



HHS Public Access

Author manuscript

Health Aff (Millwood). Author manuscript; available in PMC 2021 December 01.

Published in final edited form as:

Health Aff (Millwood). 2020 December ; 39(12): 2136–2143.

Management Of Chronic Noncommunicable Diseases After Natural Disasters In The Caribbean: A Scoping Review

Saria Hassan [assistant professor],

Emory School of Medicine and Rollins School of Public Health, Emory University, in Atlanta, Georgia. At the time of manuscript submission, she was an instructor of internal medicine at the Yale School of Medicine, Yale University, in New Haven, Connecticut.

Mytien Nguyen [student],

MD/PhD program at the Yale School of Medicine.

Morgan Buchanan [student],

Department of Social and Behavioral Sciences at the Yale School of Public Health, Yale University.

Alyssa Grimshaw [clinical research and education librarian],

Clinical Information Services at Yale University.

Oswald P. Adams [dean],

Faculty of Medical Sciences at the University of the West Indies, Cave Hill, in Bridgetown, Barbados.

Trevor Hassell [president],

Healthy Caribbean Coalition, in Bridgetown, Barbados.

LaVerne Ragster [retired professor and president emerita],

University of the Virgin Islands, in St. Thomas, US Virgin Islands.

Marcella Nunez-Smith [associate professor of medicine]

Department of Internal Medicine and director of the Equity Research and Innovation Center, both at the Yale School of Medicine.

Abstract

Extreme weather events in the Caribbean region are becoming increasingly severe because of climate change. The region also has high rates of poorly controlled chronic noncommunicable diseases (NCDs), which were responsible for at least 30 percent of deaths after two recent hurricanes. We conducted a scoping review of literature published between 1974 and 2020 to understand the burden and management of chronic NCDs in the Caribbean after natural disasters. Of the twenty-nine articles included in this review, most described experiences related to Hurricanes Dorian (2019) and Irma and Maria (2017) and the Haiti earthquake (2010). Challenges included access to medication, acute care services, and appropriate food, as well as communication difficulties and reliance on ad hoc volunteers and outside aid. Mitigating these challenges requires different approaches, including makeshift points of medication dispensing,

disease surveillance systems, and chronic disease self-management education programs. Evidence is needed to inform policies to build resilient health systems and integrate NCD management into regional and national disaster preparedness and response plans.

In 2017 the Caribbean region was devastated by its deadliest and most costly hurricane season. Two category 5 storms—Hurricanes Irma and Maria—made landfall in September, bringing record-strength winds and waves to islands across the region. With more than 3,000 lives lost and \$280 billion in damage, it was a stark realization of the worsening impact of climate change.^{1,2}

This was not the first time in recent memory that the Caribbean had suffered a major natural disaster. A catastrophic earthquake in Haiti on January 12, 2010, resulted in the deaths of more than 220,000 people and displaced 2.3 million more. In November 2010 Hurricane Tomas tore through the western edge of Haiti, adding to the existing devastation.³ In September 2019 Hurricane Dorian became the strongest storm to hit the Bahamas, with estimated losses totaling \$3.4 billion.⁴ Unfortunately, severe weather events are expected to occur more frequently in many parts of the world, including the Caribbean, because of climate change.⁵

An often unrecognized health impact after natural disasters is the morbidity and mortality associated with deteriorating control of chronic noncommunicable diseases (NCDs). Two studies estimate that at least 30 percent of deaths after Irma and Maria were due to complications from NCDs such as diabetes, hypertension, cardiovascular disease, asthma, chronic obstructive pulmonary disease, and mental health disorders.^{6,7} This is especially troubling for the Caribbean region, which is experiencing an increasing burden of NCDs and has the highest rates of premature mortality due to NCDs in the Americas.⁸ In 2016, 76.8 percent of mortality in the non-Latin Caribbean and 71.3 percent in the Latin Caribbean were attributable to NCDs. In the non-Latin Caribbean, 30.8 percent of NCD deaths were due to cardiovascular disease, 17.2 percent to cancer, and 10.8 percent to diabetes. In the Latin Caribbean, these proportions were 33.1 percent, 16.2 percent, and 3.5 percent, respectively. In the Latin and non-Latin Caribbean regions, 43.6 percent and 38.1 percent of NCD deaths, respectively, occurred prematurely in people younger than age seventy.⁹

With more people living with NCDs in the Caribbean and the increased frequency of extreme weather events, it is imperative that the Caribbean islands develop efficient, sustainable, and evidence-based strategies to manage NCDs in the face of natural disasters.^{10–14} Small island developing states in the region face unique challenges because of their geographic isolation, which often delays assistance. Therefore, it is important to document what is known about the management of NCDs in the Caribbean after natural disasters and to identify lessons learned. This scoping review explores the burden and challenges of managing NCDs in the Caribbean region and identifies strategies to reduce the morbidity and mortality associated with these conditions in the context of disaster preparedness and recovery. We expect that these findings will be relevant to other parts of the world experiencing the combination of natural disasters and high prevalence of NCDs.

Study Data And Methods

PROTOCOL AND ELIGIBILITY CRITERIA

We performed a comprehensive literature review of peer-reviewed studies conducted in the Caribbean region that described the response to a natural disaster and addressed chronic disease management. We chose to conduct a scoping review because it enabled us to identify the nature and extent of research evidence using an approach that focused on assessing the breadth of documented research discovery regardless of the rigor of the research design in reporting that experience.¹⁵ We conducted the literature search using the Participants, Interventions, Comparators, Outcomes, Study Design (PICOS) model¹⁶ for evidence-based medical research questions, as shown in online appendix A.¹⁷

SEARCH STRATEGY AND STUDY SELECTION

We limited our search to a time frame between January 1974 and January 2020 to reflect the rise in NCDs in the region and to capture the most significant hurricanes of the past half-century. We searched for relevant articles on January 15, 2020, using the Cochrane Library, Ovid Embase, Ovid Global Health, Literatura Latino-Americana e do Caribe em Ciências da Saúde, Ovid MEDLINE, PubMed, Scopus, and Web of Science Core Collection databases. Given the paucity of studies in this area, we decided to include all types of research designs, including narrative descriptions and perspective pieces. Our review also captures NCDs across a wide age range by including studies about both adults and children.

Our search was designed to produce relevant literature according to three main themes: the Caribbean region, NCDs, and natural disasters. For the first, we considered all thirty-one Caribbean islands and common variants of their names. We explored the second by selecting articles related to the following NCDs: asthma, heart disease, stroke, heart failure, hypertension, diabetes, chronic kidney disease, and mental health disorders. Although cancer is considered an NCD, we excluded it from this scoping review because its management is very specific to the disorder, and most people with cancer who are receiving active treatment are advised to leave an island before an extreme weather event occurs. For the third, we used “natural disasters” as an all-encompassing term to describe six events: earthquakes, hurricanes, cyclones, typhoons, flooding, and volcanic eruptions. We note here that although earthquakes and volcanic eruptions are not classic climate-related extreme weather events, they cause similar disruptions in the health care system that affect people living with NCDs. Details of the search strategy for Ovid Embase are in appendix B.¹⁷

Our methods were guided by the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).¹⁸

DATA COLLECTION AND ANALYSIS

We collected citations identified by the search strategy and removed duplicates. The remaining titles and abstracts were uploaded to the Covidence systematic review platform. Two authors independently reviewed the titles and abstracts for potential relevance. Conflicts were resolved by a third author, and we obtained the full text for all articles retained. Two authors independently abstracted relevant data from each article that met the inclusion

criteria, including data on key study characteristics and findings relevant to our study objectives.

LIMITATIONS

This review had some important limitations. First, we identified a relatively small number of articles, the majority of which report on events in Haiti and Puerto Rico. Many were descriptive papers and perspective pieces with-out rigorous scientific methods, which limits the conclusions that can be drawn. Although the Caribbean islands share many similarities, it is difficult to generalize the nature of NCD management among all Caribbean nations and nation states, particularly in the context of natural disasters, where information and evidence-based reporting coming from the Caribbean are lacking in the peer-reviewed literature. Other systematic reviews from the region have similarly identified a handful of islands that report and publish much of the literature for the region.¹⁹

A second limitation is that we included extreme weather events that are not climate related, such as earthquakes. It is important to note that although the types of injuries, infectious disease risks, and magnitude of destruction may vary, the disruptions to the health care system remain similar to those resulting from climate-related events. This scoping review highlights those similarities as challenges to accessing health care providers, medication, nutritious food options, and mental health care. We can therefore draw from experiences with other disasters to inform our challenges and solutions.

Another limitation was the exclusion of cancer as one of the NCDs. The challenges encountered by people needing chemotherapy are different from those encountered by people with other NCDs, although there is a growing shift toward the use of oral chemotherapy. The need for treatment at cancer centers may warrant evacuation of people with cancer before an extreme weather event. Last, the review was limited to publications in English, which may have missed relevant articles in the French and Spanish literature.

Study Results

We identified 897 unique articles published between January 1974 and January 2020. After the initial screening, we excluded 821 articles from our study. We assessed the remaining seventy-six articles for eligibility, and of these, forty-seven were excluded (twenty-five were not related to NCDs, twenty were not conducted in a natural disaster setting, and two were duplicate studies with different titles). Three studies with only published abstracts were retained because of high relevance and interest. This process is depicted by the PRISMA flowsheet in appendix C.¹⁷ We thus abstracted twenty-nine articles in our scoping review.

STUDY CHARACTERISTICS

Most of the articles (76 percent) were qualitative or descriptive. Sixteen studies reported on Hurricanes Irma and Maria in Puerto Rico, and ten studies documented the 2010 Haiti earthquake. The most common NCDs discussed in these studies were diabetes ($n = 11$), cardiovascular diseases ($n = 9$), mental health disorders ($n = 6$), and asthma ($n = 5$) (exhibit 1). Only two studies focused on pediatric populations. A number of studies addressed

chronic disease generally or service delivery for NCDs specifically ($n = 10$). Appendix D provides information about each included study.¹⁷

NARRATIVE SYNTHESIS OF RESULTS FROM ABSTRACTED ARTICLES

BURDEN OF CHRONIC DISEASE: Studies describing the disaster response in the aftermath of the 2010 Haiti earthquake, as well as the 2017 and 2019 hurricanes, emphasized the of-ten-overlooked burden of chronic disease. Descriptions from just days after the earthquake in Haiti described the large health care–related needs of people with diabetes.^{20,21} Reports from Puerto Rico documented that the majority of deaths related to chronic disease after the 2017 hurricanes were due to heart disease and diabetes.⁷ There was also an increase in hospital admissions for asthma.^{22–26} Studies also highlighted the elderly population (over age sixty) as particularly vulnerable because of its higher prevalence of comorbid conditions, use of multiple medications, and limited mobility.^{27–32}

Several studies, even if not directly reporting on mental health disorders, reported on the effects of comorbid depression, anxiety, and posttraumatic stress disorder.^{33,34} The earthquake in Haiti also exacerbated cases of mental illness, particularly among children.³⁵ Other literature confirms that disasters may precipitate increases in the prevalence of mental health disorders and exacerbate subsyndromal mental health conditions.³⁶

CHALLENGES IN MANAGING CHRONIC DISEASES: The articles in our review suggest that challenges related to chronic disease management were due to disrupted health care systems and food insecurity. Disrupted health care systems resulted in limited access to medication, remote medical advice (for example, phone consultations, telehealth), and direct in-person visits with health care providers.^{23,30,37,38} Infrastructure challenges disrupted supply and cold chains for medication and insulin delivery.^{31,39} Complications from diabetes, high blood pressure, and heart and pulmonary conditions, as noted earlier, necessitate access to remote medical consultation or direct medical care.⁴⁰ Destroyed medical facilities, impassable roads, and telephone or internet outages are common after a disaster and severely limit access to care.⁴¹ People needing medical care are unable to reach providers by telephone, are unable to find out about where to obtain care, and have difficulty reaching a medical facility; known medical facilities may be destroyed and unable to provide services. Medical care access points—safe locations where people living with chronic disease can receive care and medication supplies—were described by some authors.^{37,41,42} However, limited communication about these services before the disaster and difficulties communicating this information postdisaster mean that few people know how to reach these access points.

Access to healthy food options is critical for maintaining proper control of common chronic diseases such as diabetes and hypertension. After the Haiti earthquake, 22.6 percent of house-holds reduced the size of their children’s meals.³⁵ In Puerto Rico, food packages that arrived as part of disaster relief efforts were not consistent with the Department of Agriculture’s Dietary Guidelines for Americans.⁴³ This led to higher-than-desirable salt, saturated fat, and added sugar intake, which exacerbated underlying chronic diseases.⁴³

There were widespread disruptions to health care systems and prolonged shortages of healthy food options in the Caribbean islands resulting from the reliance on relief organizations outside of the region for medical and food assistance.⁴⁴

STRATEGIES TO ADDRESS CHRONIC DISEASE MANAGEMENT

CHALLENGES: The literature identified several strategies for overcoming these challenges that we discuss broadly according to the following themes: ensuring access to medication, communicating medical information before and after the disaster, establishing a registry of medically vulnerable people, addressing mental health needs, and empowering people to self-manage their chronic conditions.

Strategies that address medication access included using a centralized pharmacy registry to stockpile frequently used medications, establishing and creating awareness about convenient medication distribution centers, using pharmacists to help dispense NCD medications at access points or evacuation shelters, and developing a list of alternative medications that could be used if patients are not able to fill their usual prescriptions.^{37,45–47}

Effective communication with people living with chronic diseases before a disaster can provide important information on how to obtain medical care and necessary supplies. This is also an important opportunity to educate people living with chronic diseases about ways to self-manage their conditions if mild exacerbation occurs to reduce the need for urgent medical care.^{20,39} After a disaster, landlines are often not working and power outages and cell tower destruction lead to varying degrees of cell phone and internet connectivity. When the internet is available, social media platforms are an effective means of disseminating critical information to large numbers of people living with chronic diseases. Radio-based communication is another way of reaching large numbers of people after a disaster.⁴⁶

It is also important to have robust disease surveillance systems in place that capture the type, burden, and distribution of disease to adequately and appropriately respond to the needs of those with NCDs.³¹ Having a registry of people with critical chronic diseases who can be contacted or physically reached when a disaster occurs can also be helpful.^{29,46,48}

Most articles underscored the importance of addressing the stress and mental health needs of all people who experience a natural disaster. This includes people with chronic diseases seeking care who are simultaneously traumatized and unable to care for themselves. Providers, who are responsible for delivering care, may also suffer losses or undergo other stressors from the disaster that may affect their mental health.^{47,49} Some suggestions include continuous mental health programming for children and community building to enhance social support.^{25,35} A stress reduction intervention after the Haiti earthquake was also shown to significantly improve systolic and diastolic blood pressures among people with hypertension, addressing both mental and physical health problems.⁴¹

Discussion

This review highlights the challenges of managing NCDs in the Caribbean region after natural disasters. We summarize the lessons learned and strategies to overcome these challenges. These solutions, although creative, have been ad hoc and spontaneous, led by

nongovernmental and relief organizations and not island governments. This indicates the need for additional data and evidence to inform national and regional policy to address NCD management during and after disasters in the region.

Addressing NCD needs in a disaster requires integrating NCD management into existing disaster preparedness and response plans. This scoping review provides some approaches that could be adopted to achieve such integration. Examples include establishing centralized medication dispensing points that are safe, known ahead of time, and run in coordination with evacuation shelters. Shelters can be staffed with pharmacists and other trained allied health professionals who can deliver basic NCD-related care. In addition, governments should establish or reinforce registries and surveillance systems that can track both pharmaceutical needs and high-risk people who could be proactively targeted for care, follow-up, or evacuation.⁵⁰ Government-led communication and public awareness campaigns about disaster preparedness and response should include information and resources specific to the needs of people with NCDs. These strategies must reach elderly people with chronic NCDs, who are among the most vulnerable.

The level of destruction associated with a hurricane or other extreme weather event can be severe, leaving no remaining infrastructure from which to launch a response. Coordinating relief efforts with these strategies in mind is critical to ensuring the effectiveness of aid organizations and response teams. Russell Andrews and Leonidas Quintana propose an integrated global response team that allows for optimal use of resources to improve response time and quality.⁵¹ To address these challenges, Caribbean islands could consider expanding existing regional response systems for disasters—where islands that are less severely affected lead and launch the disaster response for other islands—to include the necessary NCD management components. The idea of a regional response has already been initiated, with organizations such as the Caribbean Disaster Emergency Management Agency, the Pan American Health Organization, and the Caribbean Public Health Agency taking the lead. These organizations have an existing infrastructure that can readily integrate NCD management.⁵²

Another important regional political force is the Caribbean Community, which represents a group of twenty Caribbean countries advocating for greater economic and social integration throughout the Caribbean region. The Caribbean Community led the convening of the first United Nations high-level meeting on NCDs in 2011 and, more recently, has mobilized activity around climate change.⁵³ Specifically, the Caribbean Community's current areas of focus include agriculture, where they promote climate-smart agricultural technologies suitable for the region, and environment and sustainable development, where they continue to advocate for more ambitious limiting of greenhouse gas emissions and global warming to 1.5°C, given the significant impact on small island developing states.

Another concrete step in the direction of addressing NCDs at the regional level has been the Smart Health Care Facilities in the Caribbean project, funded by the UK Department for International Development.⁵⁴ The project's goal is to build hospitals that are not only more environmentally sustainable but are also disaster-resilient, thereby reducing the level of

disruption to the health care system. The project has now been implemented in Belize, Dominica, Grenada, Guyana, Jamaica, Saint Lucia, and Saint Vincent and the Grenadines.

The examples in this review area starting point and an impetus to generate additional evidence on a larger national or regional scale that takes the Caribbean context into account. Additional evidence-based strategies are needed to ensure that people living with NCDs know how to manage their conditions and get access to essential medications in an emergency. Likewise, training disaster response teams to manage NCDs exacerbated by extreme weather events is vital because of ongoing climate variability and change.

Addressing the mental health needs of disaster-affected populations and health care providers is also essential. Working closely with civil-society organizations provides an additional approach to engaging the general public with information on NCD self-management and how to address the mental health strain of experiencing a natural disaster.⁵⁵ Civil-society organizations in the Caribbean, such as the Healthy Caribbean Coalition, are able to reach many people with chronic disease and bring together other organizations serving this population.

Although this review focuses on the Caribbean region, other parts of the world are similarly affected by climate-related severe weather events and the rising prevalence of NCDs.¹⁴ The mainland US experience with Hurricanes Katrina, Harvey, Irma, and Maria resulted in similar challenges in terms of providing NCD-related care to vulnerable populations.^{14,56} We have seen similar reports from other high-income countries such as Australia.⁵⁷ Understanding this challenge is even more urgent in low- and middle-income countries. Seventy-five percent of deaths due to NCDs occur in such countries, where extreme weather events are also common.⁵⁸ In sub-Saharan Africa, severe droughts and floods are increasing in frequency.⁵⁹ Cyclone Idai in 2019 was a stark reminder of the threat of climate-related events in that region. In Mozambique, which was severely affected by the cyclone, the prevalence of hypertension in 2015 was estimated at 38.9 percent, providing a good example of how countries in sub-Saharan Africa experience the combined burden of NCDs and climate-related events.⁶⁰ Similarly, Cyclone Amphan in 2020 caused significant destruction in India and Bangladesh. In India, more than 60 percent of mortality in 2016 was due to NCDs.⁶¹

The challenge of managing NCDs in the setting of disasters in low- and middle-income countries, although not as widely reported, must be addressed. As a result, there have been calls at an international level to have NCD management integrated into disaster preparedness and response planning.^{12,57,62} Throughout this article we have summarized approaches to addressing the needs of people living with NCDs as part of a disaster response framework that could be equally applicable to other parts of the world.

Conclusion

With each passing year, as the climate crisis worsens, the Caribbean region braces itself for increasingly severe weather events combined with high rates of NCDs. This review highlights the challenges associated with managing NCDs in natural disaster settings. There

is an urgent need to develop, implement, and evaluate evidence-based strategies to inform policies to integrate NCD management into regional and national disaster preparedness and response plans.

Acknowledgments

Saria Hassan is supported by a grant from the National Heart, Lung, and Blood Institute (Grant No. 5K12HL138037). Mytien Nguyen was also supported by National Institutes of Health Grant No. T32 GM136651. Hassan and Marcella Nunez-Smith report receiving funding from the National Heart, Lung, and Blood Institute (Grant No. U54MD010711). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The authors also acknowledge the support of the Yale Institute for Global Health and the MacMillan Center for their support under the Hecht Global Health Faculty Network Award. They also thank the Yale Center for Climate Change and Health for their collaboration.

NOTES

1. Santos-Burgoa C, Sandberg J, Suárez E, Goldman-Hawes A, Zeger S, Garcia-Meza A, et al. Differential and persistent risk of excess mortality from Hurricane Maria in Puerto Rico: a time-series analysis. *Lancet Planet Health* 2018;2(11):e478–88. [PubMed: 30318387]
2. United Nations Office for the Coordination of Humanitarian Affairs. The Caribbean: hurricane season situation report no. 12 [Internet] New York (NY): OCHA; 2017 10 13 [cited 2020 Oct 14]. Available from: <https://reliefweb.int/report/dominica/caribbean-hurricane-season-situation-report-no-12-13-october-2017>
3. Desmarais D Report of the United Nations in Haiti 2020: situation, challenges, and outlook New York (NY): United Nations; 2010.
4. World Health Organization. Assessment of the effects and impacts of Hurricane Dorian in the Bahamas [Internet] Geneva: WHO; 2019 [cited 2020 Oct 14]. Available from: <https://reliefweb.int/sites/reliefweb.int/files/resources/EZSHARE-1256154360-486.pdf>
5. Reidmiller DR, Avery CW, Easterling DR, Kunkel KE, Lewis KLM, Maycock TK, Stewart BC, editors. Fourth National Climate Assessment, volume II: impacts, risks, and adaptation in the United States [Internet] Washington (DC): US Global Change Research Program; 2018 [cited 2020 Oct 27]. Available from: <https://nca2018.globalchange.gov/>
6. Issa A, Ramadugu K, Mulay P, Hamilton J, Siegel V, Harrison C, et al. Deaths related to Hurricane Irma—Florida, Georgia, and North Carolina, September 4–October 10, 2017. *MMWR Morb Mortal Wkly Rep* 2018;67(30):829–32. [PubMed: 30070979]
7. Cruz-Cano R, Mead EL. Causes of excess deaths in Puerto Rico after Hurricane Maria: a time-series estimation. *Am J Public Health* 2019;109(7):1050–2. [PubMed: 30998411]
8. Hassell T, Hennis A. Chronic disease challenges in the Caribbean. *Glob Heart* 2016;11(4):437–8. [PubMed: 27938834]
9. Pan American Health Organization. NCDs at a glance: NCD mortality and risk factor prevalence in the Americas [Internet] Washington (DC): PAHO; 2019 [cited 2020 Oct 27]. Available for download from: <https://iris.paho.org/handle/10665.2/51696>
10. Acevedo Mejia S Gone with the wind: estimating hurricane and climate change costs in the Caribbean [Internet] Washington (DC): International Monetary Fund; 2016 10 14 [cited 2020 Oct 27]. (IMF Working Paper No. 16/199). Available from: <https://www.imf.org/en/Publications/WP/Issues/2016/12/31/Gone-with-the-Wind-Estimating-Hurricane-and-Climate-Change-Costs-in-the-Caribbean-44333>
11. Burgess CP, Taylor MA, Spencer N, Jones J, Stephenson TS. Estimating damages from climate-related natural disasters for the Caribbean at 1.5°C and 2°C global warming above preindustrial levels. *Reg Environ Change* 2018;18(8):2297–312.
12. Field CB, Barros V, Stocker TF, Dahe Q, Dokken DJ, Ebi KL, et al., editors. Managing the risks of extreme events and disasters to advance climate change adaptation: special report of the Intergovernmental Panel on Climate Change [Internet] New York (NY): Cambridge University Press; 2012 [cited 2020 Oct 27]. Available from: https://www.ipcc.ch/site/assets/uploads/2018/03/SREX_Full_Report-1.pdf

13. Slama S, Kim H-J, Roglic G, Boulle P, Hering H, Varghese C, et al. Care of non-communicable diseases in emergencies. *Lancet* 2017; 389(10066):326–30. [PubMed: 27637675]
14. Horn RB, Kirsch TD. Disaster response 2.0: noncommunicable disease essential needs still unmet. *Am J Public Health* 2018;108(S3): S202–3. [PubMed: 30192662]
15. Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J* 2009;26(2): 91–108. [PubMed: 19490148]
16. Richardson WS, Wilson MC, Nishikawa J, Hayward RS. The well-built clinical question: a key to evidence-based decisions. *ACP J Club* 1995;123(3):A12–3.
17. To access the appendix, click on the Details tab of the article online.
18. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for Scoping Reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* 2018;169(7):467–73. [PubMed: 30178033]
19. Hassan S, Sobers N, Quimby K, Adams OP, Nunez-Smith M. Use of implementation science methods to address the management of non-communicable diseases in the Caribbean: a systematic review. Unpublished paper (Emory University; Atlanta, GA).
20. Mbanya JC. Global solidarity in a time of crisis: how IDF responded to the disaster in Haiti. *Diabetes Res Clin Pract* 2010;87(3):423–5. [PubMed: 20181404]
21. Satoh J, Yokono K, Ando R, Asakura T, Hanzawa K, Ishigaki Y, et al. Diabetes care providers' manual for disaster diabetes care. *J Diabetes Investig* 2019;10(4):1118–42.
22. Velazquez V, Pena C, Bosques L. Changes in the number of pediatric asthmatic patients to PICU admissions after a natural disaster. *Ann Allergy Asthma Immunol* 2019; 123(5, Suppl):S44.
23. van Dorn A Extreme weather in 2017: time to take climate change seriously. *Lancet Respir Med* 2017;5(12):934. [PubMed: 29185420]
24. Leus X, Kintanar C, Bowman V. Asthmatic bronchitis associated with a volcanic eruption in St. Vincent, West Indies. *Disasters* 1981;5(1): 67–9.
25. Gordon JM, Orriola D, Unangst M, Gordon F, Vellon YER. Lessons learned from a medical response team 45 days post-Hurricane Maria in Puerto Rico. *Disaster Med Public Health Prep* 2019 10 23. [Epub ahead of print].
26. Ytzhak A, Sagi R, Bader T, Assa A, Farfel A, Merin O, et al. Pediatric ventilation in a disaster: clinical and ethical decision making. *Crit Care Med* 2012;40(2):603–7. [PubMed: 22020234]
27. Chowdhury MAB, Fiore AJ, Cohen SA, Wheatley C, Wheatley B, Balakrishnan MP, et al. Health impact of Hurricanes Irma and Maria on St Thomas and St John, US Virgin Islands, 2017–2018. *Am J Public Health* 2019;109(12):1725–32. [PubMed: 31622150]
28. Hardwick JM, Murnan SD, Morrison-Ponce DP, Devlin JJ. Field expedient vasopressors during aeromedical evacuation: a case series from the Puerto Rico disaster response. *Prehosp Disaster Med* 2018;33(6):668–72. [PubMed: 30409234]
29. Mellgard G, Abramson D, Okamura C, Weerahandi H. Hurricanes and healthcare: a case report on the influences of Hurricane Maria and managed Medicare in treating a Puerto Rican resident. *BMC Health Serv Res* 2019;19(1):818. [PubMed: 31703682]
30. Rudner N Disaster care and socioeconomic vulnerability in Puerto Rico. *J Health Care Poor Underserved* 2019;30(2):495–501. [PubMed: 31130532]
31. Schnall AH, Roth JJ, Ekpo LL, Guendel I, Davis M, Ellis EM. Disaster-related surveillance among US Virgin Islands (USVI) shelters during the Hurricanes Irma and Maria response. *Disaster Med Public Health Prep* 2019;13(1):38–43. [PubMed: 30841950]
32. Da Silva I, Gonzalez Ramirez GN, Rodriguez N, Nieves C, Oppenheimer L, Rosado A, et al. Frequency of perceived needs in Puerto Rican elderly at six months and a year after Hurricane Maria. *Alzheimers Dement* 2019; 15(7, Suppl):P480.
33. Eisenman DP, Zhou Q, Ong M, Asch S, Glik D, Long A. Variations in disaster preparedness by mental health, perceived general health, and disability status. *Disaster Med Public Health Prep* 2009;3(1):33–41. [PubMed: 19293742]
34. Ramphal L. Medical and psychosocial needs of the Puerto Rican people after Hurricane Maria. *Proc (Bayl Univ Med Cent)* 2018;31(3):294–6. [PubMed: 29904291]

35. Dube A, Moffatt M, Davison C, Bartels S. Health outcomes for children in Haiti since the 2010 earthquake: a systematic review. *Prehosp Disaster Med* 2018;33(1):77–88. [PubMed: 29248034]
36. Math SB, Nirmala MC, Moirangthem S, Kumar NC. Disaster management: mental health perspective. *Indian J Psychol Med* 2015;37(3):261–71. [PubMed: 26664073]
37. Melin K, Rodríguez-Díaz CE. Community pharmacy response in the aftermath of natural disasters: time-sensitive opportunity for research and evaluation. *J Prim Care Community Health* 2018;9: 2150132718813494.
38. George MP, Benza RL, Reeseman M, Hicks C, Appleby L, Werner K, et al. A port in the storm: how to address the needs of pulmonary hypertension patients during natural disasters. *Am J Respir Crit Care Med*. 2019;199: A5103.
39. Wiwanitkit V Post-earthquake problem in management of patients with diabetes mellitus: a comment. *Diabetes Metab Syndr* 2010;4(2): 97–8.
40. Srivatsa UN, Ekambaram V Jr, Saint Phard W, Cornsweet D. The effects of a short term Stress Alleviating Intervention (SAI) on acute blood pressure responses following a natural disaster. *Int J Cardiol* 2013; 168(4):4483–4. [PubMed: 23890858]
41. Alcorn T Puerto Rico's health system after Hurricane Maria. *Lancet* 2017;390(10103):e24. [PubMed: 29131798]
42. Abbasi J Hurricane Maria and Puerto Rico: a physician looks back at the storm. *JAMA* 2018;320(7): 629–30. [PubMed: 30073315]
43. Colón-Ramos U, Roess AA, Robien K, Marghella PD, Waldman RJ, Merrigan KA. Foods distributed during federal disaster relief response in Puerto Rico after Hurricane Maria did not fully meet federal nutrition recommendations. *J Acad Nutr Diet* 2019;119(11):1903–15. [PubMed: 31202694]
44. Dunne-Sosa A, Cotter T. The hidden wounds of Hurricane Dorian: why emergency response must look beyond physical trauma. *Disaster Med Public Health Prep* 2019;13(5–6): 1092–4. [PubMed: 31894753]
45. Lavery AM, Patel A, Boehmer TK, Lee L, Bhavsar T, Thomas J, et al. Notes from the field: pharmacy needs after a natural disaster—Puerto Rico, September–October 2017. *MMWR Morb Mortal Wkly Rep* 2018;67(13):402–3. [PubMed: 29621203]
46. Bonilla-Félix M, Suárez-Rivera M. Disaster management in a nephrology service: lessons learned from Hurricane Maria. *Blood Purif* 2019;47(1–3):199–204. [PubMed: 30517927]
47. World Health Organization Country Office, Haiti. Public health risk assessment and interventions: earthquake—Haiti [Internet]. Geneva: World Health Organization; 2010 1 [cited 2020 Oct 27]. Available from: https://apps.who.int/iris/bitstream/handle/10665/70221/WHO_HSE_GAR_DCE_2010.1_eng.pdf
48. Callaway DW, Peabody CR, Hoffman A, Cote E, Moulton S, Baez AA, et al. Disaster mobile health technology: lessons from Haiti. *Prehosp Disaster Med* 2012;27(2):148–52. [PubMed: 22588429]
49. Malebranche LJ. A doctor heads home to Haiti. *Ann Intern Med* 2010;152(10):677–8. [PubMed: 20167652]
50. Juin S, Schaad N, Lafontant D, Joseph GA, Barzilay E, Boncy J, et al. Strengthening national disease surveillance and response—Haiti, 2010–2015. *Am J Trop Med Hyg* 2017; 97(4_Suppl):12–20. [PubMed: 29064361]
51. Andrews RJ, Quintana LM. Unpredictable, unpreventable, and impersonal medicine: global disaster response in the 21st century. *EPMA J* 2015;6(1):2. [PubMed: 25663953]
52. Caribbean Public Health Agency. Emergency response [Internet]. Port of Spain (Trinidad & Tobago): CARPHA; 2020 [cited 2020 Oct 14]. Available from: <https://carpha.org/What-We-Do/Emergency-Response>
53. CARICOM Caribbean Community. Caribbean Community Climate Change Centre (CCCCC) [Internet]. Guyana: CARICOM; 2020 [cited 2020 Oct 14]. Available from: <https://caricom.org/institutions/caribbean-community-climate-change-centre-cccccc/>
54. Pan American Health Organization. Smart hospitals toolkit [Internet]. Washington (DC): PAHO; 2017 [cited 2020 Oct 14]. Available from: https://www.paho.org/disasters/index.php?option=com_content&view=article&id=1742:smart-hospitals-toolkit&Itemid=1248&lang=en

55. Healthy Caribbean Coalition. Our work [Internet]. St. Michael (Barbados): HCC; 2020 [cited 2020 Oct 14]. Available from: <https://www.healthycaribbean.org/category/our-work/>
56. Greenough PG, Kirsch TD. Hurricane Katrina. Public health response—assessing needs. *N Engl J Med* 2005;353(15):1544–6. [PubMed: 16221772]
57. Ryan BJ, Franklin RC, Burkle FM Jr, Aitken P, Smith E, Watt K, et al. Reducing disaster exacerbated non-communicable diseases through public health infrastructure resilience: perspectives of Australian disaster service providers. *PLoS Curr* 2016;8:ecurrents.dis.d142f36b6f5eeca806d95266b20fed1f.
58. World Health Organization. NCD mortality and morbidity [Internet] Geneva: WHO; 2016 [cited 2020 Oct 14]. Available from: https://www.who.int/gho/ncd/mortality_morbidity/en/
59. Serdeczny O, Adams S, Baarsch F, Coumou D, Robinson A, Hare W, et al. Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions. *Reg Environ Change* 2017; 17(6):1585–600.
60. Jessen N, Damasceno A, Silva-Matos C, Tuzine E, Madede T, Mahoque R, et al. Hypertension in Mozambique: trends between 2005 and 2015. *J Hypertens* 2018;36(4):779–84. [PubMed: 29210894]
61. National Health Portal India. Non-communicable diseases and their risk factors [Internet] New Delhi: NHP; 2019 11 5 [cited 2020 Oct 27]. Available from: <https://www.nhp.gov.in/healthyliving/ncd2019>
62. Gnanapragasam S, Aitsi-Selmi A, Rashbrook E, Murray V. Addressing non-communicable diseases in disaster risk reduction—an issue of equity. *J Epidemiol Glob Health* 2016;6(2):119–21. [PubMed: 27001076]

EXHIBIT 1

Articles included in the scoping review of articles addressing noncommunicable diseases (NCDs) in the Caribbean after a natural disaster, by NCD category

NCD category	Number of articles	Articles cited
Diabetes	11	Cruz-Cano, 2019 (7); Mbanya, 2010 (20); Gordon, 2019 (25); Mellgard, 2019 (29); Ramphal, 2018 (34); Wiwanitkit, 2010 (39); Alcorn, 2017 (41); Abbasi, 2018 (42); Dunne-Sosa, 2019 (44); Malebranche, 2010 (49); Juin, 2017 (50)
Cardiovascular disease (including heart disease, stroke, heart failure, hypertension)	9	Cruz-Cano, 2019 (7); Mbanya, 2010 (20); Gordon, 2019 (25); Mellgard, 2019 (29); Ramphal, 2018 (34); Srivatsa, 2013 (40); Dunne-Sosa, 2019 (44); Malebranche, 2010 (49); Juin, 2017 (50)
Mental health disorders	6	Mbanya, 2010 (20); Gordon, 2019 (25); Ramphal, 2018 (34); Dube, 2018 (35); Srivatsa, 2013 (40); World Health Organization Country Office Haiti, 2010 (47)
Asthma	5	Velazquez, 2019 (22); van Dorn, 2017 (23); Leus, 1981 (24); Gordon, 2019 (25); Ytzhak, 2012 (26)
Chronic kidney disease	2	Alcorn, 2017 (41), Bonilla-Félix, 2019 (46)
Other	10	Chowdhury, 2019 (27); Hardwick, 2018 (28); Rudner, 2019 (30); Schnall, 2019 (31); Da Silva, 2019 (32); Melin, 2018 (37); George, 2019 (38); Colón-Ramos, 2019 (43); Lavery, 2018 (45); Callaway, 2012 (48)

SOURCE Authors' analysis of 29 peer-reviewed articles published between 1974 and 2020. **NOTES** Numbers in parentheses refer to endnotes in the text. "Other" refers to articles that include other chronic diseases (for example, pulmonary hypertension) or discuss chronic diseases or health services delivery for chronic diseases generally.