Epidemiological Report


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SUMMARY: Recent large-scale outbreaks in the Lao People’s Democratic Republic (Lao PDR) were reported in 1993 and 1994 and from 2000 to 2002. On December 23, 2007, a drastic increase in acute watery diarrhea patients at a health center in Sekong Province was reported to the provincial health office. An outbreak investigation was initiated to understand the magnitude of the outbreak, identify new cases, identify the suspected causal agent, implement control measures, and prevent new cases. Through active village based surveillance, 370 cases and 3 deaths were reported from 31 villages between December 15, 2007 and January 29, 2008. Of these reported cases, 29% were under the age of 5. From 28 fresh stool samples taken, 17 (58.6%) were positive for Vibrio cholerae O1 Ogawa strain. Two water sources close to affected villages were found to be contaminated with the same strain of V. cholerae. Control measures implemented included health education for safe household water consumption and early identification and treatment of suspected cholera patients at village level. The cause of the outbreak was suspected to be a combination of contaminated drinking water and person-to-person transmission.

INTRODUCTION

Cholera is a severe bacterial diarrheal disease which is often associated with poor hygienic and sanitation conditions as it is transmitted by contaminated food and water. This disease has been an important concern for public health in Asia from the time of recorded history (1,2).

The Lao People’s Democratic Republic (Lao PDR) is a landlocked country located in the Mekong Basin of Southeast Asia. Sixteen percent of deaths in children under the age of 5 in Lao PDR can be attributed to diarrhea (3) and therefore it continues to be an important national public health problem. Monthly surveillance for acute watery diarrhea in Lao PDR has been implemented since 1988 (personal communication. National Center for Laboratory and Epidemiology [NCLE]). Since 1999, all healthcare facilities, including health centers, district hospitals, provincial hospitals, and central hospitals have reported weekly cases and deaths of acute watery diarrhea. Figure 1 shows the national monthly incidence of acute watery diarrhea between January 2005 and November 2007. Annual peaks of diarrhea activity occurred in 2005 and 2006 around April (the end of the dry season), and monthly incidence of over 7 cases per 100,000 from January until August of 2007. In Lao PDR, recent cholera outbreaks were recorded in 1993 in 2 provinces, spreading to an additional 7 provinces in 1994 (4). Additionally, in the provinces of Savannakhet, Sekong, Vientiane Municipality, and Houaphanh, increased numbers of cholera were reported from 2000–2002 (5). Recent sporadic cases have also been reported from the capital city, Vientiane (6).

MATERIALS AND METHODS

Ethics statement: As the study represented an investigation into an ongoing outbreak, under Lao PDR law there was no need to obtain informed consent from identified cases of the outbreak. The study was approved by Lao PDR National Ethical Committee for Health Research. All data collected during the outbreak from patients was analyzed in an anonymous way.

The study area: Sekong Province is located in south-
ern Lao PDR, and shares borders with Vietnam in the east and Champassak Province in the west, which in
turn borders on Cambodia and Thailand. A key road
from Vietnam to Champassak Province and onwards
to Thailand passes through Sekong Province. The river
Xe Don passes through Sekong and southwards to At-
tapeu Province. The population of Sekong is estimated
to be around 85,316 people (according to the last popu-
lation census in 2005). There are 4 districts in Sekong, 2
of which (Thateng and Lamarm) are more urbanized
due to easier access to the main road (Fig. 2).

**Alert of the outbreak:** On December 23, 2007, the
provincial hospital in Sekong Province received a phone
call from Tonti health center, located in Thateng Dis-
trict, requesting assistance with the clinical management
of an unusual number of cases with severe acute diar-
rhea. Follow-up investigations by district and provincial
health staff on December 23 and 25 revealed that there
was an outbreak of acute watery diarrhea in Thateng
District with 117 cases and 2 deaths reported. The out-
break was reported to the NCLE on December 26.
NCLE offered their assistance for further investigation
and response to the outbreak. An outbreak investigation
was initiated on December 28 to understand the
magnitudes of the outbreak, identify any new cases,
identify the suspected causal agent, implement control
measures, and prevent new cases. The outbreak investiga-
tion team consisted of surveillance staff from Sekong
Province and Thateng and Lamarm Districts, one
epidemiologist and one laboratory staff member from
NCLE, and one epidemiologist from the World Health
Organization (WHO) country office Lao PDR.

**Active surveillance:** A case was defined as any person
who was in their village, or had presented at a health
center, district hospital, or provincial hospital, with
acute watery diarrhea (more than 3 loose watery stools
per day) since December 15, 2007, in Thateng and
Lamarm Districts in Sekong Province. All villages with
suspected cases by December 28 were asked to imple-
ment active daily house to house surveillance, through
village heads and village health workers, for the identifi-
cation of new suspected cases. In addition, all health
centers in the area were asked to report daily any new
cases of acute watery diarrhea seen in their health cen-
ter, and to monitor their villages (on average each health
center has 10 villages in their coverage area) for new
cases. The district hospital located in Thateng District
and the provincial hospital in Lamarm District also par-
ticipated in active daily surveillance.

**Laboratory methods:** Fresh stool samples and water
samples were collected and sent to the NCLE in Vien-
tiane for diagnostic testing. Some were stored in Cary-
Blair medium, others were sent as whole stool. Samples
were maintained on ice during transport. Stool and
water samples were incubated with alkaline peptone
water (APW) at 35–37°C for 6–8 h. Samples were plat-
eted onto thiosulfate citrate bile salt sucrose agar (TCBS)
at 35–37°C for 18–24 h. Yellow colonies were inoculat-
ed into nutrient agar at 35–37°C for 18–24 h. Cultures
positive for suspected cholera were then screened with
a series of biochemical tests which included: oxidase test,
Kligler iron agar (KIA), lysine decarboxylase broth,
Voges-Proskauer, SIM, and hydrogen sulfide. Serotyping
was done using slide agglutination by testing with poly-
valent antisera for O1 and O139 and with mono-
valexent antisera for type specific O antigens (Ogawa, Inaba,
and Hikojima). Susceptibility testing of *Vibrio cholerae*
was done by the Kirby-Bauer method using Mueller-
Hinton agar.

**Clinical interventions:** Mild cases were defined as those that required no health care facility admission and
only oral rehydration therapy. Moderate cases present-
ed with severe diarrhea and moderate dehydration, re-
quiring oral rehydration and intravenous fluids for re-
hydration and attendance by a healthcare practitioner.
Severe cases were those with severe dehydration requir-
ing health center or hospital admission. Mild cases were
treated by village health volunteers at the village level,
whereas moderate and severe cases were usually transferred to the nearest health center or hospital for supervised treatment. In the health centers and hospitals, “cholera wards” were established to limit potential cross contamination to other patients.

Control measures: Interventions to control the outbreak included three strategies: (i) the provision of safe water to all affected villages through education campaigns on water boiling and provision of chlorine solution to disinfect all household water supplies, (ii) the improvement of water and sanitation facilities in affected villages by repairing existing water pumps and ensuring functional latrines, and (iii) the provision of health education by mobile teams to affected communities concerning safe water practices, hygiene practices, and how to identify possible ill persons.

RESULTS

Epidemiological findings: Between December 15, 2007 and January 29, 2008, a total of 370 cases were reported from Thateng and Lamarm Districts as suspected cholera. A total of 31 villages were reported to have cases in this same time period. The overall attack rate (AR) was 5% (range 0–14%), with 25 villages reporting an AR under 5%, 3 reporting an AR between 5–10%, and only 3 villages with an AR over 10%. A total of 3 deaths were reported (0.8% case fatality rate) on December 23–25. They occurred in 2 females aged 28 and 47 and one male patient aged 60 years. The epidemic curve shows that there was a steep increase in case numbers on December 20–25 and a second peak of reported cases on January 9 (Fig. 3). No further cases were reported after January 29. Of the 318 cases (86%) for whom demographic information was available, 51% (n = 162) were females. The age distribution ranged from 0 to 80 years (median = 18.5 years, mean = 22 years, 95% CI = 19.8–41.9). Cases were reported from all age groups, but the majority (29%) of cases were under 5 years of age (Table 1). In terms of clinical presentation, 310 cases (83.8%) were considered mild cases, 49 (13.2%) were moderate, and 11 (3%) were severe cases of cholera.

Laboratory findings: The detailed results of the microbiological findings have been published elsewhere (7). However, the first stool sample taken from an active case on December 27 tested positive for V. cholerae O1 Ogawa at NCLE on December 29. Of the remaining 28 stool samples which were tested for the duration of the outbreak, 17 (58.6%) tested positive for V. cholerae O1 Ogawa strain. A total of 12 water samples from 11 different water sources were also tested. Of these 3 (2 from the same source) tested positive for V. cholerae O1 Ogawa strain. The water sources were the Xe Don river and the HTayU stream, used by many of the affected villages for their main water supply. This finding explains why the majority of affected villages were clustered around these two water sources (Fig. 2).

DISCUSSION

The findings from this outbreak investigation demonstrate that a cholera outbreak occurred in Thateng and Lamarm Districts between December 2007 and January
2008. As *V. cholerae* O1 Ogawa was identified from two of the main sources of water in these districts, this finding suggests that the water was the source of the outbreak. Additionally, the shape of the epidemic curve shows a clear point source contamination at the start (due to a clear single and high peak in the early stage of the outbreak). Also, the clustering of affected villages around the contaminated rivers suggests that contaminated water caused this outbreak. The second peak in the epidemic curve can therefore be attributed to a mix of person-to-person transmission from affected villages to new villages (not clustered around the contaminated drinking water) as well as ongoing transmission in villages that continued to use water from both rivers for household purposes without following the health education recommendations. It appears that the control measures which were implemented were successful in reducing the duration and the scale of this outbreak, as less than 2 months after control measures were initiated, no further cases were identified. Additionally, all deaths occurred in the first 2 weeks after the outbreak was identified, prior to the launching of all control measures, and the case fatality rate for the entire outbreak remained below 1%. Both factors suggest that the outbreak management was successful.

During the outbreak investigation and response there were some limitations which were encountered. No analytical study was conducted to more concretely implicate the rivers' water as the cause of the outbreak. The decision not to do so was taken to avoid wasting valuable human resources on a study, and to utilize them instead for controlling the outbreak and maintaining the active surveillance. Additionally, as the water sources were implicated as contaminated early on in the outbreak it was decided that the majority of persons were already exposed, therefore limiting the ability of an analytical study to implicate the source more specifically. Due to the remoteness of the affected area and its distance from the main public health laboratory (12 h by road), only a small proportion of reported suspected cases could be confirmed by the laboratory. This suggests that the reported case numbers overestimated the actual number of persons infected with *V. cholerae* O1 Ogawa.

In this outbreak, almost one-third of reported cases were under 5 years of age. This is similar to the proportion of cases from this age group in other cholera outbreaks (1,8,9). Though it is likely that not all reported cases under 5 years of age were cholera cases, diverting from the WHO recommended suspected case definition for cholera allowed the outbreak investigation team to capture the majority of suspected cholera cases in all age groups, and to deliver appropriate medical care to all cases with acute diarrhea. During future outbreaks in resource poor settings it may be advisable to include all age groups in the surveillance case definition.

This outbreak has highlighted that continued efforts in Lao PDR need to be made to ensure that people have access to safe drinking water and health education and that they adopt more stringent hygienic measures in order to avoid future outbreaks of water- and food-borne disease.

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