

The ominous math of the Ebola epidemic

By **Joel Achenbach**, **Lena H. Sun** and **Brady Dennis** October 9, 2014

. The statistics include not just the obvious ones, such as case counts, deaths and the rate of infection, but also the ones that describe the speed of the global response.

Right now, the math still [favors the virus](#).

Global health officials are looking closely at the “reproduction number,” which estimates how many people, on average, will catch the virus from each person stricken with Ebola. The epidemic will begin to decline when that number falls below one. A recent analysis estimated the number at 1.5 to 2.

The number of Ebola cases in West Africa has been doubling about every three weeks. There is little evidence so far that the epidemic is losing momentum.

“The speed at which things are moving on the ground, it’s hard for people to get their minds around. People don’t understand the concept of exponential growth,” said Tom Frieden, director of the U.S. Centers for Disease Control and Prevention. “Exponential growth in the context of three weeks means: ‘If I know that X needs to be done, and I work my butt off and get it done in three weeks, it’s now half as good as it needs to be.’”

Frieden warned Thursday that without immediate, concerted, bold action, the Ebola virus

could become a global calamity on the scale of HIV. He spoke at a gathering of global health officials and government leaders at the World Bank headquarters in Washington. The president of Guinea was at the table, and the presidents of Liberia and Sierra Leone joined by video link. Amid much bureaucratic talk and table-thumping was an emerging theme: The [virus is still outpacing the efforts to contain it](#).

“The situation is worse than it was 12 days ago. It’s entrenched in the capitals. Seventy percent of the people [who become infected] are definitely dying from this disease, and it is accelerating in almost all settings,” Bruce Aylward, assistant director general of the World Health Organization, told the group.

Aylward had come from West Africa only hours earlier. He offered three numbers: 70, 70 and 60. To bring the epidemic under control, officials should ensure that at least 70 percent of Ebola-victim burials are conducted safely, and that at least 70 percent of infected people are in treatment, within 60 days, he said.

More numbers came from Ernest Bai Koroma, president of Sierra Leone: The country desperately needs 750 doctors, 3,000 nurses, 1,500 hygienists, counselors and nutritionists.

The numbers in this crisis are notoriously squishy, however. Epidemiological data is sketchy at best. No one really knows exactly how big the epidemic is, in part because there are areas in Liberia, Sierra Leone and Guinea where disease detectives cannot venture because of safety concerns.

The current assumption is that for every four known Ebola cases, [about six more go unreported](#).

The [latest World Health Organization statistics](#), published Wednesday, show 8,033 cases of suspected or confirmed Ebola in the West Africa outbreak, with 3,865 deaths. That

figure does not include [Thomas Eric Duncan](#), a Liberian man who died Wednesday in Dallas.

“This has been a particularly difficult outbreak because of the difficulty getting a lot of data quickly out of the countries,” said Martin Meltzer, a CDC researcher who models epidemics. “My crystal ball is painted a deep black. It’s like tracking a hurricane.”

Meltzer helped produce a report in late September that said that at current rates of infection, as many as 1.4 million people would become infected by January. That number, officials stressed, was a straight extrapolation of the [explosive spread of Ebola](#) at a time when the world had managed to mount only a feeble response. The more vigorous response underway is designed to bend that curve.

The U.S. military is [building 17 treatment centers](#) that can hold 100 people each, but the top military commander in Africa said Tuesday that they won’t be ready until mid-November. Liberia and Sierra Leone have a particularly keen need for more hospital beds. The two countries currently have 924 beds between them, [but they need 4,078](#), according to the WHO.

“The virus is moving on virus time; we’re moving on bureaucracy or program time,” said Michael Osterholm, director of the Center for Infectious Disease Research and Policy at the University of Minnesota. “The virus is actually picking up the pace. Even as we add resources, we get farther behind.”

Aylward, the WHO official, pointed to some bright spots in the response in recent weeks. Liberia has gone from just six burial teams to 54. Officials are working with religious leaders to enable safe burials while respecting cultural traditions. “There’s a way to observe most of the ritual while keeping safe,” Aylward said in an interview.

But he said that overall, the countries in West Africa still lack a coordinated response.

“What is needed in every country is a list, an Excel spreadsheet. It’s not complicated. Here is every district, every county, here is burials and who is going to lead them, here is case finding and contact tracing, here is behavioral change,” Aylward said. In effect, the countries need better numbers.

The latest data from the WHO show hints of progress in bringing Ebola under control in certain rural areas stricken by the disease earlier this year. Seven provinces in Guinea that previously reported Ebola cases saw no new infections in the most recent three-week period covered in Wednesday’s WHO update. Two districts in Sierra Leone and one in Liberia showed a decline in infections.

But experts caution against reading too much into small fluctuations that may simply reflect an increase or decrease in surveillance or a reappraisal of older data. This cautious attitude toward lower numbers particularly applies to a reported drop in new cases in Liberia in the past three weeks, which the WHO said is “unlikely to be genuine” and more likely reflects “a deterioration in the ability of overwhelmed responders to record accurate epidemiological data.”

Gerardo Chowell, a mathematical epidemiologist at Arizona State University, used data compiled through the end of August to estimate the reproduction number of 1.5 to 2 for this Ebola epidemic. Chowell said that even modest gains in lowering that number could give health officials and the military a better chance of controlling the epidemic.

“Maybe we can bring it from two to 1.2 or 1.3, which would indicate that the number of new cases will be dramatically reduced, and that will give you time,” he said.

Another key number: how many days elapse between the time symptoms occur (which is when a person becomes contagious) and when health officials diagnose the disease in that person. Driving that number down is critical to containing the virus.

The incubation period for Ebola is usually about a week to 10 days, although it can last as long as 21 days. That creates obvious challenges for health workers who have to do contact tracing — they have to repeatedly knock on doors and take the temperatures of people who weeks earlier were potentially exposed to the virus. But it also gives those same workers a decent interval of time to track down people who may be infected before they start shedding the virus and potentially spreading the disease.

There are several scenarios for how this plays out. One is that the conventional methods of containing Ebola — isolating patients and doing contact tracing of people who might be exposed — lower the rate of new infections until finally the epidemic burns itself out. That has been the case in all previous outbreaks of Ebola, although no outbreak has ever been nearly as extensive as this one.

A second scenario is more dire: The conventional methods come too late, the epidemic keeps spreading, and the virus is beaten back only when vaccines can be developed and scaled up to the point where they can be widely distributed.

As the number of infections increases, so does the possibility that a person with Ebola will carry it to another country. This is known as an export.

“So we had two exports in the first 2,000 patients,” Frieden said in a recent interview.

“Now we’re going to have 20,000 cases, how many exports are we going to have?”

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