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Public Health Implication of the Floods in Kangshan Area, Kaohsiung County

Introduction

In August of 1994, there were two consecutive typhoons followed by a third typhoon which was brought in by the southwest current. All of which were centered in the southern part of Taiwan. The Kangshan area of Kaohsiung County had the heaviest rainfall on August 12th and 13th. The rainfall measured 645 mm which resulted in serious flooding of that area in past decades⁽¹⁾. These floods caught the attention of the country and reconstruction immediately followed. Now that the floods are over and the reconstruction has been completed satisfactorily. From the view point of health care and epidemiology officials, there are still potential hazards and flood-related health problems which are of major concern.

Background

The Kangshan township is located in Kaohsiung County of southern Taiwan. This township has a population of approximately 90,000. There are 24,012 households in 35 Lis located in an area of forty seven square kilometers⁽²⁾. Farming and livestock production are the major occupations of the residents. Ah-Kung-Tien river, Tien-Pao river and Tu-Ku river run through the township. As the result of the typhoon Katherine on August 3rd and the combination of typhoons Doug and Eileen on August 12th, all within the proximity of two weeks, brought to the Kangshan area a cumulative rainfall of more than 1,000 mm, the heaviest in thirty years. This heavy rainfall brought floods to several Lis, especially Chiahsing, Kangshan and Tanti with a water level of more than 2.5 meters at times. The total number of households affected were 18,000 and the damage was estimated to be more than one billion New Taiwan dollars (NT\$)⁽²⁾. Not until August 17th, did the floods begin to subside. Immediately local civic, health and environmental authorities and the army began recovery and disinfection of the area. Afterward, an epidemiological survey of the flooded area was conducted to reassure the safety of public health and to prevent potential health hazards from reoccurring.

Materials and Methods

In-depth interviews were conducted on local key personnel such as health care workers from the county health bureau and the local health stations. Also the physicians of the Kangshan hospital, leaders of the local government and the director of a local general hospital were consulted to obtain information regarding the cause of the flood, measures of relief, reconstruction and disinfection, potential health hazards as well as the likely implication to public health and medical care systems.

A questionnaire was also mailed to forty one medical care institutions, excluding dental clinics in the Kangshan area to collect information on the number of days the clinics were closed and to estimate the loss of property damage. This was necessary in order to understand the damage to medical facilities caused by the flooding.

In addition, we collected information for the month of August from the Bureau of Labor Insurance. This information provides the number of hospital visits for the five categories of diseases in eight general hospitals in the Kangshan area. The first four categories are considered flood-related. They are gastrointestinal diseases, injuries, skin diseases, and conjunctivitis. The fifth category which concerns chronic diseases is not flood related. The following are the problems associated with the flood-related categories. First, we have the gastrointestinal diseases which include gastric ulcers, gastritis, ulcer of duodenum, abdominal pain, diarrhea and enteritis. The second category refers to the injuries which comprise drowning, sprains and strains of muscles, contusion and laceration, bites by mosquitoes and animals, burns, electric shock, and eye injuries. The third category is skin diseases which include dermatitis, allergies, pus, acute skin infections. The fourth category mentioned is conjunctivitis. The fifth category contains chronic diseases such as hypertension, diabetes, pulmonary tuberculosis, chronic obstructive pulmonary diseases, cancers, hepatitis, uremia, cataract, hemorrhoid, and chronic sinusitis.

Results

Several questions were answered from the interviews. They are summarized as follows:

1). Were medical care institutions in normal operation?

The out-patient clinics and the immunization program of the Kangshan Health Station were suspended entirely for a week at the time of the flood. All medical care services in the Kangshan Hospital remained available. When the power went off on August 13th, the hospital generator was then used immediately. Meanwhile, one uremia patient under dialysis was sent to a hospital in Kaohsiung City. Hemodialysis continued after the power resumed. Under effective management, the hospital was able to continue services to the patients. The private general hospital was in normal operation during the flood, even though both out-patient and emergency care departments were moved up to the

second floor temporarily. However, due to inconvenient transportation the number of patients declined. Soon after the floods retroceded on August 19th, the Kangshan Hospital, Air Force General Hospital, the Red Cross Society of the Republic of China and the Buddhist Compassion Relief Tzu-Chi Foundation organized medical care teams to provide free medical care in flooded areas.

During the flood stages, a relief center and several shelters were established by the Township Government to accommodate 142 refugees⁽¹⁾. No medical care personnel were assigned to the relief center and shelters.

(2) Was there enough safe drinking water and food sufficiently supplied?

Since the water level was one-story high, communication was completely interrupted. Both the power and the water supply were then disconnected. Food and drinking water had to be provided by rafts. A total of 50,000 rations were supplied during the flood period. Mineral water was used for drinking and rain water was collected for washing and bathing.

(3) Was there adequate disposal of solid wastes?

Work began on August 19th to tidy up the area with the support of the army. Garbage was collected and disposed of properly. Ditches, garbage collection sites and streets were all disinfected at least three times. The public was reminded of the importance of environmental and food sanitation to prevent the spread of disease.

(4) Was there adequate disposal of infectious organic wastes?

Dead animal bodies were burned in gasoline and the remains either buried or sent to the refuse disposal plant for disposal and disinfection.

(5) Was the sewage system in operation?

The power and the water supply was disconnected because the first floor of sewage treatment was flooded, therefore the sewage treatment plant was not in operation for a week.

(6) Was there adequate control of vectors and rats?

Soon after the flood, 1,400 bottles of lysol and antiseptic solution were distributed to 1,200 households in the seriously affected the Chiahsing Li to disinfect their homes inside and out.

(7) Were there any disease outbreaks that occurred?

Some developed skin inflammation for being in the dirty water too long. Most of them did not seek for medical care. Some were cut by sharp objects and developed serious wound inflammation. Some soldiers developed skin allergies through contacts with wastes. During the flood stage, more patients came for the treatment of injuries and gastrointestinal diseases. The number of patients began to increase after the flood retrograded. No death due to the flood was reported.

2). Impacts on Medical Care

Among 41 questionnaires being mailed to medical care facilities in Kangshan area, 28 (68.3%) of them returned. With respect to the number of days the clinic were closed, 20 (71.4%) clinics suspended their practice from 1 to 6 days, averaging 3 days; 1 (3.6%) did not suspend its practice; and 7 (3.6%) clinics did not respond. 14 (50%) clinics complained of income loss due to the reduced clinic hours, ranging from 0.5 to 19 days. 15 (53.9%) clinics complained of medicines being soaked in water. 14 (50%) clinics reported their equipment being damaged. Damaged equipment contained ECG, drug-packers, sputum-suctions, operation tables, and autoclaves. For the 21 (75%) clinics reported loss of property, the total loss was estimated to be around NT\$ 31.44 million. Each of them lost from NT\$27,000 to NT\$8.58 million respectively. Only 2 (7.1%) clinics did not report of any loss and 5 (17.9%) clinics did not respond.

3). What Resulted from the Disease Investigation

As shown in Table 1, a total of 10,669 hospital visits were reported during August of 1994 in Kangshan area. These visits were classified into the five disease categories: 1,291 (12.1%) for gastrointestinal diseases, 2,546 (23.9%) for injuries, 796 (7.5%) for skin diseases, 277 (2.6%) for conjunctivitis, and 5,759 (54%) for chronic diseases. Figure 1 indicates the distribution of each disease category across each day of August in Kangshan area. For flood-related diseases, injuries occurred most frequently than other disease categories. Gastrointestinal diseases were the second, skin diseases were the third, and conjunctivitis did not happen very often. Figure 1 also shows that the number of hospital visits declined significantly on every Sunday.

The month of August was divided into six flood stages. The first stage was called the no flood stage from August 1st to August 2nd. The second stage was named the first flood stage from August 3rd to August 5th. The third stage was called the first recovery stage from August 6th to August 11th. The fourth stage, the second flood stage, began from August 12th to August 18th. This was followed by the second recovery stage from August 19th to August 25th. Finally, the reconstruction stage was from August 26th to August 31st. This was the basis for comparing the average number of hospital visits in each flood stage.

Table 2 provides the results of these comparisons. More hospital visits of

Table 1. Frequency and Percentage of Hospital Visits by Disease Categories in Eight Hospitals, Kangshan Area, August 1994

Date of August	Gastrointestinal Diseases	%	Injuries	%	Skin Diseases	%	Conjunctivitis	%	Chronic Diseases	%	Total
1	51	11.8	98	22.7	18	4.2	23	5.3	242	56.0	432
2	51	13.9	74	20.1	26	7.1	5	1.4	212	57.6	368
3	38	13.5	64	22.8	11	3.9	3	1.1	165	58.7	183
4	22	12.0	44	24.0	14	7.7	3	1.6	100	54.6	183
5	42	11.7	91	25.3	22	6.1	26	7.2	179	49.7	360
6	41	12.4	74	22.4	31	9.4	2	0.6	182	55.2	330
7	25	22.1	46	40.7	18	15.9	0	0.0	24	21.2	113
8	18	9.5	68	36.0	17	9.0	0	0.0	86	45.5	189
9	38	9.9	89	23.1	24	6.2	5	1.3	229	59.5	385
10	35	8.9	69	17.5	24	6.1	3	0.8	264	66.8	395
11	42	11.5	74	19.8	19	5.1	6	1.6	231	61.9	373
12	22	9.9	41	18.4	19	8.5	16	7.2	125	56.1	223
13	4	9.1	11	25.0	2	4.5	0	0.0	27	61.4	44
14	6	14.3	23	54.8	3	7.1	0	0.0	10	23.8	42
15	44	16.1	68	24.9	16	5.9	8	2.9	137	50.2	273
16	43	11.0	93	23.7	33	8.4	9	2.3	214	54.6	392
17	53	11.7	96	21.2	38	8.4	6	1.3	260	57.4	453
18	46	10.9	109	25.8	32	7.6	5	1.2	231	54.6	423
19	50	10.3	110	22.6	47	9.7	40	8.2	240	49.3	487
20	33	10.8	96	31.5	28	9.2	3	1.0	145	47.5	305
21	31	22.3	57	41.0	12	8.6	1	0.7	38	27.3	139
22	72	13.4	140	26.1	40	7.5	4	0.7	280	52.2	536
23	75	14.7	123	24.2	42	8.2	6	1.2	263	51.7	509
24	59	11.9	118	23.8	37	7.5	9	1.8	273	55.0	496
25	53	11.6	99	21.7	28	6.1	9	2.0	268	58.6	457
26	53	10.9	124	25.5	40	8.2	15	3.1	254	52.3	486
27	48	16.1	70	23.4	32	10.7	4	1.3	145	48.5	299
28	29	21.3	47	34.6	12	8.8	0	0.0	48	35.3	136
29	49	8.8	138	24.7	36	6.5	40	7.2	295	52.9	558
30	47	9.8	97	20.1	45	9.3	11	2.3	282	58.5	482
31	70	13.5	95	18.3	30	5.8	15	2.9	310	59.5	20
Total	1,291	12.1	2,546	23.9	796	7.5	277	2.6	5,759	54.0	10,669

Table 2. Average Hospital Visits by Disease Categories in Each Flood Stage in Kangshan Area, August 1994

Stage	Gastrointestinal Diseases	%	Injuries	%	Skin Diseases	%	Conjunctivitis	%	Chronic Diseases	%	Total
No flood stage (Aug. 1st-2nd)	51	12.8	86	21.5	22	5.5	14	3.5	227	56.8	400
First flood stage (Aug. 3rd-5th)	34	12.4	66	24.1	15	5.5	11	4.0	148	54.0	274
First recovery stage (Aug. 6th-11th)	33	11.1	70	23.5	22	7.4	4	1.3	169	56.7	298
Second flood stage (Aug. 12th-18th)	31	11.7	63	23.7	20	7.5	9	3.4	143	53.8	266
Second recovery stage (Aug. 19th-26th)	53	12.7	106	25.4	33	7.9	10	2.4	215	51.6	417
Reconstruction stage (Aug. 27th-31th)	49	11.8	95	22.9	32	7.7	17	4.1	222	53.5	415

Figure 1. Daily Hospital Visits By Disease Categories in Kangshan Area, August 1994.

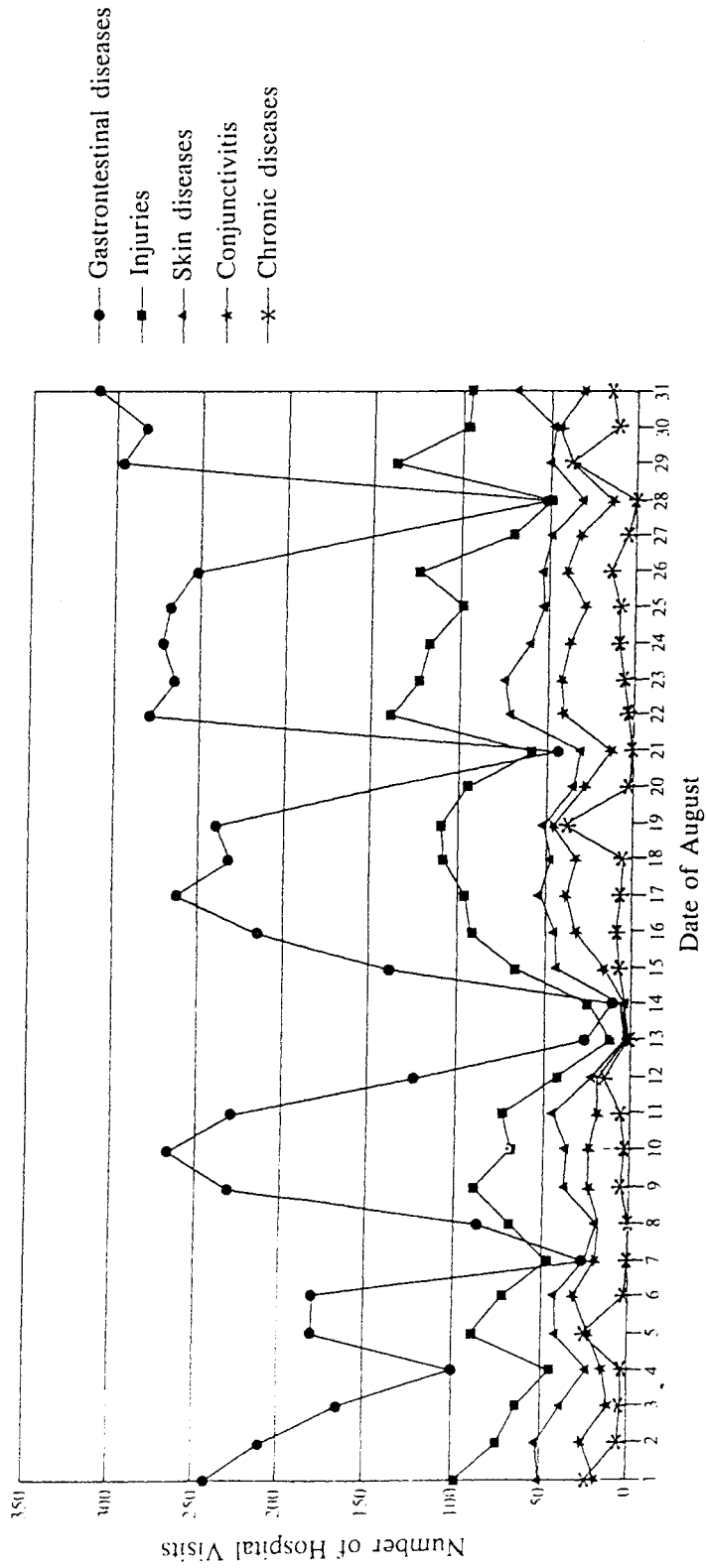
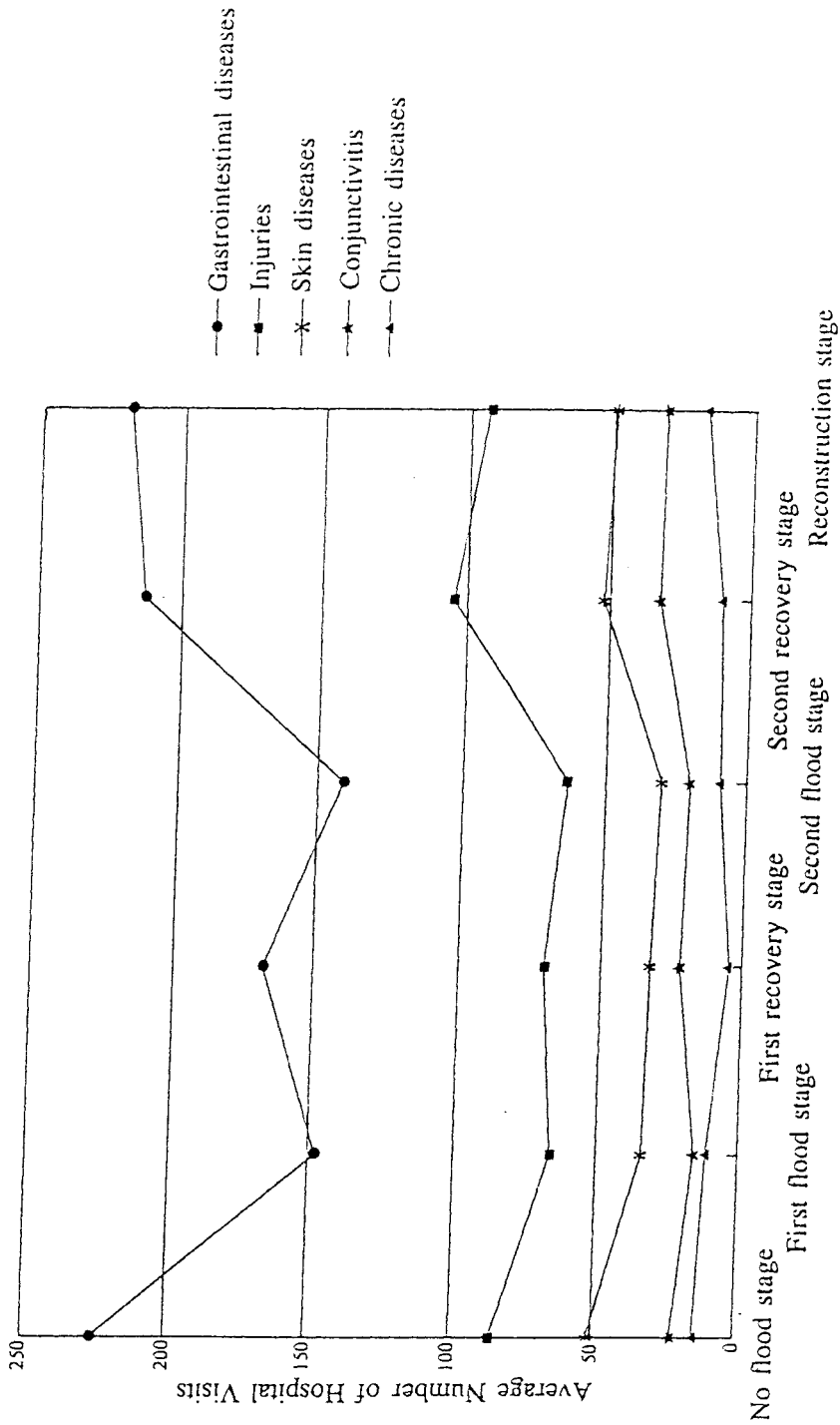


Figure 2. Average Hospital Visits by Disease Categories and Flood Stages in Kangshan Areas, August 1994.



gastrointestinal diseases, injuries and skin diseases were found in the second recovery stage. Also visits with conjunctivitis were found mainly in the last stage. Chronic disease visits appeared more frequently in the no flood stage. Additionally, gastrointestinal diseases showed the highest percentages in the first (12.8%), the fifth (12.7%) and the second (12.4%) stages, and the lowest one in the third stage (11.1%). Injuries had the highest percentages in the fifth (25.4%) and the second (24.1%) stages, and the lowest one in the first (21.5%) stage. Skin diseases appeared the highest percentages in the fifth (7.9%) and the sixth (7.7%) stages, and the lowest in the first and second stages (5.5% respectively). Conjunctivitis happened more often in the sixth (4.1%) and the second (4%) stages, and the lowest in the third (1.3%) stage. Chronic diseases had the highest percentages in the first (56.8%), the third (56.7%), and the second stages (54%), and the lowest percentage (51.6%) in the fifth stage. These results were also depicted and shown in Figure 2.

Discussion

Diseases which are most likely to be induced by floods are gastrointestinal diseases, injuries and skin diseases^(3,4). An outbreak of conjunctivitis was reported by the mass media after the flood, it was also included in the investigation. The total number of hospital visits in chronic diseases were not affected by the flood, but fluctuated because of the transportation inconveniences.

When the disaster happens, the purposes for the epidemiological studies are to provide a timely assessment of the health conditions of the area for policy making, and to evaluate the effects of intervening measures. These purposes can be achieved by establishing a Disaster Surveillance System for the purpose of data collection, data analysis and what course of action should be taken. Under these circumstances, a corresponding investigation in the early stages should proceed with principle of "Keep It Simple, Stupid" (KISS)⁽⁵⁾. This investigation should concentrate on the problems such as food and drinking water. In addition, it should focus on the basic needs of clothing, housing and medical care.

Glass and Noji⁽⁵⁾ indicated that the public and the government were concerned with meeting the most immediate and basic needs following the disaster. The needs were adequately met and the medical care institutions participated actively in the relief. Results from both the interview and the disease investigation showed that the medical care provided during the flood stages was adequate and accessible. The number of hospital visits made by patients with chronic diseases declined significantly on the 4th, the 13th and the 14th of August when the area was seriously flooded. This was perhaps due to the inconvenience in transportation. Hence, it was important at the time of the disaster to set up first-aid stations in areas where needs are identified through epidemiological investigations⁽⁴⁾. Medical teams were organized and sent to different parts of the area from August 19th to August 24th after the floods had receded. It would have been more effective if the first-aid stations had been set up along with the relief center during the flood stage.

After the month of August was divided into six stages, it was noted that both injuries and skin diseases had the highest percentages in the 5th stage immediately after the flood of August 12th. There is no evidence to indicate what impacts the flood had on diseases. As the report in the US^(5,6) suggests that flooding induces more injuries, particularly in the recovery stage after the flood. In order to understand the correct steps toward prevention we need to know the diseases which occur during and after the flood stages, as suggested by the Centers for Disease Control (CDC)⁽⁶⁾. It is commonly believed that an epidemic often follows a major disaster. This is not quite true unless we are living in refugee camps where people eat contaminated foods and drink from a common contaminated water source⁽⁵⁾. For example, mucopurulent conjunctivitis⁽⁷⁾ is acute and can be induced by various bacteria or fungus. Its incubation period ranges from 2 to 14 days. From this study, we did not find that the number of conjunctivitis increased significantly after the flood.

A month after the flood, an outbreak of dengue fever occurred in Fengshan City of Kaohsiung County. The seriously flooded Kangshan area was immune due to the mosquitoes being well controlled in this area.

A total of eight hospitals were selected in this study. They provided more information about hospital visits. They also admitted patients who were covered by various insurance schemes which were readily attainable from the Bureau of Labor Insurance. The information obtained was that of the number of hospital visits and not the number of patients. Hence, it was not able to estimate the disease-specific incidence during the flood. On the other hand, it immediately made the analysis and the distribution of diseases more feasible after the flood. Unfortunately, the Bureau of Labor Insurance was unable to provide any information on diseases that occurred before or after the flood. Therefore, no further comparisons are available.

Conclusions

Although the damage from the flood to the residents of Kangshan area was serious, the recovery was successfully carried out within a short period of time and no adverse effects were noted. The full cooperation of all parties concerned had succeeded in controlling the problems of health and environmental sanitation to a minimum. However, medical care institutions were affected by the floods. Fortunately, they had managed to continue adequate medical services to meet the demands of the residents. These efforts insured there were no serious disease outbreaks after the flood.

Furthermore, there is no epidemiological data available as to the causes of death, injuries and diseases which occurred during the disaster stage. Therefore, no baseline data⁽⁸⁾ was available for the planning of food, medicine, supplies and personnel in the event of a disaster. If major disasters are handled with the support of epidemiological investigations, more hazards to health can be avoided and expenses and waste of efforts can be prevented⁽⁵⁾.

Recommendations

The first recommendation is that hospitals in flood plain areas should not place medical record room, drug storage rooms and expensive equipment such as CT scan and X-ray machine in the basement. Second, before a flood occurs in flood plain areas, flood measures on prevention and construction should be developed in advance. The public should be educated in environmental sanitation and disaster prevention measures. A disaster investigation system should be developed and people should be trained⁽⁴⁾. Third, during the flood, health authorities in the flood area should immediately coordinate medical care institutions in the area to set up a disease reporting system and conduct investigations of diseases. They should provide a report on the health status of the people in order to substantiate prevention methods and early detection of diseases. Sufficient medical care resources should be brought under control for timely care and to prevent the occurrence of diseases, injuries and even deaths. Finally, after the flood, a follow-up and a investigation of health problems should be conducted. Epidemiological methods should be applied to address the effects of various intervening measures and to establish national epidemiological data on disasters.

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References

1. Kangshan Township Government, Report on the Flood of August 12th, 1994.
2. Kangshan Towhship Government, A General Introduction to Kangshan Township. May 24, 1994.
3. CDC. Morbidity surveillance following the midwest flood - Missouri, 1993. *MMWR* 1993; 42: 797-798.
4. CDC. Public health consequences of a flood disaster - Iowa 1993. *MMWR* 1993; 42: 653-656.
5. Glass RI and Noji EK. Epidemiologic surveillance following disasters. In Halperin WE, Baker EL, Monson RR, eds. *Public Health Surveillance*. New York: Van Nostrand Reinhold 1992: 195-205.
6. CDC. Injury surveillance during flood relief and flood clean-up in Illinois (a preliminary report). Sep. 20, 1993.
7. Lin HM. A Chinese Translation of "Ophthalmology, Principles and Concepts, 6th ed." (written by Newell FW). 1984; 185-186.
8. Noji EK. Disaster epidemiology: challenges for public health action. *Journal of Public Health Policy* 1992; 332-340.