ORIGINAL RESEARCH

Interruption of Medication among Outpatients with Chronic Conditions after a Flood

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Abstract

Introduction: The disruption of routine treatment, including the interruption of medication, exacerbates chronic conditions during disasters. However, the health consequences of the interruption of medication have not been fully examined. On 22 July 2006, a flash flood affected more than 3,000 households in five cities and four towns in the northern part of Kagoshima Prefecture in southwest Japan. The aims of this study are to describe the prevalence of the interruption of medication among the outpatients in the flood-affected area and to determine the risk and preventive factors for the interruption of medication.

Methods: This was a cross-sectional study using a self-administered questionnaire. The study subjects were the outpatients who visited nine of 15 medical facilities in the flood-affected area from 23 January and 31 January 2007. Of 810 valid respondents, 309 who received medication treatment before the event were eligible for the study. Information on socio-demographic factors, chronic health conditions, preparedness-related factors before the event and damage-related factors were collected. Overall and evacuation status-specific prevalence of interruption of medication were presented. For those evacuated, the associations between interruption of medication and relevant patient characteristics, as well as deterioration of health status after the event, were examined.

Results: The prevalence of interruption of medication was 9% in total, but it increased up to 23% among the evacuated subjects. Interruption of medication was more likely among those aged ≥75 years (odds ratio [OR] = 3.6; 95% confidence interval [CI] = 1.0–12.6) and those receiving long-term care services (OR = 4.6; 95% CI = 1.1–19.1), while it was less likely among those with hypertension (OR = 0.2; 95% CI = 0.1–0.8) and those prepared to go out with medication (OR = 0.2; 95% CI = 0.03–0.8). Those who experienced interruption of medication were more likely to have deteriorated health status one month after the event (OR = 4.5; 95% CI = 1.2–17.6).

Conclusions: Interruption of medication occurred more commonly among the evacuated subjects. Among the evacuated, the elderly and those receiving long-term care services were at high risk for interruption of medication, while the preparedness behavior of "preparing to go out with medication" had preventive effect. Special attention must be paid to the high-risk subgroups, and some preventive behaviors should be recommended.

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Introduction

Preparation to care for populations with chronic health conditions during disasters caused by natural hazards has become a key issue in disaster preparedness.[1] Although disaster planning usually has focused upon management of injuries, infectious diseases, and toxic exposures,[1,2] reports from recent disasters in developed countries have pointed out the burden of chronic diseases, including hypertension[2,3] and diabetes,[4–6] emphasizing the need to develop disaster planning for such populations.[7] Moreover, some studies of Hurricane Katrina indicate that a large proportion of the hurricane survivors actually had

chronic medical conditions.[7–9] The increasing proportion of the elderly population in developed countries exacerbates this burden of chronic diseases.

The exacerbation of chronic conditions during disasters is caused by several factors, including mental and physical stress and lack of food and water.[1] In addition to these factors, disruptions of routine treatment during a disaster, such as the interruption of medication, are relevant issues that should be avoided, especially for those who are receiving medication.[1,7,10] Several studies found that the disruption of treatment and the lack of medications commonly occurred during disasters among different types of patients with chronic disease.[2,5–8,11] However, the methods and results of these studies varied widely, and the impact of disruptions of treatment on health status and the risk factors and preventive measures for the disruptions have not been fully examined.

On 22 July 2006, a flood occurred in the northern part of Kagoshima Prefecture in southwest Japan. The flood was caused by the washout of the Sendai River after heavy seasonal rainfalls. It affected more than 3,000 households in five cities and four towns and injured at least 16 people, five of whom died. The Miyanojo area of Satsuma Town was one of the most severely affected areas, especially where the Sendai River runs through the middle of the town. The very rapid elevation of the water level of the river resulted in a flash flood within one hour after the local government issued the evacuation order. The flash flood harmed at least four people in Satsuma Town, one of whom died, and damaged 815 residences. More than 235 residents were rescued from the flooded area. At the peak of the flood, 1,380 residents were reported to be in the designated evacuation sites around the town.[12]

The aims of this study were to describe the prevalence of interruption of medication treatment among the outpatients in the flood affected area and to determine the risk and preventive factors associated with the interruption of medication, in order to provide information for future disaster management plans for those with chronic conditions.

Methods

Study Population

The target population consisted of the outpatients who had received prescriptions from medical facilities in the Miyanojo area of Satsuma Town. The area is inland and has an area of 145 km^2 and is about 40 km from Kagoshima City, the prefectural capitol. As with other rural communities in Japan, the area had a high proportion of elderly people. The population of the elderly ≥65 years accounted for 33% of the total population of 16,745 according to the 2005 census.[13]

As of December 2006, there were 15 medical facilities belonging to the Satsuma County Medical Association in Miyanojo area. All of the facilities were private practices that provide primary and/or secondary level health care generally to the patients living in Satsuma Town. This is a common situation in Japan, as the vast majority of the medical facilities are managed in private facilities, especially in the small towns. The directors of these 15 facilities were asked by mail to participate in this survey, and nine agreed. The characteristics of the non-participating facilities, such as the number of patients, general profiles of the patients, locations, and the services provided, were similar to those of participating facilities although one secondary level hospital managed directly by the Satsuma County Medical Association did not participate in the survey. This study was reviewed and approved by the Institutional Review Board of Toyo University.

Data Collection

The questionnaire was developed to determine the following four domains of variables: (1) socio-demographic factors at the time of the event; (2) chronic health conditions at the time of the event; (3) damage-related factors; and (4) preparedness-related factors before the event. Socio-demographic factors at the time of the event included age, sex, household size, occupation status (employed or unemployed/retired), highest educational level (high school graduate or under high school), and annual household income (≥3 million ¥, or less).

For the chronic health conditions at the time of the event, patients were asked to choose the types of illnesses under treatment from a provided list of illnesses at the time the flood occurred. Self-rated health status at the time of the event was determined using a five-grade scale: excellent, very good, good, fair, or poor. To identify physical disability status and requirement for special supports in daily living, patients were asked whether they had a physically disabled persons' certificate and whether they received long-term care services under the Long-Term Care Insurance System in Japan at the time the flood occurred.

Damage-related factors included health-related damage, property damage, and evacuation status. For health-related damage, interruption of medication treatment, disturbance of routine visits, and health status changes one month and six months after the event were determined. Patients were considered to have experienced interruption of medication if they missed at least one dose of any medication they had been prescribed before the event during the acute phase of the disaster. Similarly, patients were considered to have experienced a disturbance of a routine visit if they could not visit a medical facility, they were forced to postpone a visit, or they visited alternative medical facilities immediately after the event. Changes in health status one and six months after the event, compared with the status just before the flood occurred, were measured by using a five-grade scale: much better, somewhat better, about the same, somewhat worse, and much worse. Either somewhat worse or much worse was recognized as deterioration of health status. Property damage was defined as positive if patients had damage to their residences which was equivalent to inundation above the floor level or more severe and/or had lifeline damages, i.e., interruption of any one of electricity, gas, water, and/or telecommunications in their residences. As for evacuation status, they were asked whether they had evacuated when the flood occurred.

The status of several preparedness behaviors just before the event was asked and the following four behaviors were

considered to be relevant to this study: "keeping extra doses of medication"; "preparing to go out with medication"; "preparing to go out with prescription records"; and "preparing the emergency pack". Each participant was asked about his or her past experience with a disaster due to a natural hazard, because such experience might affect one's behavior before and during the disaster.

Additionally, the evacuated subjects were asked whether they brought their health-related items to the evacuation sites, including medication, prescription records, health insurance card, and cash. Statistical analyses prevalences of interruption of medication and other relevant factors are provided with frequency distributions. Continuous and categorical variables were dichotomized for the analysis. As for the variables with missing values, only the validly responding subjects were included in each analysis. As interruption of medication disproportionately more commonly occurred in the evacuated subgroup, the evacuation status-specific prevalence also was presented. For the evacuated subjects, the bivariate odds ratios (OR) of interruption of medication associated with the other factors were estimated using the exact method. This was followed by the multivariate logistic regression analysis to estimate adjusted OR of interruption of medication associated with each factor controlling for age, sex, property damage, and disturbance of routine visits. The associations between interruption of medication and deterioration of health status one month and six months after the event were examined using logistic regression analysis controlling for age, sex, health status just before the event, and damage-related factors. Additionally, the associations between relevant preparedness behaviors and bringing medication to the evacuation sites were also examined by logistic regression. All statistical analyses were performed using STATA version 10.1 (StataCorp, TX).

Results

The outpatients, who visited the nine facilities from 23 to 31 January 2007, six months after the event, were recruited as the study subjects. During the study, the nine participating facilities had a total number of 3,352 outpatients, who were included in the estimated range of 3,000–4,000 based on the average number of patients in each facility. The actual number of the study subjects, however, could be smaller than 3,352, as this included the patients who visited the same facility more than once and those who visited two or more facilities during the study period. The questionnaires were collected from 1,004 patients, of whom 810 provided valid responses on age, sex, and place of residence during the event. Age and sex distributions were similar among the responding and the non-responding subjects. Of the 810 subjects, 601 had received outpatient care, and 487 had received medication treatment before the flood. Among those 487 subjects, 339 subjects provided valid answers to the questions for interruption of medication and evacuation status. No statistically significant differences were found for the characteristics of the subjects between those who provided valid answers to the questions and those who did not. Finally, 309 subjects were regarded as eligible subjects for the analysis after the exclusion of 30 subjects who suffered from health damages caused directly by the flood and/or the recovery and who had received professional medical care. These 30 subjects were excluded, because they could have changed the treatment at a physician's discretion.

Self-administered questionnaires were distributed to the outpatients at the reception of each facility. Participation in the survey was on a voluntary basis, and each patient was asked to submit the completed form to the predefined place in each facility. The persons in charge of distributing the questionnaire at each facility were instructed not to distribute the questionnaire to the patients who had previously received it.

Of the 309 subjects, the mean value of age was 73.0 years; 48% were 75 years of age; 65% were female; 22% were single household; 40% were unemployed or retired; 50% were not a high school graduate; and 65% had annual household income of ≤3 million ¥ (Table 1). As for the health-related factors, 14% rated their health status as fair to poor; 12% had the physically disabled persons' certificate; and 19% received long-term care services. Hypertension (74%), diabetes (23%), musculoskeletal disorders (15%), heart diseases (14%), and peptic ulcer (11%) were the common chronic conditions. Other conditions, such as respiratory diseases, rheumatoid arthritis, stroke, kidney disease, neurologic diseases, cancers, and psychiatric disorders, were present in <5% of the subjects and were excluded from the following analyses. Fifty-five percent of the subjects had experienced disasters in the past, and preparedness behaviors were had been achieved in <30% of the subjects. The socio-demographic and health-related factors and preparedness behaviors were similarly distributed between the evacuated and the non-evacuated participants except for the educational level, health status before the event, and past experience of disasters.

The prevalence of the interruption of medication was 9% in total, but was 23% for those evacuated (Table 1). Other damage-related factors, including property damage (46% vs. 7%, p <0.001), disturbance of routine visit (12% vs. 5%, p = 0.04), and the deterioration of health status one month (19% vs. 4%, p <0.001) and six months (6% vs. 2%, p = 0.09) after the event, also were more commonly distributed in the evacuated subjects than in the non-evacuated. Among the evacuated, 52% brought medications; 12% brought prescription records; 54% brought a health insurance card; and 23% brought cash to the evacuation sites.

Controlling for age, sex, and other damage-related factors, interruption of medication was 3.8 times more likely among those ≥75 years of age versus those younger among the evacuated subjects (OR = 3.6; 95% CI = 1.0–12.6) (Table 2). Those receiving long-term care services were 4.6 times more likely to experience interruption of medication (OR = 4.6; 95% CI = 1.1–19.1). Interruption was less likely among those with hypertension (OR = 0.2; 95% CI = 0.1-0.8), whereas it was 3.8 times (OR = 3.8; 95% CI = 0.8–17.6) more likely among those with heart diseases, though the association was not statistically significant. Those with property damages were 4.7 times (OR = 4.7; 95% CI = 1.5–15.2) more likely to experience the interruption of medication, but those with disturbance of a routine visit were not. Those who prepared to go out with medication were less likely to

Variable	Total (n = 309)	Evacuated (n = 102)	Non-Evacuated (n = 207)	*p*-value**
	n (%)	n (%)	n (%)	
Socio-demographic factors				
Age (years)				0.21
<75	160 (52)	58 (57)	105 (51)	
≥75	149 (48)	44 (43)	102 (49)	
Sex				0.94
Female	202 (65)	67 (66)	135 (65)	
Male	107 (35)	35 (34)	72 (35)	
Size of household*				0.93
Single	65 (22)	21 (23)	44 (22)	
≤2	227 (78)	72 (77)	155 (78)	
Occupational status*				0.96
Employed or self-employed	174 (60)	57 (59)	117 (60)	
Unemployed or retired	118 (40)	39 (41)	79 (40)	
Highest education				0.02
<High School	104 (50)	41 (61)	63 (44)	
≤High School	106 (50)	26 (39)	80 (56)	
Household income (million ¥/year)*				0.73
<3	135 (65)	47 (66)	88 (64)	
≥3	74 (35)	24 (34)	50 (36)	
Health-Related Factors				
Health status before the event*				0.03
Good to excellent	241 (86)	75 (80)	166 (89)	
Fair to poor	39 (14)	19 (20)	20 (11)	
Physically disabled persons' certificate				0.51
Yes	37 (12)	14 (14)	23 (11)	
No	272 (88)	88 (86)	184 (89)	
Long-term care services				0.79
Received	58 (19)	20 (20)	38 (18)	
Not received	251 (81)	82 (80)	169 (82)	
Chronic conditions				
Hypertension	228 (74)	75 (74)	153 (74)	0.94
Heart diseases	36 (12)	14 (14)	22 (11)	0.43
Diabetes	61 (20)	23 (23)	38 (18)	0.39
Respiratory disease	10 (3)	4 (4)	6 (3)	0.74
Peptic ulcer	26 (8)	11 (11)	15 (7)	0.29
Rheumatoid arthritis	9 (3)	2 (2)	7 (3)	0.72
Stroke	8 (3)	2 (2)	6 (3)	0.99
Kidney diseases	3 (1)	2 (2)	1 (0.5)	0.25
Neurologic diseases	9 (3)	2 (2)	7 (3)	0.72
Cancers	6 (2)	0 (0)	6 (2)	0.18
Musculoskeletal disorders	51 (17)	15 (15)	36 (17)	0.55
Psychiatric disorders	11 (4)	2 (2)	9 (4)	0.35

Table 1—Overall and evacuation status-specific characteristics of the subjects and prevalence of interruption of medication (NA = not applicable; *Variable with missing values; **Chi-squared test or Fisher's exact test)
(continued on page 46)

experience the interruption (OR = 0.2; 95% CI = 0.03–0.8), while no such association was found among those who kept extra doses of medication. Those who evacuated with medications were less likely to experience interruption with statistically significant preventive associations for medication (OR = 0.2; 95% CI = 0.04–0.6) and health insurance card (OR = 0.1; 95% CI = 0.04–0.6). Those who experienced interruption of medication were 4.5 times (OR = 4.5; 95%

	Total (n = 309)	Evacuated (n = 102)	Non-Evacuated (n = 207)	*p*-value
Damage-Related Factors				
Property damage				<0.001
Yes	61 (20)	47 (46)	14 (7)	
No	248 (80)	55 (54)	193 (93)	
Disturbance of routine visit*				0.04
Yes	21 (7)	11 (12)	10 (5)	
No	267 (93)	82 (88)	185 (95)	
Preparedness-Related Factors				
Past experience of disasters*				
Yes	109 (37)	52 (55)	57 (29)	<0.001
No	183 (63)	42 (45)	141 (71)	
Preparedness before the event				
Keep extra doses of medications	50 (16)	19 (19)	31 (15)	0.41
Prepare to go out with medications	85 (28)	28 (27)	57 (28)	0.99
Prepare to go out with prescription records	54 (17)	18 (18)	36 (17)	0.96
Prepare the emergency pack	36 (12)	15 (15)	21 (10)	0.24
Outcomes				
Interruption of medication				<0.001
Yes	29 (9)	223 (23)	6 (3)	
No	280 (91)	79 (77)	201 (97)	
Health status change one month after disaster				<0.001
About the same to much better	252 (91)	75 (81)	177 (96)	
Somewhat worse to much worse	25 (9)	18 (19)	7 (4)	
Health status change six months after disaster				0.09
About the same to much better	266 (96)	87 (94)	179 (98)	
Somewhat worse to much worse	10 (4)	6 (6)	4 (2)	
Item brought to the evacuation sites				
Medications	NA	53 (52)	NA	
Prescription records	NA	12 (12)	NA	
Health insurance card	NA	55 (54)	NA	
Cash	NA	23 (23)	NA	NA

Table 1—*(continued from page 45)* Overall and evacuation status-specific characteristics of the subjects and prevalence of interruption of medication (NA = not applicable; *Variable with missing values; **Chi-squared test or Fisher's exact test)

CI = 1.2–17.6) more likely to have deteriorated health status one month after the event after controlling for age, sex, and the other damage-related factors (Table 3). However, the association was not statistically significant six months after the event (OR = 5.3; 95% CI = 0.7–39.7).

Those who had prepared an emergency pack were 5.7 times (OR = 5.7; 95% CI = 1.4–23.6) more likely to bring medication to the evacuation site after controlling for age, sex, and property damages, though no such effect was found for those who kept extra doses of medication and those who were prepared to go out with medication (Table 4).

Discussion

The overall prevalence of interruption of medication after the flood disaster was less than one tenth of the outpatients with medication treatment in the affected area. However, it occurred disproportionately more commonly among the evacuated subjects. Evacuated subjects were more likely to have had deterioration in their health status at least one month after the event. According to the previous reports from the major disasters, the prevalence of disruptions of treatment among the chronic disease patients after disaster ranged from 20 to 65%.[2,5–7] These values are higher than in the present study. However, a recent report from the Noto Peninsula Earthquake (Japan, 2007),

Variable	Crude OR (95% CI)	*p*-value	Adjusted* OR (95% CI)	*p*-value
Socio-Demographic Factors				
Older age (≥75 years)	3.5 (1.1–13.1)	0.03	3.6 (1.0–12.6)	0.04
Female sex	0.8 (0.3–2.3)	0.62	0.9 (0.3–2.7)	0.79
Single household*	3.1 (0.9-–10.1)	0.07	2.5 (0.6–10.1)	0.19
Unemployed or retired*	0.7 (0.2–2.0)	0.62	0.6 (0.2–2.1)	0.40
Lower educational level* (<high school)	1.0 (0.3–4.5)	0.99	0.8 (0.2–4.0)	0.78
Lower household income* (<3 million ¥/year)	1.9 (0.4–11.8)	0.52	2.7 (0.5–16.1)	0.27
Health-Related Factors				
Fair to poor health status before the event*	2.2 (0.6–0.7)	0.20	1.8 (0.5–6.5)	0.37
Physically disabled persons' certificate holder	0.2 (0.01–1.7)	0.18	0.2 (0.02–2.0)	0.17
Receiving long-term care services*	3.0 (0.9–9.6)	0.07	4.6 (1.1–19.1)	0.03
Chronic conditions				
Hypertension	0.4 (0.1–1.1)	0.06	0.2 (0.1–0.8)	0.02
Heart diseases	3.1 (0.8–11.8)	0.08	3.8 (0.8–17.6)	0.08
Diabetes	0.7 (0.1–2.4)	0.58	0.7 (0.2–2.9)	0.58
Peptic ulcer	0.7 (0.1–4.0)	0.99	0.9 (0.1–5.9)	0.94
Musculoskeletal disorders	1.9 (0.5–7.1)	0.32	1.6 (0.4–6.5)	0.48
Damage-Related Factors				
Property damage	4.6 (1.5–15.7)	0.004	4.7 (1.5–15.2)	0.01
Disturbance of routine visit*	1.4 (0.2–6.8)	0.70	1.0 (0.2–4.7)	0.95
Preparedness-Related Factors				
Past experience of disasters*	0.8 (0.3–2.3)	0.62	0.4 (0.1–1.4)	0.17
Preparedness behaviors				
Keep extra doses of medications	1.8 (0.5–6.0)	0.36	1.6 (0.4–5.5)	0.48
Prepare to go out with medications	0.2 (0.02–0.9)	0.03	0.2 (0.03–0.8)	0.03
Prepare to go out with prescription records	0.6 (0.1–2.6)	0.76	0.4 (0.1–1.7)	0.20
Prepare the emergency pack	0.8 (0.1–3.6)	0.99	0.3 (0.04–1.5)	0.12
Items brought to the evacuation site				
Medications	0.2 (0.1–0.7)	0.008	0.2 (0.04–0.6)	0.004
Prescription records	0.3 (0.01–2.2)	0.29	0.2 (0.03–2.4)	0.23
Health insurance card	0.2 (0.1–0.7)	0.004	0.1 (0.04–0.6)	0.004
Cash	0.4 (0.1–1.2)	0.09	0.3 (0.1–1.0)	0.06

Table 2—Association between relevant factors and interruption of medication (CI = confidence interval; OR = odds ratio)
*Variable with missing values
*Adjusted for age, sex, property damages, and disturbance of routine visit. For age, sex, property damage, and disturbance of routine visit, odds ratios were adjusted for the rest of three variables

which caused relatively small and similar size of damage compared to the current event, found no interruption of medication among the elderly victims with chronic conditions.[14]

The large difference in the prevalence of interruption of medication treatment between the evacuated and the non-evacuated patients suggests that the evacuation itself and/or the changes in lifestyle at the evacuation sites influenced the medication treatment. This finding is somewhat self-evident but previously has not fully examined—most of the previous studies focused exclusively upon the evacuated population.

	OR* (95% CI)	*p*-value
1 month after the event	4.5 (1.2–17.6)	0.03
6 months after the event	5.3 (0.7–39.7)	0.11

Table 3—Odds ratios (ORs) of deterioration of health status one month and six months after the event associated with interruption of medication (CI = confidence interval)
*Adjusted for age, sex, property damage, disturbance of routine visit, and health status before the event

Among the evacuated, the older age subjects and those receiving long-term care services were found to be at risk for interruption of medication even after controlling for the effects of others damage-related factors. Contrary to this result, some previous reports concluded that younger patients were more likely to experience the disruptions of treatment.[2,7] Kessler and others attributed their findings to lower disease severity and lack of portable insurance, such as Medicare, among younger patients.[7] However, considering the fact that the elderly are vulnerable in disaster settings because of general physical impairments,[15] it is no wonder that the elderly had some difficulty in taking their routine medicines at the evacuation sites. The elderly dominant population and an older cutoff point, i.e., ≥75 years of age used in this study could contribute to the result reported here.

The increased risk for interruption of medication among those receiving long-term care services could be due to disruptions of routine supports by the caregivers at the evacuation sites. On the other hand, there was no increased risk for interruption among holders of the physically disabled persons' certificate. Patents receiving long-term care services, by definition, require special supports in daily living,[16] while only about 10–20% of those with the physical disability certificate, in general, require such supports.[17] Therefore, the majority of those with disability certificates could manage their medication treatment by themselves despite physical disabilities. This finding suggests that these two groups should be treated separately, at least in the context of medication support at the evacuation site, although they generally were mixed together under the current government policy for disaster preparedness.[18]

Those who had sustained property damage also had a high risk for interruption of their medication. Although this association was not confirmed in a previous study of Hurricane Katrina,[2] the result suggests that they might lose medications in their collapsed residences or were unable to obtain medicines because of inundation. Psychological damage secondary to the property damage also might have affected their treatment pattern. On the other hand, disruption of routine visit was not associated with higher prevalence of interruption of medication, though a previous study showed that the lack of access to a physician was the major cause of disruption of treatment.[7] This might be explained by the relatively limited damage to the health infrastructure in the current event. The prevalence of interruption of medication was lower among the patients with hypertension than for those being treated for other chronic conditions. The result was consistent with previous findings that indicated that the cutback of the treatment after the disaster was less common for conditions, such as cardiovascular diseases, that quickly become symptomatic if treatment is reduced.[7] In the current study, those with heart diseases, however, had suggestive increased risk for interruption of medication. One possible reason is that patients with heart diseases took more types of medications compared with the patients with other illnesses; patients with heart diseases usually have primary chronic conditions, such as hypertension and diabetes, therefore, had a larger chance of missing medications.

Preparedness	OR* (95% CI)	*p*-value
Keep extra doses of medications	0.5 (0.2–1.4)	0.17
Prepare to go out with medications	1.3 (0.5–3.1)	0.61
Prepare to go out with prescription records	1.1 (0.4–3.3)	0.80
Prepare the emergency pack	5.7 (1.4–23.6)	0.02

Table 4—Odds ratios (ORs) of bringing medication to the evacuated sites associated with key preparedness behaviors (CI = confidence interval)
*Adjusted for age, sex, and property damage

As for the preparedness behaviors, "preparing to go out with medication" was likely to have a preventive effect on interruption of medication, while "keeping extra doses of medication," which is usually listed on the tips for disaster preparedness for chronic disease patients, did not have such an effect. This means that just having medications might not be enough when a patient faces situations like a flash flood, which occur suddenly and do not allow sufficient time for preparation for evacuation.

These preparedness behaviors were achieved only in one-third of the subjects though more than half had experienced disasters in the past. No statistically significant associations were found between these preparedness behaviors and the characteristics of the subjects, including past experience with disasters. The disaster that was experienced by most of the subjects was the flood in 1972. Such experience might be too long ago for the residents to improve their preparedness behaviors.

Nearly half of the evacuated subjects did not bring medications to the evacuation site. This was similar to the findings of the surveys of the victims of Hurricane Katrina,[11] but was higher than that for the victims of the Noto Peninsula Earthquake.[14] This might be due to the nature of the flash flood that required imminent evacuation. Those who brought medications to the evacuation site were much less likely to experience interruption of medication. The results also suggest that some of the subjects who did not bring medications with them received them through *ad hoc* health services or other sources—the number of those whose medication was interrupted was much smaller than for those who did not bring medications to the evacuation sites. Those who evacuated with a health insurance card

also had a lower risk for interruption. Although those without health insurance had a higher risk for disruption of treatment among the survivors of Hurricane Katrina,[7,8,11] this is not supported in the current study, since there is a universal insurance system in Japan. However, having a health insurance card might have a facilitating effect upon refilling medications among the evacuated subjects. On the contrary, some of those who brought medications to the evacuation sites also experienced an interruption of medication. Running out of medications after evacuation, lacking some of the medications they took, and forgetting to take medications could be some of the other possible reasons.[2,7]

Preparing the emergency pack could be an effective preparedness behavior to bring medications to the evacuation sites. Thus, patients could be urged to prepare the emergency pack, but they also should be careful to include sufficient types and doses of medicines in the pack. Some local governments already have started such efforts (recommending to have some stocks of medicines always in hand and ready for unexpected events), but such efforts remain quite limited. Interestingly, those who were prepared to go out with medication did not bring them to the evacuation site. Although this behavior had potential preventive effect on interruption of medication, it might be true that such preventive behaviors not always were effective, and therefore, they should be complemented by the supports at the community and governmental levels.

This study had several limitations. First, the selection bias caused by convenient sampling design should be taken into account. Those who visited other medical facilities and those who visited the participating facilities but did not visit during the survey period were not included. Those who moved from the affected area or who died or were hospitalized after the flood were not included as well. Such patients might have a higher prevalence of disruption of treatment, and exclusion of these patients might cause underestimation of the prevalence of interruption of medication. If such cases could be followed up by survey, a deterioration in health status among the patients might be revealed more clearly, both after one month and six months after the flood. Exclusion of the subjects who did not respond to the key questions also could have biased the results. However, such bias was considered to be minimal because no statistically significant differences were found for the characteristics of the subjects between those who provided valid responses and those who did not.

Second, recall bias must be considered because of the relatively longer recall period of the survey. This also could have caused underestimation of the prevalence of interruption.

Third, the clinical relevance of interruption of medication defined in this study was not verified, and the information on the types of medications and the duration of interruption was not obtained. Further investigations are required in order to examine medication-specific interruption status. Fourth, the data collection based upon self-reporting might not capture some key information, such as the names of treated illness and property damage. Fifth, the relatively small sample size might cause the typ-2 error to failing to find statistical significance for some associations.

Conclusions

The interruption of medication among the outpatients with chronic conditions occurred more commonly in the participants who were evacuated. Among the evacuated, the elderly and those receiving long-term care services were at high risk for interruption of medication, while the behavior of "preparing to go out with medication" had preventive effect on interruption. Special attention must be paid to the high-risk subgroups, and some preventative behaviors should be recommended when the disaster preparedness plans for the patients with chronic disease are developed.

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References

1. Mokdad AH, Mensah GA, Posner SF, *et al*: When chronic conditions become acute: Prevention and control of chronic diseases and adverse health outcomes during natural disasters. *Prev Chronic Dis* 2005;2(Special Issue):A04.
2. Krousel-Wood MA, Islam T, Muntner P, *et al*: Medication adherence in older clinic patients with hypertension after Hurricane Katrina: Implications for clinical practice and disaster management. *Am J Med Sci* 2008;336(2):99–104.
3. Kario K, Matsuo T, Kobayashi H, *et al*: Earthquake-induced potentiation of acute risk factors in hypertensive elderly patients: Possible triggering of cardiovascular events after a major earthquake. *J Am Coll Cardiol* 1997;29(5):926–933.
4. Inui A, Kitaoka H, Majima M, *et al*: Effect of the Kobe earthquake on stress and glycemic control in patients with diabetes mellitus. *Arch Intern Med* 1998;158(3):274–278.
5. Kamoi K, Tanaka M, Ikarashi T, *et al*: Effect of the 2004 Mid Niigata Prefecture earthquake on glycemic control in type 1 diabetic patients. *Diabetes Res Clin Pract* 2006;74(2):141–147.
6. Kirizuka K, Nishizaki H, Kohriyama K, *et al*: Influences of The Great Hanshin-Awaji Earthquake on glycemic control in diabetic patients. *Diabetes Res Clin Pract* 1997;36(3):193–196.
7. Kessler RC: Hurricane Katrina's impact on the care of survivors with chronic medical conditions. *J Gen Intern Med* 2007;22(9):1225–1230.
8. Brodie M, Weltzien E, Altman D, *et al*: Experiences of Hurricane Katrina evacuees in Houston shelters: Implications for future planning. *Am J Public Health* 2006;96(8):1402–1408.
9. Ford ES, Mokdad AH, Link MW, *et al*: Chronic disease in health emergencies: In the eye of the hurricane. *Prev Chronic Dis* 2006;3(2):A46.
10. Cefalu WT, Smith SR, Blonde L, *et al*: The Hurricane Katrina aftermath and its impact on diabetes care: observations from "ground zero": Lessons in disaster preparedness of people with diabetes. *Diabetes Care* 2006;29(1):158–160.
11. Greenough PG, Lappi MD, Hsu EB, *et al*: Burden of disease and health status among Hurricane Katrina-displaced persons in shelters: A population-based cluster sample. *Ann Emerg Med* 2008;51:426–432.
12. Kagoshima Prefecture: North Kagoshima Prefecture heavy rainfall disaster in July 2006: Summary of the damages and record of the responses. Available at http://www.pref.kagoshima.jp/bosai/saigai/h1807/index.html. Accessed 17 November 2008.

13. Statistics Bureau, Director-General for Policy Planning (Statistical Standards), and Statistical Research and Training Institute: Information on the 2005 population Census of Japan. Available at http://www.stat.go.jp/english/data/kokusei/index.htm. Accessed 16 April 2009.
14. Okumura J, Nishita Y, Kimura K: Pharmaceutical supply for disaster victims who need chronic disease management in region with aging population based on lessons learned from the Noto Peninsula Earthquake in 2007. *Yakugaku Zasshi* 2008;128(9):1275–1283.
15. Fernandez LS, Byard D, Lin CC, *et al*: Frail elderly as disaster victims: emergency management strategies. *Prehosp Disaster Med* 2002;17(2):67–74.
16. General Affairs Division, Health and Welfare Bureau For the Elderly, the Ministry of Health, Labour and Welfare: Long-term Care Insurance in Japan. Available at http://www-bm.mhlw.go.jp/english/topics/elderly/care/index.html. Accessed 18 November 2008.
17. Policy Planning Division, Department of Health and Welfare for Persons with Disabilities, Social Welfare and War Victims' Relief Bureau, the Ministry of Health, Labour and Welfare: Report of the survey on the actual status of physically disabled persons and children in 2006. Available at http://www.mhlw.go.jp/toukei/saikin/hw/shintai/06/dl/01.pdf. Accessed 17 November 2008.
18. Investigative commission for the evacuation strategy for the people with special needs to disaster: Guidelines for the evacuation support for the people with special needs to disaster. Available at http://www.bousai.go.jp/hinan_kentou/060328/hinanguide.pdf. Accessed 18 November 2008.