ORIGINAL RESEARCH

Post-flood — Infectious Diseases in Mozambique

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Abbreviations:
IDP = internally displaced person
JDR = Japan Disaster Relief
STD = sexually transmitted disease
WHO = World Health Organization

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Abstract

Introduction: The types of medical care required during a disaster are determined by variables such as the cycle and nature of the disaster. Following a flood, there exists the potential for transmission of water-borne diseases and for increased levels of endemic illnesses such as vector-borne diseases. Therefore, consideration of the situation of infectious diseases must be addressed when providing relief.

The Japan Disaster Relief (JDR) Medical Team was sent to Mozambique where a flood disaster occurred during January to March 2000. The team operated in the Hokwe area of the State of Gaza, in the mid-south of Mozambique where damage was the greatest.

Methods: An epidemiological study was conducted. Information was collected from medical records by abstracting data at local medical facilities, interviewing in habitants and evacuees, and conducting analyses of water.

Results: A total of 2,611 patients received medical care during the nine days. Infectious diseases were detected in 85% of all of patients, predominantly malaria, respiratory infectious diseases, and diarrhea. There was no outbreak of cholera or dysentery. Self-reports of the level of health decreased among the flood victims after the event. The incidence of malaria increased by four to five times over non-disaster periods, and the quality of drinking water deteriorated after the event.

Conclusions: Both the number of patients and the incidence of endemic infectious diseases, such as malaria and diarrhea, increased following the flood. Also, there was a heightening of risk factors for infectious diseases such as an increase in population, deterioration of physical strength due to the shortage of food and the temporary living conditions for safety purposes, and turbid degeneration of drinking water. These findings support the hypotheses that there exists the potential for the increased transmission of water borne diseases and that there occurs increased levels of endemic illnesses during the post-flood period.

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Introduction

The types of medical care needed during a disaster are determined by various features such as the disaster cycle and nature.[1] Following a flood, there may exist a potential for transmission of water-borne and/or vector-borne diseases.[2] Therefore, consideration of the situation of infectious diseases is an important consideration when providing relief. On the other hand, disasters rarely occur. The likelihood of a disaster resulting from an event is influenced by the social background of the affected community and the health care needs associated with the impact of the event. The ability to pre-

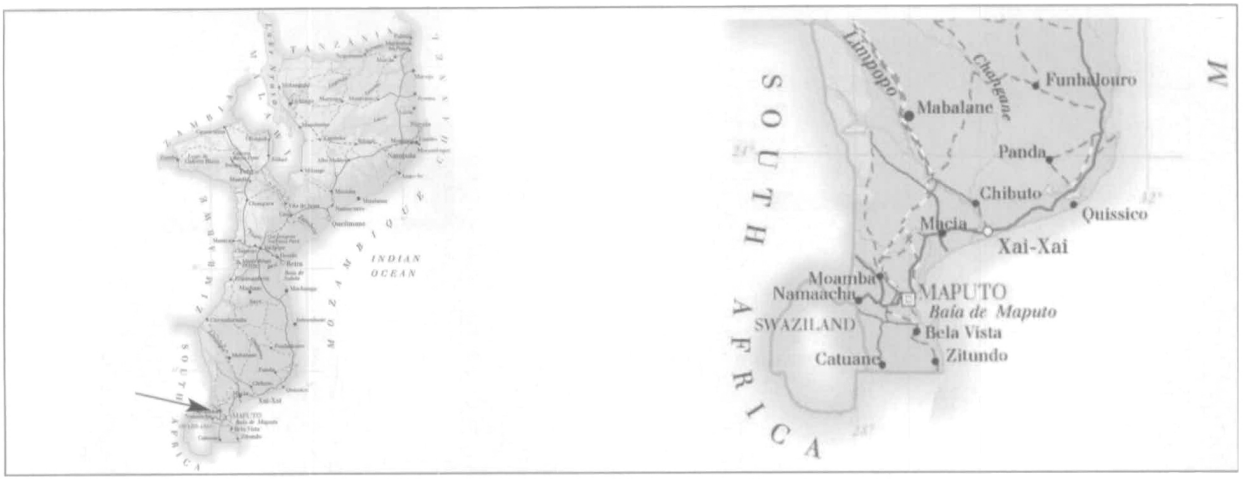

Figure 1—Map of Mozambique illustrating location of the Howke area of the Chokwe district of the Gaza province

Province	District	Locale	Victims
Gaza	Chokwe	Chiyakelane	87,183
Safala	Buzi	Buzi	38,941
Gaza	Bilene/Macia	Macia	36,600
Gaza	Chokwe	Hokwe	30,650
Gaza	Guija	Chibabele/Javanhane	15,000
Maputo	Manhica	Xinavane	14,000
Gaza	Xai-Xai	Chicumbane	12,000
Inhambane	Govuro	Mambone	10,570

Table 1—Numbers of victims affected by Province, District, and Area due to the floods in Mnozanbique in 2000

dict the health care needs that will follow an event adversely does not exist.

In Mozambique during mid-January 2000, it rained intermittently, and the rain was particularly heavy from 11 to 13 February. As a result, the country experienced flood damage of the largest scale in the last 50 years. The floods inflicted enormous personal and physical damage on the inhabitants of Mozambique. In some districts, cities and towns were left isolated, creating difficult access for the provision of relief provisions and the transportation of materials. As of 16 February, 48 persons had died and 800,000 victims evacuated according to an announcement by the Mozambique government. In addressing disaster-related issues, the Japanese government decided to provide a resource grant and to send the Japan Disaster Relief (JDR) Medical Team to Mozambique. The JDR Medical Team was sent during the period from 16 March to 29 March 2000, with a mission of providing medical care to flood-disaster victims.

Its activities were deployed in the Hokwe area of the Chokwe district, Gaza province. Hokwe is located about 200 km from the capital, Maputo (Figure 1). About 30,000 victims flowed into Hokwe from the Xilembane district as temporary inhabitants. Medical care was deployed for nine days from 18 March to 26 March in a tent-clinic located in front of the Hokwe Area Health Center.

An epidemiological study with special emphasis on the occurrence of malaria and diarrhea after the flood in Mozambique in 2000 was completed.

Methods

I. Patient Data

Health Facilities—Information about patients who received medical care, both during normal circumstances and following the floods, was collected during October 2001, from the Hokus health Post and Chokwe district hospital.

Household Surveys—A questionnaire-aided interview on the health conditions and hygiene was conducted of randomly selected families. The families selected included those living in their houses as before the event, those living as temporary lodgers in houses of relatives, and those residing in a camp. The questionnaire included items related to changes in health conditions following the event (i.e., drinking water and toilet situation, food situation, and the presence of malaria and/or diarrhea-relevant risk factors including insect bites and hand washing). This survey focused on a population of mothers who had children aged <10 years, using a questionnaire that included items related to both mothers and children.

Drinking Water—In the Hokwe district, no service water supply was available. Instead, 143 wells were available. Since it was not possible to subject each of these 143 wells to investigation, sample wells were selected so as to eliminate area bias. Water samples freshly drawn from the selected wells and water held in storage after being drawn, were examined using the following methods:

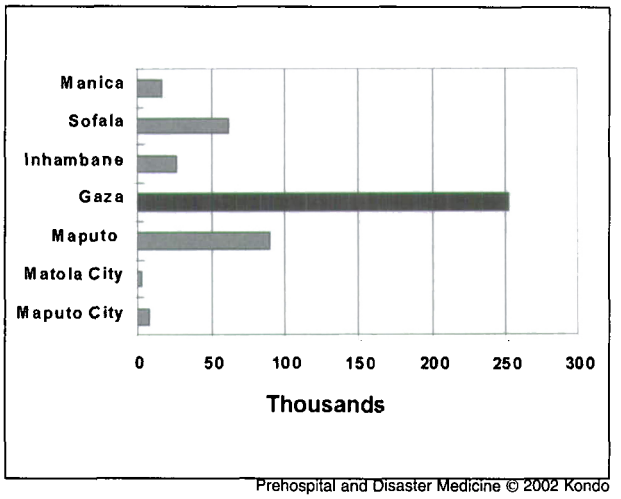

Figure 2a—Numbers of victims by Provinces from the 2000 floods in Mozambique

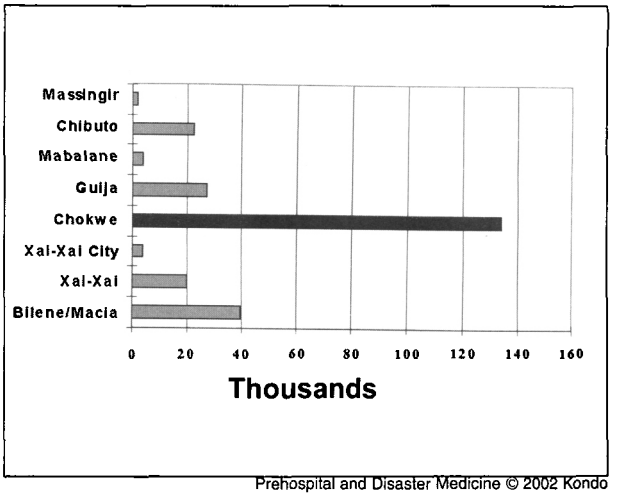

Figure 2b—Numbers of victims by Districts within the Gaza Province from the 2000 floods in Mozambique

1. COD (Ready-To-Use Water Quality Analysis Kit: Pack Test,® Kyoritsu Chemical Check Laboratory Corporation, Japan);
2. Ammonium (Ready-To-Use Water Quality Analysis Kit: Pack Test,® Kyoritsu Chemical Check Laboratory Corporation, Japan);
3. General bacteria (Test Paper "Bacto-Strip Method",® Kyoritsu Chemical Check Laboratory Corporation, Japan); and
4. Coliform bacteria (Test Paper "Bacto-Strip Method",® Kyoritsu Chemical Check Laboratory Corporation, Japan).

II. Surveys

The patient analysis was based on a review of the medical records of 2,611 patients who attended the JDR Medical Team clinic during 16 March to 29 March 2000 in the Hokwe area. Diagnosis was made in accordance with "WHO Case Definition", except for the following criteria for malaria and diarrheal diseases:

1. *Malaria*—All febrile patients aged <15 years and adult patients who were suspected of having malaria by doctors were tested with a malaria rapid diagnostic kit (Plasmal PF,® Kenza Diagnostics, South Africa). This kit identifies Plasmodium falciparum histidine-rich protein-2 in the plasma.[3] Then, 229 randomly selected samples were cross-checked using an acridine orange-stained blood smear examination.
2. *Diarrheal Diseases*—The diagnosis of diarrheal diseases was made based mainly on clinical symptoms. For the diagnosis of those patients who were suspected of having cholera or dysentery, cultivation tests were carried out using deoxychalate hydrogen sulfate lactose (DHL), salmonella-shigella (SS), thiosulfate citrate bile salt sucrose (TCBS), and medium for vibrio.

Results

Patient Characteristics

The population size in the Hokwe area increased rapidly following the flood: pre-event, there were 20,000 inhabitants; post-event, the numbers swelled to 50,000 due to the concentrated flow of many victims from the surrounding areas into Hokwe. The greatest increase by internally displaced persons occurred in the province of Gaza (Figure 2a) and within this province in the Chokwe district (Figure 2b). The numbers of victims in the area by locale are provided in Table 1. The population of the Hokwe area in the Chokwe was augmented by more than 30,000 IDPs, and was selected for the study.

During the nine days that the clinic operated, a total of 2,611 patients received medical care from the staff. The age and gender distribution of the patients is in Figure 3. Children (ages 0–14 years) and young adults (15–44 years) were distributed equally (41.7% and 40.7%, respectively). Only 443 patients (17.6%) were ≥45 years old. Also, there were no gender differences in the ages of children and adults aged 45 years or older, whereas in the 15 to 44 year old population, there were more female patients (male:female ratio of 1:2).

A total of 62 families were interviewed, including 30 living as temporary inhabitants in a camp, 10 living in relatives' houses, and 22 living in their house as before the flood. The average age of the mothers with whom the interviews were conducted was 35 years, the average number of family members was 8.5, and the average number of children per family was five. Among them, two mothers had experienced loss of family members.

Medical Diagnoses

In nearly 90% of those interviewed, their general health was reported to have worsened. Major symptoms that worsened included those suggestive of infectious diseases such as fever, headache, abdominal pain, cough, and diarrhea. The distribution of the diagnoses of the patients who presented to the clinic is in Figure 4. Frequently detected illnesses of the visitors included malaria, respiratory tract infections,

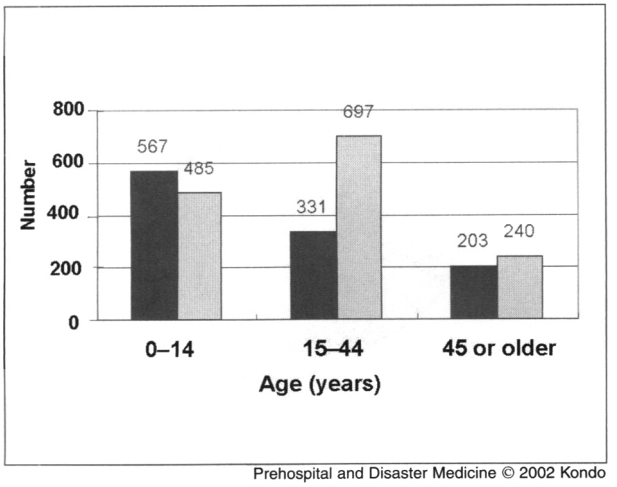

Figure 3—Distribution of patients by age and gender who presented to the JDR Clinic during the nine days of deployment in the Hokwe area of Mozambique (black = male; gray = female)

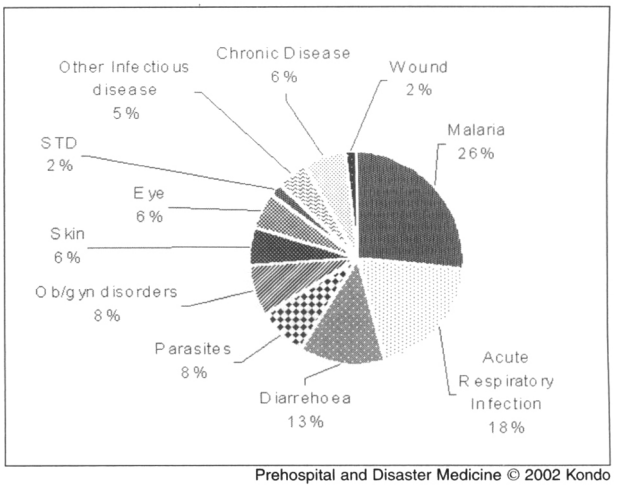

Figure 4—Distribution by diagnoses of patients who presented to the JDR Medical Team Clinic in Mozambique from 16 to 19 March 2000 (Ob/gyn = obstetrics and gynecology)

Sample No.	origin	Type of water	NH4	COD	E..coli	General bacteria
1	well	source	0.1	10	-	-
2	well	stock	0.1	20	-	-
3	well	source	0.1	50	>50	>200
4	well	source	0.1	5	4	40
5	well	source	0.1	5	7	>200
6	well	stock	0.1	5	11	>200
7	well	stock	0.1	5	15	>200
8	well	source	0.1	10	16	>200
9	well	source	0.1	10	43	>200
10	rain	stock	0.1	10	16	>200
11	well	stock	0.1	10	37	>200
12	well	source	0.1	20	16	>200
13	well	stock	0.1	10	7	>200
14	well	source	0.1	10	56	>200
16	well	stock	0.1	10	66	53
17	well	source	0.1	10	18	53
18	well	stock	0.1	10	17	>200
19	well	stock	0.1	5	15	48
20	well	stock	0.1	5	26	>200
21	well	stock	0.1	5	8	62
22	well	source	0.1	5	14	16
23	well	source	0.1	10	10	>200
24	well	source	0.1	10	8	4
25	well	source	0.1	20	47	>200
26	rain	stock	0.1	20	14	32
27	well	stock	0.1	5	24	73
28	well	stock	0.1	5	26	39
29	well	source	0.1	5	18	46

Table 2—Analysis of drink water from 29 sources following the flood in Mozambique in 2000

and diarrheal diseases. Infectious diseases, inclusive of sexually transmitted diseases (STDs), and parasitic diseases comprised 85% of the total number of persons with illnesses. On the other hand, chronic diseases and injuries were observed infrequently.

Together, malaria (26%), acute respiratory infections (18%), and diarrhea (13%) comprised more than half (57%) of the diagnoses. The remainder of the diagnoses (obstet-

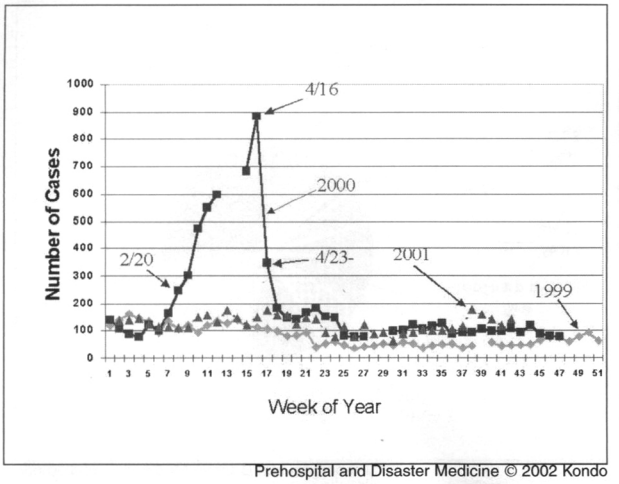

Figure 5—Incidence of malaria cases in the months following the flood compared with the same periods in 1999 and 2001 (Data not available for blank period due to numbers exceeding 100 per day)

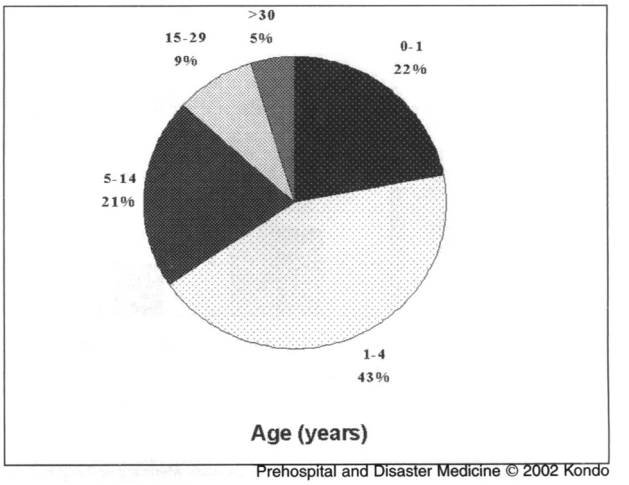

Figure 6—Distribution by age of patients diagnoses with malaria who presented to the Japanese Disaster Relief Medical Team clinic from 16 to 29 March 2000

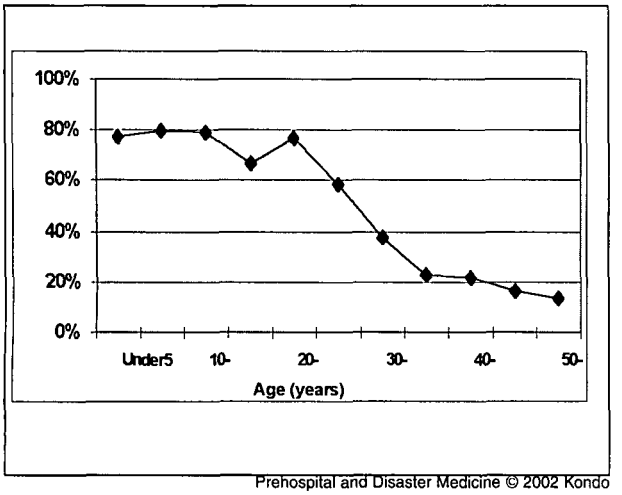

Figure 7—Distribution by age groups by proportion of the total patients in the age group diagnosed by a positive "Plasma PF" Rapid Malaria Test as the mean values for the number of positive cases per number of tested cases

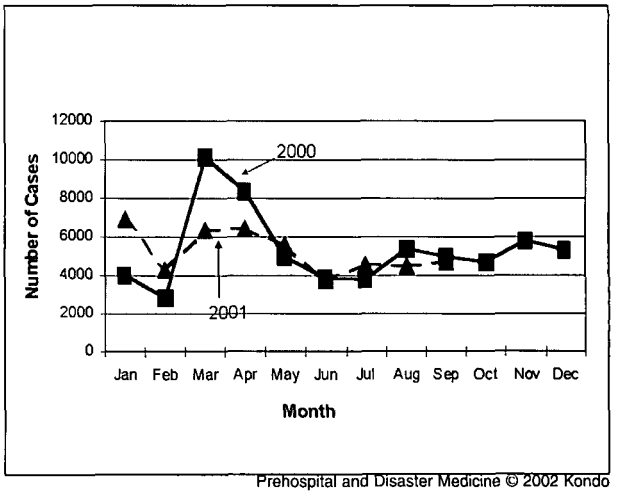

Figure 8—Incidence of malaria in the Chokwe district of Mozambique by month for the years of 2000 and 2001

rics/gynecology, parasitic infestation, chronic diseases, eye disease, sexually transmitted diseases, skin diseases, wounds, and other infectious diseases were distributed about equally (2–8%) among the patient population.

Malaria

In the present investigation, an increase in the number of patients with malaria was recognized through analysis of the data collected by a local clinic. Based on the experience of the JDR Medical Team, 30% of the total number of patients evaluated were diagnosed as having malaria, and 5% of the deaths were related to malaria. The diagnosis of malaria was made on the basis of the results from the use of the rapid diagnosis kits. The diagnoses obtained using these kits were confirmed by microscopic examination.

Data from the Hokwe health post suggest that thebnumber of patients with malaria increased during the post-flood period. The number of patients with malaria who consulted the health post was four to five times greater than it was during the same period in other years. The Hokwe area was designated for the establishment of camps for persons displaced by the flood. As a result of the migration, the population in the area increased about three fold over its usual level. Therefore, the incidence of malaria increased 1.5 to 2.0 times. The incidence of malaria in the Chokwe district also increased 1.5 to 2 fold.

No clear definitions of thresholds for an "epidemic" have been agreed upon. An epidemic is suspected when there is an increase in the mortality or morbidity in an area associated with a disease. Blood smears have been accepted as a means to confirm or reject the diagnosis of malaria at an epidemic level.[4] In the current study, the number of malaria cases increased, but the disease was not detected through the use of blood smears. However, the JDR clinic found that a high percentage of febrile patients had malaria detected using the rapid malaria test. This test correlated

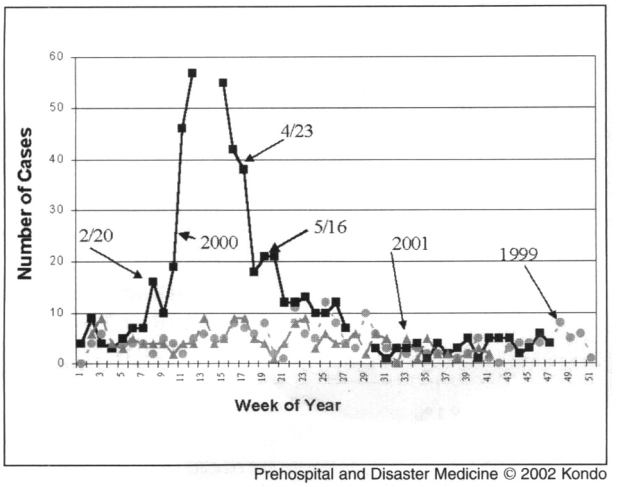

Figure 9—Number of cases with diarrhea identified in the Hokwe health post by week of the year for 1999, 2000, and 2001. Missing data due to presentation rates >100 patients per day with diarrhea

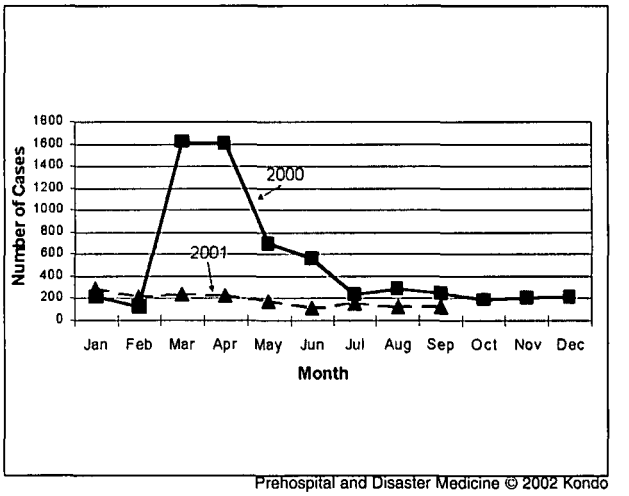

Figure 10—Number of cases of diarrhea in the Chokwe district of Mozambique by month during 2000 and 2001

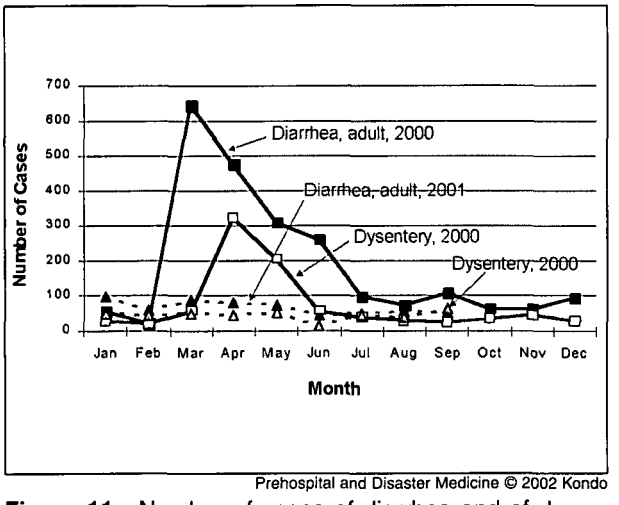

Figure 11—Number of cases of diarrhea and of dysentery in the Chokwe district by month during 2000 and 2001

with the blood smears and thus, an outbreak of malaria occurred in the Chokwe district during the post-flood period. Similar findings were observed following the floods in Sudan in 1985,[5] in Bangladesh during 1989–1991,[6] and in Costa Rica in 1991.[7] On the other hand, in spite of similar water-related events the number of patients with malaria did not increase in Hoduras following Hurricane Mitch,

This increase in the incidence of malaria in this population, could be related to various factors such as post-flood destruction of the living environment, creation of an environment favoring propagation of malaria-carrying mosquitoes, and population movements and subsequent population concentration within the temporary residence of the internally displaced persons (IDPs). It is suggested that the risk of infection with malaria increased in association with living outdoors and the post-flood propagation of mosquitoes. Through the family surveys used in this study, the interviewees reported that the frequency of being bitten by a mosquito did increase. In addition, an increased number of persons with malatia add to the risk of infection with malaria. As mentioned above, the number of patients with malaria actually increased. Therefore, the risk of infection with malaria also might have been increased. This risk is enhanced further by the increase of general risk factors for infectious diseases such as increased population size and density, poor environmental conditions, and lowered physical strength due to shortage of food.

Malaria was one of the main health problem in the area affected by the floods in Mozambique in 2000, Both the incidence and the risk of infection were augmented following the flood.

Diarrhea

According to the interview of the JDR Medical Team clinic, incidence of diarrhea increased after the flood. Diarrhea was the third most frequently problem encountered by the staff: 15% of visitors for medical examination were diagnosed as having diarrheal disease. Data from the Hokwe Health Post also suggest that the number of patients increased 5–10 fold during the post-flood period. Taking the population increase into consideration, the incidence of diarrhea was 2–4 times greater than during the same time period in other years. The number of patients in Chokwe with diarrhea increased eight fold compared to the same period in other years. Further, as noted in the family interviews, the was an increased number of persons who complained of diarrhea following the flood. On the other hand, cholera and dysentery that potentially could have caused epidemics were not detected in the patients complaining of diarrhea.

Currently, many believe that an epidemic of non-endemic disease is unlikely in such a setting., still endemic diseases potentially can increase.[2] Outbreaks of cholera during or after a disaster have been reported in countries in which cholera is endemic.[9–12] The key information necessary to define an outbreak of diarrhea include the number of adults that die from diarrhea, and increase in the num-

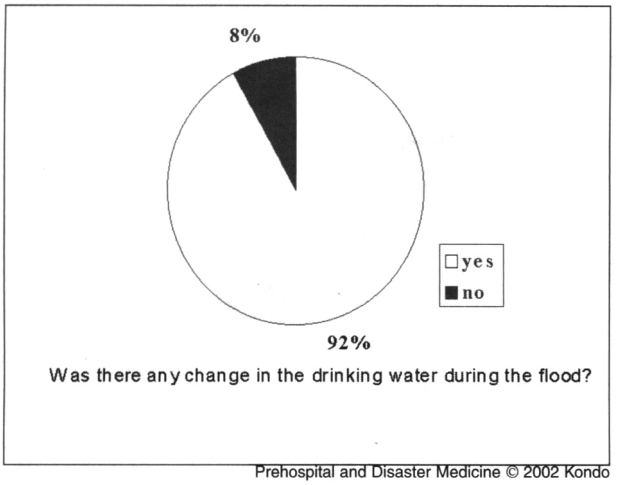

Figure 12a—Situation of potable water following the floods in Mozambique as determined from interviews conducted in randomly selected households; changes in drinking water

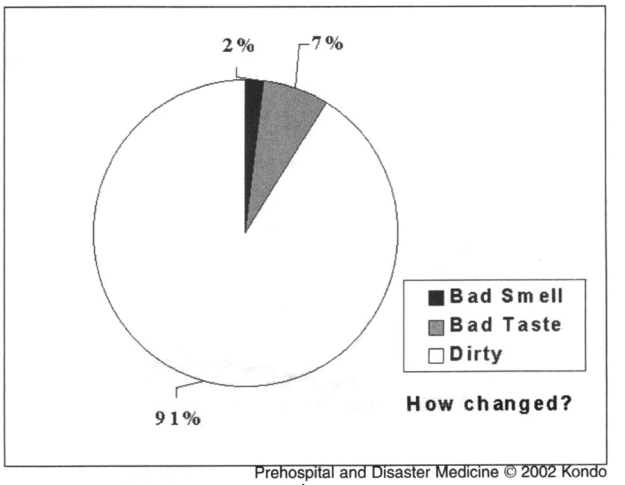

Figure 12b—Situation of potable water following the floods in Mozambique as determined from interviews conducted in randomly selected households, characteristics of the changes

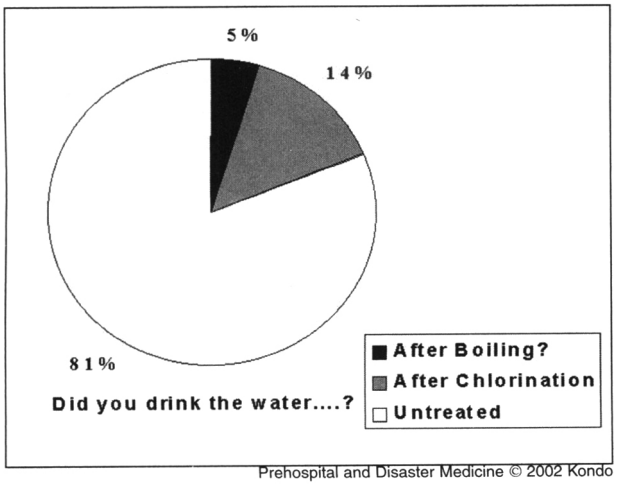

Figure 12c—Situation of potable water following the floods in Mozambique as determined from interviews conducted in randomly selected households; Treatment of water prior to drinking

ber of cases with diarrhea and dehydration, a significant increase in the number of cases of dysentery, and a rise in the case fatality rate. In the current study, the number of patients in the Chokwe area with diarrhea or dysentery While it was fortunate that there were no cholera cases in this investigation, non-specific diarrhea increased.

Risk factors for diarrheal diseases consist of water-borne infectious disease-related hygienic conditions, including contaminated drinking water and toilet facilities. The findings of the present investigation through household survey as well as investigation of drinking water indicated that the drinking water became contaminated following the flood, and that the contaminated drinking water was drunk without any treatment such as sterilization or boiling. Thus, the drinking water-related risk of infection was recognized to be higher. On the other hand, cleaning of toilets, for the most part, was found to be satisfactory. In spite of an increased risk for diarrhea, the possibility of an immediate outbreak of epidemics of cholera and dysentery did not seem great.

Diarrhea was one of the main health problems in the area affected by the flood in Mozambique in 2000. The incidence and risk for the development of non-specific diarrhea increased following the flood.

Conclusion

A large flood affected Mozambique in 2000. An epidemiological study to identify the medical needs after the flood was performed. As a result, it was speculated that both the number of patients and the incidence of endemic infectious diseases such as malaria and diarrhea increased following the flood in the Hokwe area in the central part of Mozambique. Also, there was a heightening of risk factors for infectious diseases. These findings support the hypothesis that there is a potential for the transmission of water borne disease and for increased levels of endemic illnesses such as vector-borne diseases during the post flood period.

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