



# Diabetes and Disasters: Recent Studies and Resources for Preparedness

Pamela Allweiss<sup>1</sup>

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## Abstract

**Purpose of Review** Studies have shown that disasters may exacerbate the comorbidities in vulnerable populations such as those with a pre-existing chronic medical condition like diabetes. This article highlights recent studies that look at the impact of disasters on people with diabetes and also shows recent resources for consumers, health care providers, and policy makers to improve resiliency in people with diabetes.

**Recent Findings** Recent articles have looked at the short-term impact of disasters upon people with diabetes and its comorbidities such as Hurricane Sandy in 2012, the triple disaster of 2011 in Japan (earthquake, tsunami, and nuclear accident), and the 2016 Kumamoto earthquake in Japan as well as the long-term impact of disasters such as Hurricane Katrina in 2005.

**Summary** Several public and private partners have used the past and recent findings to develop resources that help consumers with diabetes and the people who care for them, prepare for a disaster BEFORE the event.

**Keywords** Disaster preparedness · Emergency preparedness · Diabetes · Manmade and natural disasters · Disasters and chronic conditions

## Background and Introduction

There is a worldwide epidemic of diabetes; thus, a larger number of people living with diabetes who may be affected by disasters. The International Diabetes Federation (IDF) estimates that in 2017, approximately 425 million adults (aged 20–79 years) were living with diabetes, and by 2045, this will rise to 629 million worldwide. The IDF estimates that four million people living with diabetes are displaced as a result of man-made and natural disasters [1].

There are many aspects of disasters that need to be considered: type, size, nature of the affected area, duration of the disaster, people's experience with such disasters, local infrastructure, and socioeconomic situation. Post-disaster, there is limited access to the basic necessities of life like water, food,

and shelter. For instance, some people may need to shelter in place. Others may be evacuated to shelters. Limited access to healthy food options, opportunities for physical activity, medicine, supplies, and medical care may occur. Pharmacies and medical clinics may be closed.

Past studies have shown short-term and long-term exacerbations of diabetes and its comorbidities during and post-disasters. Increased emergency room visits and hospitalizations for acute complications such as hypoglycemia and hyperglycemia (which may lead to diabetic ketoacidosis in people with type 1 diabetes), and foot infections have been reported [2–7]. Studies done in Japan, post-Hanshin earthquake [8]), and in Louisiana, post-Hurricane Katrina [9–13] showed elevation of A1c levels in people for several months post-event.

Limited access to medications and supplies has been a problem. The medications may have been destroyed, people may not have extra supplies even for a few days, people at shelters may not have a list of their medications, and shelters may not have the same medications. Increased collaboration among pharmacists, health plans, insurers, and physicians, pre-, during, and post-disaster may help [14].

Emergency preparedness planners and responders also have many tools to assess the damage in affected areas. A

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✉ Pamela Allweiss

<sup>1</sup> Lexington, Kentucky, USA

study after Hurricane Charlie in Florida suggested that the need of medication for chronic conditions should be made earlier in the assessment process (first few days vs. the current 10–14-day post-disaster) so that replacement medications may be obtained [15]. Knowing the prevalence of major chronic conditions and the medication of the community before an event may be helpful in aiding preparedness and stockpiling certain medications [16, 17].

Some studies recommended the development of more educational resources for consumers (those with diabetes and their caregivers) and health care providers (primary care/diabetes care providers and emergency preparedness providers) about the specific needs of people with diabetes pre, during, and post a disaster [5, 7, 9, 12]. A module on preparedness may be included in diabetes self-management education. Many health care providers in the primary care and diabetes specialty have limited knowledge about preparedness issues. Many first responders have limited knowledge about the management of diabetes. Both workforces need to be trained. In fact, Sphere, a global humanitarian preparedness agency, added a set of humanitarian standards in 2012 that addressed the needs of people with chronic conditions in disasters. <https://spherestandards.org/addressing-chronic-conditions-in-disasters/>.

Everything is local and assessments of the community's prevalence of diabetes and established partners in diabetes care may help emergency preparedness planners [5, 7, 9, 12]. These partners may include the following: the Centers for Disease Control and Prevention (CDC) supported state diabetes control and prevention team, local Medical Reserve Corps members, local chapters of the American Diabetes Association (ADA), American Association of Diabetes Educators (AADE), and American Association of Clinical Endocrinologists (AACE). These organizations and others have developed resources for consumers and providers in response to the needs [18].

## Recent Studies on the Impact of Disasters on People with Diabetes

Studies looking at the impact of recent disasters on people with diabetes have substantiated some of the findings of past reports and looked at attitudes about preparedness planning. A recent systematic review of health effects of storms and floods reported an increase of diabetes-related complications post-events. These included an increase in A1c levels and an increase in the number of evaluations for diabetic foot infections [19••]. Other recent studies have looked at the long-term impact of past events like Hurricane Katrina on adults and children.

## Hurricane Katrina

One study looked at the long-term effects of disasters on health care utilization of older adults post-Hurricane Katrina. The authors examined Medicare claims and enrollment data from 2002 to 2004 (pre-Katrina) and 2006–2008 (post-Katrina) in areas severely affected by Katrina as well as in nearby areas not as severely affected by Katrina. They compared the proportion of individuals with pre-existing diabetes who received a diabetes-related screen before and after Katrina. The utilization rates in the 2002–2004 period were similar in both groups. The 2006–2008 utilization rates were generally lower for the groups of people from the areas most severely affected by Katrina. For instance, those directly affected by Hurricane Katrina were less likely to obtain cholesterol screenings for the 3 years following the storm. The authors conclude that medical care providers need to stay vigilant and ensure people affected by a disaster do not experience disruptions in their preventive care screenings even a few years post-event [20].

Another recent study examined the longer term impact of Hurricane Katrina on children with diabetes who were displaced by the storm. The authors analyzed individual-level enrollment and utilization data of children with diabetes who were displaced from Louisiana and then enrolled in the Texas Medicaid Hurricane Katrina emergency waiver, a mechanism to provide short-term health insurance coverage to those affected by disasters. The clinical measures were as follows: A1C tests, eye exams, microalbumin tests, thyroid tests, and diabetic ketoacidosis. Children enrolled in the waiver program generally did not experience a decrease in care compared with those not enrolled in the program while the waiver program was in effect. After the waiver ended, however, there was a drop in care and an increase in complications compared with the control group. The authors concluded that future waivers may be improved by ensuring that enrollees continue to receive care after the waivers expire [21].

## Hurricane Sandy

Hurricane Sandy occurred in 2012 and affected an estimated 60 million people in 24 states in the eastern part of the USA. Two studies found an increase in post-disaster Emergency Department (ED) visits for a primary or secondary diagnosis of diabetes especially in adults aged 65 and older. The authors compared the patterns of ED use among adults with diabetes located in the highest level evacuation zone in New York City during the first week after Hurricane Sandy's landfall to utilization before the event. Information was collected from an all-payer claims database looking at the demographics, insurance status, and medical comorbidities of post-disaster ED patients with diabetes. The diagnoses included hypertension, possible complication from and follow-up of a recent procedure,

chronic skin ulcers, myocardial infarction, prescription refills, drug dependence, and dialysis. The authors concluded that there is a need to support adults with diabetes in the week after a disaster by ensuring access to medications, aftercare for patients who had a recent procedure, and to try to improve their cardiovascular health in order to reduce the risk of heart attacks [22•, 23].

Other recent studies have looked at attitudes about preparedness, medical needs, and access to care in the populations affected by Hurricane Sandy.

Burger et al. looked at ethnic differences in experiences, medical needs, and access to care after Hurricane Sandy in New Jersey's Federally Qualified Health Centers (FQHC). The clinic patients faced the same challenges reported in past disasters: lack of transportation, open health centers, medicines, and shelters. Twelve percent of people reported that they had diabetes. The prevalence of diabetes was highest in the African American population compared with Hispanic/Latino and Caucasian.

One of the recommended action steps was that the FQHC could educate the patients about being prepared pre-event such as giving clear information about evacuation vs. sheltering in place, and how to deal with their own medical needs such as having an appropriate disaster kit, and self-management skills [24].

Burger et al. also asked the affected populations about the overall personal impact of the storm, their specific concerns, if and when they evacuated, and their future preparedness plans. Knowledge about how people prepare for disasters could help to develop strategies to improve resiliency. Thirty-five percent of respondents were not going to prepare for an event but 65% planned on taking personal action to reduce their risk, including evacuating, seeking more information about preparedness, buying necessary supplies, and protecting their family. More Blacks and Hispanics planned on preparing than Whites (68% vs. 55%), and more Hispanics planned on evacuating compared with others. People who had problems getting to health centers or pharmacies were more likely to prepare than others. Some said that in the future, they would evacuate earlier and plan to have sufficient supplies to shelter in place.

Challenges noted in the Burger et al. study included the absence of suitable shelters that had adequate medicine and food for people with specific needs. Suggestions for emergency planners include providing more and better supplied shelters, providing better emergency transportation, backup electrical sources (such as generators), and a method of checking on seniors [25].

Heptulla et al. looked at the impact of Hurricane Sandy on children with type 1 diabetes. The study compared the emergency preparedness plans and post-traumatic stress effects of Hurricane Sandy in affected populations (New Jersey) with relatively unaffected populations (Bronx, NY). Data on demographics, glycemic control, insulin regimens, and socio-

economic status (SES) were collected. An assessment tool about preparedness called the Hurricane-Related Traumatic Experiences (HURTE) questionnaire was used to evaluate symptoms of post-traumatic stress. Ninety-five percent of families reported to be generally well to moderately prepared for the hurricane and 83% reported to be very well prepared with regard to their child's diabetes during the disaster. A measure of preparedness was the availability of a disaster supply kit that included 3-day supply of food, water and current prescriptions, and a first aid kit which included non-prescription treatments for common illnesses.

In the study by Heptulla et al., there was no difference between the sites for preparedness for the disaster based on age or gender. People in the affected area had greater psychological impact from the hurricane. Poor glycemic control was significantly associated with lower SES, but SES was not related to preparedness for diabetes management during the hurricane.

The American Academy of Pediatrics has emphasized the need for disaster preparedness as a priority. A positive finding in the Heptulla study was that many of the families were very prepared and had the items and skills necessary to care for a child with diabetes which include the following: wearing a medical alert bracelet, completion of diabetes education classes, maintenance of current blood glucose logs, possession of a glucagon emergency kit, at least 3-day supply of current prescriptions (insulin, insulin syringes/insulin pens and pen needles, glucose meter, glucose test strips, lancets and lancing device, and insulin pump supplies if using an insulin pump) and up to date immunizations. This may not reflect the preparedness levels of all families who have children with type 1 diabetes and certainly, more dissemination of this information would be helpful [26].

## Japan

### 3/2011 Disasters

In March 2011, there were 3 disasters in a row in Japan: The Great East Japan Earthquake, a tsunami, and the Fukushima Daiichi nuclear plant disaster. One study showed deterioration of glycemic control post-disasters. An increase in A1c levels was more common in urban residents compared with rural residents and in younger people compared with older people. Certainly, psychological stress also played a role in the deterioration of glycemic control [27, 28].

Two studies looked at the metabolic indicators in people who evacuated after the Fukushima nuclear plant disaster. The disasters forced the evacuation of a large number of residents and created changes in the evacuees' lifestyle leading to decreased physical activity, less availability of healthy foods, and subsequent weight gain. Satoh found that these changes may have affected the evacuees' glucose metabolism, which

contributed to an increase in the incidence of diabetes. Hasegawa found that the evacuees had a 1.3–1.6 times higher risk of dyslipidemia, diabetes mellitus, and being overweight compared with the non-evacuees in a prospective analysis [29, 30].

### Japan: Kumamoto Earthquake 2016

In April 2016, the Kumamoto area located on the island of Kyushu, southwest Japan, was severely damaged by several massive earthquakes. Kondo studied the effects of these earthquakes on glycemic control and stress factors, glycosylated hemoglobin, glycosylated albumin, and other biochemical parameters. A self-administered lifestyle-associated questionnaire and disaster-associated stress scores were analyzed. A total of 557 patients with diabetes were enrolled, and data were collected at 13 months before to 13 months after the earthquakes. An interesting pattern emerged. Glycemic control did not deteriorate in patients with type 1 diabetes due to self-management skills. In patients with type 2 diabetes, A1c values unexpectedly decreased at 1–2 months after the earthquakes. After 3–4 months or longer however, many patients with type 2 diabetes showed worsened glycemic control. Factors that contributed to these results a few months post disaster included: lack of antidiabetic agents, insufficient food supply, largely destroyed houses, changes in work environment, and mental and physical stress levels.

The article also discussed a tool and strategies developed after the 2011 Great East Japan Earthquake. The Japan Diabetes Society published a book titled *Diabetes Treatment Manual in the Situation of Disaster* in 2014. One recommendation was to develop a DiaMAT, a Diabetes Medical Assistance Team in advance. Indeed, the authors developed a team immediately after the event and offered diabetes disease management assistance to the affected populations and can serve as a model for other disasters [31].

**Hurricane Maria** Studies are just being done on the impact of Hurricane Maria in Puerto Rico in 2017. One study established that there were at least 1200 excess deaths due to the hurricane. About 16% were due to diabetes. Excess deaths were slightly higher among men than women and more common among people aged 60 years or older [32].

Another study looked at the medical and psychosocial needs of the population after Hurricane Maria. A community clinic in Puerto Rico, the Bantiox Clinic, was developed to serve the medical needs of an affected area in response to an urgent need for medical treatment of the community residents. Evaluations for hypertension, diabetes, and medication refills appeared to be the primary reasons for treatment [33].

## Conclusion

A recent article focused on the importance of addressing the key influences on successful self-management post-disaster for people with non-communicable diseases such as diabetes in disaster plans. The research found that key influencers on the ability to self-manage a chronic medical condition such as diabetes post-disaster were as follows: access to medication, medical services, water, treatment and care, power, and food. Accessing medication and medical services were priorities for all patients post-disaster [34, 35].

A key theme of the studies on the impact of recent and past disasters on people with diabetes has been that partnerships between the diabetes world and preparedness world need to be established before a disaster strikes. These partnerships can address the “key influencers” mentioned above and develop and disseminate resources. Educational resources for consumers to teach them about self-management and planning for disasters are essential. Collaboration among health care providers, emergency planners, and public and private entities can help increase resiliency of people with diabetes post-disaster.

Community-based partnerships can help address the needs of people pre-, during, and post-disaster and can aid recovery. Public and private partners like the Red Cross, universities, pharmacies, health departments, and professional organizations can collaborate on preparedness [36, 37, 38]. For example, Kentucky sponsored a continuing education program that featured experts from the state diabetes team and the state preparedness team.

Many resources have been developed for consumers and providers. Examples of some resources can be found in the [Appendix](#). Preparedness before an event is key.

## Compliance with Ethical Standards

**Conflict of Interest** The author declares that she has no conflict of interest.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

## Appendix: Examples of Resources

American Association of Clinical Endocrinologists <https://www.empoweryourhealth.org/sites/all/files/Diabetes-Emergency-Web-Download.pdf>

American Association of Diabetes Educators  
<https://www.diabeteseducator.org/docs/default-source/living-with-diabetes/tip-sheets/aade-disaster-planning-toolkit.pdf?sfvrsn=0>

<https://www.diabeteseducator.org/practice/educator-tools/app-resources/disaster-preparedness>

## American Diabetes Association

- <http://www.diabetes.org/living-with-diabetes/treatment-and-care/emergency-preparedness/>
- [http://main.diabetes.org/dorg/PDFs/emergency-preparedness/DDRCPatientPreparednessPlan2018Short.pdf?\\_ga=2.70347736.912672844.1565544259-902224453.1565544259](http://main.diabetes.org/dorg/PDFs/emergency-preparedness/DDRCPatientPreparednessPlan2018Short.pdf?_ga=2.70347736.912672844.1565544259-902224453.1565544259)
- <http://www.diabetes.org/assets/pdfs/living/emergency-preparedness/switching-between-insulin-1.pdf>
- American Diabetes Association Statement on Emergency and Disaster Preparedness: A report of the Disaster Response Task Force. *Diabetes Care* 2007;30(9):2395–8

## Australian Diabetes Educators Association

Diabetes and Natural Disasters Online Learning Module.

<https://static.diabetesaustralia.com.au/s/fileassets/diabetes-australia/e67a31ea-e2e5-4b56-95e5-06f05f224ebc.pdf>

Centers for Disease Control and Prevention

<https://www.cdc.gov/diabetes/ndep/people-with-diabetes/emergency.html>

Diabetes Disaster Response Coalition (DDRC) <https://www.diabetesdisasterresponse.org/our-vision>

Insulin for Life

<http://ifl-usa.org/>

Johns Hopkins Diabetes Guide: Disaster Emergency Preparedness in Diabetes

[https://www.hopkinsguides.com/hopkins/view/Johns\\_Hopkins\\_Diabetes\\_Guide/547203/all/Disaster\\_Emergency\\_Preparedness\\_in\\_Diabetes](https://www.hopkinsguides.com/hopkins/view/Johns_Hopkins_Diabetes_Guide/547203/all/Disaster_Emergency_Preparedness_in_Diabetes)

Katzki L. Disaster Preparedness and Diabetes. *Diabetes Self Management*. Published July 22, 2016 <https://www.diabetesselfmanagement.com/managing-diabetes/general-health-issues/disaster-preparedness-diabetes/>

HealthCare Ready

<https://www.healthcareready.org/>

HealthCare Ready has a program called Rx open that connects people with open pharmacies and also has resources about preparedness for people with chronic conditions. [https://www.healthcareready.org/system/cms/files/1555/files/original/20170331\\_Chronic\\_Care\\_Roundtable\\_-\\_Discussion\\_Slides.pdf](https://www.healthcareready.org/system/cms/files/1555/files/original/20170331_Chronic_Care_Roundtable_-_Discussion_Slides.pdf)

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- Of major importance

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