

to go to waste.” Clearly, the economic crisis has allowed the Obama administration to undertake far-reaching health care initiatives that it could not otherwise have launched quickly, if at all. The government will now have to determine how to spend the money promptly — and wisely.

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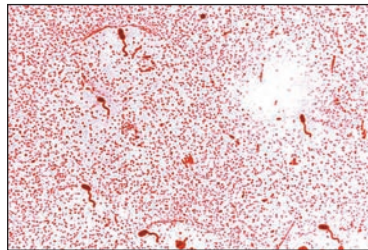
A Lion in Our Village — The Unconscionable Tragedy of Cholera in Africa

Eric D. Mintz, M.D., and Richard L. Guerrant, M.D.

Inexcusably, the completely preventable ancient scourge of cholera rages among poverty-stricken and displaced people today, with as many as one in five persons with severe illness dying for lack of safe drinking water and sanitation and a simple therapy consisting of salt, sugar, and water. Cholera, a dreaded waterborne disease of centuries past, remains a troubling barometer — and often a fatal consequence — of inadequate access to safe drinking water and sanitation. Epidemic cholera is the indicator of widespread contamination of drinking water with human feces. As such, it is the bellwether of many less dramatic but equally fatal or disabling diseases that flourish in filth and a litmus test of our willingness to tolerate flagrant violations of the human right to clean water and sanitation.

More than 150 years ago in London, an astute physician, John Snow, described the mode of transmission of cholera (nearly 30 years before Robert Koch discovered the causative agent, *Vibrio cholerae*; see

photo), and a visionary engineer, Joseph Bazalgette, established an effective means of preventing it: the provision of municipal sanitation.



Photomicrograph of *Vibrio cholerae* with Leifson Flagella Stain.

tion. Cholera is thus one of the first infections whose mode of transmission was understood and for which effective prevention measures, collectively referred to as “the sanitary revolution,” were developed and implemented. Because of these early observations and interventions, cholera has become vanishingly rare in the United States and other developed countries.

In the 1960s, the continued flourishing of cholera in its endemic home of South Asia inspired the treatment revolution of oral rehydration therapy (ORT). ORT has dramatically reduced cholera’s case

fatality rate, which was once more than 30%, to less than 1% in South Asia and has prevented millions of deaths worldwide. In the 1990s, when epidemic cholera returned to Latin America after a century-long absence, governments, United Nations agencies, and the private sector reacted swiftly with investments in health care, drinking water, and sanitation. These concerted efforts, which drew from the sanitary and treatment revolutions, kept mortality below 1% and reduced the number of cases from more than 1 million in the 1990s to fewer than 5000 in the new millennium.¹ Notable decreases in the rates of typhoid fever, hepatitis A, and overall infant mortality soon followed. Together, these two revolutions should have relegated cholera to the history books. However, neither the sanitary revolution nor the treatment revolution has been fully realized in Africa, where illness rates and mortality are soaring for lack of water, sanitation, salt, and sugar.¹

Since we understand the transmission, prevention, and treatment of cholera so well, the disease pos-

 A slideshow is available at NEJM.org

es little risk to people of means, even in the poorest societies. Treated bottled or running water, soap or hand sanitizer, and private flush toilets are available in every city in the world, though their price is often beyond the reach of the general population. Travelers to countries where cholera is endemic or epidemic may purchase further protection through immunization for a fraction of their plane fare. If infected, people with cash or credit can easily obtain effective therapies, such as ORT and antimicrobial agents.

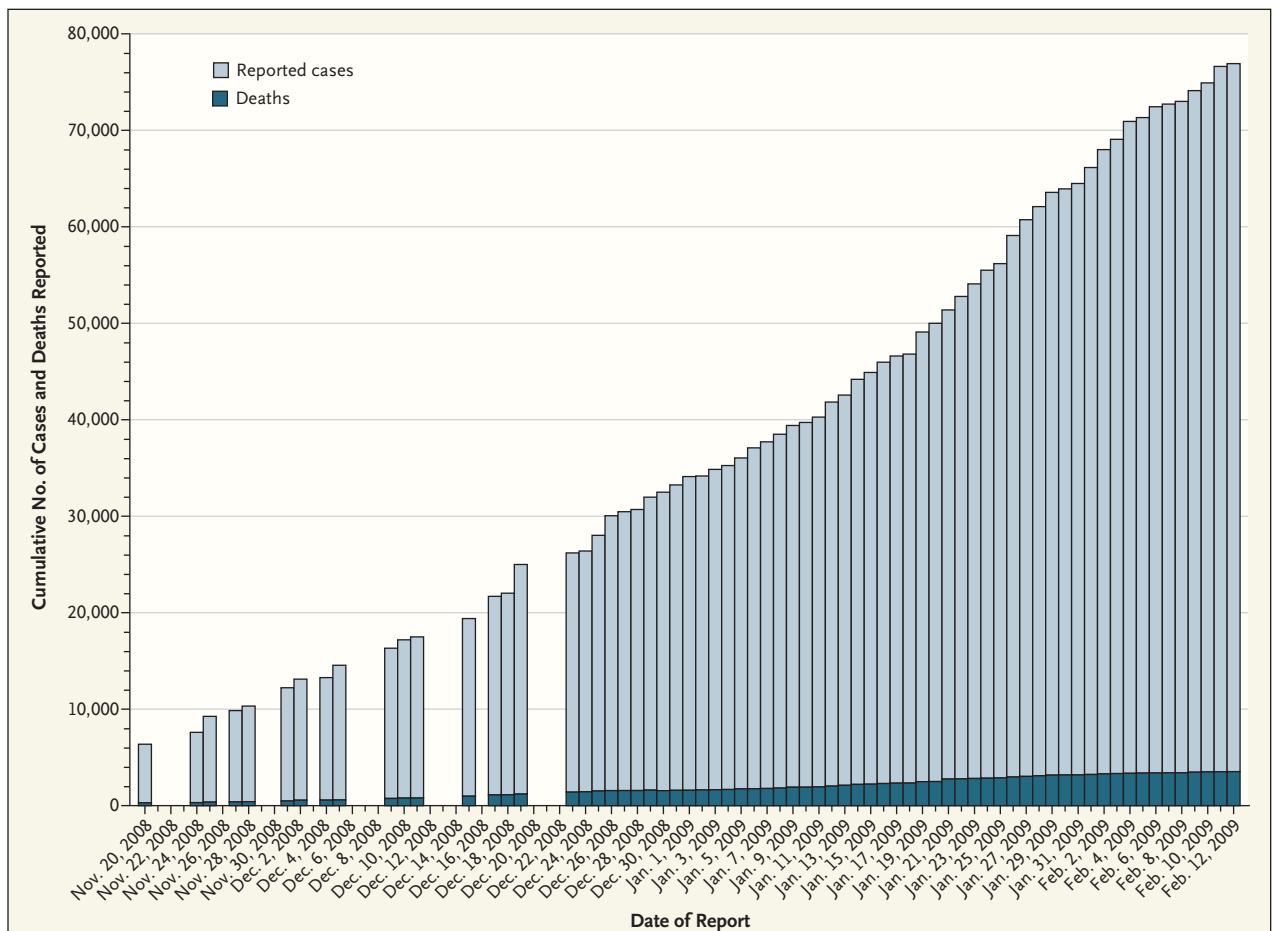
Unlike the severe acute respiratory syndrome, avian influenza, and other infectious-disease threats that have emerged recent-

ly, cholera is easily avoided and easily treated. The failure of the global community to mobilize the resources needed to prevent and to treat cholera among the less fortunate reflects our lack of commitment to equity and social justice. Improving access to safe drinking water, adequate sanitation, and basic health services are among the core Millennium Development Goals agreed to by all United Nations member states.

Epidemic cholera represents a fundamental failure of governance, and bold and visionary leadership is required if we are to attack its root causes. Such leadership has been demonstrated in other contexts in Africa. For example, Presi-

dent Yoweri Museveni of Uganda began to change public attitudes toward the human immunodeficiency virus and succeeded in reducing the rates of AIDS in his country, in part by recharacterizing the disease as similar to any other threat to the community: “When a lion comes into your village,” he said, “you must raise the alarm loudly.”

It is time to sound the alarm again. Whereas reported case fatality rates for cholera in the rest of the world are now well below 1%, rates in excess of 5% are still commonly reported in many African countries.¹ According to United Nations agencies, the cumulative case fatality rate in the ongoing



Cholera Cases and Deaths in Zimbabwe (November 20, 2008–February 12, 2009).

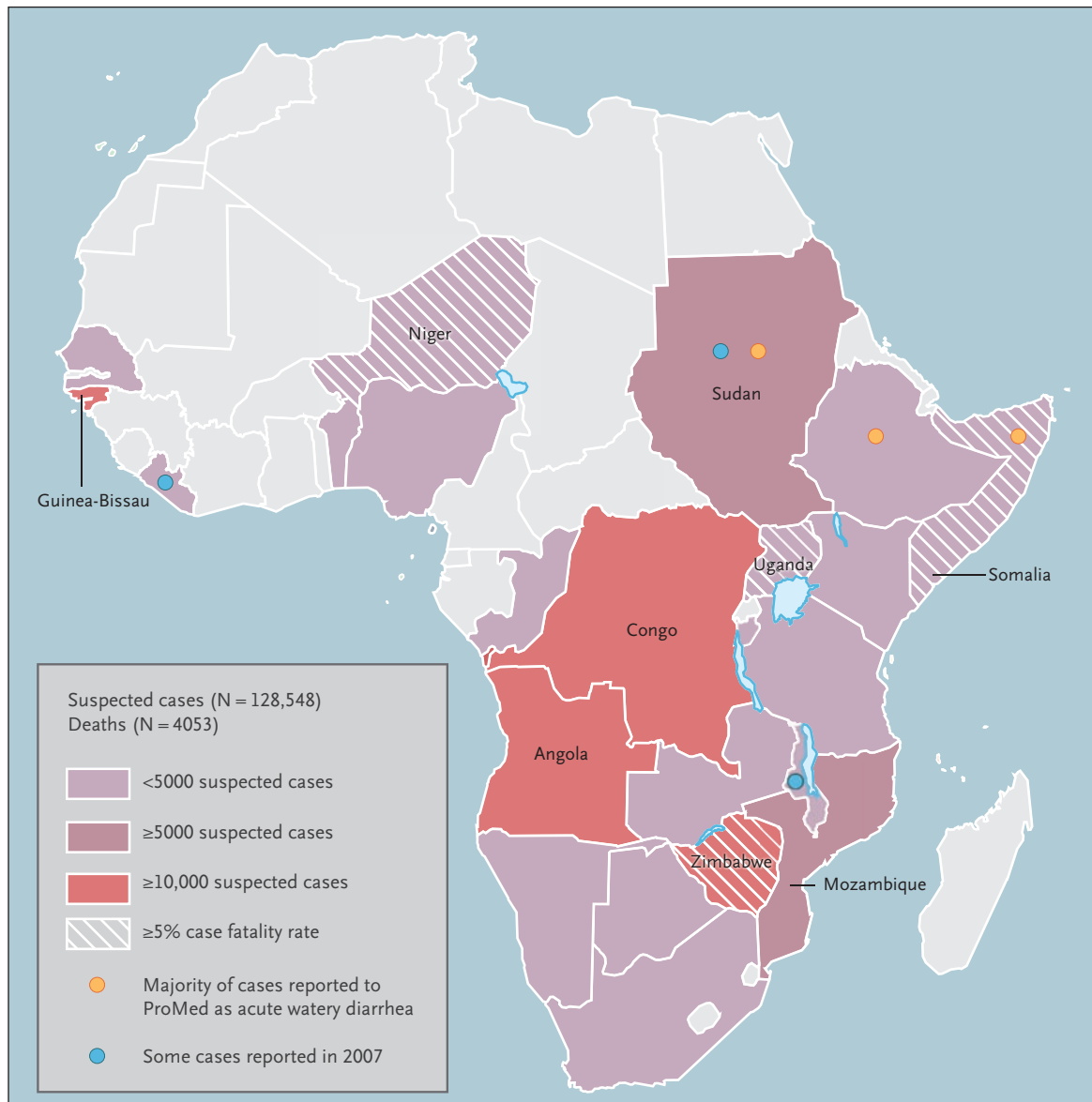
Data are from the United Nations Office for Coordination of Humanitarian Affairs (ochaonline.un.org/zimbabwe).

cholera epidemic in Zimbabwe remained stubbornly above 4.7% through February 12, 2009, by which point 5 months had elapsed since the epidemic began, and more than 73,000 cases and 3500 deaths had been reported (see graph). The epidemic in Zimbabwe shows no signs of waning and has spread to neighboring South Africa and Zambia, causing

thousands of additional cases. Unrelated epidemics in more than a dozen countries in sub-Saharan Africa within the past year have caused nearly 100,000 illnesses and well over 1000 deaths (see map). Just as the many cholera cases reported in Africa reflect a lack of access to safe drinking water and proper sanitation, the high death rate underlines a lack of access to basic health care services

and supplies. Worrisome declines have been documented in the proportion of African children who receive ORT and continued breastfeeding or other types of feeding for routine management of diarrheal diseases.² Wider availability and use of ORT and effective adjunct therapies (such as oral zinc, which reduces the illness duration and stool output) could prevent many deaths from cholera and

 An interactive version of this map is available at NEJM.org



Map of Cholera Outbreaks in Sub-Saharan Africa in 2008, Showing Numbers of Suspected Cases per Country.
Data are from ProMed (www.promedmail.org/pls/otn/f?p=2400:1000); data for unshaded countries were not reported.

other diarrheal diseases in Africa.³ Beyond the immediate threat of death lies the menace of the silent, long-term effect of repeated or persistent diarrheal illnesses that impair the physical and cognitive development of impoverished children, who may be robbed of intellectual potential — up to 10 IQ points, according to some estimates — by the lack of safe water and sanitation.⁴

Although it is clear that resources and political will must be mobilized to bring the sanitary and treatment revolutions to sub-Saharan Africa, critical questions remain about cholera prediction, prevention, and response in Africa. We are only beginning to understand the interactive microbial and societal virulence factors that influence the spread of *V. cholerae*. Recently shed vibrios, for example, appear to be substantially more infectious than those that have adapted to their aquatic environment — a finding that highlights the importance of disruptions in water and sanitation. Rising water temperatures, which lead to plankton blooms, may increase the prevalence of vibrios in the natural environment and the risk of epidemic cholera in areas where drinking water is obtained

from untreated surface sources. Vibriophage, on the other hand, may dampen an epidemic and might provide a biologic tool for epidemic control. Inexpensive techniques for household water treatment (including point-of-use chlorination, filtration, and solar disinfection) can prevent cholera and other waterborne diseases but have not been scaled up to reach the hundreds of millions of people who could benefit from them while awaiting access to piped treated water. An oral cholera vaccine is widely marketed, but despite a successful field trial in Mozambique,⁵ the number of doses, time required to engender protective immunity, short duration of protection, and cost have limited its usefulness in epidemic response and in the control of endemic disease. A less expensive and simpler single-dose formulation of this vaccine is currently in field trials.

In 2005, the reported incidence of cholera in Africa was 95 times that in Asia and 16,600 times that in Latin America. In 2007, the reported rate of death from cholera in Africa was seven times that in Asia; no cholera-related deaths have been reported in Latin America since 2001.¹ These preventable cases and deaths result from a

lack of essential infrastructure, inadequate health care delivery, and the failure of the global community to muster the political will necessary to extend the benefits of the sanitary and treatment revolutions to all people. The lion is in our human village, and we must do more than sound the alarm.

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The views presented here are those of the authors and are not necessarily those of the Centers for Disease Control and Prevention.

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Rotavirus Vaccines — Early Success, Remaining Questions

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In 2006, the results of pivotal clinical trials of two new rotavirus vaccines — RotaTeq (Merck) and Rotarix (GlaxoSmithKline) — were published, and high efficacy (85 to 98%) against severe rotavirus diarrhea was reported for both products.^{1,2} Perhaps even

more important, neither vaccine was associated with intussusception, an adverse effect that had led to the withdrawal of another rotavirus vaccine — RotaShield, made by Wyeth–Lederle — from the U.S. market in 1999. The rapid resurgence of rotavirus vaccines

after the abrupt and devastating setback associated with the withdrawal of RotaShield was remarkable, reflecting the commitment of the public health community and the vaccine industry to preventing this most common cause of severe diarrhea in children. In