

*Weekly*

September 3, 2004 / 53(34);783-786

Persons using assistive technology might not be able to fully access information in this file. For assistance, please send e-mail to: mmwrq@cdc.gov. Type 508 Accommodation and the title of the report in the subject line of e-mail.

Cholera Epidemic Associated with Raw Vegetables --- Lusaka, Zambia, 2003--2004

Zambia experienced widespread cholera epidemics in 1991 (13,154 cases), 1992 (11,659), and 1999 (11,327) (*1*). In response to the large outbreak in 1999, the Zambian Ministry of Health (ZMOH) urged use of in-home chlorination with the locally produced solution, Clorin[®], and the practice increased substantially. Clorin[®] had been introduced in Zambia in 1998 as part of the Safe Water System (SWS), a point-of-use water disinfection and safe-water storage strategy* launched by the Society for Family Health, in partnership with ZMOH, the U.S. Agency for International Development, and CDC. Although no outbreaks were reported during 2000--2002, cholera remained endemic. Epidemic cholera returned to Zambia in November 2003, when cases of toxigenic *Vibrio cholerae* O1, serotype Ogawa, biotype El Tor were confirmed in the capital city, Lusaka. During November 28, 2003--January 4, 2004, an estimated 2,529 cholera cases and 128 cholera deaths (case-fatality rate [CFR] = 5.1%) occurred in Lusaka. In February 2004, the Lusaka District Health Management Team (LDHMT) invited CDC to assist in an investigation of the epidemic. This report summarizes the results of that investigation, which implicated foodborne transmission via raw vegetables and demonstrated a protective role for hand washing with soap. The results underscore the importance of hygiene, clean water, and sanitary food handling for cholera prevention.

In response to increasing cases, Zambian authorities began opening designated cholera-treatment centers (CTCs) in Lusaka in December 2003. All seven CTCs were functional by early January 2004, and all patients with suspected cholera were

referred to these facilities. During January 5--March 1, an additional 2,101 cases and 25 deaths from cholera (CFR = 1.2%) were recorded at CTCs in Lusaka.

Investigators conducted a matched case-control study to identify risk factors for cholera. A case was defined as watery diarrhea in a person aged ≥ 5 years, who was admitted to the Chawama (Figure) or Kanyama CTC during February 11--22. Stool cultures were performed for all eligible patients. Homes of enrolled patients were visited, and one age-, sex-, and neighborhood-matched control per case was selected systematically from neighboring households.

A total of 71 case-control pairs were enrolled in the study. *V. cholerae* O1 was identified in stool cultures from 52 (74%) patients. Both bivariate and multivariate analyses were performed, comparing all cases with culture-confirmed cases; because data were comparable for the two groups, results are reported for all cases in aggregate. The median age of patients was 27 years (range: 5--75 years); 58% were male. Common symptoms, in addition to diarrhea, included vomiting (61 [86%]) and leg cramps (44 [62%]).

Bivariate analysis indicated that consumption of raw vegetables was associated with cholera (matched odds ratio [MOR] = 3.9; 95% confidence interval [CI] = 1.7--9.6; $p = 0.0004$). Hand soap was observed in 41 (58%) case homes and 64 (90%) control homes. Presence of hand soap was considered a proxy for actual hand washing and was determined to be protective (MOR = 0.14; 95% CI = 0.05--0.40; $p = 0.0001$). Consumption of kapenta, a local sardine-like dietary staple, also was protective (MOR = 0.35; 95% CI = 0.2--0.8; $p = 0.005$). Drinking untreated water was reported by 48 (67%) case-patients and 37 (52%) controls, but the association with disease did not reach statistical significance (MOR = 1.9; 95% CI = 0.9--3.9; $p = 0.06$). In-home chlorination of drinking water with Clorin[®] was reported by 48 (67%) controls and 47 (66%) case-patients. Free chlorine residuals were detected in stored water in 19 (27%) case homes and 14 (20%) control homes (MOR = 1.5; 95% CI = 0.7--3.3; $p = 0.21$).

Kapenta, raw vegetables, presence of soap, and in-home water treatment were included in a multivariate model. Water treatment, either by boiling or home chlorination, was not significantly protective. Consumption of raw vegetables remained significantly associated with cholera (adjusted odds ratio [AOR] = 4.7; 95% CI = 1.7--13.0). The presence of hand soap remained significantly protective against cholera (AOR = 0.1; 95% CI = 0.04--0.40), as did consumption of kapenta (AOR = 0.3; 95% CI = 0.1--0.7).

On the basis of these results, the Zambian Central Board of Health and LDHMT enhanced cholera-prevention efforts by reinforcing hand-washing promotion messages and recommending that vegetables be cooked or washed in treated water. Plans were created to improve hygiene and increase availability of latrines at

Lusaka's major market to minimize cross-contamination of produce. Long-term prevention measures under discussion by local authorities include improving the quality and quantity of municipal water supplies. In April, cholera cases declined dramatically, and LDHMT closed the CTCs.

Reported by: *M Sinkala, MD, M Makasa, MD, F Mwanza, P Mulenga, Lusaka District Health Management Team, Zambia. P Kalluri, MD, R Quick, MD, E Mintz, MD, RM Hoekstra, PhD, Div of Bacterial and Mycotic Diseases, National Center for Infectious Diseases; A DuBois, MD, EIS Officer, CDC.*

Editorial Note:

This month marks the 150th anniversary of the removal of the famed Broad Street pump handle after John Snow's classic study of epidemic cholera in London. Cholera is caused by toxigenic *V. cholerae*, serogroup O1 or O139. Infection can result in rapidly progressive, profuse, dehydrating diarrhea, with CFRs $\geq 22\%$ when treatment is delayed (2). Cholera, which is still propagated by many of the same vehicles described by John Snow in the mid-1800s (3), remains a public health threat in sub-Saharan Africa and certain Asian countries. In 2003, the World Health Organization reported a total of 111,575 cholera cases and 1,894 deaths (CFR = 1.7%) in 45 countries; 97% of reported cases occurred in sub-Saharan Africa (4). In recent decades, the CFR of cholera has decreased because of dramatic improvements in oral and intravenous rehydration therapy (5).

In this epidemic of cholera, the primary mode of transmission was foodborne rather than waterborne, a possibility recognized by Snow (3). The implication of vegetables as a vehicle of transmission in this epidemic emphasizes the need for further assessment of produce hygiene during transport, delivery, and use in the home.

This investigation also documented the widespread acceptance of the SWS in cholera-affected communities in Lusaka. Implemented as a pilot project in Zambia in 1998, SWS has been determined to reduce the risk for diarrhea by $\geq 40\%$ (7). The SWS consists of Clorin[®], a dilute solution of locally produced sodium hypochlorite bleach, packaged and marketed for disinfection of water in the home, and promotion of plastic 20-liter jerricans for safe storage of treated water. The demand for Clorin[®] escalated during the 1999 cholera epidemic, and sales increased steadily in subsequent years. In 2003, approximately 1.7 million bottles of Clorin[®] were sold in Zambia. Findings of this investigation suggest that, 5 years after introduction of the SWS in Zambia, $>20\%$ of persons residing in Lusaka's shantytown purchase Clorin[®] solution and add it to their water.

The presence of soap in the home, which serves as a proxy for improved hygiene, was protective against cholera during this investigation. This finding is consistent with other studies that suggest hand washing reduces the risk for diarrhea by >40% (8) and echoes the work of Snow, who implicated poor hand hygiene in cholera transmission.

Approximately 50% of Zambia's 10 million residents live in cities. An estimated 60% of the 2 million residents of Lusaka reside in shantytowns without municipal water supplies or sewer systems (9). Snow's London of 1854 resembles numerous cities in the developing world today, where inadequate water and sanitation services and overcrowding contribute to a high burden of preventable diseases such as cholera. An estimated 1.1 billion persons in the world live without access to improved water supplies such as piped municipal systems; hundreds of millions more use inadequate systems, which routinely provide water that is contaminated and unsafe. Waterborne transmission of enteric pathogens contributes to the estimated 2 million diarrheal deaths that occur among children aged <5 years each year (10). In recognition of this continuing problem, member states of the United Nations established a Millennium Development Goal for Water to reduce by half the proportion of persons without sustainable access to safe drinking water by 2015. To achieve this goal, an estimated 300,000 persons must gain access to safe drinking water each day for the next 11 years. Even if this challenge is met, more than half a billion persons will still lack access to safe drinking water. As in Snow's day, field epidemiology and practical prevention strategies remain critical to meeting public health challenges in the modern world.

Acknowledgments

The findings in this report are based in part on contributions by S Leuschner, C Robinson, P Kalenga, Society for Family Health, Lusaka; M Tembo, PhD, Tropical Diseases Research Center, Ndola; V Mukonka, MD, V Mtonga, MMED, Central Board of Health, Zambia. M Roulet, MD, J Vincent, World Health Organization, Geneva, Switzerland. S Sasaki, Japan International Cooperation Agency, Tokyo, Japan.

References

1. World Health Organization. Communicable disease surveillance and response: disease outbreaks reported: cholera in Zambia, 1998. Available at <http://www.who.int/disease-outbreak-news/n1999/jan/n27jan1999.html>.
2. Goma Epidemiology Group. Public health impact of Rwandan refugee crisis: what happened in Goma, Zaire, in July, 1994? *Lancet* 1995;345:339--44.

3. Snow J. Snow on cholera, being a reprint of two papers. New York, New York: The Commonwealth Fund, 1936.
4. World Health Organization. Cholera, 2003. Wkly Epidemiol Rec 2004;79:281-8.
5. Baqui AH, Yunus M, Zaman K. Community-operated treatment centres prevented many cholera deaths. J Diarrhoeal Dis Res 1984;2:92--8.
6. Estrada-Garcia T, Mintz ED. Cholera: foodborne transmission and its prevention. Eur J Epidemiol 1996;12:461--9.
7. Mintz E, Bartram J, Lochery P, Wegelin M. Not just a drop in the bucket: expanding access to point-of-use water treatment systems. Am J Public Health 2001;91:1565--70.
8. Curtis V, Cairncross S. Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. Lancet Infect Dis 2003;3:275--81.
9. Quick R, Kimura A, Thevos A, et al. Diarrhea prevention through household-level water disinfection and safe storage in Zambia. Am J Trop Med Hyg 2002;66:584--9.
10. World Health Organization. Global Water Supply and Sanitation Assessment 2000 Report. New York, New York: World Health Organization and United Nations Childrens Fund, 2000:1--6,77--9.

* Detailed information available at <http://www.cdc.gov/safewater>.

Figure

FIGURE. Treatment and recovery tents at Chawama Cholera-Treatment Center, where more than 100 patients per day were treated at the peak of the epidemic — Lusaka, Zambia, 2004



Photo/CDC

[Return to top.](#)

Use of trade names and commercial sources is for identification only and does not imply endorsement by the U.S. Department of Health and Human Services.

References to non-CDC sites on the Internet are provided as a service to *MMWR* readers and do not constitute or imply endorsement of these organizations or their programs by CDC or the U.S. Department of Health and Human Services. CDC is not responsible for the content of pages found at these sites. URL addresses listed in *MMWR* were current as of the date of publication.

Disclaimer All *MMWR* HTML versions of articles are electronic conversions from ASCII text into HTML. This conversion may have resulted in character translation or format errors in the HTML version. Users should not rely on this HTML document, but are referred to the electronic PDF version and/or the original *MMWR* paper copy for the official text, figures, and tables. An original paper copy of this issue can be obtained from the Superintendent of Documents, U.S. Government Printing Office (GPO), Washington, DC 20402-9371; telephone: (202) 512-1800. Contact GPO for current prices.

****Questions or messages regarding errors in formatting should be addressed to mmwrq@cdc.gov.**

Page converted: 9/2/2004

[HOME](#) | [ABOUT MMWR](#) | [MMWR SEARCH](#) | [DOWNLOADS](#) | [RSS](#) | [CONTACT](#)
[POLICY](#) | [DISCLAIMER](#) | [ACCESSIBILITY](#)

SAFER • HEALTHIER • PEOPLE™

Morbidity and Mortality Weekly Report
Centers for Disease Control and Prevention
1600 Clifton Rd, MailStop E-90, Atlanta, GA 30333,
U.S.A



[Department of Health
and Human Services](#)

This page last reviewed 9/2/2004