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Funerals during the 1994 cholera epidemic in Guinea-Bissau, West Africa: The need for disinfection of bodies of persons dying of cholera

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SUMMARY

The 1994 cholera epidemic in Guinea-Bissau resulted in 15878 reported cases and 306 deaths. Early in the epidemic, although the health ministry mandated that the bodies of persons dying of cholera be disinfected, outbreaks occurred in several villages following funerals in the region of Biombo. To determine the influence of disinfection and funeral activities on cholera transmission, we analysed surveillance data and conducted a case-control study following a funeral. The attack rate during the week following funerals was higher in villages where bodies were not disinfected (risk ratio = 2·6, 95% confidence interval [CI] 1·9–3·8). Cholera was strongly associated with eating at a funeral with a non-disinfected corpse (odds ratio [OR] = 14·5, 95% CI 0·9–786) and with touching (i.e., transporting, washing) the body (OR = 36·2, 95% CI 2·6–1769). During cholera epidemics, in addition to other cholera prevention activities, health officials should inform community leaders about the risk of cholera transmission during funerals, meals should not be served at funerals, and bodies of persons dying of cholera should be disinfected.

INTRODUCTION

The first cholera epidemic during this century in Guinea-Bissau occurred in 1987, almost 2 decades after the seventh pandemic reached West Africa [1]. In late 1994, a second epidemic in Guinea-Bissau resulted in more than 15000 reported cases and 306 deaths among the one million inhabitants [2]. The 1994 epidemic began in the Bijagós Islands and spread rapidly to Bissau, the capital of Guinea-Bissau, and its surroundings (Fig. 1). In mid-October the Guinea-Bissau National Public Health Laboratory isolated *Vibrio cholerae* O1, serotype Ogawa, biotype E1 Tor, from stool samples collected from patients in Guinea-Bissau. During the 1994 epidemic, as in the 1987 epidemic, the region of Biombo had the highest recorded cholera incidence outside of the capital.

Previous investigations of cholera in Africa have demonstrated the importance of contaminated food and water in the transmission of cholera [1]. Further studies in West Africa have suggested that funerals may also contribute to cholera transmission [3, 4], but rigorous investigations of funeral activities have not been described. During the 1987 cholera epidemic in Guinea-Bissau, a large outbreak (111 cases, 15 deaths) occurred after a funeral in a village in Biombo belonging to the Papel ethnic group; most of the persons with cholera apparently became infected during the large community meal served at the funeral

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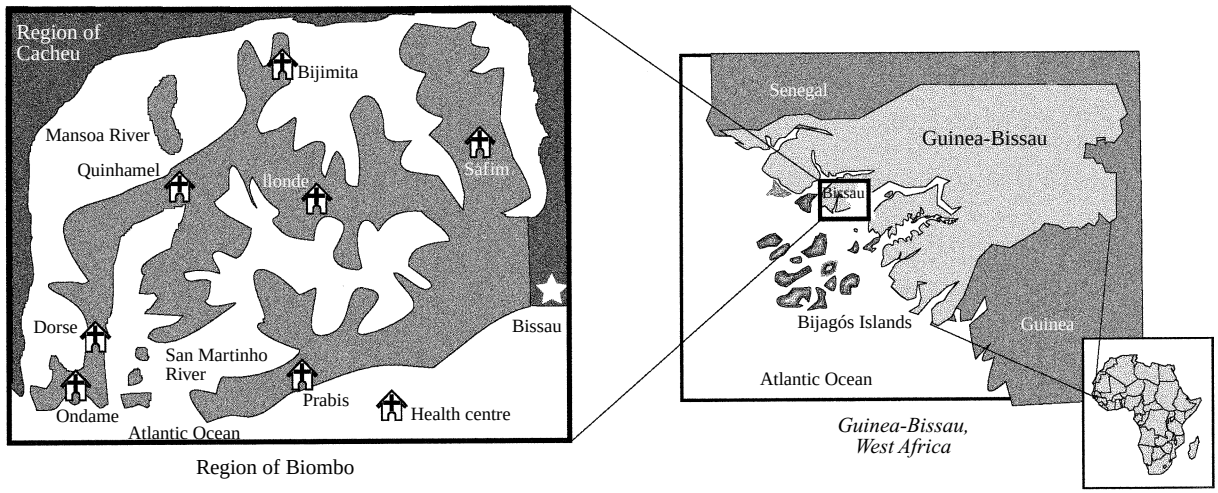

Fig. 1. Geographic location of the Republic of Guinea-Bissau and Biombo.

[5]. At the beginning of the 1994 cholera epidemic, in October, the Ministry of Public Health mandated that the bodies of all persons dying of cholera be disinfected with 2% sodium hypochlorite bleach by health personnel and buried within 24 h after death. Early in the epidemic, however, several cholera outbreaks in Biombo again seemed to follow funerals. We launched an investigation to determine the influence of various funeral activities and disinfection on the transmission of cholera in Biombo.

METHODS

Biombo (pop. 61522), with an estimated 73 inhabitants per square kilometre, is the most densely populated of the nine regions outside of the capital Bissau. The median population of the 136 villages in Biombo is 316 inhabitants (range 8–3557) (Table 1). The villages are arranged in compounds, in which extended family members live in several thatch-roof huts. Water is collected from shallow wells or springs. Few villages have latrines or electricity. Soap is rarely used for handwashing. The diet consists largely of rice and fish, usually served in a common bowl and eaten from the hand. The population is predominately Papel (73%) or Balanta (19%) ethnic groups; both groups adhere mainly to African religions.

Funerals

The Papel usually have prolonged funerals, which include large social gatherings. After the death of an adult, the body is transported to the native village of the person who died, where the body is taken to an appropriate house for washing, often the home of the deceased. The body is washed with soap and water at night; the bowels are not evacuated. Deceased women are washed by their close female relatives; deceased men are washed by their wives, daughters, and close male relatives (children are not involved in the washing of the body). After being washed, the body is wrapped with funeral shrouds and a meal is usually served to participants. Every morning until the corpse is buried, women enter the funeral house and 'offer rice' for the deceased by eating small amounts of cooked rice and sprinkling rice on the floor. During the day, the body is taken out of the funeral house by male relatives and wrapped with additional shrouds, before being returned to the funeral house in the evening. The body is usually buried 3–5 days after death. A large community meal is served for which animals are slaughtered if, through divination, the 'spirits' are thought to be favourable. In certain situations, including emergencies such as a cholera epidemic, the religious leaders may postpone the large community meal.

The Balanta have funeral activities similar to those of the Papel except there is less manipulation of the body, there are fewer shrouds, and the body is usually buried within 24 h after death. The Balanta also tend to have larger community meals during funerals than the Papel.

Surveillance

For surveillance purposes, a case of cholera was defined as acute, watery diarrhoea in a Biombo

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Table 1. *Cholera attack rates and average time to burial, by disinfection and funeral history, for 136 villages in Biombo, Guinea-Bissau, October 1994–January 1995*

	Number of villages (median village population)	Population $\geqslant$ 2 years	Number of cholera cases $\geqslant$ 2 years	Cholera attack rate (%) $\geqslant$ 2 years	Number of cholera funerals	Average time to burial (h)	Village cholera adult attack rate (%) $\leqslant$ 1 week after funeral	Relative risk	95% confidence interval
Villages with cholera funeral – bodies not disinfected	5 (616)	2700	129	4·8	6	43	2·6	2·6	1·9–3·8
Villages with cholera funeral – bodies disinfected	26 (520)	18902	575	3·0	56	11	1·0	(Referent)	—
Villages without cholera funeral	69 (342)	28920	484	1·7	—	—	—	—	—
Villages without cholera case	36 (170)	6836	—	—	—	—	—	—	—
All villages	136 (316)	57358	1188	2·1	62	—	—	—	—

resident greater or equal 2 years of age presenting to one of the seven health centers in Biombo (including persons who died before their presentation) during the period of the cholera epidemic, 20 October, 1994 to 13 January, 1995. Health centre nurses registered cholera cases and prospectively completed case report forms, which contained information on demographics and information on potential exposures in the week before onset of diarrhoea. Exposures included travel, presence of cholera among family members living in the same compound, and, for persons $\geqslant$ 15 years of age, contact with (i.e., touching, transporting) the body of a person who had died. Estimated village populations, extrapolated from the 1991 census, were used to determine village-specific attack rates.

We identified cholera deaths by reviewing case report forms; we also attempted to ascertain unreported deaths during frequent interviews with health centre staff and visits to the villages. For each cholera death, interviews with health centre nurses and family members of the deceased were conducted with a standardized questionnaire between March and June 1995. Information obtained included funeral activities such as the use of bleach to disinfect the body and the time between death and burial.

Case-control study

To determine the role of specific funeral activities in the transmission of cholera, a case-control study was conducted in a Papel village in northern Biombo that had several cholera cases following the funeral of a woman who died of cholera; prior to the funeral, no registered cholera cases had occurred in the village or neighbouring villages during this epidemic. The person who died of cholera was a native of the study village, but was on a visit in another village when she became ill with watery diarrhoea. She died in the other village and her body was transported to her native village for her funeral on 24 October, 1994. Her body, which was not disinfected, was buried on 26 October, 48 h after her death. A small meal was served after the body was washed (approximately 12 h after her death), but the funeral did not include a large community meal.

The estimated population of the village, extrapolated from the 1991 census, was 914 persons, of whom approximately 520 were $\geqslant$ 15 years of age. From 30 November to 4 December 1994, we visited each of the compounds in the village, confirmed there were no

reports of residents with symptoms of cholera with illness onset prior to the funeral of the person who died of cholera, and compiled a roster of residents $\geqslant 15$ years of age. All residents $\geqslant 15$ years of age were asked about the occurrence of diarrhoea or cholera with an onset of diarrhoea during the study period, 24 October to 30 November 1994 (from the date of the cholera death to the beginning of the case-control study). Senior family members were asked to respond for persons who were not present during the visit.

This roster of village residents was used for selecting cases and controls for a case-control study. We attempted to enroll all of the identified cholera cases (residents of the study village who were $\geqslant 15$ years of age, and who reported having cholera with onset of diarrhoea between 24 October and 30 November 1994). For controls, 60 village residents were selected using a random number generator and interviews were accepted with those who reported having no diarrhoea during this period. Prior to developing the questionnaire, open-ended interviews with key informants and family members of the index case were conducted to develop hypotheses. Interviews were conducted with cases and controls between 10 December 1994 and 12 January 1995, using a pretested, standardized questionnaire; surrogates were not interviewed. Case-control participants were asked about their history of travel (including travel to the village where the person who died had become infected), visitors, presence of cholera in their compound, and attendance at funerals (from 24 October to 30 November for the controls, and from 24 October to the date of diarrhoea onset for the cases). Participants were also asked about their relation to the person who died. Persons who attended the funeral of the person who died were asked about their participation in various activities at the funeral such as transporting the body from the other village, washing the body, wrapping the body with funeral shrouds, and consumption of water, food or alcohol. All interviews were completed with the help of a Papel translator.

To compare the funeral-related results, which were based on a clinical case definition of cholera, with results based on a serological case definition, we attempted to collect a blood sample, after free and informed consent, from the 60 randomly selected village residents. These samples, along with samples collected from all other village residents who reported developing cholera during the study period, were also used to determine the association between a clinical diagnosis of cholera and the development of vibriocidal antibodies. Samples were collected in microcontainers via finger prick; persons giving blood were offered a bar of hand soap. The blood samples were stored in an ice chest (2–8 °C) until they were spun down and frozen at the National Public Health Laboratory in Bissau on the afternoon they were collected. Sera were analysed at the Centers for Disease Control and Prevention in Atlanta, Georgia, USA, for vibriocidal antibody titres in January and February 1995 [6].

Analysis

Univariate analysis of the data was performed with Epi-Info (USD Inc., Stone Mountain, GA, USA). Statistical comparisons were done with the Student t test for comparing means, the Mantel–Haenzel test for trend, or the Mantel–Haenzel χ^2 test with Cornfield or exact 95% confidence intervals calculated for the odds ratio (for the case-control study) and Taylor series 95% confidence intervals calculated for the risk ratio (for the surveillance data).

RESULTS

Surveillance

During the epidemic, 1188 cases of cholera were registered in the region of Biombo (Fig. 2). The median age of the patients was 34 years (range 2–80). Sixty-five percent of cholera cases were female compared to 53% of the general population in Biombo ($P < 0{\cdot}01$). Among the 1029 persons with cholera who were $\geqslant 15$ years of age, 101/726 (14%) reported having contact in the 1 week before the onset of their diarrhoea with a corpse; males and females were equally likely to report such contact. Persons with cholera occurring during the first half of the epidemic, before 19 November (the day the median case of cholera of the epidemic was recorded), were 2·0 times more likely (95% confidence interval [CI] 1·4–2·9) than later patients to report having contact in the 1 week before the onset of their diarrhoea with a corpse; 62 of 320 (19%) patients whose onset occurred before 19 November reported such contact compared with 39 of 406 (10%) later patients.

Sixty-two (5·2%) of the 1188 registered cholera cases died (Table 1); 51 (82%) were Papel, 11 (18%) were Balanta. No additional cholera deaths were detected during visits to numerous villages in Biombo.

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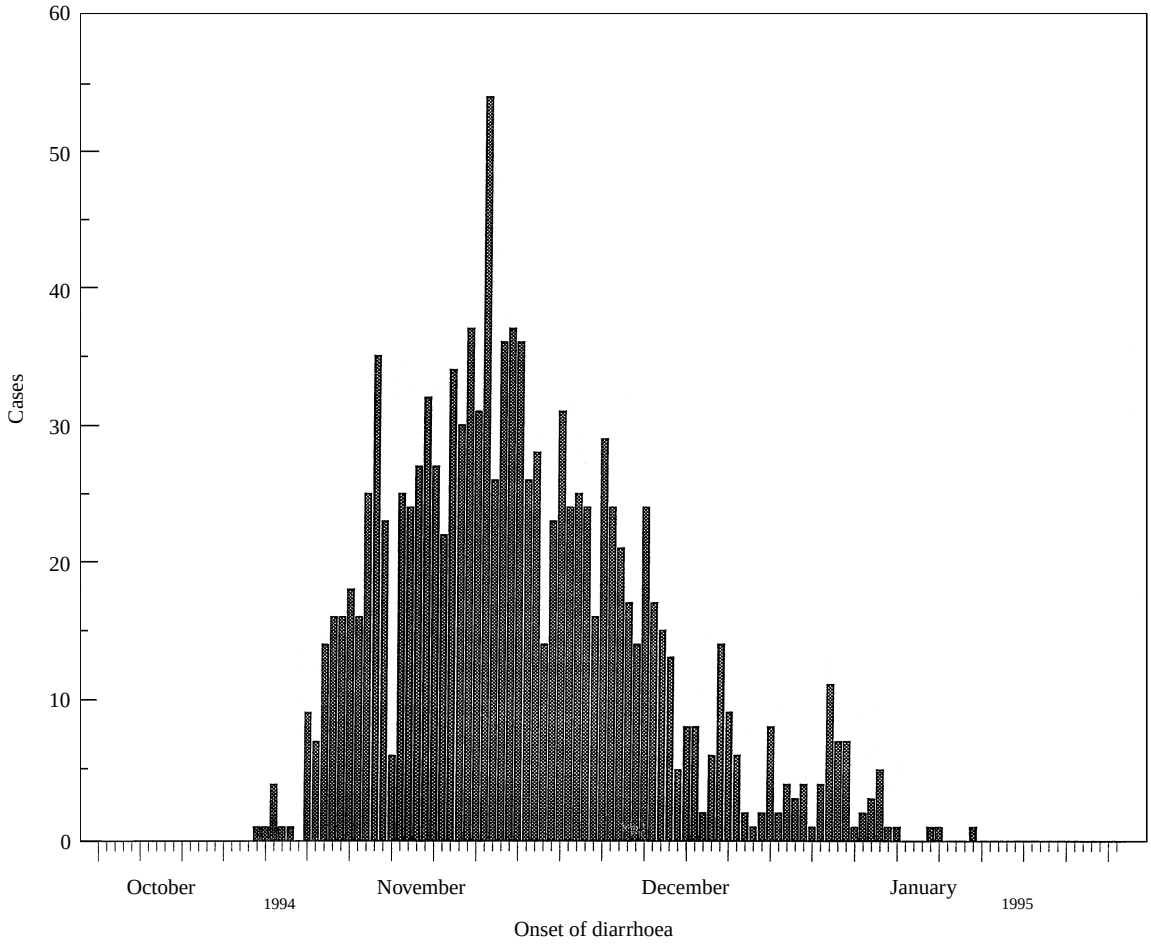

Fig. 2. Cholera cases, by date of onset of diarrhoea, Biombo, Guinea-Bissau, October 1994 to January 1995.

Seventeen deaths in Biombo occurred outside the health centres. Assistance from local police was required in at least 4 instances to implement the Ministry of Public Health policy of disinfection and rapid burial of persons dying with cholera. All bodies were disinfected except 6 of the 17 bodies of persons who died of cholera outside the health centres. The external surfaces of all bodies which were disinfected, were washed with bleach, shortly after death (before the body was returned to the relatives), by health personnel who wore rubber gloves and aprons. The burial of the 6 bodies that were not disinfected occurred an average of 43 h after death (range 19–74 h) compared with an average of 11 h after death for those that were disinfected (range 1–31 h) ($P <$ 0·001) (Table 1). Five of the 6 bodies that were not disinfected were Papel; one was Balanta.

Funerals for the 6 persons whose bodies were not disinfected were conducted in 5 villages. The cholera attack rate was 2·6% in these villages during the week following the funerals – 2·6 times higher than the 1·0% attack rate that occurred in the week following the funerals in the villages in which the bodies were disinfected (95% CI 1·9–3·8) (Table 1). The overall cholera attack rate during the epidemic period was 4·8% in the 5 villages where bodies were not disinfected before burial, 3·0% in the 26 villages where only disinfected bodies were buried, and 1·7% in the 69 villages with no cholera deaths (test for trend $P < 0{\cdot}01$).

During the epidemic, 32 cases of cholera with 1 death (the women whose body was transported to the village) were recorded from the study village in the surveillance data. Twenty-one of these cases were included in the case-control study; one case involved a child, and the person who died of cholera occurred before and 9 cases occurred after the beginning of the case-control study in the village. Cholera cases in the study village did not differ significantly from other Biombo cases with respect to patient age, sex or history of travel during the week before illness onset. However, contact in the week before illness onset with

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Table 2. *Analysis of risk factors for clinical cholera. Case-control study, Guinea-Bissau, October to November 1994*

Exposure	Proportion of case-patients exposed (%)	Proportion of controls exposed (%)	Odds ratio	95% confidence interval
Village residents				
Travel outside village	16/25 (64)	29/45 (64)	1·0	0·3–3·1
Visitors to their compound	10/25 (40)	9/45 (20)	2·7	0·8–9·1
Cholera in their compound	18/25 (72)	17/45 (38)	4·2	1·3–14·1
Related to index case	21/25 (84)	22/45 (49)	5·5	1·5–24·9
Attended funeral of index case	19/25 (76)	30/45 (67)	1·6	0·5–5·8
Attended other cholera funerals	3/25 (12)	5/45 (11)	1·1	0·1–6·2
Persons who attended the funeral				
Drank water at the funeral	9/19 (47)	7/30 (23)	3·0	0·7–12·3
Drank alcohol at the funeral	8/19 (42)	5/30 (17)	3·6	0·8–17·2
Ate at the funeral	5/19 (26)	1/30 (3)	10·4	1·0–506·2
Entered funeral house	6/19 (32)	6/30 (20)	1·8	0·4–8·4
Touched the corpse	6/19 (32)	1/30 (3)	13·4	1·3–636·2

the body of a person who had died was reported more commonly by patients from the study village (52%) than by other case-patients in the Biombo region (13%).

Case-control study

We identified 458 persons ⩾ 15 years of age living in the study village, of whom 62% were female. Forty-one persons (9%) reported having an episode of diarrhoea during the study period, 24 October and 30 November 1994. Twenty-five of the 41 persons with diarrhoea attended a health centre with acute watery diarrhoea (thereby meeting the surveillance case definition for cholera), but only 21 (84%) were recorded in the surveillance data. The median age of the 25 persons with cholera was 42 years (range 15–75 years), 19 (76%) were female. Onset of diarrhoea occurred between 26 October and 18 November; earliest onset of diarrhoea occurred 48 h after the burial of the person who died of cholera. Many of the 25 persons with cholera also reported vomiting (68%) and muscle cramps (75%). Twenty of 25 (80%) persons with cholera were hospitalized at least overnight. Interviews are completed with all 25 cholera patients. The mean time between illness onset and the interview, for the cases, was 49 days. Fifty-one of the 60 randomly selected residents did not have diarrhoea during the study period and were eligible to be controls; 45 of the 51 were interviewed (1 refused to participate and 5 could not be contacted despite several return visits to the village).

Blood samples were collected from 52 of the 60 randomly selected residents of the study village (2 refused to participate and 6 were absent); a sample was collected from 45 controls, 3 case-patients, and 4 persons with diarrhoea without cholera. However, serum samples from 2 controls were insufficient for antibody determination. Blood samples were also collected from the 22 additional case-patients. For case-patients, the interval between onset of diarrhoea and venipuncture varied from 16–78 days (mean 44 days). Having a clinical diagnosis of cholera was strongly associated with having vibriocidal antibodies; persons with cholera were 8·9 times more likely than persons who reported not having had diarrhoea to have vibriocidal antibody titre ⩾ 640 (95% CI 1·9–55). Ten of the 25 (40%) persons with self-reported cholera had vibriocidal antibody titres ⩾ 640 compared with 3 of 43 (7%) of persons who reported not having diarrhoea.

There were no differences between case-patients and controls in the proportion who were females or were ⩾ 35 years of age. There were also no differences in their history of travel or visitors (Table 2). However, persons with cholera were 4·2 times more likely than persons without diarrhoea to have had another person in their compound with cholera during the study period (95% CI 1·3–14·1), and 5·5 times more likely to be related to the fatal index case (95% CI 1·5–24·9).

We analysed the risk of specific exposures at the funeral of the person who died of cholera among the 49 funeral attendees (Table 2). Cholera among persons who attended the funeral was associated with eating

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at the funeral, although few persons reported eating there. The only food reportedly eaten at the funeral was the rice prepared for the rice offerings and a small meal served to the persons who had washed the body after that task was completed. Persons with subsequent cholera were 10·4 times more likely than persons without diarrhoea to have eaten at the funeral (95% CI 1·0–506). Case-patients were not more likely than controls to have entered the funeral house, but persons with cholera were 13·4 times more likely than persons without diarrhoea to have touched the body (95% CI 1·3–636). Similar results, although not statistically significant, were seen among the randomly selected village residents using a serological (rather than clinical) case definition. Persons with vibriocidal antibody titres $\geqslant 640$ were 10·5 times more likely than persons with titres < 640 to have touched the body (95% CI 0·6–168); 2 of 6 persons with high titres reported such contact compared with 2 of 44 with low titres.

Thirteen persons with cholera had onset of diarrhoea within 1 week after the burial; 9 of whom attended the funeral. When the analysis was repeated, restricting the cases to the 9 persons with cholera who attended the funeral and whose onset of diarrhoea occurred within 1 week after the burial, associations with funeral activities were even stronger. Case-patients were 36·2 times more likely than controls to have touched the body (95% CI 2·6–1769); 5 of 9 (56%) cases, compared to 1 of 30 (3%) controls. Similarly, although not statistically significant, cholera patients with diarrhoea onset that began within 1 week of the burial were 14·5 times more likely than persons without diarrhoea to have eaten at the funeral (95% CI 0·9–786); 3 of 9 cases (33%), compared to 1 of 30 (3%) controls. When the analysis among study village residents was repeated restricting the cases to those 12 persons whose onset of diarrhoea occurred later than 1 week after the burial, cholera was not associated with any funeral activities. However, case-patients were 4·9 times more likely than controls to report the presence of another person with cholera in their compound (95% CI 1·0–31).

DISCUSSION

Data from this investigation provides the first supported evidence, to our knowledge, on the benefit of bleach disinfection of corpses during a cholera epidemic; the cholera attack rates were lower in Biombo villages where the bodies of persons who died of cholera were disinfected compared with villages were bodies were not disinfected. This beneficial effect of disinfection was probably due to a reduced level of contagion and increased precautions associated with an heightened awareness by the disinfection process of the potential of cholera transmission at funerals. Bodies which were disinfected also were buried more rapidly, however, requiring more rapid burials (without requiring disinfection) probably would not prevent many cases of cholera. In the case-control study most of the funeral participants who developed cholera had close contact with the non-disinfected body within 12 h of the death of the decedent.

Previous investigations in West Africa have demonstrated the potential for large community meals to result in explosive funeral-associated outbreaks [3, 4], but this is the first study to demonstrate the association between several funeral activities and transmission of cholera. In the case-control study, the body of a person who died of cholera was transported to study village; prior to this introduction, no case of cholera had been registered in the area which allowed a unique opportunity to study the contribution of funeral activities in the transmission of cholera. Since none of the village residents shared exposures with the person who died of cholera, cholera apparently was introduced into the village during the funeral – which allowed a unique opportunity to study the contribution of funeral activities in the transmission of cholera. Cholera was strongly associated with transporting, washing or wrapping the non-disinfected body of a person who died of cholera, and eating afterwards; practices which clearly might have resulted in faecal–oral transmission of cholera. Other funeral activities which were less closely associated with the non-disinfected body (such as attending the funeral, entering the funeral house, or drinking at the funeral) were not associated with an increased risk of cholera.

Several strategies might be attempted to diminish the risk of cholera transmission at funerals in West Africa where funerals are a major social event – illustrated by the attendance of approximately 70% of the adult population in the study village at the funeral of the person who died of cholera. During the 1987 cholera epidemic in Guinea-Bissau, an attempt was made to ban all funerals of persons who died of cholera [5]; this failed because of poor compliance. At the beginning of the 1994 epidemic in Guinea-Bissau, the Ministry of Public Health mandated the immediate disinfection of all bodies of persons dying of

cholera and provided concentrated bleach to health centres, where it was diluted to 2% bleach and used for disinfection. This policy generally had a good reception in Biombo. In most instances when a person died of cholera in a village, someone from the village went to the health centre to request disinfection of the body. In a few cases, however, local authorities were needed to ensure compliance. Most importantly, the policy appears to have been effective in reducing cholera transmission in Biombo; the proportion of cholera patients who reported recent contact with the body of a person who had died decreased significantly during the epidemic, and the one-week post-funeral cholera attack rates were significantly lower in villages where the bodies had been disinfected. The overall cholera attack rate was 1·6 times higher in villages where bodies were not disinfected. This suggests that the disinfection strategy in the villages where bodies were disinfected, a policy which was relatively simple to enforce and required few resources, prevented up to 375 cholera cases or 24% of what would have been the total epidemic in Biombo.

Although interventions aimed at funeral activities may prevent a significant burden of illness during a cholera epidemic, most cholera cases result from ingestion of contaminated food or water outside of funerals [1], emphasizing the need to incorporate interventions aimed at funeral activities in a broader cholera prevention programme. In our case-control study, the only significant risk factor for cholera transmission more than one week following the burial was having another person with cholera in the same compound. The presence of other persons with cholera in the same compound emphasizes the need to protect domestic food and water sources from potential contamination. Possible local strategies which would require appropriate health education include point-of-use chlorination of home water supplies, or the acidification, with lemon juice, of stored drinking water or sauces used for food [7, 8].

This investigation concerned the funeral practices of two ethnic groups, the Papel and the Balanta. Although uncommon outside of Guinea-Bissau, these two ethnic groups share many cultural features with more than 10 other ethnic groups, the so-called Senegambians, who live along the West African coast [9]. Most of these groups adhere to animistic traditions and share many funeral practices. Some of the conclusions drawn from this investigation may be applicable among these other groups and others that share similar funeral practices. Results from this study may also be relevant to understanding the funeral transmission of other infectious diseases, such as *Shigella dysenteriae* type 1 and Ebola virus.

This study investigated the importance of funerals for the transmission of cholera during an epidemic using clinical observation and data from regional surveillance and a case-control study. Based on its results, we recommend that, as a part of a comprehensive cholera prevention programme, public health officials consider requiring bleach disinfection and rapid burial of all bodies of persons dying of cholera during an epidemic to reduce the risk of transmission to persons who will have direct contact with the body during the funeral. During a cholera epidemic, because of the uncertainty often associated with determining the cause of death, officials might also consider expanding the policy of disinfection and rapid burial to all deaths, irrespective of perceived cause. We also recommend that health officials should inform local religious leaders and other authorities about the risk of cholera transmission during funerals. Reducing the risk associated with funerals for persons not directly involved with preparing the body for burial can be accomplished by postponement of large community meals until after an epidemic. After two epidemics with great social costs in Guinea-Bissau, we believe these funeral measures are culturally acceptable and will limit the spread of future cholera epidemics.

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