SUPPLEMENT ARTICLE

National Surveillance Data on the Epidemiology of Cholera in Cameroon

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Background. The cholera burden in Cameroon has increased during the past 2 decades. During 2010 and 2011, the largest number of cholera cases in Cameroon since February 1971 were reported. This article describes cholera outbreaks during 2010–2011.

Methods. Data received from the national surveillance system from 2010 and 2011 were compiled and analyzed.

Results. The first suspected cholera cases were reported in the Far North region on 6 May 2010. In 2010, 10 759 cholera cases were reported by 8 of the 10 regions in the country, with 657 deaths (case-fatality ratio [CFR], 6.1%). In 2011, through September 22, 17 121 suspected cholera cases, including 636 deaths (CFR, 3.7%), were reported all over the country. During 2010, the Far North region accounted for 87.6% of cases (9421/10 759) and 91.6% of deaths (602/657) recorded. By contrast, during 2011, 5 regions (Far North, North, Center, Southwest, and Littoral) accounted for 90.6% of cases (15 511/17 121) and 84.0% of deaths recorded. *Vibrio cholerae* was identified in 525 stool specimens, and all organisms were serogroup O1.

Conclusions. The ongoing cholera outbreak in Cameroon increased in intensity and geographic spread from 2010 to 2011. Nevertheless, the overall CFR decreased during this period. Strengthening the early warning system and enhancing water, sanitation, and hygiene interventions and sensitization should be considered in addressing cholera outbreaks.

Keywords. Cameroon; cholera; epidemiology; outbreaks; surveillance; *Vibrio cholerae*.

Cholera reached the coast of Cameroon in February 1971, leading to 2167 cases according to reports by the World Health Organization (WHO) [1]. This was followed by a 20-year period characterized by sporadic disease clusters. Like the other countries in the Lake Chad Basin (ie, Niger, Nigeria, Chad), cholera outbreaks in Cameroon occurred seasonally in specific regions and among specific populations. Two at-risk areas were identified: (1) coastal areas open to the ocean and subject to regular flooding, and (2) northern areas characterized by frequent population movements along the border with Chad and Nigeria and by the presence of flood zones along the Logone river.

The cholera burden in Cameroon has increased during the past 2 decades: the annual number of reported cases [1] increased between 1991 and 2010, with 4026 cases in 1991, 5796 in 1996, 8005 in 2004 [2], and 10 759 in 2010 [3]. By contrast, the case-fatality ratio (CFR) has decreased [1], with values of 12% in 1991, 8.3% in 1996, and 6.3% in 2010. This article presents public surveillance data from 2010 and 2011 on a regional level and describes the achievements and challenges for public cholera surveillance in Cameroon to date.

METHODS

Data Sources

The data reported in this document were gathered from the Guide for the Treatment of Emerging Infectious

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Diseases and Priority Diseases in Cameroon, a data entry form for cholera data collection that has been used since the beginning of 2011, a report on the epidemiological situation as of 3 January 2011, summary information on the cholera outbreak of 6 May 2010 to 30 December 2010, and reports from the Pasteur Center of Cameroon. These documents were available within the Ministry of Health, Department of Disease Control as part of their official capacity.

Organization of Cholera Surveillance in Cameroon

Cameroon has mandatory cholera reporting as part of a passive surveillance system with case follow-up. The Epidemiology Service, part of the Disease Control Department of the Cameroon Ministry of Health, is in charge of the epidemiological surveillance of cholera [4]. The service includes the Response Office and the Epidemiological Surveillance and Research Office. Three laboratories participate in the biological surveillance of cholera in Cameroon: the Centre Pasteur Cameroon, in Yaoundé; the Centre Pasteur Antenne de Garoua; and the Laboratory for Emerging Infectious Diseases, University of Sciences of Buea. The first 2 are part of the Pasteur Institute network (available at: http://www.pasteur-international.org/ip/easysite/pasteur-international-en; accessed 24 February 2012). The objectives of cholera surveillance include the detection of cholera outbreaks, monitoring trends over time, and comparing CFRs and case counts over time nationally and in comparison to neighboring countries.

Case Definitions

During April 2010, cholera case definitions were revised. During the cholera outbreak period, suspected cases were defined as acute watery diarrhea with or without signs of dehydration, and with or without vomiting. Outside of the cholera outbreak period, suspected cases were defined as severe dehydration or death following acute watery diarrhoea in patients aged >5 years. Confirmed cases were defined as suspected cases with laboratory identification of *V. cholerae* in a stool culture.

Outbreak Definition

A confirmed case of cholera in a given region constitutes an outbreak. The end of the cholera outbreak is declared for a region when there are no confirmed cases of cholera in that region for at least 1 month and for the country if there are no confirmed cases in any region.

Reporting and Outbreak Investigation

Cases identified in healthcare facilities are reported daily to district healthcare facilities. Data from the health districts are then sent to the regional Delegations of Public Health, which then compile the information and send it to the National Disease Control Department, Cameroon Ministry of Public Health, and to the WHO twice per week. Outside of the epidemic season, information on age, sex, geographic location, and clinical outcomes are collected weekly by means of a standardized data collection form for information related to diseases of epidemic potential. During the outbreak period, summary counts of suspected cases and deaths linked to cholera are compiled daily by means of standardized data collection forms.

Stool samples collected from suspected cholera cases are evaluated by the National Reference Laboratories, using culture; identified *V. cholerae* isolates are tested for antibiotic resistance. Universal testing of stool samples is done at the start of a cholera outbreak in a given region; when the outbreak peak is reached, the frequency of testing decreases to 1 sample per 10 patients. At the end of the outbreak, universal testing of samples of suspected cases is started up again.

Ethical Issues

The current evaluation analyzed reportable public health data, with analysis performed by representatives of the government agency in charge of cholera surveillance. Consequently, no institutional review board approval was sought or obtained for this review of public health surveillance data.

RESULTS

The completeness of the notification process from the peripheral to the central levels varies and is not done in a sufficiently timely manner (Figure 1). The average completeness of data collected on surveillance forms in 2011 from the 181 health districts that make up the country was 72%. The lowest completeness was 34% for the Littoral region and 38% for the Northwest region, both of which also had the lowest frequencies of notification. On average, 20% of reports were received by the agreed-on date. The highest frequency of timeliness was observed in Adamawa (45%), and the lowest frequencies were observed in the Northwest (0%), South (8%), and North (9%) regions.

The current cholera outbreak started on 6 May 2010. The first suspected cholera cases were reported in the Far North region. A total of 10 759 suspected cases, including 657 deaths (CFR, 6.1%), were reported by the national surveillance system during 2010 (Table 1). From 3 January 2011 through 22 September 2011, a total of 17,121 suspected cholera cases, including 636 deaths (CFR, 3.7%), were reported, bringing the total number of cases and deaths since the start of the outbreak to 27 725 and 1282 (CFR, 4.6%), respectively. During 2010, 2 of 10 regions in the country (the East and South regions) reported no suspected cases, whereas all regions were affected in 2011 (see Supplementary Figures 1 and 2). In 2010, the cholera outbreak was mostly concentrated in the Far North (9421 cases), North (498 cases), and Littoral (456 cases) regions. In 2011, the Far North, North, and Central regions reported the greatest number of suspected cases (3661, 3591, and 3133, respectively). The decrease in CFR from 2010 to 2011 occurred in all active regions except the Adamawa region (with an increase from 0%

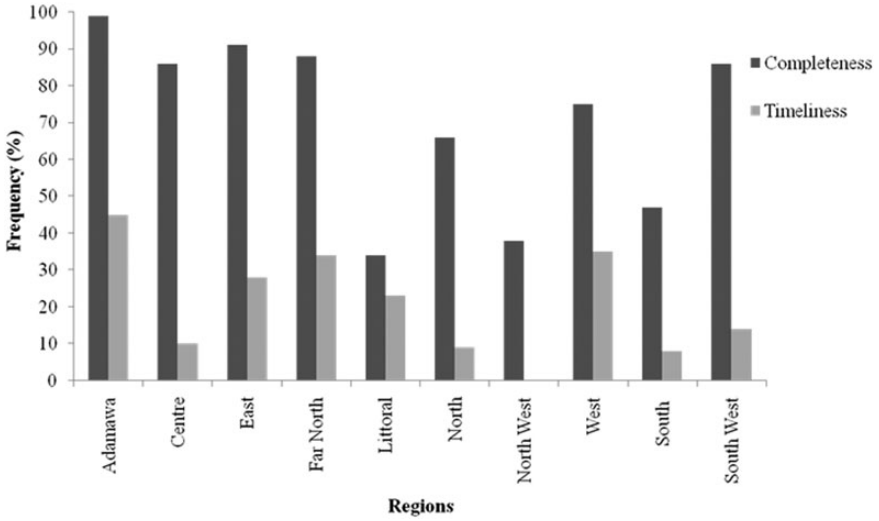

Figure 1. Completeness and timeliness of suspected cholera reports in Cameroon during 2011, by region.

[for 1 suspected case] to 9.3%), the West region (an increase from 0% to 5.9%), and the North region (an increase from 4.5% to 5.8%).

At the national level, during 2010 there was a single peak at week 38. During 2011, reported counts of suspected cholera cases gradually increased from the start of the year (Figure 2), with an initial peak around week 21 and a second epidemic peak at week 33. The first peak corresponded to peaks in weekly case counts in the West (n = 245), North (n = 232), and Center (n = 117) regions, while the second peak corresponded to peaks in weekly case counts in the Far North (n = 414), North (n = 221), and Coastal (n = 113) regions.

Although the Far North, North, and Center regions reported the greatest number of suspected cholera cases since January 2011, they each had independent epidemiologic characteristics, as illustrated by weekly case counts and variations in attack rate (Figure 3). The Center region experienced a rapid increase in the incidence of cholera cases, with a peak during week 12 and a gradual decrease in cases during subsequent weeks, with an average of 15 cases per week after week 25. The North region had few cases early, followed by a gradual increase starting during week 17; a plateau during week 27–31, with case counts varying from 250 to 326 cases; and a more recent decrease. The Far North region experienced 2 moderate increases

Table 1. Incidence of Cholera Cases and Deaths in Cameroon, by Region and Time

	6 May to 31 December 2010				1 January to 22 September 2011			
Region	Cumulative Cases, No.	Cumulative Deaths, No.	Attack Rate[a]	CFR (%)	Cumulative Cases, No.	Cumulative Deaths, No.	Attack Rate[a]	CFR (%)
Adamawa	1	0	0.1	0.0	183	17	17.5	9.3
Center	46	2	1.3	4.3	3133	99	106.3	3.2
East	0	0	0.0	0.0	1	0	0.1	0.0
Far North	9421	602	263.5	6.4	3661	146	111.0	4.0
Littoral (Coastal)	456	17	16.9	3.7	2096	49	87.5	2.3
North	498	22	23.1	4.5	3591	209	168.2	5.8
Northwest	1	1	0.0	100.0	142	10	6.5	7.0
West	1	0	0.0	0.0	1228	72	66.9	5.9
South	0	0	0.0	0.0	56	3	8.5	5.4
Southwest	335	13	16.0	2.5	3030	31	204.1	1.0
Overall	10 759	657	56.0	6.1	17 121	636	90.4	3.7

Abbreviation: CFR, case-fatality ratio.

[a] Defined as cases/100 000 inhabitants.

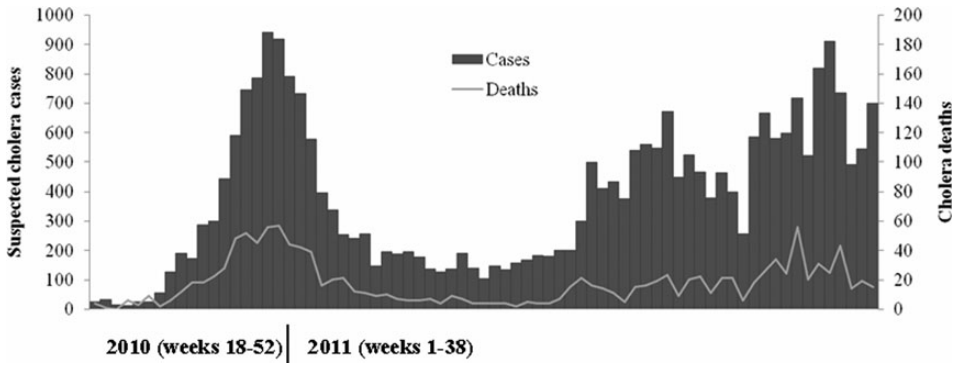

Figure 2. National epidemic curve of suspected cholera cases and deaths, Cameroon, 2010–2011. The current outbreak started during week 18 in 2010 (the week of 6 May). The first epidemiological week of 2011 was 3 January to 9 January 2011.

in cases, with a maximum of 114 cases, followed by an abrupt increase starting week 30 and peaking during week 35, at 659 cases.

Within regions, substantial variation in reported suspected cholera cases was documented. For example, in the Far North region, the cholera outbreak was centered in the districts of Maga, Guere, and Kousseri, which experienced attack rates of 793, 496, and 433 cases/100 000 inhabitants, respectively. In the North region, peaks occurred in Bibemi and Figuil districts, with attack rates of 1097 and 508 cases/100 000 inhabitants, respectively. In the Center region, peaks occurred in Biyem-Assi and Obala districts, with attack rates of 593.3 and 694.5 cases/100 000 inhabitants. The highest district attack rate documented occurred outside of the 3 regions with the most cases, in Foumbot district in the West Region, with an attack rate of 1224 cases/100 000 inhabitants.

During 2010, 113 of 302 analyzed stool samples (37.4%) from patients with suspected cases of cholera tested positive for *V. cholerae* O1 (Table 2). During 2011, through 12 September, 412 of 626 analyzed stool samples (65.8%) tested positive for *V. cholerae* O1.

DISCUSSION

Prolonged cholera outbreaks have been observed in several locations in Africa over the past 2 years, including Zimbabwe, Angola, Ethiopia, Somalia, and Sudan [5]. Since May 2010, Cameroon has had the largest documented cholera outbreak in

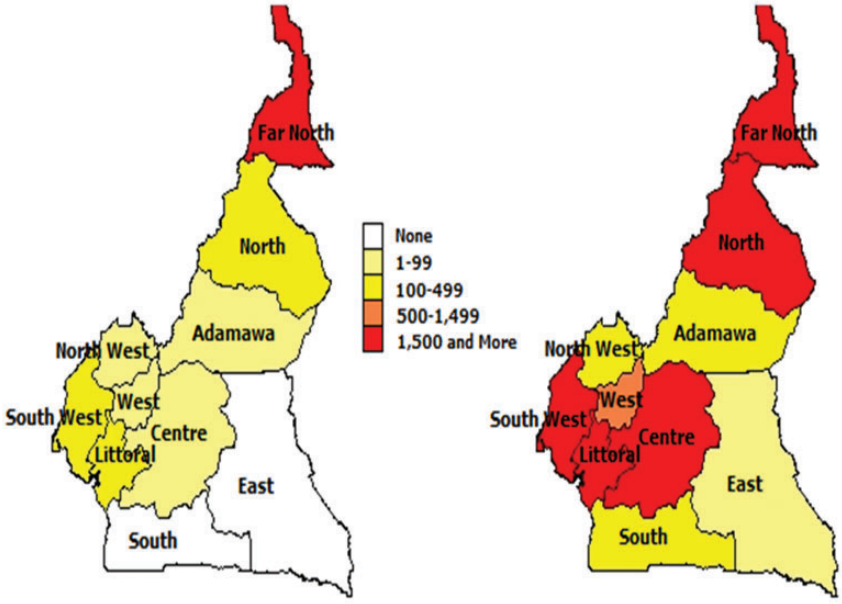

Figure 3. Suspected cholera attack rates per 100 000 inhabitants in Cameroon, from May to December 2010 (left) and from January to 22 September 2011 (right).

Table 2. Laboratory Surveillance for *Vibrio cholerae* in Cameroon, 2010–2011

Region(s)	6 May 2010 to 27 December 2010		1 January 2011 to 12 September 2011	
	Stool Samples, No.	Samples Positive for *V. cholerae* O1, No. (%)	Stool Samples, No.	Samples Positive for *V. cholerae* O1, No. (%)
Center	45	8 (17.8)	231	144 (62.3)
Littoral	105	41 (39.0)	212	157 (74.1)
West	10	1 (10)	25	12 (48.0)
Northwest	. . .	. . .	8	6 (75)
South	1	0	8	5 (62.5)
Southwest	8	4 (50.0)	4	3 (75)
East	3	0	22	1 (4.5)
Northern regions	130	61 (46.9)	116	84 (72.4)
Overall	302	113 (37.4)	626	412 (65.8)

its history in terms of duration and number of suspected cases. As of week 38 during 2011, there were 17 121 cases of cholera, well above the 10 759 cases recorded during the previous year, suggesting that the outbreak is accelerating. The national epidemic curve shows 2 peaks, one in May, associated with increased case numbers in the West, North, and Center regions, and a second in July, corresponding to an increase in cases in the Far North, North, and Littoral regions. The onset of the second peak occurred when the cholera epidemic spread across the border to the 4 countries of the Lake Chad Basin [6].

To control the current cholera epidemic, the Cameroon government has taken numerous steps, which are organized and overseen by an interdepartmental National Operational Committee for Cholera Control that includes representation from the Ministries of Health, Education, and Water and Energy. This committee also oversees interdepartmental regional committees. The country has been organized with 5 centers for coordination of cholera control that provide technical leadership, management of cholera epidemics, epidemiological surveillance, case management, laboratory and logistics support, and social mobilization. The Cameroon government has worked with the WHO and the SURVAC project (available at: http://www.cdcfoundation.org/what/program/strengthening-disease-surveillance-and-response-central-africa; accessed 9 October 2012) to improve surveillance activities, including strengthening the Integrated Disease Surveillance and Response system (available at: http://www.afro.who.int/en/clusters-a-programmes/dpc/integrated-disease-surveillance/features/2473-idsr-epidemiological-report-july-2010.html; accessed 9 October 2012), increasing field epidemiology training, and improving reporting tools. To address cross-border issues, Cameroon has designated a specific focal point; initiated or strengthened technical and information exchanges with Niger, Chad, and Nigeria; organized with Chad a unified communication policy along their common border; supported an anthropologic study of perceptions about cholera along the border with Chad; and provided free treatment for patients, regardless of nationality, along the border with Chad.

Risk factors for cholera in Cameroon have not been evaluated systematically. Numerous possible explanations for the current outbreak exist, including cross-border trade through weekly markets; seasonal markets; seasonal fluctuations in agriculture, fishing, and livestock management; widespread poverty among households, including those in the Littoral region along the coast, with poor access to clean water and sanitation; funerary practices and rituals such as traditional autopsies; and the intensity of traffic along the railway lines connecting to the Center region. Environmental risk factors have also likely contributed to the outbreak, particularly the rainy season and an increase in flooding along lakes and rivers. Indeed, in the 3 main affected areas, the epidemic peaked during the rainy season. These risk factors are accentuated by inadequate healthcare access, such as the lack of seeking medical attention because of the fear of being stigmatized and the lack of physical access to medical facilities.

Lack of healthcare access also contributes to underestimation of the cholera disease burden. Underestimation is further accentuated by incomplete reporting, which in turn varies by region. The cholera surveillance system could be improved by the involvement of trained informants in the field, including social mobilization teams, members of the health and sanitation committees in the communes, and members of nongovernmental organizations. Such teams could participate in expanding the extent of investigations, active research and notification of cases in the community, maintaining health district records, and rumor control. Better financial incentives and regular feedback of information to different actors in the surveillance system could improve the completeness and promptness of the reporting.

The current surveillance system does not allow identification of high-risk populations toward which interventions can be directed. The ability to target high-risk populations is particularly critical in resource-limited settings to maximize the impact of control and prevention measures. However, case-based reporting is not conducted, and the report form provides only

summary information on the number of cases and deaths by week and location. Contextual information on the circumstances and history of the outbreak is not collected. Consequently, one mechanism to improve identification of at-risk populations is to use more-sophisticated individual-level reporting forms that record data such as age, sex, address, and profession.

Additional deficiencies include poor timeliness of reporting; poor representativeness, because reported cases are limited to individuals treated at healthcare facilities; and failure at local levels of the healthcare system to use a national standardized cholera case definition. The latter has resulted from the abundance of old materials and information circulating on cholera. To adapt to changes in the social, economic, ecological, and technical environment and to meet International Health Regulation requirements, ongoing reinforcement of the cholera surveillance system in Cameroon will be necessary. Changes should address improving timeliness for both data collection and reporting, analyzing compiled data and reporting results, and targeting interventions to the most vulnerable populations. The partnership agreement between Cameroon and Africhol is one component of this strategy, because it will improve integrated disease surveillance and response.

Two serogroups of *V. cholerae*, O1 and O139, are usually found in cholera outbreaks in Asia and Africa [7]; the former is responsible for the current epidemic in Cameroon. The frequency of positive results among suspected cases increased between 2010 and 2011. Several factors explain this: (1) the use of rapid diagnostic tests since 2011, which have made it possible to reduce misclassification errors; (2) the reinforcement of healthcare professionals' skills in diagnosing suspected cases; and (3) the retraining of personnel on sampling, storage, and transport methods for stool samples.

The cholera CFR is an indicator of the quality of cholera case management. Cameroon has achieved a substantial decrease in the cholera CFR, but it remains higher than the 1% considered by the WHO as a standard upper limit [8]. In addition, large regional disparities exist, with some regions exhibiting a CFR of >9%. Decreases in CFRs could be enhanced by the renovation of highway infrastructure, the continuous training of healthcare service providers, and the creation of oral rehydration points of service in isolated and low-density zones managed by previously trained social mobilization teams and equipped with mobile units (transport) for the evacuation of suspected cases.

A key limitation in comparing current results to previous cholera data from Cameroon is the change during April 2010 in the case definitions of suspected cholera. Until 2010, the case definition for suspected cholera emphasized severe illness and included all persons presenting with severe rice water or palm wine diarrhea that occurred 10–100 times per day, involuntarily, without obstruction, with severe dehydration or anuria and with or without vomiting. This emphasis on severe cases likely increased specificity at the expense of sensitivity and thus likely underestimated the cholera burden and overestimated CFRs.

Cholera is occurring in Cameroon at previously undocumented levels. Controlling the outbreak will require a multifaceted approach. Programs in the Lake Chad Basin should continue to work on a harmonized and consistent approach, including cross-border policies related to water and sanitation. Medical facilities and treatment centers should be updated and adequately staffed by trained medical professionals. All levels of the national health system should work on further improvements to timely surveillance and case-detection activities. Long-term solutions will include providing clean water to the 52% of the rural population and the 23% of the urban population with current inadequate access [9] and improving basic sanitation in the most affected communities.

Supplementary Data

Supplementary materials are available at *The Journal of Infectious Diseases* online (http://jid.oxfordjournals.org/). Supplementary materials consist of data provided by the author that are published to benefit the reader. The posted materials are not copyedited. The contents of all supplementary data are the sole responsibility of the authors. Questions or messages regarding errors should be addressed to the author.

Notes

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Potential conflicts of interest. B. D. G. works for Agence de Medecine Preventive, which receives unrestricted and grant specific support from Sanofi Aventis, a manufacturer of cholera vaccines; Agence de Medecine Preventive also receives grant support from GlaxoSmithKline, Pfizer, and Merck. All other authors report no potential conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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