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# Community Mortality from Cholera: Urban and Rural Districts in Zimbabwe

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*Abstract.* In 2008–2009, Zimbabwe experienced an unprecedented cholera outbreak with more than 4,000 deaths. More than 60% of deaths occurred at the community level. We conducted descriptive and case–control studies to describe community deaths. Cases were in cholera patients who died outside health facilities. Two surviving cholera patients were matched by age, time of symptom onset, and location to each case-patient. Proxies completed questionnaires regarding mortality risk factors. Cholera awareness and importance of rehydration was high but availability of oral rehydration salts was low. A total of 55 case-patients were matched to 110 controls. The odds of death were higher among males (adjusted odd ratio [AOR] = 5.00, 95% confidence interval [CI] = 1.54–14.30) and persons with larger household sizes (AOR = 1.21, 95% CI = 1.00–1.46). Receiving home-based rehydration (AOR = 0.21, 95% CI = 0.06–0.71) and visiting cholera treatment centers (CTCs) (AOR = 0.07, 95% CI = 0.02–0.23) were protective. Receiving cholera information was associated with home-based rehydration and visiting CTCs. When we compared cases and controls who did not go to CTCs, males were still at increased odds of death (AOR = 5.00, 95% CI = 1.56–16.10) and receiving home-based rehydration (AOR = 0.14, 95% CI = 0.04–0.53) and being married (AOR = 0.26, 95% CI = 0.08–0.83) were protective. Inability to receive home-based rehydration or visit CTCs was associated with mortality. Community education must reinforce the importance of prompt rehydration and CTC referral.

## INTRODUCTION

In August 2008, Zimbabwe experienced a *Vibrio cholerae* O1 El Tor outbreak.[1–5] After this outbreak, a second wave occurred, affecting 55 of the 62 districts in this country.[6] This outbreak was the largest recorded in Zimbabwe and one of the largest in Africa.[1–4,7,8] During August 2008–July 28, 2009, the Zimbabwean Ministry of Health and Child Welfare reported 98,592 cases and 4,288 cholera deaths.[6] The crude case-fatality rate (CFR) was 4.3%, and 61.4% of the cholera deaths occurred in communities outside areas with health facilities.[6]

In epidemics, *V. cholerae* transmission occurs primarily by contact with contaminated food and water. Symptoms start abruptly and include profuse characteristic rice-water diarrhea and vomiting. The voluminous diarrhea can lead to severe dehydration, acute renal failure, shock, and death. Prompt fluid and electrolyte replacement to match losses is lifesaving. For severe cholera, intravenous solutions are needed.[9] Untreated, the cholera CFR can be 50%.[9] With timely, appropriate treatment, the CFR should remain < 1%.[10]

Hyperinflation, inadequate finances, shortages of clinicians, medications, and supplies left Zimbabwe with an inadequate health care system and unable to respond adequately to a cholera outbreak. When the outbreak began, free cholera treatment centers (CTCs), oral rehydration points, and cholera treatment units within facilities were set up to increase access to treatment. Access to these services varied nationally. Poor access to healthcare may have contributed to the unusually high proportion of community deaths. Furthermore, additional, potentially preventable, factors may have inhibited Zimbabweans from seeking care. Those belonging to the Apostolic faith may have higher risk of community mortality because the faithful often do not believe in medical interventions.[11] Risk factors may also differ between urban, rural, and remote rural settings. Understanding these factors could assist in preventing excess mortality in future outbreaks in Zimbabwe.

We assessed community cholera-associated mortality in three heavily affected districts. We conducted a case–control study in one rural district to identify differences in health-seeking behavior, reasons for not seeking care, and risk factors for death.

## MATERIALS AND METHODS

Both studies took place during August 20, 2009–September 5, 2009. The descriptive study was conducted in three districts of Zimbabwe: Kadoma Urban (population = 76,351), Chivi (population = 155,640), and Gokwe North (population = 214,359) (Figure 1).[12–14] Reported ward numbers for each of these districts varied and differed from 2002 census data.[12–14] Of 8 districts severely affected by cholera (reporting > 1,500 cholera patients with > 100 community deaths), these 3 were selected because they were geographically separated, they represented urban (Kadoma Urban), rural (Chivi), and extremely remote rural (Gokwe North) settings, and were of small enough size to complete data collection within 10 days. There also had been no previous studies conducted at these sites during the recent cholera outbreak that may have biased the surveyors or respondents. In selected villages in each district, key informants filled out community-generated line lists to provide information on the community members who had cholera and died (cases) or survived (controls).

A cholera case was defined as anyone in the selected district, who had lived in the ward (a geographic cluster of villages identified by the government, which make up a district) for ≥ 7 days before cholera onset; died outside an institution (healthcare facility or prison) within 14 days of symptom onset; was ≥ 5 years of age; and had ≥ 3 episodes of sudden onset of

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FIGURE 1. Zimbabwe showing Kadoma Urban, Gokwe North, and Chivi Districts.

watery, non-bloody diarrhea in 24 hours during October 1, 2008–July 28, 2009. Controls met the same criteria as cases. However, they survived the cholera episode.

For the descriptive study, a standardized questionnaire was developed to collect information on demographics, health-seeking behaviors, the presence and distance to oral rehydration points and health facilities, and patients, family members' or caretakers' perceptions about cholera. Case proxies from the three districts (Kadoma Urban, Chivi, and Gokwe North) completed questionnaires for the community cholera deaths. In Chivi, this same questionnaire was used for the case–control study. When the affected member was ≤ 15 years of age or unavailable, proxies for controls completed the questionnaire. In Chivi and Gokwe North, wards with the greatest number of listed cases were included in the study. Because Kadoma Urban had fewer wards, all wards were surveyed.

The Chivi community–generated line lists were used to match two controls to each case by age category (age = 5–20 years, 21–35 years, 36–50 years, and ≥ 51 years), time of symptom onset (on or before December 25, 2008 versus after December 25, 2008), and ward. Because risk factors could be age dependent, we matched on age category. Matching by time of symptom onset was used as interventions could impact health-seeking behavior. Investigators selected a date near the midpoint of the outbreak that would be easy for participants to remember (the Christmas holiday). Because the ability to reach a health center may be location dependent, we matched by ward. In addition, education campaigns and interventions occurred over time and varied by location, again indicating reasons to match on time of symptom onset and ward. Controls were selected from a community-generated non-ordered list of cholera patients. If a control was not located, the next person who met matching criteria was selected. Case proxies selected were the primary caretaker of the cholera patient. If the primary caretaker was not available, the next closest relative or household member was selected. The sample size for the case–control study, assuming 10% non-response rate, confidence interval (CI) of ±5% around a 10% exposure of attending the CTC among controls, 80% power, and an unmatched odds ratio (OR) = 4.0, was 53 cases and 106 controls.

All study instruments were translated into Shona, back translated, and piloted before the study. After verbal informed consent was obtained, trained interviewers completed the questionnaire, one-on-one, with proxies or patients. All interviewers were locally recruited and had previous survey experience.

Bivariate analysis on the descriptive case study used chi-square or Fisher's exact tests. Bivariate and multivariable analyses were conducted on the case–control data by using conditional logistic regression that adjusted for matching. All variables from the bivariate analysis with a $P < 0.1$ or previously found to be significant in the literature were entered into an initial conditional logistic regression model. Using backward elimination, we kept variables in the model if they were significant ($P < 0.05$). Epi Info version 3.5.1 (Centers for Disease Control and Prevention, Atlanta, GA) and SAS version 9.2 (SAS Institute, Cary, NC) were used for data entry and analysis, respectively.

The Centers for Disease Control and Prevention National Center for Environmental Health Internal Review Board reviewed the protocol and determined that the activity was not human subjects research and that the primary intent was public health response. Personal identifiers were deleted from the data once data was collected. Partners accepted this review determination for their ethical clearance.

## RESULTS

**Descriptive study of community deaths from three districts.** A total of 144 case proxies were interviewed: 37 in Gokwe North (4 wards), 55 in Chivi (4 wards), and 52 in Kadoma Urban (17 wards). Response rate was 100% (no refusals). Age, sex and marital status were similar across the three sites. There were significant differences in religion, education, and income (Table 1).

**Kadoma Urban.** In Kadoma Urban, the median age was 37 years and 12% of cases were ≥ 65 years of age (Table 1). More than half (60%) of cases were males and 40% were married. Reflecting the urban setting, 96% of the cases reportedly had some education and 58% reportedly had some income, which was higher than either rural district (Table 1).

During the outbreak in this urban setting, 91% of the proxies reported the case had received information on cholera (Table 2). Of the case proxies who received information on cholera during the outbreak, 97% reported knowing how to make salt-sugar solution (SSS); however, only 65% knew the correct amount of sugar, salt and water when asked. Despite dollar hyperinflation, 69% reported being able to afford sugar. Furthermore, 58% of respondents reported oral rehydration solution (ORS) sachets were present in Kadoma Urban from the time of the outbreak. More than half of the cases (62%) received home-based rehydration (water, SSS, and/or ORS) and 85% sought care outside the home. Proxies reported a large proportion of cases went to a CTC (68%) during the outbreak before they died at home.

**Gokwe North.** Although not significant, cases in Gokwe North were older than cases in the other districts (median = 40 years and 35% of cases were ≥ 65 years of age) (Table 1). In this very rural location, fewer cases (43%) were males and

TABLE 1

Demographic characteristics among community cholera deaths in Kadoma Urban, Gokwe North, and Chivi Districts, Zimbabwe, October 1, 2008–July 28, 2009

| Characteristic | No. (%) deaths from cholera outside a health facility | | | |
|---|---|---|---|---|
| | Kadoma Urban, n = 52* | Gokwe North, n = 37* | Chivi, n = 55* | *P* |
| Mean age, years (median) | 40 (37) | 46 (40) | 42 (37) | 0.40 (mean), 0.63 (median) |
| 5–20 | 6 (12) | 7 (19) | 12 (22) | 0.32 |
| 21–35 | 17 (33) | 7 (19) | 14 (25) | |
| 36–50 | 17 (33) | 8 (22) | 12 (22) | |
| ≥ 51 | 12 (23) | 15 (40) | 17 (31) | |
| Male sex | 31 (60) | 16 (43) | 33 (60) | 0.22 |
| Married | 21 (40) | 21 (57) | 23 (42) | 0.25 |
| Religion† | n = 52 | n = 37 | n = 55 | < 0.001 |
| None | 14 (27) | 1 (3) | 8 (15) | |
| Apostolic (Marange or other) | 17 (33) | 22 (59) | 9 (16) | |
| Protestant | 8 (15) | 1 (3) | 8 (15) | |
| Catholic | 5 (10) | 1 (3) | 5 (9) | |
| Zionist | 1 (2) | 1 (3) | 11 (20) | |
| Other | 6 (12) | 2 (5) | 13 (24) | |
| Traditional ancestral beliefs | 1 (2) | 9 (24) | 1 (2) | |
| Education† | n = 46 | n = 37 | n = 55 | 0.002 |
| None | 2 (4) | 13 (35) | 12 (22) | |
| Primary | 15 (33) | 14 (38) | 22 (40) | |
| Secondary | 26 (57) | 8 (22) | 16 (29) | |
| Tertiary | 3 (7) | 2 (5) | 5 (9) | |
| Any income | n = 52 | n = 37 | n = 54 | < 0.001 |
| | 30 (58) | 5 (14) | 7 (13) | |

*Percentage adjusted for missing information.
†By Fisher's exact test.

more (57%) were married. Perhaps reflecting the remoteness of this setting, only 65% of the cases attended school. Gokwe North had the highest proportion of cases belonging to the Apostolic faith (59%).

In Gokwe North, 66% of case proxies reported that the case received information on cholera (Table 2). Of those who received information on cholera during the outbreak and answered the questions on SSS, all respondents reported they knew how to make SSS. However, only 38% could correctly describe the proper amount of all three components. Perhaps reflecting the poverty of the area, only one-third reported that sugar was affordable. More than two-thirds (68%), reported receiving home-based rehydration and 35% sought care outside the home. Only 19% went to a CTC (Table 2), one went to a clinic that was not a CTC and 14% went to a faith healer, rather than seeking westernized care. In Gokwe North, the non-mutually exclusive reasons for not seeking care included that there was no CTC (55%), religion forbade attendance (33%), lack of transport (11%), or they were too sick to go (7%).

**Chivi.** In the rural district of Chivi, cases had a median age of 37 years and 25% of cases were ≥ 65 years of age (Table 1). Similar to Kadoma, 60% were males and 42% were married. Most (78%) of the proxies reported the cases had some education, but only 13% had any income.

In this rural setting, 67% of proxies reported the case received information on cholera during the outbreak (Table 2). Of those that received information on cholera during the outbreak, most (97%) reported knowing how to make SSS, but similar to Kadoma Urban, only 63% had correct responses for amount of all three components. Chivi respondents reported ORS in the village infrequently (30%), which might reflect the more rural setting, but 62% of proxies reported sugar was affordable. Although 58% of Chivi cases received home-based rehydration, only 24% sought care outside the home with 16% going a CTC. The most common reasons for not seeking care in Chivi included lack or cost of transport (38% each) or they were too sick to go (24%).

**Case–control study in rural Chivi.** A total of 55 cases and 110 controls were enrolled in the case-control study. The median age of the cases and controls was 37 and 36 years, respectively (Table 3). There were no differences between the cases and controls for having any education or by religion (Table 3), although Chivi had the lowest proportion of respondents of the Apostolic faith of the three districts (Table 1). In the bivariate analysis, mortality was associated with male sex, having no income, larger household size, not receiving home-based rehydration, and not seeking care outside the home or at a CTC (Table 3).

To determine if cases and controls had similar levels of symptom severity, respondents were asked about the symptoms of the cholera patient. Case proxies versus controls reported 80% versus 70% with sunken eyes, 65% versus 65% with abdominal cramps, and 69% versus 66% with arm or leg cramps. The only symptom that differed between cases and controls was the presence of dry mouth (47% cases versus 69% controls; $P = 0.01$).

A total of 67% of case proxies and 80% of controls reported receiving cholera information during the outbreak ($P = 0.15$) (Table 2). No difference was found between case proxies and controls in access to ORS in the village (30% and 28%, respectively; $P = 0.69$).

For those who received cholera information, 81% of case proxies and 61% of controls reported knowing how to make ORS ($P = 0.39$), and 97% of proxies and 99% of controls reported knowing how to make SSS ($P = 0.81$). No differences in describing the correct proportion of SSS ingredients were found between proxies and controls. When asked about sugar, 62% of proxies and 51% of controls said they could afford it ($P = 0.19$).

A significantly higher proportion of controls reported receiving home-based rehydration compared with case proxies (83% and 58%, respectively; OR = 0.26, 95% CI = 0.12–0.58, $P < 0.001$) (Table 3).

Those who received cholera information during the outbreak had significantly higher odds of receiving home-based rehydration (OR = 4.30, 95% CI = 1.34–14.00, $P = 0.02$). Those who received information from a village health worker (VHW) or a community mobilizer also had greater odds of receiving home-based rehydration (OR = 3.00, 95% CI = 1.09–8.00, $P = 0.03$). Of those who received home-based rehydration, 34% of case and 54% of control families had received cholera information from a VHW.

In the bivariate analysis, the most important factor for survival was whether the patient went to the CTC. A total of 66% of controls versus 16% of the cases visited the CTC (OR = 0.08, 95% CI = 0.03–0.23, $P < 0.001$) (Table 3).

There was a significant association between the families who received cholera information during the outbreak and those who went to the CTC (OR = 2.87, 95% CI = 1.07–7.64, $P = 0.04$). The most effective mode of information dissemination appeared to be person-to-person by VHWs. Receiving person-to-person communication about cholera from anyone

TABLE 2

Receipt of information on cholera, source of information, interventions available, and knowledge of intervention in Kadoma Urban, Gokwe North, and Chivi Districts, Zimbabwe, October 1, 2008–July 28, 2009*

| Characteristic | Cases, no. (%) | | | Controls, no. (%) | |
|---|---|---|---|---|---|
| | Kadoma Urban, n = 52 | Gokwe North, n = 37 | Chivi, n = 55 | Chivi, n = 110 | *P* value for bivariate case-control |
| Received information on cholera | n = 46 | n = 32 | n = 52 | n = 103 | |
| | 42 (91) | 21 (66) | 35 (67) | 82 (80) | 0.15 |
| Among those receiving cholera information† | | | | | |
| Mode of information‡ | n = 42 | n = 21 | n = 35 | n = 82 | |
| Person to person | 24 (57) | 8 (38) | 16 (46) | 42 (51) | 0.47 |
| Community meeting | 17 (41) | 11 (52) | 21 (60) | 54 (66) | 0.37 |
| Source of information | n = 42 | n = 21 | n = 35 | n = 82 | |
| Village health worker/community mobilizer | 18 (43) | 10 (48) | 18 (51) | 52 (63) | 0.15 |
| Other government worker | 8 (19) | 14 (67) | 18 (51) | 36 (44) | 0.64 |
| Could make SSS | n = 37 | n = 20 | n = 34 | n = 81 | |
| | 36 (97) | 20 (100) | 33 (97) | 81 (99) | 0.81 |
| Composition of SSS correct | n = 37 | n = 21 | n = 35 | n = 80 | |
| | 24 (65) | 8 (38) | 22 (63) | 54 (67) | 0.23 |
| Could make ORS | n = 32 | n = 17 | n = 26 | n = 64 | |
| | 22 (69) | 14 (82) | 21 (81) | 39 (61) | 0.39 |
| Could afford sugar | n = 52 | n = 36 | n = 55 | n = 110 | |
| | 36 (69) | 12 (33) | 34 (62) | 56 (51) | 0.19 |
| ORS available in village | n = 45 | n = 26 | n = 44 | n = 98 | |
| | 26 (58) | 8 (31) | 13 (30) | 27 (28) | 0.69 |
| If oral rehydration salts available in the village | | | | | |
| Had ORS in home | n = 25 | n = 6 | n = 11 | n = 27 | |
| | 17 (68) | 3 (50) | 3 (27) | 6 (22) | 0.56 |
| Received home-based rehydration (water, SSS and/or ORS) | n = 52 | n = 37 | n = 55 | n = 110 | |
| | 32 (62) | 25 (68) | 32 (58) | 91 (83) | 0.001 |
| Sought care outside home | n = 52 | n = 37 | n = 55 | n = 110 | |
| | 44 (85) | 13 (35) | 13 (24) | 91 (83) | < 0.001 |
| Went to cholera treatment center | n = 50 | n = 27 | n = 55 | n = 109 | |
| | 34 (68) | 5 (19) | 9 (16) | 72 (66) | < 0.001 |

*SSS = sugar-salt solution; ORS = oral rehydration solution.
†Reported list is not comprehensive but includes frequent modes and sources.
‡Percentage adjusted for missing information.

increased the odds of CTC attendance (OR = 3.70, 95% CI = 1.27– 11.10, *P* = 0.04). Those receiving communication from a VHW had higher odds of going to the CTC (OR = 3.50, 95% CI = 1.18–10.00, *P* = 0.05).

Other potential sources of information assessed in this survey (friends, family, non-governmental organizations) and the mode of transmission (radio, or printed word) were not found to be associated with increased or decreased odds of CTC attendance.

**Factors associated with cholera mortality.** In the final conditional logistic regression model, being male (AOR = 5.00, 95% CI = 1.54–14.30) and having a larger household size (adjusted OR [AOR] = 1.21, 95% CI = 1.00–1.46) were associated with increased odds of mortality (Table 4). Receiving home-based rehydration (AOR = 0.21, 95% CI = 0.06–0.71) and visiting a CTC (AOR = 0.07, 95% CI = 0.02–0.23) were associated with lower odds of community cholera death.

When we evaluated males and other potential socio-medical risk factors for increased mortality, including human immunodeficiency virus infection, alcohol intake, self or proxy-perception of overall wellness, decreased food intake, and occupation location (within or outside the district), we found no association with sex or death.

TABLE 3

Bivariate analysis of demographic and healthcare access characteristics of cholera cases and controls in Chivi District, Zimbabwe, October 1, 2008–July 28, 2009*

| Characteristic | Cases, n = 55, no. (%) | Controls, n = 110, no. (%) | Odds ratio (95% CI) | *P* |
|---|---|---|---|---|
| Mean age, years (median) | 42 (37) | 39 (36) | | |
| Male sex | 33 (60) | 42 (38) | 2.56 (1.27–5.00) | 0.01 |
| Married | 23 (42) | 57 (52) | 0.61 (0.29–1.27) | 0.18 |
| Religion | | | | |
| Apostolic | 9 (16) | 24 (22) | 0.67 (0.28–1.63) | 0.38 |
| Other | 46 (84) | 86 (78) | | |
| Education | | | | |
| Any | 43 (78) | 86 (78) | 1.0 (0.38–2.70) | 1.00 |
| None | 12 (22) | 24 (22) | | |
| Any income | 7 (13) | 28 (25) | 0.28 (0.09–0.89) | 0.03 |
| No. persons sleeping in house: mean (median) | 6.4 (6) | 5.3 (5) | 1.14 (1.02–1.29) | 0.03 |
| ≥ 6 persons sleeping in house | 30 (55) | 44 (40) | 2.23 (1.00–4.83) | 0.05 |
| Received home-based rehydration (water, SSS and/or ORS) | 32 (58) | 91 (83) | 0.26 (0.12–0.58) | < 0.001 |
| Went to cholera treatment center | 9 (16) | 72 (66)† | 0.08 (0.03–0.23) | < 0.001 |

*Conditional logistic regression with matching used for analysis. CI = confidence interval; SSS = sugar-salt solution; ORS = oral rehydration solution.
†Missing one response.

TABLE 4

Multivariate matched logistic regression for risk factors for community cholera mortality in Chivi District, Zimbabwe, October 1, 2008–July 28, 2009*

| Risk factor | Adjusted odds ratio | 95% Confidence interval | *P* |
|---|---|---|---|
| Male sex | 5.00 | 1.54–14.30 | 0.01 |
| Received home-based rehydration (water, SSS and/or ORS) | 0.21 | 0.06–0.71 | 0.01 |
| Average no. persons sleeping in the house at night | 1.21 | 1.00–1.46 | 0.05 |
| Any income | 0.25 | 0.05–1.14 | 0.07 |
| Went to cholera treatment center | 0.07 | 0.02–0.23 | < 0.001 |

*SSS = sugar-salt solution; ORS = oral rehydration solution.

There was a relationship between males and being married. Males were more likely to be married compared with females (56% versus 44%; $P = 0.01$). We found that 42% of cases were married, and 52% of controls were married, but the difference was not statistically significant ($P = 0.18$) (Table 3). We also found that slightly more married men than unmarried men survived (60% versus 40%; $P = 0.43$).

Because patients who survived whether they went to a CTC could be included in the study, but patients who died at the CTC could not be included in the study, a selection bias may have been introduced. To account for the potential differences in the way cases were selected, an additional analysis was conducted looking at both cases (n = 46) and controls (n = 37) who did not go to the CTC. In that model, males were still at increased odds of death and receiving home-based rehydration and being married had reduced odds of when controlling for sex, receipt of home-based rehydration, household size, and income (Table 5).

## DISCUSSION

In Zimbabwe, many factors, such as hyperinflation, inadequate finances, shortages of clinicians, medications, and supplies, could have contributed to the high community mortality that was found during the 2008 outbreak. This study assessed community cholera-associated mortality in three heavily affected districts and used a case-control study in one rural district to identify risk factors for community deaths. Understanding these factors could assist in preventing excess mortality in future outbreaks in Zimbabwe.

Our results found that differences in religion, education, and income existed among cases in these urban, rural, and remote rural districts. Education, income, receipt of cholera information, and use of a CTC were higher in the urban setting of Kadoma. In spite of high education levels, income, cholera knowledge and access to CTCs, community deaths still occurred. Two-thirds of the Kadoma cases went to a CTC, but still died in the community after discharge. Many factors could have contributed to this scenario, such as overcrowding in the facilities, too few and/or inexperienced staff, and shortages of supplies at the CTC. Without an assessment of the health facilities, it is difficult to know what elements of healthcare were lacking and how these deaths could have been prevented. An evaluation of the numbers and capacity of health workers to provide care, and the quantity and stock outs of supplies, both oral and intravenous hydration, is needed.

TABLE 5

Multivariate matched logistic regression for risk factors for community cholera mortality excluding controls and cases who went to a cholera treatment center in Chivi District, Zimbabwe, October 1, 2008–July 28, 2009*

| Risk factor | Adjusted odds ratio | 95% Confidence interval | *P* |
|---|---|---|---|
| Male sex | 5.00 | 1.56–16.10 | 0.01 |
| Received home-based rehydration (water, SSS or ORS) | 0.14 | 0.04–0.53 | 0.03 |
| Average no. persons sleeping in the house at night | 1.21 | 0.99–1.48 | 0.06 |
| Any income | 0.40 | 0.11–1.49 | 0.17 |
| Married | 0.26 | 0.08–0.83 | 0.02 |

*SSS = sugar-salt solution; ORS = oral rehydration solution.

Although hypothesized, this study did not find that religion, specifically Apostolic faith, was a significant risk factor for community death. Apostolic religious preference varies countrywide and often tends to be higher in remote rural districts; Gokwe North is more remote than Chivi and had the higher proportion of Apostolics. Unfortunately, the small number of Apostolics in this sample limited our ability to determine if this was risk factor. Apostolic sects are described as less likely to seek health care at a facility or take medications, including ORS.[11,15–18] It would be worthwhile to include this potential risk factor in future studies with a larger sample of those of the Apostolic faith.

Our finding that males had greater odds of dying in the community was not fully explainable in our analysis, nor previously identified in the literature. One study did find a trend toward men being disproportionately affected, although they were unable to fully explore why.[19] We found no association with sex or death when we looked at other health conditions. From available CTC databases in Kadoma, we did not find a difference in mortality based on sex. In Chivi, the census data reported the proportion of males as 44.8–46.9% in the wards we evaluated.[20] The Chivi community line lists had more females with a ratio of female-to-male controls of 2.09. The ratio of female-to-male controls used in the case-control study was 1.62. Only 10% of females with cholera died in the community, whereas 23% of males cholera died. These findings make the finding of higher deaths in males more striking. We did find an interesting relationship between males and marriage status. Although marriage did not decrease the odds of death, for those who did not go to the CTC, being married was protective. No other studies were found on cholera that identified marriage as a protective factor for mortality.

In Chivi, cholera patients that received cholera information (from VHWs and by person-to-person communication), had greater odds of receiving home-based rehydration or attending a CTC. Those with cholera who received home-based rehydration also had greater odds of both visiting a CTC and surviving cholera. The role of local health workers in prevention and treatment of diarrheal disease outbreaks also was found to be important in Kenya and Sudan.[21,22] In Guinea-Bissau and Peru, interpersonal communication was key in assisting communities to identify cholera cases.[23,24] In India, ORS use at home was found to drastically reduce mortality.[25] Interestingly, in Peru, ORS and/or SSS was not found to be protective against mortality, although less than one-third of respondents knew how to make SSS properly compared with 63–66% in this study in Zimbabwe.[26] Limited knowledge on how to properly prepare home oral rehydration therapy has been found with increased mortality in other settings.[27–29]

There were several limitations to this study. We used a clinical case definition for cholera because laboratory confirmation was not possible, so other disease entities may have been captured. In addition, because the interviews were conducted with proxies for the deceased, the responses may have differed from what the case experienced. However, for both these issues, it was reassuring that both proxies and controls reported similar percentages of cholera symptoms. Finally, because the study was conducted more than six months after some disease episodes and death occurred, there may have been recall bias.

In Chivi district, males and those with larger household size had higher odds of mortality. This is a new finding. Patients who received home-based rehydration and went to a CTC had lower odds of death. Although receipt of cholera information by the family did not independently demonstrate a protective effect from death, it did demonstrate an increased odds of the patient receiving home-based rehydration and going to a CTC. There is a need to raise community awareness of cholera through use of person-to-person communication and support VHWs to emphasize the importance of early home-based rehydration and use of CTCs. Increasing family and community awareness of cholera prevention and treatment is paramount from the beginning of a cholera outbreak.

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