In 2015, a cholera epidemic occurred in Tanzania; most cases and deaths occurred in Dar es Salaam early in the outbreak. We evaluated cholera mortality through passive surveillance, burial permits, and interviews conducted with decedents’ caretakers. Active case finding identified 101 suspected cholera deaths. Routine surveillance had captured only 48 (48%) of all cholera deaths, and burial permit assessments captured the remainder. We interviewed caregivers of 56 decedents to assess cholera management behaviors. Of 51 decedents receiving home care, 5 (10%) used oral rehydration solution after becoming ill. Caregivers reported that 51 (93%) of 55 decedents with known time of death sought care before death; 16 (29%) of 55 delayed seeking care for >6 h. Of the 33 (59%) community decedents, 20 (61%) were said to have been discharged from a health facility before death. Appropriate and early management of cholera cases can reduce the number of cholera deaths.

Cholera is an acute diarrheal illness caused by infection with the bacterium *Vibrio cholerae* (1). Severe cholera can be rapidly fatal; patients who do not receive appropriate treatment could die within hours (1). Prompt replacement of fluids and electrolytes through the use of oral rehydration solution (ORS) and intravenous fluids can prevent cholera death (2). With appropriate care, case-fatality rates for cholera should be <1% (1).

Tanzania reported an outbreak of cholera on August 15, 2015 (3,4). At that time, 6 of 8 countries bordering Tanzania were experiencing cholera outbreaks (5). Cholera outbreaks can spread rapidly, crossing national borders, and are a major global health security problem.

Early in the Tanzania outbreak, most cases and deaths were reported in Dar es Salaam, where 3,371 cases and 36 deaths (case-fatality rate 1.1%) had been recorded by October 31, 2015. Deaths were exclusively reported from cholera treatment centers (CTCs), but additional deaths in the community were rumored. When cholera deaths in the community were suspected, an environmental health officer was required to visit the decedent’s house, prepare a burial permit, obtain a rectal swab for culture, and assist with the disposal of the body. The burial permit included the decedent’s name, suspected cause of death, and date of death. We conducted a cholera mortality evaluation to identify unreported deaths, investigate household cholera management practices, and describe healthcare-seeking behaviors.

The Study
We obtained a list of persons who were suspected to have died of cholera (decedents) from the CTCs and obtained the burial permits from the CTCs, referral hospitals, and municipal offices (for complete description of methods, see online Technical Appendix 1, https://wwwnc.cdc.gov/EID/article/23/13/17-0529-Techapp1.pdf). The case definition for suspected cholera death was death of a person ≥2 years of age with acute watery diarrhea with or without vomiting with illness onset after August 15, 2015, in Dar es Salaam. A confirmed cholera death was defined as death of a person ≥2 years of age whose stool was positive for *Vibrio cholerae* O1 (6). All suspected and confirmed cholera deaths identified from CTC reports and burial permits were included in the evaluation.

We developed survey instruments with the Open Data Kit software (https://opendatakit.org/). Written informed consent was obtained from the decedent’s caretaker. We presented preliminary results at the American Society of Tropical Medicine and Hygiene Annual Meeting; November 13–17, 2016, Atlanta, Georgia, USA.
consent to take surveys was obtained, and then trained enumerators completed surveys with caregivers or relatives of the deceased (online Technical Appendix 2, https://wwwnc.cdc.gov/EID/article/23/13/17-0529-Techapp2.pdf). During January 19–23, 2016, these data were collected electronically on Galaxy Tablets (Samsung, Seoul, South Korea).

During August 16, 2015–January 16, 2016, the cholera surveillance system in Dar es Salaam identified 48 cholera deaths, all reported by CTCs. These deaths included persons who died at CTCs and persons who were dead on arrival. The burial permit assessment identified an additional 53 cholera deaths for a total of 101 total deaths (Figure 1); therefore, 52% of the total deaths were not captured by the existing surveillance system.

Cholera cases and deaths peaked in late September, with fewer deaths reported from November through January (Figure 2, panels A, B). The decrease in deaths coincided with a decrease in reported cholera cases. Of 101 decedents, 45 (45%) were not included in the study: for 35 (87.5%), caretakers could not be located; for 3 (7.5%), the caretakers had moved; 2 (5%) were an entire family unit with no respondent to give a survey; and 5 were misclassified (2 were <2 years of age and 3 had negative cultures with clinical signs inconsistent with cholera). Anecdotal reports suggested that many of the decedents for whom family members and caretakers could not be found were migrant workers who lived alone in single rented rooms, and the homes of others were not disclosed because of the stigma associated with cholera and local political pressure not to report.

Caretakers interviewed for this evaluation were family members (73%), landlords and neighbors (21%), employees (4%), and friends (2%) of the 56 decedents. The median age of decedents was 23 (range 2–80) years, and 32 (57%) were men or boys (Table).

Fecal samples from 39 (70%) decedents yielded *V. cholerae*. Laboratory results from 16 (29%) decedents were not available. The location of death was the community or en route to a health facility for 33 (59%) decedents, a health facility for 22 (39%), and an unknown location for 1 (2%) (Table). Of the 51 respondents who reported that decedents received home treatment, 5 (10%) said ORS was consumed. Reasons the decedents did not take ORS at home included not knowing what ORS was (38%) and not thinking that ORS would help (33%). Of 56 decedents, 26 (46%) consumed fluids other than ORS, including water (30%), soft drinks (13%), and porridge (5%), at home before their deaths.

Of 55 decedents with a reported time of death, 44 (80%) died within 24 hours of symptom onset, and of the 51 (93%) decedents who sought care before death, 16 (31%) waited >6 h from symptom onset to seek care. All decedents were able to reach a health facility from their home within 1 hour. Of 33 decedents who died in the community or en route to a health facility, 20 (61%) had previously been discharged alive from a health facility.

**Conclusions**

More than half of the records of cholera deaths in Dar es Salaam were missing from the existing surveillance system, which only captured patients who arrived at CTCs. Deaths that occurred in other treatment locations

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5 misclassified</td>
</tr>
<tr>
<td>96 decedents in study population</td>
</tr>
<tr>
<td>40 could not be located</td>
</tr>
<tr>
<td>56 (55%) decedents included in investigation</td>
</tr>
</tbody>
</table>

**Figure 1.** Study population for cholera mortality evaluation, Dar es Salaam, Tanzania, August 16, 2015–January 16, 2016.

**Figure 2.** Suspected and confirmed cholera cases (A) and deaths (B) from cholera mortality evaluation and burial permit assessment, by week, Dar es Salaam, Tanzania, August 16, 2015–January 16, 2016. CTC deaths are deaths in patients ≥2 years of age with suspected or confirmed cholera who died following admission to a hospital or CTC. Community deaths were deaths in persons ≥2 years of age highly suspected of having cholera or having culture-confirmed cholera who died in the community or en route to a CTC. The date of death could not be determined for 6 decedents who were therefore excluded from the epidemic curves. CTC, cholera treatment center.
运输作为及时护理的障碍

研究已识别出健康设施的距离或缺乏，但并未直接涉及寻求护理的延迟影响。在一项调查中，超过30%的霍乱死亡者延迟寻求护理超过一天。一些研究观察到自制ORS（口服补液盐）的使用和知识的下降。在一些项目中，商业化的ORS正在减少，而信息传递不一致。ORS的使用和知识在中等收入国家的下降或停滞，特别是在撒哈拉以南非洲的国家。

我们通过人际传播有关自制ORS的信息（ORS）。ORS的使用和知识的下降是由于缺乏卫生工作者或过早出院。坦桑尼亚卫生部门在2015年11月开始对霍乱病例管理问题进行培训。当时，霍乱死亡率相对较低（图2，面板B）。使用直肠拭子确认霍乱死亡者可能是一个有用的实践，特别是在解释未解死亡的背景下。

加强监测，霍乱病例管理培训，以及强有力的社会教育，专注于正常化疾病，以及鼓励人员在社会边缘寻求医疗援助来管理霍乱。这些措施可以帮助加快疫情的发现和响应，以及卫生工作者应对霍乱病例管理问题；启动这些时间，霍乱死亡率相对较低（图2，面板B）。ORS的使用和知识的下降是由于缺乏卫生工作者或过早出院。坦桑尼亚卫生部门在2015年11月开始对霍乱病例管理问题进行培训。当时，霍乱死亡率相对较低（图2，面板B）。使用直肠拭子确认霍乱死亡者可能是一个有用的实践，特别是在解释未解死亡的背景下。

我们感谢Ilala、Kinondoni和Temeke地区的卫生管理团队，以及环境健康官员，没有他们的帮助，这项研究将无法进行。我们感谢PSI坦桑尼亚的工作人员，他们在数据收集中提供了帮助。

我们感谢全球疾病预防控制中心的资助，感谢全球疾病预防控制中心的工作人员为帮助获取数据的许可审议和协助在机构审查委员会批准程序中工作。我们也感谢坦桑尼亚的 PSI 在数据收集中提供的帮助。

研究资助

我们感谢伊丽莎白·韦尔德、疾病控制和预防中心、亚特兰大、乔治亚州、美国的国家微生物学和传染病中心、水性病预防和控制分支、疾病控制和预防中心和Zoonotic Infectious Diseases中心。

资助

这项研究的资助来自Global Health Security Agenda of the US Centers for Disease Control and Prevention。

Dr. McCrickard是Waterborne Disease Prevention Branch, Division of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia, USA的 Epidemic Intelligence Service Officer。她还曾在西里伯亚拉省的Waterborne Disease Prevention Branch, Division of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia, USA工作。

参考文献

DH。她的主要研究兴趣包括应用公共卫生和疾病预防。


Address for correspondence: Lindsey S. McCrickard, Centers for Disease Control and Prevention, 1600 Clifton Rd NE, Mailstop A31, Atlanta, GA 30327-4027, USA; email: lmccrick@gmail.com