circulated about the polio vaccine, citizens in northern Nigeria witnessed the Pfizer suit being filed in and thrown out of courts across continents. The release of Wikileaks documents exposed a backroom deal between Pfizer and the Nigerian government that settled for substantially less damages than what the plaintiffs were seeking. The lack of delivered justice further legitimated tainted vaccine rumors among a public that clearly knew where it stood when it came to pharmaceutical geopolitics.

Despite these political challenges, polio workers intensified infant immunization and educated communities on vaccination in very insecure areas. Then, in 2013, nine women vaccinators were assassinated in the northern city of Kano. The terrorist group, Boko Haram, was accused of the attacks but no suspects were identified.

In the face of these devastating events the EOC continued working and, against all odds, eliminated polio just months before Ebola arrived in Nigeria. At that point, Faisal Schuaib oversaw a repurposing of the EOC's operations, which moved from Abuja to Lagos. Forty EOC staff physicians stayed on and their expertise was morphed from managing polio to managing Ebola. Schuaib helped to scale up donations from the Nigerian government ($11.5 million) and private domestic and international donors. Dr. Idris, the Lagos State Minister of Health in charge of the Lagos EOC, secured funds to support a coordinated Lagos State infrastructure already in place.

Like the Federal EOC, the Lagos State government has dealt with its fair share of medical emergencies. In the past 15 years, it has responded to two different airplane crashes in densely populated neighborhoods, a massive weapons explosion at the Ikeja military cantonment near the airport, oil pipeline explosions, floods, cholera outbreaks, and swine flu. As Dr. Idris would later put it, these previous disasters and the state's emergency management experience provided "the templates and mechanisms for interstate, intergovernmental and international collaboration."

Federal and state officials are often accused of not working well together in Nigeria. But Lagos State administrators and federal authorities quickly merged two existing systems of disease surveillance and community mobilization. Staff volunteers were recruited and trained for higher pay and guaranteed life insurance. It ultimately took an emergency paid-volunteer workforce of 2,600 Nigerian health experts to make it all work.

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On August 12, not long after the nurse Justina Ejelonu, arrived in the isolation ward, Mrs. Ukoh, the nurse assistant, died. The patients inside the isolation center waited 12 hours before WHO authorities removed the body. The bed sheets and mattress were burned and the entire area scrubbed down with disinfectant. The mood was severely dampened after the news that Jatto

Abdulqudir, the ECOWAS representative who had contact with Patrick Sawyer, had died the same day in the men's ward. Despite the fact that patients on the wards were getting good care and outside support through prayer circles and phone calls, they were under immense emotional strain.

In anticipating the need for psychosocial support, the EOC recruited psychologists, medical psychiatrists, and social workers. One of the patients in the ward was "Mr. James" (a pseudonym). Three weeks after his admission, James was confused, sleeping poorly, and displaying erratic and often unruly behavior, similar to that observed in Patrick Sawyer. Before diagnosing him, health workers referred James to the psychosocial team. Led by Dr. Abdulaziz Mohammed, the team found that James felt he was not responding well to ORS, was deeply fearful of the outcome of his illness and had immense anxiety. The team had to figure out if James was suffering from a psychosocial disorder or if in fact he had contracted "Ebola virus encephalitis," a brain disease that is not well understood. But they could diagnose only by psychological evaluation. A neurological evaluation was too dangerous for health staff to undertake.

The team determined that James did not have brain damage because he did not display any discernable central nervous system pathology, speech defects or convulsions. Instead, he was diagnosed with "adjustment disorder with mixed disturbances of emotion." In addition to daily psychotherapy, he was prescribed the drug, amitriptyline, for his anxiety and irregular sleep patterns. The psychosocial team, the clinical staff and James' family, worked together to manage his condition. With this intervention, James' anxiety and confusion were significantly reduced. Soon thereafter, he was declared Ebola-free and the psychosocial team followed him for three months after his discharge.

The biggest priority for the team was to encourage family and friends to actually visit their loved ones in the wards – something never attempted in the history of an EVD outbreak. These were viewed as key to patient survival. But it took an immense amount of work. The team shuffled between family and friends on the outside and patients in the isolation wards, making visits to each up to three times a day.

Obinna Victor a social worker at LUTH who provided counseling in the men's ward recalls: "The relatives of those victims – whether suspected Ebola cases or real ones – were so much more emotionally and psychologically traumatized than the victims themselves because of the sudden confinement of their loved ones.

"I was bringing in the information concerning someone's wife or parents, telling the patients that their families are still very much with them and willing to come and see them, despite their

condition. They were ready to share the burden."

Two weeks after Sawyer died, the Lagos State Ministry of Health along with private partners finished their round-the-clock preparations for setting up a new and better isolation ward. The ward's infrastructure was designed to safely accommodate the friends and family members who were encouraged to visit. They encountered buildings with white hanging sheets that created restrictive space and increasing degrees of sensitive quarantine areas. There were signs indicating in red letters "contaminated area," or "safe area," as well as security ropes marking off designated footpaths. From the quarantine point of entry, family and friends followed the psychosocial team members' footsteps into a chamber where they had to be gowned. Near the entry was a room where relatives and friends could communicate through a protective barrier.

For those in isolation wards, moving to the new ward was a huge relief. Dr. Igonoh described it as "leaving hell and going to heaven." It was a cleaner building with better infrastructure. Patients even found brand new towels and nightwear neatly folded on the new beds. They also found that their colleagues – some who had worked alongside them to care for hospital patients at Lagos medical institutions – were now in the Ebola wards doing everything they could to save their friends. Volunteer physicians gowned up in intolerable heat and ran three shifts per day. Adesola Olalekan, a medical microbiologist and lecturer at the University of Lagos, worked as one of the phlebotomists. Like most others who volunteered, she was highly over-qualified for this task.

It is not easy to draw blood from someone with a hemorrhagic fever. Even before the needle gets inserted bleeding can occur, even from slight pressure. Given that this was the first outbreak in Nigeria, Olalekan and colleagues had to be trained by shadowing WHO and MSF physicians. Then they would draw blood while being supervised. Once they got signed off, two or more people were needed to draw blood at a time. After performing multiple tasks to gown up before entering the ward, one person collected blood, while another discarded and disinfected immediately thereafter. A third person might be on hand in case of heat exhaustion or potential accidents. Safety and contamination prevention were the highest priorities. There was a zero-tolerance policy for mistakes.

Bamidele Oke, a trained physician and a graduate student studying virology under Professor Omilabu, was part of a team that evaluated blood draws. All research in the virology lab came to a halt and activities were entirely dedicated to Ebola. One room was used to house and analyze blood samples. It had to be decontaminated before each use. For Oke, blood analysis wasn't easy or straightforward.

“We also looked at clinical symptoms and things like that. If someone was already vomiting but we were thinking it was a negative result, a new sample was needed.” Because Nigeria experiences chronic power outages, anything could go wrong in a lab, so one of Oke’s activities included hunting down diesel to power the lab’s generator, which was essential to maintaining samples and running the new polymerase chain reaction machine used to identify the Ebola virus.

The move to the new ward was bittersweet. It occurred the night of Justina Ejelonu’s death. The women in the isolation ward, including Ada Igonoh, encouraged each other to stay positive under incredibly grim and depressing circumstances. The following night, Stella Ameyo Adadevoh, the chief physician who had prevented Patrick Sawyer from leaving hospital, was moved from solitary isolation to the women’s ward. Although WHO doctors were administering IV fluids and oxygen support, she was now in a coma. For Igonoh, it was unbearable to see her mentor and such a significant force at First Consultants in this state.

As Adadevoh’s son, Bankole Cardos, explained: “On the first day I was able to come close and at least stand by the window and have a conversation with her. The second day, the same thing.... it appeared she may pull through; and on my birthday, on a Sunday, it was the most optimistic day. Then the next day we went in and the whole story changed. They called us into a room and just explained that this is going to happen. And it’s not even a matter of days anymore. It might be hours.”

Adadevoh died on August 19 at the age of 57.

The media and Nigerian households celebrated Adadevoh as the true heroine of the Ebola outbreak in Nigeria, as the key person who saved the rest of the country from a cataclysmic Ebola nightmare. She was the great granddaughter and grand-niece of two prominent nationalists and founders of independent Nigeria, Herbert Macaulay and Nnamdi Azikwe. Throughout the country, she was spontaneously mourned in a manner fitting of her family legacy.

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The EOC still had to locate highly dispersed Ebola contacts and the question was how to engage them. An emergency presidential decree enabled health officials to access mobile phone records to use for tracing purposes, but as Dr Patrick Nguku recalled, “we learned from the other countries that this idea of calling potential contacts with the index patient wasn’t working.”

Well-executed face-to-face discussions on infectious disease outbreaks tend to diffuse fear and anxiety. Phone calls have the potential to induce panic. The EOC recruited 500 “social mobilizers” and “contact tracers” – expert epidemiologists and public health officials. The contact tracers

conducted daily house-to-house outreach with people who had primary or secondary contact with the index patient. The social mobilizers swept through a broad radius of the Ebola contacts in order to meet with and check on others living near those under clinical watch.

To put the massive nature of this work into perspective, the former polio EOC tracked 40,000 communities and identified more than 900,000 children-recipients of the vaccine. Previous experience tracking polio included working with local community leaders and conducting polio-specific census work. When transformed to track Ebola, the tracers used apps on smart phones that collected names and their geo-coordinates. They logged body temperature and other health signs. The stats they produced showed up on a dashboard that officials could view on a big screen at the EOC. Those at the EOC headquarters could see a geographical representation of the contact tracers performing their work as it happened in real time.

At the end of the day, emergency responders called their families before arriving home. Family members took turns leaving buckets of water infused with bleach inside the front gate of their houses. Upon arrival, workers drove past the gate, parked the car, disrobed, and scrubbed down. Then they entered and resided in a separate part of the house. Unable to be in the presence of their loved ones and participate in the usual evening activities – cook and eat dinner, help the kids with homework, and tuck them in bed – the bleach bucket replaced all familiar greetings throughout the emergency response.

With a critical mass of contact tracers and social mobilizers, "there was a deliberate effort to account for every contact," Nkguku recalled. "We were reassuring each other that this was the right approach. But a couple days into the monitoring we made a decision that the very high risk contacts needed to stay at home.

"They would say, 'why are you telling us to stay at home? Is it because you think we had already contracted this disease?' It was high tension, high emotion. But the contact tracing staff's nature was to say with compassion and confidence that 'if we get you early, we treat you, we deal with the fever, we deal with the infections, and you have a better chance of survival.' That was the basics but it took some time."

This ongoing negotiating was one of the most difficult things that the EOC conceptualized and committed to managing. More than anything, this approach was meant to avoid encouraging people to disappear off of the EOC's radar. But just days into the emergency response, something very frightening happened. Two contacts being monitored left Lagos. One went to Enugu, a large town in eastern Nigeria. Another went to Port Harcourt, the international city-port located in the heart of Nigeria's oil country – the Niger Delta. Both of them ultimately tested positive for Ebola.

Like Patrick Sawyer, it was never fully understood why they left isolation. Faced with the possibility of infection, survival logics (early detection and early management) were probably being weighed against the potential for stigma and alienation. Everyone knew that surviving Ebola could mean re-entering the world as a transformed and abandoned stranger. Running away probably seemed like a sensible action in a place where all routines and human contact suddenly ended.

Faced with these disappearances, the EOC reached out to its former polio contact tracers, who lived in Enugu and Port Harcourt. They were immediately looped into the Ebola EOC. Tracers found that the nurse who left Lagos for Enugu was with her family. She was easily contacted and officials from Lagos escorted her and her husband back to the city. Contact tracers identified a total of 21 people who were immediately put under a clinical watch in Enugu. The nurse survived and luckily no Ebola infections showed up in her hometown.

But the man who escaped to Port Harcourt, Koye Olu-Ibukun, presented a nightmare scenario. Olu-Ibukun, one of the ECOWAS diplomats who rode in the car with Patrick Sawyer on the day he arrived in Lagos, disappeared and switched off his mobile phone. According to Nigerian journalists, he confided to a colleague in Lagos that he had developed symptoms. Through this colleague, a physician located in Port Harcourt, Dr. Ikechukwu Samuel Enemuo, agreed to provide him medical care.

Port Harcourt is home to 1.9 million people and is one of the largest delta regions in the world. The city has withstood colonial and indigenous powers duking it out for control of the rivers during the palm oil and Atlantic slave trades. These histories morphed into current-day deadly conflicts between local communities, multinational companies and the Nigerian military over the control of oil.

Along with passengers from all over Nigeria and all over the world, Olu-Ibukun boarded a flight to Port Harcourt. Once he landed, he made his way through the airport and the city. He checked into Mandate Gardens, a hotel close to Dr. Enemuo's clinic. The physician came daily to the hotel to treat Olu-Ibukun with oral rehydration therapy. Once he was relatively stable, he packed his things and left the hotel. Before Enemuo handed over the keys, he heavily doused everything in the hotel room with bleach.

Once back in Lagos, Olu-Ibukun contacted officials, but did not inform them that he had survived Ebola. They were relieved that a high-risk contact who went off the radar appeared never to have developed symptoms. On August 26, just days after Olu-Ibukum's return, the Federal Minister of Health, Dr. Onyebuchi Chukwu, very happily, but cautiously, announced to media: "Ebola has

been curtailed. All 129 people currently under surveillance have completed the 21-day observation period and only one person is symptomatic and being observed."

The Minister and other health officials did not know that two weeks prior, on August 11, Dr. Enemuo had developed a persistent fever in Port Harcourt. He continued to see patients and he performed surgery on two of them. Soon after, his symptoms worsened and he stayed at home. At some point during these two weeks, the doctor and his wife (also a physician) held a gathering at their home to celebrate the arrival of their newborn baby. On August 16, Enemuo was admitted to the Good Heart Hospital but he apparently never disclosed that he had discretely and successfully treated an Ebola patient. He received numerous visitors including members of his church who performed a healing ritual. Over the next six days, medical staff attended to him until his death on August 22. Five days later, Aremu Omilabu's virology department in Lagos confirmed that he died of Ebola.

The day after the Minister's announcement, the government retracted the good news. A new EOC was immediately established in Port Harcourt. An isolation facility was set up; house-to-house information campaigns commenced; and radio in local languages and dialects was used to educate the public. Twenty-one contact tracing teams were also deployed to Port Harcourt. They identified 526 people who had contact with Olu-Ibukum and Enemuo. Since Olu-Ibukun made his way by flight, the passenger lists were collected and attempts were made to contact all travelers. None of them contracted EVD. Port Harcourt's international airport was also saturated with workers screening people traveling within Nigeria and to other parts of the world. The tracers also had to find Ebola contacts living in nearby riverine areas, which are only accessible by boat.

The EOC discovered that the clinic where Enemuo resided never suspected Ebola until the day before the doctor died. High-level containment precautions were never taken. During his hospitalization, he shared a room with an elderly patient. His wife came for visits. His sister spent the night. Both his wife and the patient sharing a room in the hospital contracted Ebola. Enemuo's wife survived, the patient did not.

Once the events in Port Harcourt hit the national news, many in Nigeria made calls for criminalization, forced quarantine and the suspension of international flights. Despite the challenge of a brand new urban outbreak and the colossal logistics, the EOC refused these demands. It continued to stress the need to ensure public trust with face-to-face contacts, constant media education and daily national briefings made by the Minister of Health. It insisted that a compassionate approach and the stories of people surviving encouraged others to seek care and trust the process.

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Nigeria's approach to combatting Ebola contrasted with how events were unfolding in Liberia, Sierra Leone, and Guinea. After a nine month-long outbreak, and two weeks after Patrick Sawyer's arrival in Lagos, the WHO finally declared a global emergency. By that time, Ebola in the Mano River region had stretched across multiple generations of contact. It began in rural areas and was not 'visible' to authorities until it reached the cities.

In Monrovia, the capital of Liberia, government actions were not well coordinated or deployed. Attempts to reach out to communities were failing dismally. At the same time that Port Harcourt was being monitored, an isolation center was set up in the impoverished West Point, Monrovia – a neighborhood coping with many unattended Ebola infections. News of the center reached the neighborhood's residents via rumor instead of official communication. Soon thereafter, residents of West Point destroyed the isolation center. The government responded by ordering security forces to seal off the community in an attempt to contain infections. Protests immediately erupted and residents clashed with the police. The quarantine was lifted a week later, but there was still no United Nations or WHO global plan of coordination in place – something drastically needed for a country whose infrastructure and medical expertise had long been compromised by civil war and World Bank-induced debt. In the end, the U.S. military, which was closely involved in rebuilding Liberia's post-war security apparatus, was called in to manage what was then a dire situation. Prior to Ebola, the post-war reconstruction efforts invested massive resources in militaries and very little into health care systems, creating the logic of a militarized solution to Ebola in Liberia.

But following the 2014 military deployments by the U.S., UK, France and others to help curb the Ebola outbreak, there was a huge increase in infections. This prompted West Africans to question the usefulness of foreign military presence. It also spurred speculation on alternative motives of western humanitarian intervention. These speculations were driven by the already massive foreign expropriation of natural resources extracted from the mineral rich Mano River countries. Moreover, it coincided with foreign military ambitions after September 11, 2001, which fueled multi-millions of investment in biodefense, foreign military bases and counter-terrorism initiatives in the region. All these agendas left residents forgotten and alienated in the midst of the high stakes globalization.

While angry protests in West Point and other locations across the Mano River countries were making international headlines, far fewer reports detailed how Nigeria worked to eliminate Ebola. In less than 10 weeks, Nigerian health workers screened more than 147,000 people passing through airports, attending school, and moving about in public places. The contact tracing teams identified 894 contacts with the index patient; and nearly 19,000 home visits were conducted to

screen potential contacts and monitor symptoms. On October 20, 2014, the WHO declared the country Ebola-free. Nigerian health officials did not necessarily celebrate. In fact, they anticipated and waited for new infections to arrive, which fortunately never happened. But health authorities' vigilance remained until the entire region was declared Ebola-free in July 2016.

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Six days after being admitted to the isolation ward, Dr. Igonoh's symptoms cleared up. Then, two days later, her fever returned leaving her perplexed. She suspected it was malaria, which strikes Nigerians as often as the common cold does to those living in temperate climates. She decided to self-treat because during the outbreak no routine malaria testing had taken place in the ward due to safety concerns. Her instincts were accurate and the fever disappeared within two days. She moved from drinking only ORS to eating bananas and eventually to solid bland foods. On August 16th, two weeks after she went into isolation, she tested negative for Ebola.

Igonoh left behind everything she brought with her and went for a chlorine bath. She got dressed, walked out of the bathroom and down a path toward the isolation ward's medical staff, who were all waiting for her at the exit. She was handed a pair of scissors so that she could cut the red ribbon that led back to everything she had temporarily left behind. On the other side of the cheers and hugs was her family, completely ecstatic and also Ebola-free after weeks of isolation.

In Nigeria, the only treatment that Igonoh and all others received was bottles of oral rehydration solution, aspirin and vitamin supplements. There was no medicine in existence to treat Ebola infection. However, there were untested pharmaceuticals available. A promising treatment, ZMapp, licensed by the San Diego-based Mapp Biopharmaceuticals, was in short supply. Even though ZMapp's efficacy and side effects were relatively unknown, it was offered as compassionate treatment to western aid workers infected while combatting the epidemic. Most of those in the early stages of the infection survived Ebola.

However, at that point, no Africans had been offered ZMapp. Not even Sierra Leone's sole virologist and hemorrhagic fever specialist, Dr. Sheikh Umar Khan. International officials were worried that if Dr. Khan died of Ebola after receiving treatment from westerners, the potential for social unrest among an already angry Sierra Leoneon public would compromise the national response. Khan died on July 29, 2014, the same day, according to journalist Chernoh Bah, that the only ZMapp dose in Sierra Leone was flown to Liberia to treat two American aid workers. Unlike Dr. Khan (who may have lapsed into unconsciousness at the time his case was discussed), they were given the choice to try the experimental drug. Two weeks later, ZMapp was flown to Liberia only

because President Ellen Sirleaf requested it. By then 700 people had already been diagnosed with EVD.

In the face of these global racial divides, Nigerian officials had to rely upon their experience and expertise instead of pharmaceuticals. A total of twenty patients were diagnosed with EVD and twelve of them survived. This notable survival rate of 60% is one of the highest figures in Ebola outbreak history. This success occurred in spite of the fact that physicians were on strike, health care workers often fail to get their salaries on time (if at all), and that health care systems are dramatically underfunded and undersupplied.

The Nigerian government's extensive post-Ebola report explains the multiple factors that mitigated the outbreak: The determination to humanize patients was decisive in curbing the outbreak. In addition to the compassion that was instilled at every level of EOC operations, it was the first time that concentrated psychosocial support was implemented into an Ebola emergency response. It was also the first time "isolation" was completely redefined to include visits by family members to the wards, which proved essential to survival. The insistence that widespread public trust was possible, was also pivotal in controlling the outbreak.

After the Ebola emergency abated, 200 Nigerian volunteers travelled to the Mano River States to help contain Ebola infections there. Most responders returned to their normal duties. For some, it was the usual lab work, university lecturing and seeing patients. For others, it was attending to chronically reoccurring emergencies. Dr. Francisca Nwaokorie, who helped with the Lagos Ebola education programs, returned to Benue State in Nigeria's Middle Belt where a cholera outbreak had been underway since 2012 – an emergency that required attention to sanitation systems not scheduled for overhauls any time soon. Dr. Nguku's pioneering work on polio vaccination resumed when the virus unfortunately resurfaced again in 2016. Efforts to contain polio remain hampered by the security situation as a result of terrorist activity in northeast Nigeria, which has internally displaced two million people. The family of Dr. Ameyo Stella Adadevoh has established a trust in her name, which works to curb infectious disease and improve Nigerian health care systems and service delivery.

The Nigerian response was recognized as a model for future Ebola emergency outbreaks – an achievement that carried both pride and sadness. As Dr. Igonoh stated at a Lagos press conference that featured the governor and most Ebola survivors: "we are privileged to see this day, to be here with everybody, it's an honor…We remember the people that we lost, the wonderful people who risked their lives. We will never forget them. We can't. Our lives have been changed. And every one of us who went through this ordeal, we know that we are better for it."