AN OUTBREAK OF EL TOR CHOLERA ASSOCIATED WITH A TRIBAL FUNERAL IN IRIAN JAYA, INDONESIA

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Abstract. An outbreak of El Tor biotype cholera occurring in a rural village in Irian Jaya, Indonesia was evaluated for risk factors associated with death from cholera. Among those dying in the village during the epidemic, a significant association between membership in one of the five tribal groups in the village complex was associated with an elevated risk of suffering a cholera death (odds ratio = 5.9). Interviews with members of the decedents' families revealed a very strong association (odds ratio = 11.6) between risk of cholera death and having attended the two day funeral of a woman who died of a cholera-like illness a few days prior to an outbreak of cholera-like diarrheal disease in the village complex. Recent flooding may have contributed to the creation of an environment conducive to cholera transmission.

INTRODUCTION

The seventh cholera pandemic that began in 1961 in Sulawesi, Indonesia, quickly spread to the neighboring islands of Java, Borneo, and Irian Jaya Kamal (1975) where the El Tor biotype remains endemic. In July 1995, health workers in Kwamki Lama, a village in southern Irian Jaya, noted an increase in the number of deaths per month. We report an outbreak of *Vibrio cholerae* O1, El Tor biotype, serotype Ogawa in the Indonesian province of Irian Jaya associated with an Ikari tribal funeral.

MATERIALS AND METHODS

Setting and subjects

Kwamki Lama is a village in the southern lowlands of Irian Jaya, Indonesia. It is located in tropical rainforest at 43 meters above sea level, and consists of five neighborhoods, Sosial, Blok I-V, Kangguru, Mambruk and Cendrewasih. The area is inhabited by members of several Irianese tribes including Amungme, Dani, Damal, Moni and Ikari, in addition to immigrants from other areas of the Indonesian Archipelago. All inhabitants of Kwamki Lama meeting inclusion criteria were eligible for inclusion.

Inclusion criteria

For purposes of defining an epidemic curve for diarrheal cases, health records at the Kwamki Lama recorded community health clinic were reviewed, and all cases of diarrhea in residents of Kwamki Lama during July and August of 1995 were in-

cluded. We were not able to differentiate cholera from non-cholera diarrhea from the health clinic records. Confirmed cases were defined as any person with acute diarrhea whose stool culture was positive for *V. cholerae* O1, El Tor biotype, serotype Ogawa.

Investigation of deaths

Verbal autopsies were performed on all people who died during the months of July and August 1995 in Kwamki Lama. Decedents were identified by the village chief's office and local clinic records. Family members of each decedent were then interviewed at the home of the deceased using a standardized questionnaire. Interviews were conducted by team physicians and trained local public health workers, who also acted as interpreters. Responses were recorded on a 55-question form that elicited information on decedent demographics, medical history, symptoms prior to death, and hospital admissions. Questionnaire format included "Yes", " No", and "Don't know" responses. "Don't know" responses were excluded from analysis. Where available, questionnaire responses were compared with hospital inpatient records of the deceased. A " cholera-like death" was defined as a death that was, according to family members, preceded by acute, watery diarrhea. All other villagers' deaths not preceded by acute watery diarrhea were defined as " non-cholera-like deaths".

Laboratory data

During July and August of 1995, stool samples were collected from patients presenting to the community health clinic (PUSKESMAS) with acute diarrhea. The samples were obtained via rectal swab by team physicians or trained public health workers. Specimens were placed in Cary-Blair transport medium and processed in a field laboratory the same day. The establishment of a field laboratory and the initial confirmation of *V. cholerae* were performed by an experienced microbiologist-physician. Thereafter, a trained local laboratory technician processed all stool specimens. Stool specimens were cultured on thiosulfate-citrate-bile-sucrose (TCBS) according to standard technics. Colonies typical of *V. cholerae* were tested for agglutination with *V. cholerae* O1 polyvalent and monovalent (Ogawa and Inaba) antisera. All *Vibrio*

isolates were inoculated in nutrient agar and sent to Naval Medical Research Unit #2 (NAMRU-2) in Jakarta, Indonesia for confirmation and for O139 testing using the modified CAMP procedure described previously (Lesmana *et al*, 1994). In addition, once the TCBS media were inoculated at the field laboratory, the swabs were returned to the Cary-Blair transport medium, and shipped to NAMRU-2 for testing for other enteric pathogens including *Salmonella, Shigella, Campylobacter* and *Aeromonas*.

Water samples were collected from the community well-pump, several community holding tanks, and a shallow well and rainwater barrels at the home of decedent X who died on 24 July. Samples were collected in sterile 500 ml bottles, and shipped the same day on ice to NAMRU-2 for coliform count and culture on McConkey and TCBS plates. Water samples from community holding tank were tested for chlorine levels in the field by local mining company water treatment personnel.

Statistics

Statistical analysis was performed with EPI-Info 6.04 program (Centers for Disease Control and Prevention, Atlanta, GA, USA and World Health Organization, Geneva, Switzerland).

RESULTS

During the months of July and August 1995, 249 cases of acute diarrheal illness were documented in health clinic records. The epidemic curve (Fig 1) shows a constant level of diarrheal disease in Kwamki Lama between 1 and 29 July. Then the number of diarrheal cases rapidly escalated, peaking in about a week then returning to earlier levels by the end of the first week in August. Data on diarrheal cases kept in the community clinic log book from August 10 to 14 could not be located for inclusion. Among the 249 recorded cases of acute diarrhea, stool cultures were obtained from 51 subjects, 25 of which were positive for *V. cholerae* O1, El Tor biotype, serotype Ogawa. No cases of *V. cholerae* O139 were identified. No other enteric pathogens were isolated.

During July and August 1995, 37 deaths were recorded in Kwamki Lama. On verbal autopsy, 19

of these deaths were preceded by a cholera-like illness and 18 were preceded by a "non-cholera-like" illness. Review of the epidemic curve shows that no deaths were recorded until 12 July; the number of cholera deaths then rapidly increased until the incidence of diarrheal cases began to decline. Only three cholera deaths were seen after the peak of diarrheal disease cases on 1 to 3 August. Non-cholera deaths, on the other hand, were not as closely associated with the week prior to the peak or with the peak itself (Fig 1).

In two neighborhoods, Mambruk and Kangguru, cholera deaths constituted a higher proportion of all deaths (73%) than in the other neighborhoods (35%) (Table 1). Because the residents of these two neighborhoods are predominantly members of the Ikari tribe, the association between cholera deaths and tribe was investigated. Fifteen of 19 (79%) cholera deaths occurred in Ikari tribesmen while only 4 of 15 (27%) occurred in non-Ikari persons (Table 2). Verbal autopsies of all decedents revealed that 7 of 19 cholera deaths, and 0 of 18 non-cholera deaths occurred in Ikari people who attended the funeral of X, an Ikari woman who died 24 July 1995, near the beginning of the epidemic curve. For analysis purposes, the 6 cholera deaths and the 7 non-cholera deaths that occurred prior to 25 July were excluded when evaluating any association between funeral attendence and cholera death (Table 3). In addition, 25 non-fatal diarrhea cases were traced to attendance at these funeral activities. Review of Fig 1 shows that the funeral of decedent X, held on 25 to 27 July, occurred two to four days before the dramatic increase in the number of diarrhea cases in Kwamki Lama. Her funeral consisted of a traditional pig feast at her home, and was attended by a majority of the local Ikari tribe who stayed at her house in Mambruk for the duration of the three day feast and ate and drank from common food and water sources on the premises.

Though no food from the pig feast remained for laboratory examination at the time of the outbreak investigation, water samples were taken from rain water catch barrels and a shallow seepage well at the home of the deceased all contained "too numerous to count" coliforms. No *Vibrio* species were identified.

The local rainfall averaged 597 mm for the month of July from 1983 to 1993. Rainfall for July, 1995, however, was 1,500 mm. These record rains resulted in flooding of Kwamki Lama, with the exception of Sosial neighborhood which has better drainage than the rest of the village.

DISCUSSION

Our data demonstrate the presence of an outbreak of *Vibrio cholerae* O1, El Tor biotype, serotype Ogawa, which occurred during the months of July and August, 1995 in southern Irian Jaya. Cholera deaths began to appear two weeks prior to the outbreak of non-fatal diarrheal cases, and increased in number until the non-fatal diarrheal cases peaked at the beginning of August (Fig 1).
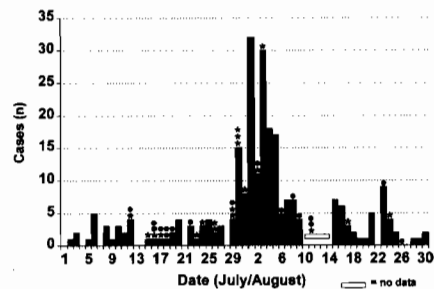

Fig 1–Diarrheal disease cases, cholera deaths (*) and non-cholera deaths (o) occurring between 1 July and 30 August 1995, Kwamki Lama, Irian Jaya, Indonesia. No data on non-fatal diarrheal cases were available between 10 and 14 August.

The outbreak was closely associated in two ways with the funeral activities surrounding the death of an Ikari woman. This woman's death occurred a week before the diarrheal disease outbreak, and her funeral occurred 2 to 4 days prior to that outbreak. Funerals are documented forums for the spread of cholera. In his original monogram on the mode of communication of cholera in England, John Snow noted "the duties performed about the body, such as laying it out, when done by women of the working class, who make the occasion one of eating and drinking, are often followed by an attack of cholera; and persons who merely attend the funeral, and have no connection with the body, frequently contract the disease, in consequence, apparently, of partaking of food which has been prepared or han-

Table 1

Deaths in Kwamki Lama, July and August 1995 by neighborhood.

Neighborhood	Cholera deaths (n)	Non-cholera deaths (n)	Odds ratio (95% CL*)
Sosial, Blok I-V, Cendrawasih	8	15	
Kangguru and Mambruk	11	3	6.88 (1.23-47.04)**

Odds ratio, confidence limits, and chi - square evaluate the risk to Kangguru and Mambruk residents referent to residents of other villages.

*   Exact confidence limits

** chi- square, p = 0.01

Table 2

Deaths in Kwamki Lama, July and August 1995 by ethnicity.

Tribe	Cholera deaths (n)	Non-cholera deaths (n)	Odds ratio (95% CL*)
Amungme	1	2	
Dani	1	6	
Damal	1	1	
Moni	1	2	
Ikari	15	7	5.89 (1.14-33.5)**

Odds ratio, confidence limits, and chi-square evaluate the risk to Ikari referent to all others.

*   Exact confidence limits

** chi-square, p = 0.013

Table 3

Deaths in Kwamki Lama, 25 July and after, by funeral attendance.

Funeral attendence	Cholera deaths (n)	Non-cholera deaths (n)	Odds ratio (95% CL*)
No	6	11	
Yes	7	0	>11.6 (>1.0-<324)**

Odds ratio, confidence limits, and chi-square evaluate the risk to funeral attendees referent to non-attendees.

*   Exact confidence limits

** chi-square, p = 0.03

dled by those having duties about the cholera patient, or his linen and bedding"(Snow, 1855). Cholera outbreaks among persons attending funerals have also been reported during the current pandemic in Guinea (St Louis *et al,* 1990) and Guinea-Bissau (Shaffer *et al,* 1988)), both of which were associated with eating rice-based meals at the funerals, prepared by persons who had previously prepared the body for burial (Swerdlow *et al,* 1994).

Though we were not able to test food served at the funeral pig feast, Swaddiwudhipong and colleagues (1990) reported an outbreak of *V. cholerae* O1 Inaba, El Tor biotype in 24 of 264 people attending a funeral in Thailand in which uncooked pork was implicated as the vehicle of transmission (odds ratio = 15, p<0.01).

Fifteen of the 19 cholera deaths occurred in members of the Ikari tribe, which accounts for only 10.9% of the total population of Kwamki Lama. The most likely explanation is that of increased risk of exposure to high *Vibrio* inocula at an Ikari funeral. Although no *Vibrio* species were isolated from the water sources at the home of decedent X, the isolation of coliforms "too numerous to count" indicates the presence of conditions conducive to cholera transmission. These conditions may have been aggravated by the 2.5 times increase in rainfall and resultant flooding in July. Other theoretical contributing factors could include differential susceptibility among Ikari tribal people, such as that conferred by increased prevalence of type O blood (Glass *et al,* 1985) or *Helicobacter pylori* - associated hypochlorhydria (Richardson, 1994).

The cholera outbreak was halted by supplying chlorinated water for drinking and cooking, and an educational campaign encouraging local residents to use only boiled or chlorinated water. Prompt establishment of oral rehydration and treatment centers controlled subsequent morbidity. Although this outbreak was quickly contained, cholera promises to remain endemic in southern Irian Jaya. Further studies examining tribal susceptibility patterns, local surveillance, and preventive measures should continue.

ACKNOWLEDGEMENTS

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