

Disaster-Driven Evacuation and Medication Loss: a Systematic Literature Review

July 18, 2014 · Research Article

Citation

Ochi S, Hodgson S, Landeg O, Mayner L, Murray V. Disaster-Driven Evacuation and Medication Loss: a Systematic Literature Review. PLOS Currents Disasters. 2014 Jul 18 . Edition 1. doi: 10.1371/currents.dis.fa417630b566a0c7dfdbf945910edd96. [Tweet](#)

Authors

[Sae Ochi](#)

Department of Internal Medicine, Soma Central Hospital, Soma, Fukushima, Japan .

[Susan Hodgson](#)

School of Public Health, Imperial College London, London, UK.

[Owen Landeg](#)

Extreme Events and Health Protection, Public Health England, London, UK.

[Lidia Mayner](#)

Flinders University Disaster Research Centre, Flinders University, Adelaide, South Australia, Australia.

[Virginia Murray](#)

Extreme Events and Health Protection, Public Health England, London, UK.

Abstract

AIM: The aim of this systematic literature review was to identify the extent and implications of medication loss and the burden of prescription refill on medical relief teams following extreme weather events and other natural hazards.

METHOD: The search strategy followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Key health journal databases (Medline, Embase, PsycINFO, Maternity and Infant Care, and Health Management Information Consortium (HMIC)) were searched via the OvidSP search engine. Search terms were identified by consulting MeSH terms. The inclusion criteria comprised articles published from January 2003 to August 2013, written in English and containing an abstract. The exclusion criteria included abstracts for conferences or dissertations, book chapters and articles written in a language other than English. A total of 70 articles which fulfilled the inclusion criteria were included in this systematic review.

RESULTS: All relevant information was collated regarding medication loss, prescription loss and refills, and medical aids loss which indicated a significant burden on the medical relief teams. Data also showed the difficulty in filling prescriptions due to lack of information from the evacuees. People

with chronic conditions are most at risk when their medication is not available. This systematic review also showed that medical aids such as eye glasses, hearing aids as well as dental treatment are a high necessity among evacuees.

DISCUSSION: This systematic review revealed that a considerable number of patients lose their medication during evacuation, many lose essential medical aids such as insulin pens and many do not bring prescriptions with them when evacuated.. Since medication loss is partly a responsibility of evacuees, understanding the impact of medication loss may lead to raising awareness and better preparations among the patients and health care professionals. People who are not prepared could have worse outcomes and many risk dying when their medication is not available.

Funding Statement

This project was not funded. The authors have declared that no competing interests exist.

Introduction

After an extreme weather event or other natural hazard, the continuity of routine care is one of many challenging aspects of post disaster healthcare. Although a disaster can impact on all available services, healthcare facilities can be overwhelmed reducing their ability to maintain normal function. Structural and non-structural damage to their buildings, creating an insecure environment for hospital staff, and disruption of supply chains, all lead to closure of wards for new admissions, or even evacuation of patients and staff, at a time when they are critical for those who are injured by the disaster. Recognising the impact of extreme events on healthcare facilities, normal functioning is still required for people needing routine health management such as oncological treatment, dialysis and maternity care, as well as those people with chronic conditions who require daily medication to maintain their wellbeing.

Long-term non-communicable diseases ¹ are increasing with a growing and ageing world population and in 30 years from 1990, NCD's are estimated to increased 1.8 times ². Ensuring continuation of routine care for chronic conditions will be an increasing burden during and post disaster periods both in developing and developed countries ³. Interruption of routine medication lead can lead to an exacerbation of chronic conditions such as insulin-dependent diabetes ⁴ and infectious diseases for example tuberculosis ⁵. This can also potentially cause secondary life-threatening outcomes as a result of the deterioration of chronic conditions such as ischemic heart diseases among patients with hypertension ⁶, and low compliance to medication regimens in the future ^{7,8}.

During any disaster, medication maintenance is problematic due to people not having adequate dosages for a sufficient period of time, not having prescriptions with them, not remembering the medication they are on and more likely not having any medication with them at all. These people have been described as 'drug refugees'. In the Great East Japan Earthquake in 2011, for example, a large number of 'drug refugees' were reported ⁹, and at least 283 people were reported to have died from the exacerbation of pre-existing conditions due to lack of access to healthcare ¹⁰. The health impacts on drug refugees has had, little research conducted among the affected population.

Since medication loss is partly a responsibility of evacuees, understanding the impact of medication loss may lead to raising awareness and better preparations among the patients and health care professionals. The aim of this systematic literature review was to identify the extent and implications of medication loss and the burden of prescription refill on medical relief teams following extreme weather events and other natural hazards.

Methods

The search strategy followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement where applicable, and this checklist was used in designing and reporting our review ¹¹.

Identification

The key health journal databases (Medline, Embase, PsycINFO, Maternity and Infant Care, and Health Management Information Consortium (HMIC)) were searched via the OvidSP search engine. Search terms were identified by consulting MeSH terms. The validity of the search was confirmed by comparing the generated results to articles obtained from expert consultation and 'snow-ball' search). After this pilot search, it was revealed that using only MeSH terms was not sufficient to identify all relevant articles. Therefore, key words related to disaster and medication were added to MeSH term search as shown in Table 1. The relevant articles were searched by combining [Terms for disasters] AND [Terms for medications].

Table 1. Search terms used and limitations

Search Area	Term Category	Terms
MeSH terms	Disaster	Disasters Disaster medicine Disaster planning Emergencies Emergency shelter Relief work
	Medication	Chronic disease Community-based participatory research “Delivery of health care” Drug prescriptions Drug utilization “Health services needs and demand” Health services accessibility Medication adherence Needs assessment “Patient acceptance of health care” Patient compliance Pharmaceutical preparations Prescriptions Prescription drugs
Key words	Disaster	Disaster\$ Earthquake/Earthquakes Evacu\$ Flood/Floods Hurricane/Hurricanes Landslide/Landslides Tsunami Typhoon/Typhoons Volcan\$ Wildfire/Wildfires
	Medication	Prescri\$ Chronic disease/diseases Chronic condition/conditions Medication/medications Needs assessment/assessments
Limitations specified when searching the literature: Human; Date of publication from 2003-2013; English Language; with abstract		

Eligibility criteria**1) Inclusion criteria**

Articles were eligible if they were published over the period from January 2003 to August 2013, were written in English, and included an abstract. We limited the search period to 10 years because technology and needs for chronic diseases such as dialysis and home oxygen therapy treatments have changed over this period of time. Eligible articles described the following: (i) evacuees' actions of bringing prescription medications with them; (ii) burden of prescription refills or prescription of

medication for chronic conditions within relief activities after disasters, and/or (iii) disruption of medications due to evacuees not bringing their medications.

2) Exclusion criteria

Articles and papers were excluded if they were (i) abstracts for conferences or dissertations; (ii) chapters of books; and (iii) articles written in a language other than English.

Study selection

The search was conducted on 5th September, 2013 and generated 5,382 results of which 1,652 were duplicates and removed, leaving 3,730 records. Out of these records 2,961 were apparently irrelevant when screened by title exclusion criteria. Hence, the initial screening by title identified 811 records as relevant and for these remaining articles, abstracts were checked independently by SO and other co-authors (SH and LM). Abstract eligibility screening excluded a further 513, however, given the wide range of sources searched, an additional 66 abstracts were added as a result of citation searching, shown as 'secondary screening' in Figure 1. Overall, a total of 364 articles were identified. The full-text articles eligibility screening identified those not fulfilling the inclusion criteria which totalled 294, thus leaving a total of 70 articles for this systematic review (Figure 1).

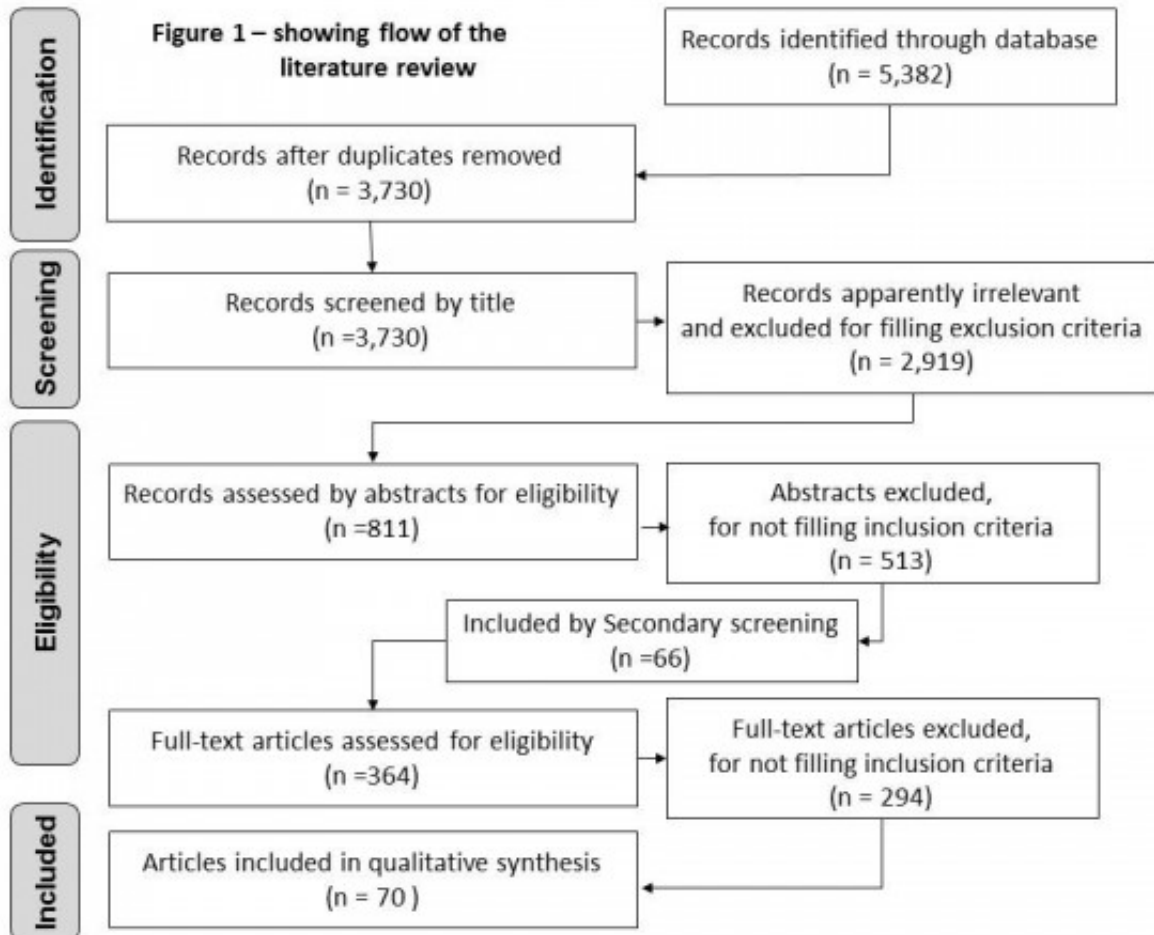


Fig. 1: Study selection flow chart

Risk of bias and data synthesis

Most of the data collected were from observational studies using convenience population samples because obtaining robust data from appropriate population samples is almost impossible immediately after an extreme event. Due to the heterogeneity of the data, no formal assessment of bias in each study was made. In addition, due to the wide variety of the targeted populations, statistical data synthesis was considered inappropriate.

Results

This is the first systematic review that has addressed the topic of medication needs in disaster driven evacuation. Most of these publications did not focus on the medications needs from disaster driven evacuation thus the information was limited and often not covered comprehensively. Although the results are provided in detail below the findings are used principally to inform a detailed commentary of the assimilated results from the many publications identified.

From the MeSH terms, 70 papers were identified of which 69 articles were related to extreme events. These events showed a wide range of disasters occurring from 1992 to 2011 and included 14 hurricanes, typhoons or cyclones; eight earthquakes; two flooding; one wildfire; and one power outage and one conflict (Table 2). There were 29 (44%) articles that reported on the impacts from the 2005 Hurricane Katrina. Additionally 54 (78%) of the disasters identified occurred in the United States of America (USA), a total of nine countries were found to have reported these extreme events.

Table 2. Chronological list of the reviewed events

Year	Month	Name of events	Country	No. of articles
1992	August	Hurricane Andrew	US	4
1992	September	Hurricane Iniki	US	3
1994	January	Northridge earthquake	US	1
1995	January	Hanshin earthquake	Japan	1
1998-1999	–	Kosovo crisis	Kosovo	2
2001	January/February	El Salvador earthquakes	El Salvador	1
2001	June	Tropical Storm Allison	US	3
2003	August	New York Blackout	US	1
2003	December	Bam earthquake	Turkey	1
2004	April	Typhoon Sudal	Micronesia	1
2004	August	Hurricane Charley	US	1
2004	August-September	Hurricane Frances	US	1
2004	September	Hurricane Ivan	US	1
2004	September	Hurricane Jeanne	US	1
2004	October	Mid-Niigata Prefecture earthquake	Japan	1
2005	August	Hurricane Katrina	US	29
2005	September	Hurricane Rita	US	2
2005	October	Pakistan earthquake	Pakistan	1
2005	October	Hurricane Wilma	US	2
2006	October	Flash flood in Japan	Japan	1
2007	October-November	California Wildfire	US	1
2008	June	Flooding in Iowa	US	1
2008	August-September	Hurricane Gustav	US	1
2008	September	Hurricane Ike	US	1
2010	January	Haiti earthquake	Haiti	1
2011	February	Cyclone Yasi	Australia	1
2011	March	Great East Japan Earthquake	Japan	3
–	–	Not specific		2
Total		27 events	9 countries	69 articles

Table 3 is a summary of articles related to medication loss and interruption of care listed by evacuees, condition type and population based studies and lists chronologically the type of disaster, study method, sample and sample size for this systematic review where relevant. There are three sections within Table 3 and within each section there is an account of the outcome of each report relating to medication loss, medication unavailability and not having an adequate supply.

Table 3

Table 3. Summary of articles related to medication loss and interruption of care listed by evacuees, condition type and population based studies

Articles listed by author and year of publication	Disaster	Type of research	Sample type (size-n)	Outcome
Table 3A Evacuees				
Fowler, 2005 [12]	Kosovo crisis	Qualitative analysis	Key informants involved in the evacuation (17)	One of the critical challenges in providing healthcare was lack of medical records and tuberculosis test results.
Brodie, 2006 [13]	Hurricane Katrina	Evacuees-based survey	Randomly-selected individuals (580)	32% did not have the prescription medicines they needed.
CDC, 2006 [14]	Hurricane Katrina	Shelters-based survey	Head of household (106)	42.7% had gone without medications at some point in the two weeks since the hurricane.
Ridenour, 2007 [16]	Hurricane Katrina	Shelters-based survey	Convenience sample of adults (323)	The most common need was dental care (57%), followed by eye glasses (34%), dentures (28%), and medical services (25%).
Greenough, 2008 [15]	Hurricane Katrina	Shelters-based survey	Cluster sample (499)	At least 48.4% had arrived at shelters without medications.
Lamb, 2008 [58]	Hurricane Katrina	Case study	A patient (1)	A patient evacuated with a 4-day supply of medication and ran out on the 5th day.
Arrieta, 2009 [17]	Hurricane Katrina	Qualitative analysis	Health and social service providers (34)	Medication procurement was the most frequent mentioned challenge to chronic disease management. Many patients arrived at a new provider facility without their prescriptions and with inadequate knowledge of their medical histories or medication names and dosages.
Jenkins, 2009 [7]	California Wildfire	Shelters-based survey	Households (161)	28.6% of households had at least 1 family member who had left their medication behind during evacuation.
Chan, 2010 [18]	Pakistan earthquake	Surveillance at internally displaced camps	Cluster sample of households (167)	The proportion of households that had no available drugs to manage their chronic medical conditions was 26% in official camps, 40% in larger rural unofficial camps and 86% in the smallest unofficial camp.
Tomio, 2010 [19]	Flash flood in Japan	Hospital-based survey	Outpatients (309)	62% brought medications with them but 23% of the evacuees who left medications experienced interruption of medication.
Table 3 B Patients with specific condition types				
Prezant, 2005 [26]	Blackout in New York	Hospital-based survey	Medical device-dependent patients (65)	Within the first 48 hours of the blackout there were 65 visits of which 56 visits were related to respiratory device failure and medication-related conditions such as the inability to find/reach medications or being unable to obtain tests to adjust medication.
Kamoi, 2006 [31]	Mid-Niigata Prefecture earthquake	Hospital-based survey	Diabetic patients (229)	66% of diabetic patients had to discontinue the use of insulin pens immediately after the disaster due to the loss of their medication or the device.
Kleinpetar, 2006 [74]	Hurricane Katrina	Review	Patients taking peritoneal dialysis (N.A.)	Most patients were evacuated with only about 1 week of peritoneal dialysis supplies.
Rudowitz, 2006 [22]	Hurricane Katrina	Report	Psychiatric patients (N.A.)	According to interviews by an insurance company, several bipolar and schizophrenic patients endured weeks without their prescriptions, which resulted in some individuals inflicting self-harm.
Clark, 2007 [24]	Hurricane Katrina	Hospital-based survey	Outpatients with HIV (175)	63% had a treatment interruption of more than 1 week, of these 62% reported running out of medication as the major reason for the interruption. Of the 48 patients taking pain relief medication, 56% ran out after 2 days and 64% believed they went through withdrawal symptoms.
Rath, 2007 [26]	Hurricane Katrina	Clinic-based survey	Convenience sample of paediatric outpatients (531)	19.7% of paediatric outpatients ran out of medications following the hurricane.
Platz, 2007 [27]	Hurricanes Charley, Frances, and Jeanne	Hospital-based survey	Patients visiting Level I trauma centres (5,148)	Within 3 days of the hurricanes, there was an increase in the number patients presenting at hospitals because of loss of power leading to lack of oxygen supplies and home haemodialysis.
Wang, 2008 [23]	Hurricane Katrina	Population-based survey	Randomly-selected individuals (1,043)	Among those with pre-existing mental disorders, 10.2% reported reduced treatment and 12.7% terminated treatment following the hurricane. Of these, 12.2-16.7% reported that services were unavailable.
Krousel-Wood, 2008 [8]	Hurricane Katrina	Clinic-based survey	Hypertensive outpatients (210)	7% did not bring medications, and 26% ran out of medications.
Potash, 2009 [25]	Hurricane Katrina	Clinic-based survey	Veterans taking pain treatment (42)	2 out of 42 (4.8%) ran out of pain relief medication briefly, one of whom experienced symptoms of sustained depressed mood and severe auditory hallucinations.
Kishimoto, 2012 [30]	Great East Japan Earthquake	Review	Diabetic patients (N.A.)	Many patients had lost their medication records, and the medical team had no idea what treatments they had received before the disaster.
Johnson, 2013 [21]	Cyclone Yasi	Report	Dialysis patients (N.A.)	Most of the patients evacuated from Cairns to Brisbane and arrived without personal identification, medications or medical information.
Sato, 2013 [29]	Great East Japan Earthquake	Prefecture-wide survey	Oxygen-dependent patients (1,106)	4.2% ran out of oxygen before oxygen cylinders were delivered.
Table 3 C Population based studies				
Bay/eyegri, 2006 [32]	Hurricane Ivan	Population-based survey	Cluster sample of residents (210)	10% had problems in obtaining medication 1 week after the hurricane.
CDC, 2006 [35]	Hurricane Katrina	Household-based survey	Randomly-selected Households (200)	34% of the households had a member who needed medical care at the time of the interview, and 29% of the households reported having a member who would require a prescription refill within 3 days.
CDC, 2006 [33]	Hurricane Wilma	Population-based survey	Randomly-selected Households (306)	Six (4%) of 150 households reported that a household member had been unable to obtain needed medical care.
Kessler, 2007 [36]	Hurricane Katrina	Population-based survey	Randomly-sampled English-speaking adults (1,043)	Probability of treatment disruption amongst patients with chronic conditions was 3.0% for those with musculoskeletal conditions and 15.3% for those with oncological therapy for cancer. The reason for disrupted treatment was attributed by 52.5% to the limited access to medication.
Cherniack, 2008 [34]	Hurricane Wilma	Hospital-based survey	Geriatric outpatients (547)	3.4% of ambulatory patients and 6.7% of clinic-visiting patients missed medications following the hurricane.
Quintisk, 2011 [37]	Flooding in Iowa	Population-based survey	Randomly selected households (214)	18.3% of urban households and 16.2% of rural households reported that at least one individual lacked access to a 3-day supply of prescription medications.

Table 3A Evacuees

A significant proportion of evacuees from, or residents at, disaster areas lost their medication.

In the first study chronologically, Fowler et al.,¹² reported from interviews with humanitarian workers involved in the evacuation after the Kosovo crisis in 1999, which revealed that one of the critical challenges in providing healthcare was the lack of medical records and tuberculosis (TB) test results. From the six studies involving Hurricane Katrina it is possible to determine that a major proportion of people did not have adequate medication supplies, an issue identified in five of these papers. In three studies the percentage of those without medication were identified, namely 32% by Brodie et al.¹³; 42.7% by CDC¹⁴ and 48.4% by Greenough et al.¹⁵. In addition the questionnaire-based survey amongst evacuees who arrived at a family assistance centre two weeks after Hurricane Katrina revealed that the 42.7% had run out of their medications even when they brought them¹⁴. In another study Ridenour et al.,¹⁶ reported that, from a convenience sample of 323 adults, 57% of people required dental care, 34% eye glasses, 28% denture and 25% medical services. In the final paper in this category from Hurricane Katrina, Arrieta et al.¹⁷ reported that medication procurement was the most frequent mentioned challenge to chronic disease management and that ‘*many patients arrived at a new provider facility without their prescriptions and with inadequate knowledge of their medical histories or medication names and dosages*’.

The remaining publications in this section related to a Californian wildfire, the Bam earthquake and flash floods in Japan. Data from California showed that patients did not have their medications with them during evacuation for one family member in 28.6% of households⁷. Information from a cluster sample of households following the Bam earthquake reported that 25% of people in official camps, 40% in larger rural unofficial camps and 85% in the smallest unofficial camp had no available drugs to manage their chronic medical conditions¹⁸. After the flash floods in Japan in 2006, 48% of the evacuees left their medication and 88% left their prescription records behind¹⁹.

Table 3B Patients with specific condition types

In this section, the focus was on people with specific medical conditions and availability of continued medication treatment following an extreme event. Eight articles focussed on hurricanes in the USA, seven were related to Hurricane Katrina and one article covered the impact of three consecutive hurricanes in Florida. Other articles in this section covered a power outage in New York, earthquakes in Japan and a cyclone in Queensland, Australia.

Following Hurricane Katrina evacuees on peritoneal dialysis were asked to bring with them approximately 1 week supply of personal medical supplies²⁰; however, some dialysis patients evacuated from Cairns to Brisbane during cyclone Yasi arrived without personal identification, medications or medical information²¹.

Mental health impact reports following Hurricane Katrina showed that some psychiatric patients inflicted self-harm as a result of not having prescriptions filled²². A telephone interview with randomly-selected English-speaking adult Katrina survivors in New Orleans, Alabama, Louisiana, and Mississippi indicated that 21.3% had a pre-existing mental disorder, of whom 10.2% had reduced, and 12.7% terminated, their treatment because of the hurricane²³.

Again from Hurricane Katrina reports, treatment interruption occurred for more than 1 week for 53% of people with HIV, of which 82% reported the interruption being due to their medication running out, further, 48 patients from this study who were taking pain relief medication 56% ran out after 2 days and 54% believed they were going through withdrawal symptoms²⁴. In another study, Potash et al.²⁵ reported that 4.8% of people ran out of their pain relief medication which caused one person to

experience severe side effects from not having this medication. Rath et al. ²⁶ reported that 19.7% of paediatric outpatients ran out of medications, while 7% of patients with hypertension did not bring their medication with them and 28% ran out of their supply ⁸.

In Florida following the three Hurricanes of Charley, Frances and Jeanne there was an increase in the number patients presenting at hospitals because of loss of power leading to lack of oxygen supplies and home haemodialysis ²⁷.

During the New York blackout, within 48 hours the Emergency Department of Montefiore Medical Center reported that 56 out of 65 visits were related to respiratory device failure and that medication-related problems were due to people unable to find or reach medications or were unable to obtain tests needed to adjust medications such as warfarin ²⁸.

In Japan during the following the Great East Earthquake 4.2% of people ran out of oxygen before a new supply of oxygen cylinders could be delivered ²⁹. Kishimoto and Noda ³⁰ noted that many diabetic patients had lost their medication records, and the medical team could not determine what treatments they had received before the disaster. After the Mid-Niigata earthquake in Japan in 2004, hospital-based survey reported that 65% of patients with type 1 diabetes with insulin therapy were unable to continue the use of insulin pens due to medication loss immediately after the earthquake ³¹.

Table 3C Population based studies

In this section six reports focus on groups of people and their medication treatment in the USA following Hurricanes Ivan, Katrina and Wilma and the flooding in state of Iowa.

Bayleyegn et al. ³² reported that 10% of a cluster sample of 210 people had problems obtaining medication 1 week following Hurricane Ivan. After Hurricane Wilma, six (4%) of 150 households surveyed, reported that a household member had been unable to obtain needed medical care ³³ and Cherniack et al. ³⁴ reported that 10.1% of patients missed medications after the hurricane. Following Hurricane Katrina surveys showed that 34% of the households had a member who needed medical care at the time of the interview, and who would require a prescription refill within 3 days ³⁵. Kessler et al. ³⁶ noted that treatment was disrupted for patients with musculoskeletal conditions (3.0%) and those with oncological conditions (15.3%) and that 32.5% attributed this disruption to the limited access to medication.

Following the floods in Iowa, 18.3% of urban households and 16.2% of rural households reported that at least one individual lacked access to a 3-day supply of prescription medications ³⁷.

Table 4

Table 4. Summary of articles reporting on prescription refills, by study type.

Articles listed by author and year of publication	Disaster	Type of research	No. of patients	Outcome
Nufer, 2003 [69]	Hurricane Andrew Tropical Storm Allison	Medical record of relief team	712	Requests for medication refills accounted for 12.6% and 2.6% of complaints following hurricane Andrew and tropical storm Allison, respectively.
Nufer, 2004 [68]	Hurricane Andrew Hurricane Iniki	Medical record of relief team	259	Medication refill shared 12.6% and 8.7% of chief complaints in Andrew and Iniki, respectively, and 6.7% and 3.5% of diagnoses.
Post, 2003 [42]	El Salvador earthquakes	Report	NA	One of the most popular services offered by the US Army Reserve hospital unit was the dispensing of 1,500 pairs of eyeglasses
CDC, 2006 [14]	Hurricane Katrina	Clinic-based survey	124	12.9% of ED visits were for medication refill
Gavagan, 2006 [41]	Hurricane Katrina	Clinic-based survey	11,245	2700 prescriptions were refilled on day 3 and 4.
Millin, 2006 [50]	Hurricane Katrina	Clinic-based survey	501	20.6% of all visits were for medication refills
Nufer, 2006 [62]	Hurricanes Andrew Hurricane Iniki Northridge earthquake Tropical Storm Allison	Medical record of relief team	2,255	Records showed that 6.8% of patients seeking care attended requested medication refills.
Partridge, 2006 [70]	Typhoon Sudal	Clinic-based survey	163	1 patient's final diagnosis was 'medication refill'
Gnauck, 2007 [66]	Hurricanes Andrew Hurricane Iniki Northridge earthquake Tropical Storm Allison	Medical record of relief team	643 children and 1553 adults	Medication refills were requested for 1.9% paediatric patients and 5.4% adults.
Irvin, 2007 [38]	Hurricane Katrina	Clinic-based survey	716	641 out of 716 patients requested medical evaluation, of which 80% required prescriptions
Krol, 2007 [64]	Hurricane Katrina	Clinic-based survey	1205	12.6% of visits were for pharmacy needs, which included requests for medication refills.
Pierce, 2007 [39]	Hurricanes Katrina and Rita	Shelter-based survey	198	44% required prescription refill
Taylor, 2007 [71]	Hurricane Wilma	Medical record of relief team	3,218	17% of all visits were for medication refills
Cookson, 2008 [67]	Hurricane Katrina	Hospital-based survey	174 before and 151 after the event	Many evacuees had to leave needed medications behind, which increased their risk for chronic disease exacerbations
Howe, 2008 [85]	Hurricane Katrina	Clinic-based survey	465	20.8% requested medication refills
North, 2008 [63]	Hurricane Katrina	Medical record of relief team	421	28.3% of patients' problems were related to the need for medication refill
Post, 2008 [40]	Hurricane Katrina	Medical record of relief team	6,563	Medication refill was ranked third of 'immediate health needs' following 'doctor' and 'dentist' requests
Sharma, 2008 [61]	Hurricane Katrina	Community-wide survey	21,673	7.2% of the visits were related to requests for medication refills
Broz, 2009 [65]	Hurricane Katrina	Interview with relief team staff	33	most of the patients attended primary care settings; specifically for prescription medications and care for chronic conditions
Jenkins, 2009 [51]	Hurricane Katrina	Clinic-based survey	31,272	18.5% of the visits were for medication refills. 3,356 items of durable medical equipment (e.g. glasses, dentures, etc.) were also dispensed
Krieg, 2009 [73]	Bam earthquake	Clinic-based survey	16,677	4.37% patients with chronic diseases attended for care at the emergency response unit
Bloem, 2013 [44]	Haiti earthquake	Activity report	N.D.	The health care team treated many chronic disease exacerbations (eg. hypertension, diabetes, congestive heart failure, asthma, and chronic obstructive pulmonary disease) brought about by lack of medication and regular care
Noe, 2013 [72]	Hurricane Gustav Hurricane Ike	Medical record of relief team	5,602	Medication refill requests were 5.0% of the total attendances

Table 4 is a summary of articles reporting on prescription refills, by study type and lists chronologically the disaster, type of research, number of patients and the relevant outcome from each study.

Twenty-three articles described patients coming to field clinics or emergency hospitals for prescription refills. In each article listed, where available, the frequency of refill request percentage by study is documented. Details of some of the studies and their most relevant findings are summarised briefly below:

- After Hurricanes Katrina and Rita, 88 out of 198 evacuees (44%) at one shelter required a prescription refill ^{38,39}; according to a rapid needs assessment among the Katrina evacuees, medication refill was ranked third in terms of 'immediate health needs' following 'doctor' and 'dentist' ⁴⁰.
- Gavagan et al. ⁴¹ reported on the post Hurricane Katrina evacuation complex in the Houston Astrodome. They found that chronic disease problems or medication refills prompted most adult visits to the clinic and that these refill requests were the fourth most common health and health related issue identified. Of note they showed that obtaining prescriptions for narcotic pain relief medication or refills of implanted narcotic and baclofen pumps proved difficult.
- Medications are not limited to orally-taken pills – after the earthquake in El Salvador in 2001, one of the most popular services offered by the US Army Reserve hospital unit was the dispensing of 1,600 pairs of eyeglasses ⁴² and the loss and breakage of eyeglasses was also identified as an issue by Sareen and Shoaf ⁴³ following the Northridge earthquake
- Following the Haiti earthquake a health care team survey showed that many chronic disease exacerbations (eg, hypertension, diabetes, congestive heart failure, asthma, and chronic obstructive pulmonary disease) were brought about by lack of medication and regular care ⁴⁴.

Table 5

Table 5. Examples of the range of medical needs following post disaster evacuation

Routine medications
E.g. prescription medications for hypertension, diabetes, etc. See Table 4 for references.
Medical records
List of medications (Clark et al., 2007; Kamoi et al., 2006; Kishimoto and Noda, 2012; Krousel-Wood, 2009; Lach et al., 2005)
Medication logs (e.g. chemotherapy) (Imamura and Ueno, 2011)
Laboratory data (e.g. Tuberculosis test results, CD4 ⁺ T-cell counts for HIV patients) (Fowler et al., 2005)
Allergy information (Fung and Loke, 2010)
Style and serial numbers of the devices (e.g. pacemakers) (Lach et al., 2005)
Devices for specific care
Devices for insulin delivery (e.g. needles, glucose-sensor, cartridge) (Jenkins et al., 2009b; Kamoi et al., 2006; Miller and Arquilla, 2008)
Nebulizer machines (Jenkins et al., 2009b)
CPAP machines (Jenkins et al., 2009b)
Power generator / automobile with inverter for electrical device (Tanaka, 2013)
Oxygen cylinders/concentrators (Jenkins et al., 2009b)
Canned nutritional supplements for the tube feedings (Mace et al., 2010)
Devices for daily life
Glasses (Lach et al., 2005; Sakashita et al., 2013)
Hearing aids (Lach et al., 2005)
Canes (Jenkins et al., 2009b)
Walkers (Jenkins et al., 2009b)
Wheel chairs (Lach et al., 2005)
Dentures (Lach et al., 2005; Sareen and Shoaf, 2000)
Emergency medications
e.g. potassium-binding resin for patients taking dialysis (Foster et al., 2011; Millin et al., 2006)
Over-the-counter (OTC) medications
Painkillers/medication for fever (Fung and Loke, 2010)
Anti-histamine agents (Fung and Loke, 2010)
Others
Personal identifier for those who cannot speak (Andersson et al., 2006)
Medication opening devices for those with hand disabilities (Mori et al., 2007)

The most challenging part to bringing medication is ensuring a patient carries the full range of medication they need, including medical records, emergency drugs and life-support devices. Examples of the range of medications required following a disaster and evacuation was drawn from the reviewed articles, and is summarised in Table 5.

Medical records are critical in some situations, such as CD4 cell count and HIV RNA levels for HIV patients²⁴ medication logs for cancer patients⁴⁵ and Tb test results¹². Even for other patients, medical records including allergy to medications^{24,30,31,46,47} are essential. For patients with specific medical devices such as pacemakers, style and serial numbers of the devices is important⁴⁷. It is recommended that individuals keep a list of these essential items, which should be reviewed updated periodically⁴⁶ and the list preferably kept in wallet or purse, which is likely to be brought along during an emergency⁴⁸.

Prescriptions specific to emergency situations should also be considered for each patient. For example, dialysis patients need to bring a potassium-exchanging resin, which is essential to reduce the potassium level when the access to dialysis is limited^{49,50}. Devices for insulin injection (vials, needles or pens with replaceable cartridges of insulin)³¹, gluco-metres^{4,31,51}, fluids and devices for peritoneal dialysis,²⁰ nebuliser machines, CPAP machines, oxygen cylinders,⁵¹ batteries for aspirators and artificial ventilators⁵², suctioning and tube feedings, and canned nutritional supplements for the tube feedings⁵³ should also be considered as part of the emergency pack for patients to bring. For the families with children who are dependent on technology and electrical devices, it seems more difficult to prepare for all the life-supporting equipment required, such as power generator or car/vans that can be used to generate electricity⁵⁴.

Supportive tools for daily life, such as wheel chairs, hearing aids⁴⁷, canes, walkers,⁵¹ dentures, glasses^{43,47}, extra batteries for wheelchairs and other assistive devices, and incontinence briefs for the elderly⁴⁷ are often lost at the time of evacuation. For those who cannot speak, bringing a personal identifier is also critical⁵⁵. Over-the-counter medicines, such as medication for fever or pain, anti-histamine for allergy, denture adhesive, and sanitary products are also important when access to pharmacies are disrupted⁵⁶. For those with hand disabilities, openers for the medications are also an essential item⁵⁷.

Discussion

This systematic review revealed that a considerable number of patients lose their medication during evacuation. As a result, medication refill is an immediate health need, making the prescription of medications for pre-existing conditions an increasing burden of medical relief activities at a time when acute needs are also over-whelming. At the current time, preparedness with respect to medications for disasters is not fully appreciated nor given much attention by those requiring daily and constant medication; meaning that a large number of patients facing extreme events could have avoided prescription interruption had they not lost their medication and or medical devices. Until individuals, with the assistance of their healthcare providers, undertake preparative actions, those organising relief activities need to be prepared to cope with emerging treatment alongside the management of chronic illnesses, including medication refills and devices.

The discussion is presented by a) the impact of medication loss and interruption of care, b) the impact of prescription refill post disaster and c) the value of effective preparation actions.

a) The impact of medication loss and interruption of care

Studies from developed countries show that the impact of medication loss and interruption of care can be a significant issue. From the results above, it is possible to demonstrate that surveys targeting paediatric patients in New Orleans after Hurricane Katrina revealed that 33.9% of evacuated children with pre-existing chronic conditions ran out of medication;²⁶ as a result, 58.4% experienced at least one disruption to care. In a questionnaire-based survey of geriatric patients visiting a hospital in Florida one year after Hurricane Wilma, 3.4%-6.7% reported that they had missed medication within two weeks of the event³⁴. Some studies found that although some people brought their medication with them upon evacuation, they had only brought enough supply for a limited period⁵⁸. After Hurricane Ivan in 2004, 10% of households in most affected counties had problem obtaining medication one week after the storm, thus bringing sufficient supply may have been difficult³². After the Great East Japan Earthquake and the following tsunamis in 2011, many evacuees had no time to gather their belongings. Some of them were treated with unique medication, such as immunosuppressants, which were not obtainable at the disaster area. As a result, these patients had to stop their medication for weeks knowing that their medical conditions would deteriorate⁵⁹.

The problem regarding medication loss is not limited to developed countries. Among the internally-displaced population from the 2005 Pakistan earthquake, 85% of the households in small unofficial camps had no available drugs to manage their chronic medical conditions. After the Haiti earthquake in 2010, a relief team reported treating many women for chronic disease exacerbations brought about by lack of medication and/or regular care ⁴⁴.

Some articles reported medication by specific chronic condition, which showed that the level of preparation may vary by conditions. People with mental illness are also at high risk of medication interruption ^{23,1}.

Examples of loss of medication lists and medical devices were identified as medical and life-support devices are as important as technological tools like haemodialysis and oxygen. A questionnaire conducted on the evacuees two weeks after Hurricane Katrina revealed that medical services were only the fourth most commonly reported medical need. The most common was dental care (57% of the respondents), followed by eyeglasses (34%) and dentures (28%). Other devices needed were hearing aids, canes, wheel-chairs, and walkers ¹⁶.

b) The impact of prescription refill post-disaster

The high prevalence of the need of prescriptions becomes a burden on medical teams at the disaster area which was identified in Table 4. For example, an analysis of survey data after Hurricane Katrina revealed 7.2% of the patients visiting emergency treatment facilities within 2 months of the hurricane were attending for medication refill ⁶¹.

Looking at the timeline of health needs following a disaster, the proportion of medication refills does not appear to change between the early and late stage of the relief activities. For example, according to a retrospective review on the patients seen by a Disaster Medical Assistance Team during four extreme events in New Mexico, US, the proportion of the patients visiting for medication refill was 6.0% within 7 days from the events and 7.6% after 7 days ⁶². Even for specialty care, medication refill often shares a significant part of relief activities. After Katrina, of 421 patients who were seen by mental health professionals, 119 (28.3%) were attending for medication refill ⁶³.

Despite medication refills being a common need among the disasters studied, the proportions of patients coming to health facilities for medication refill vary within and between events. For example 20.9% in a Louisiana clinic site two weeks after the event, ⁵⁰, within 2 months 20.8% in a temporary clinic in New Orleans ²⁴, 12.6% in the mobile medical units within 3 weeks, ⁶⁴ and 48% in medical units in Chicago between 1-4 weeks after the event. ⁶⁵

Additionally, a comparison between disasters suggested the burden differs depending on the scale and types of the disasters ⁶⁶ For example, Cookson et al. ⁶⁷ reported that non-significant increases were seen with medication refill request after the Katrina. In other cases, the proportion requiring medication refill was reported to be 3.5-3.6% after the Hurricane Iniki in 1992 ^{66,68}, 6.7%-10.0% after the Hurricane Andrew in 1992 ^{66,68}, 1.3-3.7% after Tropical Storm Allison in 2001, ^{66,69} 0.6% after Typhoon Sudal in Micronesia in 2004 ⁷⁰, 7% after the Hurricane Wilma in 2005, ⁷¹ and 4.8-7.1% after Hurricanes Gustav and Ike in 2008 ⁷². Another example from the Bam Earthquake in Iran in 2003 showed that the management of 'chronic disease under treatment' when measured required only 4.37% of the tasks of the emergency response unit. ⁷³

c) The value of effective preparation actions

Although the main scope of the review was to identify patients' reactions relating to bringing their medications during a disaster, several implications for effective preparedness were identified.

Twelve articles described possible effective preparation actions for patients. Having a personal

stockpile is recommended in many articles, though the recommended personal stockpile ranges from 3–4 days^{20,74} to 1 month⁷⁵. In a survey study conducted in California, US, the proportion of those who had a 2-week supply of medication ranged from 60.1% among non-veteran women to 81.9% among veteran men⁷⁶. It was customary in India for pregnant women (81.1% reported) to have individual stockpile of their routine medications⁷⁷.

However, just keeping extra doses of medication stockpiled is likely to have limited impact. In a hospital-based survey study targeting evacuated outpatients from the Japanese flash flood in 2005, keeping a personal stockpile did not increase the likelihood of bringing medications to the evacuated sites¹⁹. On the other hand, those who had prepared an emergency pack were 5.7 times more likely to bring medications to the evacuated sites¹⁹. Therefore, the researchers recommended that the stockpile is packed in a bag for easy access. Even so, the compliance for making an emergency pack seems to be low. For example, 63% of the haemodialysis patients in California had a 2-week supply of medicines but only 31% stored the items in an emergency pack.⁴⁹ In a study targeting patients with rheumatoid arthritis in Japan, 46% reported they had a personal stockpile of their medications but only 25% had packed an emergency bag⁷⁸. Other researchers reported that although 82.8% of households with children had stocked common medication for fever or pain for 3 days, only 60.6% kept a first aid box and only 14.6% thought they would take their medications during evacuation⁵⁶.

Carrying medications at all time^{58,78,79} or keeping extra medication in multiple places, such as schools and offices⁸⁰, are described as the most robust and effective emergency plan for patients. However, low compliance with this action has been reported. Among the rheumatoid arthritis patients in Japan, only 53% of those who had a personal stockpile carried their medication all the time⁷⁸. Among HIV patients, 33% of patients did not have individual health cards at the time of interview, potentially making the provision of therapy to these patients difficult^{19,79}.

Although having a personal stockpile is recommended by the Centres for Disease Control and Prevention (CDC) and the American Red Cross⁸¹, our review implies that just having a personal stockpile might not be effective⁷⁸. Many onsite workers recommend patients should have an emergency bag. For example, a station manager at The Hampshire Fire & Rescue Service in the United Kingdom (UK) remembered: 'after fires, many people had to go back to their home to get medications and medical devices they need.' He said that if communities can be educated in advance they will be able to prepare an emergency 'grab bag' containing vital personal items such as prescription medicines and medical devices and glasses/contact lenses, and suggests that this increases the likelihood of bring medicines/devices during a disaster⁸².

To achieve patients' preparedness, healthcare professionals play an essential role in establishing effective emergency planning for patients.

- First of all, they should provide patients with medications and other resources sufficient for disaster preparedness as well as up-to-date medical records.³⁰ A successful case study can be taken from the time of the election violence in Kenya⁷⁹, during which the dispensing of greater quantities of prescriptions were protective against treatment interruption among HIV patients.⁷⁹
- Secondly, health professionals have a responsibility to educate patients about the potential health impacts of medication interruption, and can emphasise that bringing medication and medical records may be the only way to enable them to continue normal care in an emergency.
- Thirdly, they must help patients to design an individualised and practical emergency plan that takes in to account patient-specific barriers such as forgetfulness,⁵⁸ side effects⁸, and allergy⁸³. In addition, they can help train patients in practices of safe storing medicines and packing necessary medical devices⁷⁵: the medication and medical devices in the emergency pack should be effectively protected from contamination by toxins from flood waters⁸⁴ or mechanical damage

by an earthquake ⁴³.

- Fourthly, in disasters for which there is some advance warning, such as hurricanes, health professionals may make contact with patients when a disaster alert has been made, reminding them to bring their medication and medical records when they evacuate ^{58,74}.
- Finally, and most importantly, front-line public health workers and the members of rescue teams should have adequate medication for their own medical conditions to sustain them for the duration of their rescue efforts during a disaster ^{56,85}.

Other stakeholders, such as policy makers and researchers, should also coordinate around patients' emergency planning (Figure 2). Recently, an increasing effort has been made by national and local governments in several countries to encourage patients to prepare an emergency bag. For example, in the UK, the National Health Service provides discharged patients with a carry bag ('green bag') for their medications to encourage patients to bring their medication in emergency situations ⁸², which is applicable to the time of evacuation. In the US, the CDC and American Red Cross raised 'gather emergency supplies' as the first step for emergency preparedness ^{85,86}.

Figure 2 Recommendations from this review on how community members can prevent medication losses**Fig. 2: Recommendations on how community members can prevent medication losses**

Even so, evidence is still weak with regard to preparedness actions by patients and the efficacy of intervention to encourage preparation. Researchers should be actively involved in disaster plans to leverage the preparedness among patients. For example, health impacts caused by loss of medication should be assessed using feasible and standardised methods to enable targeted aid following a disaster. Baseline data should also be measured and made available to appropriate agencies, including the burden of chronic diseases in each community ^{87,88}, health care disparities ⁸⁹, vulnerable populations for whom preparedness is a challenge ⁹⁰, preparedness of general or specific groups of people ^{34,37} as well as factors that affect emergency preparedness ⁹¹. Intensive research following disasters is also critical, and should include rapid health needs assessment among the evacuees, ^{37,61} health impact assessment including medication adherence ⁹², and evaluation of the efficacy of preparedness actions ⁹⁰ to inform future planning and preparation.

The key findings and recommendations are summarised in Box 1.

- 1. Bringing medication is the key to:**
 - i. Continuity of care
 - ii. Health emergency risk reduction and improving emergency risk management
- 2. Preparedness actions include:**
 - i. Having a personal stockpile
 - ii. Making a personal or household emergency kit
 - iii. Having a full list of medicines and medical devices
 - iv. Periodical review of emergency personal or household plans
- 3. All the stakeholders should be involved, they include:**
 - i. Patients
 - ii. Healthcare professionals
 - iii. Policy makers
 - iv. Researchers
- 4. Further research should:**
 - i. Further assess health impact of medication loss
 - ii. Evaluate programs for DRR and DRM preparedness
 - iii. Further Identify vulnerable populations
 - iv. Evaluate any programs on disaster driven evacuation and access to personal medication, to assess effectiveness if implemented

Box 1. Summary of key findings

DRR – disaster risk reduction; DRM – disaster risk management

Limitations

The most significant limitation of this study is lack of comparative data. There is no standardised way of measuring the impact of bringing medication at evacuation. Most frequently, survey is conducted on convenience samples, which makes it hard to generalise beyond that particular population. After a disaster, obtaining quality data is challenging due to the flow of evacuees and temporary nature of their status, lack of personnel, and ethical concerns accompanying the conduct of research on suffering people. Simple, unobtrusive and feasible approaches of monitoring preparedness and health outcomes should be carefully designed and established before disasters occur, especially in those regions subject to frequent disasters.

Another limitation is publication bias; most of the relevant articles were from the US, and a large proportion specifically focused on hurricane Katrina. Whether the issue of medication loss is less a problem in developing countries or simply less frequently studied and/or published is not clear. There is a clear need for evidence from all over the world, and from the most marginalised, thus rarely reported, populations.

This research does not focus on longer term crises, such as drought or political and economic failures, in which restoration of healthcare provision may take many months⁵. In such disasters, other issues may predominate, and preparing and bringing a stockpile of medication/medical devices may not be the best solution.

Conclusion

To achieve patients' preparedness, healthcare professionals play an essential role in establishing effective emergency planning for patients should provide patients with medications and other resources sufficient for disaster preparedness as well as up-to-date medical records. Health professionals have a responsibility to educate patients about the potential health impacts of medication interruption, emphasising that bringing medication and medical records may be the only way to enable them to continue normal care in an emergency. They must help patients to design an individualised and practical emergency plan that takes in to account patient-specific barriers such as forgetfulness. In disasters for which there is some advance warning, such as hurricanes, health professionals may make contact with patients reminding them to bring their medication and medical records when they evacuate. Front-line public health workers and the members of rescue teams should have adequate medication for their own medical conditions to sustain them for the duration of their rescue efforts during a disaster.

People may survive the initial disaster but if they are not educated or appropriately prepared in particular when medication is involved they may not survive the aftermath.

Appendix 1

PRISMA Checklist

[Download PDF](#)

References

1. WHO (2011) Global status report on noncommunicable diseases 2010. Geneva, Switzerland: World Health Organization.

[REFERENCE LINK](#)

2. Murray CJ, Lopez AD. Alternative projections of mortality and disability by cause 1990-2020: Global Burden of Disease Study. *Lancet*. 1997 May 24;349(9064):1498-504. PubMed PMID:9167458.
3. Chan EY, Kim J. Chronic health needs immediately after natural disasters in middle-income countries: the case of the 2008 Sichuan, China earthquake. *Eur J Emerg Med*. 2011 Apr;18(2):111-4. PubMed PMID:20679898.
4. Miller AC, Arquilla B. Chronic diseases and natural hazards: impact of disasters on diabetic, renal, and cardiac patients. *Prehosp Disaster Med*. 2008 Mar-Apr;23(2):185-94. PubMed PMID:18557300.
5. Veenstra N, Whiteside A, Laloo D, Gibbs A. Unplanned antiretroviral treatment interruptions in southern Africa: how should we be managing these? *Global Health*. 2010 Mar 31;6:4. PubMed PMID:20356383.
6. Murakami H, Akashi H, Noda S, Mizoue T, Okazaki O, Ouchi Y, Okaji Y, Kajiwara C, Miyoshi C. A cross-sectional survey of blood pressure of a coastal city's resident victims of the 2011 Tohoku tsunami. *Am J Hypertens*. 2013 Jun;26(6):799-807. PubMed PMID:23455946.
7. Jenkins JL, Hsu EB, Sauer LM, Hsieh YH, Kirsch TD. Prevalence of Unmet Health Care needs and description of health care-seeking behavior among displaced people after the 2007 California wildfires. *Disaster Med Public Health Prep*. 2009 Jun;3(2 Suppl):S24-8. PubMed PMID:19491584.
8. Krousel-Wood MA, Islam T, Muntner P, Stanley E, Phillips A, Webber LS, Frohlich ED, Re RN. Medication adherence in older clinic patients with hypertension after Hurricane Katrina: implications for clinical practice and disaster management. *Am J Med Sci*. 2008 Aug;336(2):99-104. PubMed PMID:18703901.
9. Ochi S, Murray V, Hodgson S. The great East Japan earthquake disaster: a compilation of published literature on health needs and relief activities, march 2011-september 2012. *PLoS Curr*. 2013 May 13;5. PubMed PMID:23787732.
10. Cabinet Office GoJ (2012) Report on the Great East Japan earthquake related to mortality (title translated 東日本大震災等に係る状況). 18th Subpanels on medical affairs, Social Security Council. Tokyo: Cabinet Office, Government of Japan.

[REFERENCE LINK](#)

11. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med*. 2009 Aug 18;151(4):264-9, W64. PubMed PMID:19622511.
12. Fowler N, Redwood-Campbell L, Molinaro E, Howard M, Kaczorowski J, Jafarpour M, Robinson S. The 1999 international emergency humanitarian evacuation of the Kosovars to Canada: A qualitative study of service providers' perspectives at the international, national and local levels. *Int J Equity Health*. 2005 Jan 12;4(1):1. PubMed PMID:15647108.
13. Brodie M, Weltzien E, Altman D, Blendon RJ, Benson JM. Experiences of hurricane Katrina evacuees in Houston shelters: implications for future planning. *Am J Public Health*. 2006 Aug;96(8):1402-8. PubMed PMID:16571686.
14. Illness surveillance and rapid needs assessment among Hurricane Katrina evacuees--Colorado, September 1-23, 2005. *MMWR Morb Mortal Wkly Rep*. 2006 Mar 10;55(9):244-7. PubMed PMID:16528233.
15. Greenough PG, Lappi MD, Hsu EB, Fink S, Hsieh YH, Vu A, Heaton C, Kirsch TD. Burden of disease and health status among Hurricane Katrina-displaced persons in shelters: a population-

based cluster sample. *Ann Emerg Med*. 2008 Apr;51(4):426-32. PubMed PMID:17583378.

16. Ridenour ML, Cummings KJ, Sinclair JR, Bixler D. Displacement of the underserved: medical needs of Hurricane Katrina evacuees in West Virginia. *J Health Care Poor Underserved*. 2007 May;18(2):369-81. PubMed PMID:17483565.

17. Arrieta MI, Foreman RD, Crook ED, Icenogle ML. Providing continuity of care for chronic diseases in the aftermath of Katrina: from field experience to policy recommendations. *Disaster Med Public Health Prep*. 2009 Oct;3(3):174-82. PubMed PMID:19865042.

18. Chan EY, Kim JJ (2010) Characteristics and health outcomes of internally displaced population in unofficial rural self-settled camps after the 2005 Kashmir, Pakistan earthquake. *Eur J Emerg Med* 17: 136-141.

19. Tomio J, Sato H, Mizumura H (2010) Interruption of medication among outpatients with chronic conditions after a flood. *Prehosp Disaster Med* 25: 42-50.

20. Kleinpeter MA, Norman LD, Krane NK (2006) Disaster planning for peritoneal dialysis programs. *Advances in peritoneal dialysis Conference on Peritoneal Dialysis* 22: 124-129.

21. Johnson DW, Hayes B, Gray NA, Hawley C, Hole J, et al. (2013) Renal services disaster planning: Lessons learnt from the 2011 Queensland floods and North Queensland cyclone experiences.

22. Rudowitz R, Rowland D, Shartz A (2006) Health care in New Orleans before and after Hurricane Katrina. *Health Aff (Millwood)* 25: w393-406.

23. Wang PS, Gruber MJ, Powers RE, Schoenbaum M, Speier AH, et al. (2008) Disruption of existing mental health treatments and failure to initiate new treatment after Hurricane Katrina. *The American Journal of Psychiatry* 165: 34-41.

24. Clark RA, Mirabelli R, Shafe J, Broyles S, Besch L, et al. (2007) The New Orleans HIV outpatient program patient experience with Hurricane Katrina. *The Journal of the Louisiana State Medical Society : official organ of the Louisiana State Medical Society* 159: 276, 278-279, 281.

25. Potash MN, West JA, Corrigan S, Keyes MD (2009) Pain management after Hurricane Katrina: outcomes of veterans enrolled in a New Orleans VA pain management program. *Pain Med* 10: 440-446.

26. Rath B, Donato J, Duggan A, Perrin K, Bronfin DR, et al. (2007) Adverse health outcomes after Hurricane Katrina among children and adolescents with chronic conditions. *Journal of health care for the poor and underserved* 18: 405-417.

27. Platz E, Cooper HP, Silvestri S, Siebert CF (2007) The impact of a series of hurricanes on the visits to two central Florida Emergency Departments. *Journal of Emergency Medicine* 33: 39-46.

28. Prezant DJ, Clair J, Belyaev S, Alleyne D, Banauch GI, et al. (2005) Effects of the August 2003 blackout on the New York City healthcare delivery system: a lesson for disaster preparedness. *Crit Care Med* 33: S96-101.

29. Sato K, Morita R, Tsukamoto K, Sato N, Sasaki Y, et al. (2013) Questionnaire survey on the continuity of home oxygen therapy after a disaster with power outages. *Respir Investig* 51: 9-16.

30. Kishimoto M, Noda M (2012) The Great East Japan Earthquake: Experiences and Suggestions for Survivors with Diabetes (perspective). *PLoS Curr* 4: e4facf9d99b997.

31. Kamoi K, Tanaka M, Ikarashi T, Miyakoshi M (2006) Effect of the 2004 Mid Niigata Prefecture earthquake on glycemic control in type 1 diabetic patients. *Diabetes research and clinical practice* 74:

141-147.

32. Bayleyegn T, Wolkin A, Oberst K, Young S, Sanchez C, et al. (2006) Rapid assessment of the needs and health status in Santa Rosa and Escambia Counties, Florida, after Hurricane Ivan, September 2004. *Disaster Management and Response* 4: 12-18.
33. Rapid needs assessment of two rural communities after Hurricane Wilma--Hendry County, Florida, November 1-2, 2005. *MMWR Morb Mortal Wkly Rep.* 2006 Apr 21;55(15):429-31. PubMed PMID:16628183.
34. Cherniack EP, Sandals L, Brooks L, Mintzer MJ (2008) Trial of a survey instrument to establish the hurricane preparedness of and medical impact on a vulnerable, older population. *Prehosp Disaster Med* 23: 242-249.
35. Rapid community needs assessment after Hurricane Katrina--Hancock County, Mississippi, September 14-15, 2005. *MMWR Morb Mortal Wkly Rep.* 2006 Mar 10;55(9):234-6. PubMed PMID:16528229.
36. Kessler RC, Wang PS, Kendrick D, Lurie N, Springgate B (2007) Hurricane Katrina's impact on the care of survivors with chronic medical conditions. *Journal of General Internal Medicine* 22: 1225-1230.
37. Quinlisk P, Jones MJ, Bostick NA, Walsh LE, Curtiss R, et al. (2011) Results of rapid needs assessments in rural and urban Iowa following large-scale flooding events in 2008. *Disaster Med Public Health Prep* 5: 287-292.
38. Irvin CB, Atas JG (2007) Management of evacuee surge from a disaster area: solutions to avoid non-emergent, emergency department visits. *Prehosp Disaster Med* 22: 220-223.
39. Pierce JR, Jr., Pittard AE, West TA, Richardson JM (2007) Medical response to hurricanes Katrina and Rita: local public health preparedness in action. *J Public Health Manag Pract* 13: 441-446.
40. Post DE, Kasofsky JM, Hunte CN, Diaz JH (2008) A regional human services authority's rapid needs assessment of evacuees following natural disasters. *American journal of disaster medicine* 3: 253-264.
41. Gavagan TF, Smart K, Palacio H, Dyer C, Greenberg S, et al. (2006) Hurricane Katrina: Medical response at the Houston astrodome/reliant center complex. *Southern medical journal* 99: 933-939.
42. Post JC, Melendez ME, Hershey DN, Hakim A (2003) Lessons learned from a successful MEDRETE in El Salvador. *Mil Med* 168: 287-292.
43. Sareen H, Shoaf KI (2000) Impact of the 1994 Northridge earthquake on the utilization and difficulties associated with prescription medications and health aids. *Prehosp Disaster Med* 15: 173-180.
44. Bloem CM, Miller AC (2013) Disasters and women's health: Reflections from the 2010 earthquake in Haiti. *Prehospital and Disaster Medicine* 28: 150-154.
45. Imamura CK, Ueno NT (2011) How can we address cancer care after a natural disaster? *Nature Reviews Clinical Oncology* 8: 387-388.
46. Krousel-Wood MA (2009) Moving beyond the katrina crisis: from danger to opportunity overview of key lessons learned for better disaster preparedness from the american journal of the medicine sciences third post-katrina anniversary symposium issue. *Ochsner J* 9: 60-62.
47. Lach HW, Langan JC, James DC (2005) Disaster planning: are gerontological nurses prepared?

Journal of gerontological nursing 31: 21-27.

48. Banks L (2013) Caring for elderly adults during disasters: improving health outcomes and recovery. *Southern medical journal* 106: 94-98.

49. Foster M, Brice JH, Shofer F, Principe S, Dewalt D, et al. (2011) Personal disaster preparedness of dialysis patients in North Carolina. *Clin J Am Soc Nephrol* 6: 2478-2484.

50. Millin MG, Jenkins JL, Kirsch T (2006) A comparative analysis of two external health care disaster responses following Hurricane Katrina. *Prehospital Emergency Care* 10: 451-456.

51. Jenkins JL, McCarthy M, Kelen G, Sauer LM, Kirsch T (2009b) Changes needed in the care for sheltered persons: a multistate analysis from Hurricane Katrina. *American journal of disaster medicine* 4: 101-106.

52. Tanaka S (2013) Issues in the support and disaster preparedness of severely disabled children in affected areas. *Brain & development* 35: 209-213.

53. Mace SE, Sharieff G, Bern A, Benjamin L, Burbulys D, et al. (2010) Pediatric issues in disaster management, part 3: special healthcare needs patients and mental health issues. *American journal of disaster medicine* 5: 261-274.

54. Sakashita K, Matthews WJ, Yamamoto LG (2013) Disaster preparedness for technology and electricity-dependent children and youth with special health care needs. *Clinical pediatrics* 52: 549-556.

55. Andersson HC, Narumanchi TC, Cunningham A, Bowdish B, Thoene J (2006) Genetic/metabolic health care delivery during and after hurricanes Katrina and Rita. *Mol Genet Metab* 88: 3-6.

56. Fung OW, Loke AY (2010) Disaster preparedness of families with young children in Hong Kong. *Scand J Public Health* 38: 880-888.

57. Mori K, Ugai K, Nonami Y, Kirimura T, Kondo C, et al. (2007) Health Needs of Patients With Chronic Diseases Who Lived Through the Great Hanshin Earthquake. *Disaster Management and Response* 5: 8-13.

58. Lamb KV, O'Brien C, Fenza PJ (2008) Elders at risk during disasters. *Home healthcare nurse* 26: 30-38; quiz 39-3840.

59. Nagamatsu S, Maekawa T, Ujike Y, Hashimoto S, Fuke N, et al. (2011) The earthquake and tsunami--observations by Japanese physicians since the 11 March catastrophe. *Crit Care* 15: 167.

60. Connelly M (2006) IMERT deployment to Baton Rouge, Louisiana in response to Hurricane Katrina, September 2005. *Disaster Manag Response* 4: 4-11.

61. Sharma AJ, Weiss EC, Young SL, Stephens K, Ratard R, et al. (2008) Chronic disease and related conditions at emergency treatment facilities in the New Orleans area after Hurricane Katrina. *Disaster Med Public Health Prep* 2: 27-32.

62. Nufer KE, Wilson-Ramirez G, Shah MB, Hughes CE, Crandall CS (2006) Analysis of patients treated during four Disaster Medical Assistance Team deployments. *J Emerg Med* 30: 183-187.

63. North CS, King RV, Fowler RL, Polatin P, Smith RP, et al. (2008) Psychiatric disorders among transported Hurricane evacuees: Acute-phase findings in a large receiving shelter site. *Psychiatric Annals* 38: 104-113.

64. Krol DM, Redlener M, Shapiro A, Wajnberg A (2007) A mobile medical care approach targeting

underserved populations in post-Hurricane Katrina Mississippi. *Journal of health care for the poor and underserved* 18: 331-340.

65. Broz D, Levin EC, Mucha AP, Pelzel D, Wong W, et al. (2009) Lessons learned from Chicago's emergency response to mass evacuations caused by Hurricane Katrina. *American Journal of Public Health* 99: 1496-1504.

66. Gnauck KA, Nufer KE, LaValley JM, Crandall CS, Craig FW, et al. (2007) Do pediatric and adult disaster victims differ? A descriptive analysis of clinical encounters from four natural disaster DMAT deployments. *Prehospital and disaster medicine : the official journal of the National Association of EMS Physicians and the World Association for Emergency and Disaster Medicine in association with the Acute Care Foundation* 22: 67-73.

67. Cookson ST, Soetebier K, Murray EL, Fajardo GC, Hanzlick R, et al. (2008) Internet-based morbidity and mortality surveillance among Hurricane Katrina evacuees in Georgia. *Prev Chronic Dis* 5: A133.

68. Nufer KE, Wilson-Ramirez G (2004) A comparison of patient needs following two hurricanes. *Prehospital and disaster medicine : the official journal of the National Association of EMS Physicians and the World Association for Emergency and Disaster Medicine in association with the Acute Care Foundation* 19: 146-149.

69. Nufer KE, Wilson-Ramirez G, Crandall CS (2003) Different medical needs between hurricane and flood victims. *Wilderness and Environmental Medicine* 14: 89-93.

70. Partridge R, King K, Proano L (2006) Medical support for emergency relief workers after typhoon Sudal in Yap, Micronesia. *Prehospital and disaster medicine : the official journal of the National Association of EMS Physicians and the World Association for Emergency and Disaster Medicine in association with the Acute Care Foundation* 21: 215-219.

71. Taylor MM, Stokes WS, Bajuscak R, Serdula M, Siegel KL, et al. (2007) Mobilizing mobile medical units for hurricane relief: The United States Public Health Service and Broward County Health Department response to hurricane Wilma, Broward County, Florida. *Journal of Public Health Management and Practice* 13: 447-452.

72. Noe RS, Schnall AH, Wolkin AF, Podgornik MN, Wood AD, et al. (2013) Disaster-related injuries and illnesses treated by American Red Cross disaster health services during Hurricanes Gustav and Ike. *Southern medical journal* 106: 102-108.

73. Krieg CM, Gardemann J (2009) A record of morbidity and medical request profiles in international humanitarian aid, taking the earthquake in Bam in Iran in 2003 as an example. *Journal of Public Health* 17: 97-106.

74. Kleinpeter MA, Norman LD, Krane NK (2006a) Dialysis services in the hurricane-affected areas in 2005: lessons learned. *Am J Med Sci* 332: 259-263.

75. Arrieta MI, Foreman RD, Crook ED, Icenogle ML (2008) Insuring continuity of care for chronic disease patients after a disaster: key preparedness elements. *The American Journal of the Medical Sciences* 336: 128-133.

76. Heslin KC, Gin JL, Afable MK, Ricci K, Dobalian A (2013) Personal medication preparedness among veteran and nonveteran men and women in the California population. *Prehosp Disaster Med* 28: 359-366.

77. Adhikari A, Biswas S, Gupta RK (2011) A study on habit of preservation of prescriptions by

pregnant women in India. *Nepal Med Coll J* 13: 17-19.

78. Tomio J, Sato H, Mizumura H (2012) Disparity in disaster preparedness among rheumatoid arthritis patients with various general health, functional, and disability conditions. *Environ Health Prev Med* 17: 322-331.

79. Bamrah S, Mbithi A, Mermin JH, Boo T, Bunnell RE, et al. (2013) The impact of post-election violence on HIV and other clinical services and on mental health-Kenya, 2008. *Prehosp Disaster Med* 28: 43-51.

80. Kishimoto M, Noda M (2013) Diabetes care: After the Great East Japan Earthquake. *Journal of Diabetes Investigation* 4: 97-102.

81. Cross AR (2013) Get a survival kit.

82. Blackpool (2011) Green Bag campaign urges patients to take their own medicines when admitted into Blackpool hospital.: NHS Foundation Trust.

83. Feret B, Bratberg J (2008) Pharmacist-based intervention to prepare residents of assisted-living facilities for emergencies. *J Am Pharm Assoc* (2003) 48: 780-783.

84. Velazquez L, Dallas S, Rose L, Evans KS, Saville R, et al. (2006) A PHS pharmacist team's response to Hurricane Katrina. *Am J Health Syst Pharm* 63: 1332-1335.

85. Howe E, Victor D, Price EG (2008) Chief complaints, diagnoses, and medications prescribed seven weeks post-Katrina in New Orleans. *Prehosp Disaster Med* 23: 41-47.

86. CDC Emergency Preparedness and You. CDC.

87. Allweiss P, Albright A (2011) Diabetes, disasters and decisions. *Diabetes Management* 1: 369-377.

88. Ford ES, Mokdad AH, Link MW, Garvin WS, McGuire LC, et al. (2006) Chronic disease in health emergencies: in the eye of the hurricane. *Prev Chronic Dis* 3: A46.

89. Davis MV, MacDonald PD, Cline JS, Baker EL (2007) Evaluation of public health response to hurricanes finds North Carolina better prepared for public health emergencies. *Public health reports* (Washington, DC: 1974) 122: 17-26.

90. Frumkin H (2011) Bumps on the road to preparedness. *Am J Prev Med* 40: 272-273.

91. Ablah E, Konda K, Kelley CL (2009) Factors predicting individual emergency preparedness: A multi-state analysis of 2006 BRFSS data. *Biosecurity and Bioterrorism* 7: 317-330.

92. Islam T, Muntner P, Webber LS, Morisky DE, Krousel-Wood MA (2008) Cohort study of medication adherence in older adults (CoSMO): extended effects of Hurricane Katrina on medication adherence among older adults. *Am J Med Sci* 336: 105-110.