

Impact of Hurricane Matthew on Diabetes Self-Management and Outcomes

Kevin R. Travia, Anna R. Kahkoska, Daria Igudesman, Katherine J. Souris, Cherry Beasley, Elizabeth J. Mayer-Davis

BACKGROUND Individuals with diabetes require extensive self-management. Little is known about how Hurricane Matthew (Matthew) or Hurricane Florence (Florence) impacted diabetes self-management and outcomes in Robeson County, North Carolina.

METHODS Mixed methods were used to assess the impact of hurricanes on diabetes self-management and outcomes. Individuals with diabetes were recruited for focus groups to understand the perceived impact on diabetes self-management. Health care providers were recruited for parallel key informant interviews. Mean hemoglobin A1c (HbA1c) and frequency of diabetic ketoacidosis (DKA) from hospital data six months before and after Matthew were compared using Student t-tests.

RESULTS A demographic breakdown of 34.25% white, 21.70% Black or African American, and 21.38% American Indian or Alaska Native was observed from focus groups. Qualitative results highlight a limited access to a balanced diet and medications. No significant differences were found between mean HbA1c values before and after Matthew (before Matthew: mean HbA1c $8.34 \pm 1.87\%$; after Matthew: mean HbA1c $8.31 \pm 1.93\%$; $P = .366$). The period prevalence (PP) of DKA was higher after Matthew than before (before Matthew: 39 cases out of 4,025 visits, PP = .010; after Matthew: 87 cases out of 3,779 visits, PP = .023; $P < .0001$).

LIMITATIONS Limitations include non-random sampling and limited sample sizes. Also, the cross-sectional panel approach did not follow the same individuals over time.

CONCLUSIONS The period prevalence of DKA was higher in the six-month time period following Matthew compared to before the hurricane. Future interventions may improve outcomes via increased access to foods and medications recommended for those with diabetes.

Despite significant efforts to curb the rising incidence of diabetes in the United States, the Centers for Disease Control and Prevention (CDC) has estimated that in 2015, 1.5 million new cases of diabetes were diagnosed in US adults over the age of 18 alone [1]. The CDC further reported that more than 100 million US adults (> 40% of US adults) are now living with diabetes or pre-diabetes, a condition that, if untreated, often leads to type 2 diabetes within five years [1]. Diabetes self-management is defined as behaviors related to physical activity, healthy eating, taking medication, monitoring blood glucose, diabetes self-care-related problem-solving, reducing risks of acute and chronic complications, and psychosocial aspects of living with diabetes, according to the American Diabetes Association (ADA) Standards of Care [2]. Access to nutritious food, health insurance, specialized care, and diabetes medications and supplies have been identified as key determinants of glycemic control [3]. The CDC found natural disasters and other weather events pose challenges to individuals trying to self-manage their disease, specifically calling diabetes challenging because of resource shortages [4]. Despite the availability of online resources and emergency preparation materials in multiple languages from the CDC and ADA, disasters continue to pose challenges to those with diabetes [1, 4]. Negative impacts from natural disasters affect access to important resources like water, economic stability, transportation, and medications [4]. One study examining Hurricane Katrina's (Katrina) impact on those with diabetes found that access to major medical centers, food, water, and medications

were limited leading to significant effects on diabetes self-management and outcomes [5]. Additionally, investigators found significant increases in mean HbA1c measurements at the Medical Center of Louisiana at New Orleans following Katrina compared with measurements taken before [6]. In the case of the Kobe Earthquake, researchers found that those with diabetes had to change their diabetes medication during the disaster [7]. Also, mean HbA1c was significantly higher during the earthquake period compared with other time periods measured [7]. From these studies, it has been shown that natural disasters pose challenges to diabetes self-management and outcomes [5, 7].

Following Hurricane Matthew (Matthew), thousands of people were forced to evacuate their homes as flooding decimated towns along the US Eastern Seaboard [8]. The storm made significant impact in Robeson County, North Carolina, on October 8th, 2016, when more than 26 people lost their lives and an estimated \$4.8 billion in damages was sustained [8]. More than 800,000 homes lost power, 635 roads were closed, and 88,000 homes were either destroyed or damaged [8].

Hurricane Florence (Florence) made landfall in Robeson County, North Carolina, on September 14th, 2018, nearly two

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Address correspondence to Elizabeth Mayer-Davis, 245 Rosenau Hall, 135 Dauer Dr., Chapel Hill, NC 27514 (mayerdav@email.unc.edu).

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years after Matthew [9]. The Robeson County Emergency Management team reported over 500 buildings damaged, with 75% of homes losing power [9]. The Lumber River running through Lumberton, North Carolina, crested at 25.4 feet high, over a foot higher than it did during Matthew [9].

Robeson County, North Carolina, has a population of 134,871, a total diabetes prevalence of 15.7%, and a demographic breakdown of 38.6% Native American, 25.7% white, and 24.0% Black [8, 10, 11]. According to the NC Rural Center's Health Rankings and Living Wage data, Robeson County ranks last of all North Carolina counties for health outcomes and in the lowest quartile in terms of weighted average household income [12].

Although many barriers to care for individuals with diabetes have been identified, the impact of Matthew and Florence on diabetes self-management practices and related health outcomes in Robeson County is not fully understood [13]. This study was designed to reduce this knowledge gap.

Methods

The researchers employed a convergent mixed methods design to examine and compare qualitative and quantitative method approaches to best address the two main aims of this study and best understand the impact of Matthew on diabetes self-management and outcomes.

First, focus groups and key informant interviews were used to characterize how Matthew and Florence affected perceived access to reliable food, medications, and supplies described by individuals with diabetes in Robeson County. A framework of questions pulled from Inui and coauthors formed the basis from which focus group and key informant interview questions would be generated [7]. Secondly, researchers used electronic health record (EHR) data analysis, stemming from Cefalu and coauthors' methodology, to quantify the impact Matthew had on diabetes outcomes [5]. A one-year time span centered on Matthew was cut into two equal time periods (six months each; before and after) to be compared as two cross-sectional panels.

Focus Groups

Focus Group Procedure

Recruitment took place from several locations around Lumberton, including local churches and community centers. Recruitment flyers were distributed in lobbies, and local representatives at faith-based organizations and community centers mentioned the study during services with a recruitment script. Only individuals with diabetes over 18 years old who lived in Robeson County during Matthew or Florence were included in the focus groups. The selection process was equitable among relevant demographic groups as flyers were distributed at public spaces accessible to everyone. The first and second focus groups took place at local faith-based organizations on October 17th and October 25th, 2018, respectively.

Focus group participants signed consent before audio recording began, per the IRB protocol (UNC IRB study 18-1027 and SRMC IRB study 18.260). We utilized a semi-structured focus group guide for each session to understand the impacts of both Matthew and Florence on perceived access to food, medications, and supplies.

The focus group (and key informant interview) raw questions were generated from relevant questions about emergency preparedness during a natural disaster in previous studies [5, 7]. Once generated, the Odum Institute for Research in Social Science at The University of North Carolina at Chapel Hill was consulted for recommendations about refining the questions to address three main topics: access to food, medications, and supplies. These three main topics were chosen because they relate to the qualitative aim of this study: to characterize how Matthew affected perceived access to reliable food, medications, and supplies for individuals with diabetes in Robeson County, North Carolina.

Analysis Procedure for Focus Group Data

Two independent transcribers evaluated audio recordings from each focus group. Each transcriber created a separate encrypted word document stored on Sharepoint and accessible only by UNC IRB-approved staff. The transcribers compared their transcriptions and resolved any discrepancies found to create one complete transcription for each focus group conversation.

Once transcribed, the documents were analyzed for common themes. Themes were extracted utilizing a two-researcher approach. Each transcription file was read and labeled by the topic discussed. Participant IDs were not connected to specific quotes or statements. Once all quotes were categorized, a second review grouped quotes with similar labels into broader themes encompassing many quotes, becoming the set of themes extracted by that researcher. A second researcher repeated this process and differences were resolved. The final themes and subthemes table for focus groups are compiled in Table 1.

Key Informant Interviews

Key Informant Interview Procedure

The rationale for key informant interviews was to gain another perspective into how Matthew and Florence impacted self-management practices of those with diabetes. A local community leader assisted with recruitment of key informants based on their involvement in emergency shelters, surrounding clinics and organizations, or the hospital during the storm. Five individuals were selected for interview because of their occupation (health care providers or community resource liaisons for those with diabetes) during Matthew or Florence.

Participants signed consent forms and interviews following a similar methodology as focus groups. Questions were again tailored and individuals were only included if they lived in Robeson County during Matthew or Florence, were over

18, and were an active health care provider for individuals with diabetes or in a community leadership role.

Analysis Procedure for Key Informant Interview Data

Interview sessions were reviewed for common themes and subthemes, mirroring the process used for focus group theme extraction. Themes and subthemes were identified using a similar two-researcher approach as previously detailed, shown in Table 2.

Electronic Health Records

Hospital data from the Southeastern Regional Medical Center (SRMC) were utilized to compare cross-sectional panels. A one-year time span that centered around the landfall of Hurricane Matthew was split into two cross-sectional panels spanning an equal six months of time each and labeled as before and after, respectively (Figure 1). Only Robeson County residents over 18 and not pregnant when they were measured were included in the data and statistical analysis. The ADA guidelines describe an individual with diabetes as having an HbA1c level at or above 6.5, so all participants with an HbA1c less than 6.5 were excluded [14]. Both mean HbA1c and the period prevalence of diabetic ketoacidosis (DKA) were compared between the two cross-sectional panel time frames.

Analysis Procedure for Electronic Health Records

Student t-tests analyzed whether statistically significant changes in prevalent cases of DKA-related ER visits and mean HbA1C changes occurred from before to after Matthew. Chi Square and Fisher's Exact tests were used to confirm that potential confounding variables, including age, sex, and race/ethnicity, did not vary between time periods, thus statistical adjustment for confounding was not necessary (Table 3).

Results

Focus Groups

The first and third focus groups took place at two different First Baptist Churches in Lumberton, North Carolina. The second "focus group" had only one participant and their responses were treated as a key informant interview.

There were observable differences in self-reported racial demographics between the first (South Lumberton) and third (North Lumberton) focus groups. Note, the North Lumberton focus group was composed of members of the same immediate family and had a lower sample size ($n = 5$) when compared to the South Lumberton group ($n = 19$). A lack of racial diversity was found in both focus groups and saturation among focus group responses was quickly reached. Further data analysis shed light on differences in emergency kit preparedness for Matthew and Florence. No significant differences were found between Matthew and Florence for barriers to resources.

According to individuals in both focus groups, those in

the lower lying areas and near the Lumber River, often those in lower socioeconomic position (SEP), fared the worst from the impacts of the hurricane. The qualitative data represented in Table 1 highlight a lack of access to diabetes-appropriate food, medications, and supplies for individuals with diabetes during both Matthew and Florence.

Themes that emerged from the focus group participants included trouble accessing food, water, diabetes education and support, medications, test strips, and health care guidance when they needed it during Matthew and Florence, as represented in Table 1. Subthemes emerged from comments about barriers accessing needed power, water, medications, and test strips; subtheme discussions also included other issues regarding flooding, emergency shelter supplies, and community support. Both infrastructure changes and availability of pertinent diabetes management resources were at the foundation of challenges facing individuals with diabetes in Robeson County throughout the hurricanes.

Key Informant Interviews

Themes extracted from the interviews included infrastructure changes, clinical access and resource changes, and emergency shelter impacts. From these themes, we identified subthemes pertaining to food, medication, utility, and community changes. Three registered nurses, a professor from the University of North Carolina at Pembroke, and a community center leader (key informants selected in this study) all pointed out the need for specialized emergency preparedness and disaster recovery for individuals with diabetes. Key informants stated that specific foods to best manage diabetes were often unavailable in emergency shelters. They also highlighted how flooding led to disparities among those who could access required resources based on geographic location. Many of these disparities in resource access (FEMA funding, food, water, and medications) were also found in focus group discussions.

Electronic Health Record Data

From the SRMC EHR analysis, demographic distributions before and after Matthew in Robeson County (averaged: 34.5% white, 22.4% Black or African American, and about 20.2% Native American) do not mirror North Carolina overall (68.9% white, 21.5% Black or African American, and 1.2% Native American) [15]. Other demographic data regarding age, sex, and race/ethnicity breakdown can be found in Table 3.

The two cross-sectional panel analyses shown in Table 4 depict changes in mean HbA1c before and after Matthew, showing the frequency change of DKA. The mean HbA1c value measured for individuals with diabetes at the SRMC was not significantly higher before Matthew compared with after ($P = .54$). However, the frequency of DKA experienced by individuals with diabetes who visited the SRMC was significantly higher after Matthew compared with before ($P < .0001$).

Discussion

The Perceived Impact of the Storm

Focus group participants described many challenges accessing food, medications, and supplies critical to managing their diabetes. From major themes and subthemes extracted from focus groups, flooding, utility shortages, and emergency shelter limitations created barriers to food,

medications, and supplies. Transportation-related barriers from road flooding prevented access to food, medications, and supplies for those with diabetes. Difficulty accessing power made it nearly impossible to keep perishable foods, medications, and supplies. Diabetes management became much more difficult without access to healthy foods, prescribed medications, and relevant supplies for those confined to emergency shelters. Focus group participants noted

TABLE 1.
Focus Group Qualitative Themes

Theme	Sub-theme	Text
Food	Power	"My power went out for about seven days, so we ended up cooking everything we had in the freezer, but some of the churches had hot meals..." "We couldn't cook a lot of things without power. They weren't in the shelters during Florence."
	Diabetes Management	"Accessing a balanced diet was hard. We didn't have access to food. Our stores were shut down." "And with diabetes, the kind of food you have to eat—it's hard to get it" "Everybody had to change [their diet]. You ate all your reserves, ate out of a can, and when you went to the store, everything was gone or very expensive."
	Emergency Shelters	"The Red Cross—they don't care about us. The food doesn't benefit us."
	Community	"There were [many] going through this and they worked together... to get food and we all went together."
	Flooding	"But each time we had to evacuate, we had to go and stay with one of our children and they were fast food eaters."
	Medications	Emergency Shelters
Community		"I guess you could get your medicine before, like if you see it on the radio, TV, or news, you can go and get everything you need." "If the pharmacy or drug store was closed, you couldn't get [your medications]. Many of them were robbed to get the medicines."
Flooding		"Those shelters need to be able to have the medications for you. In case the storm hit [and] you didn't pack your insulin, they need to be able to have that insulin for you." "I was out of my medication and [the closest supplier] was 170 miles away."
Diabetes Supplies and Community Resources	Power	"If you didn't have a cell phone, when the power went out, there was no way to get in contact with the doctor."
	Diabetes Management	"There were a lot of changes you have to go through [when evacuating]. And we couldn't carry it all with us because carrying all that I have to medically... the old oxygen thing with us was a big inconvenience." "I think it was harder for everyone. It was something new to us. When Florence came along, at least we had some idea of what to do. But when Matthew came, we were in the dark about everything." "[Diabetes education] would've helped during this time." "...it didn't take but three days, but I was out of my test strips [then]."
	Emergency Shelters	"Yeah just having someone to check your blood pressure and blood sugar [at the emergency shelters] is needed. Like if you get sick, who does that?"
	Community	"During Hurricane Matthew, they seemed more readily available for us to fill out the FEMA application. My situation is a little different... I'm still out of my home." "Gas prices went sky high. Prices everywhere." "Yeah, you can see the difference [in FEMA funding] because if you drive down to the Tanglewood area (North Lumberton), you can see all the sides being torn out and being repaired, but down this way (South Lumberton), nothing." "5th Street did better off with funding, they had more funding. In regards to FEMA, they would turn people away from the other parts of town saying, 'Sorry, your area wasn't affected.'"
	Flooding	"No transportation to [the doctor's office]. Roads were closed and you couldn't get to it... they weren't open anyways." "First time that we had water in this area, I saw the water; it was coming down the street. So, the emergency vehicles... they ain't coming down."

Participant demographic identities (n=25)

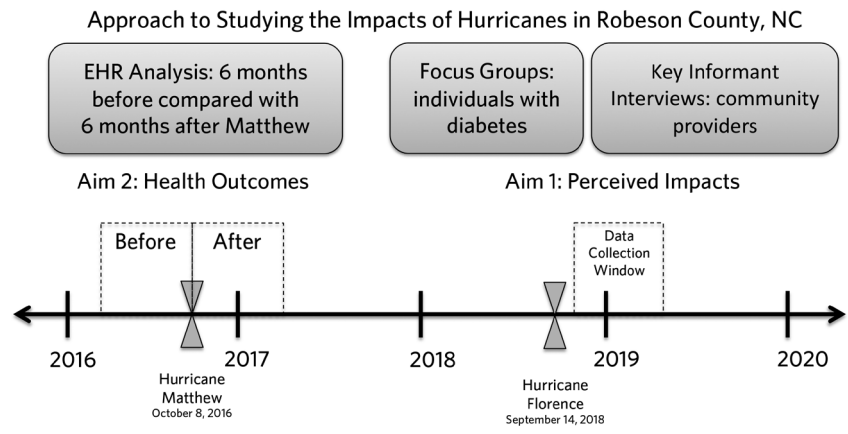
Sex: male (50%), female (45%); Race: Black (75%), White (20.8%), American Indian or Alaska Native (8.3%)

TABLE 2.
Key Informant Qualitative Themes

Theme	Sub-theme	Text	Informant	
Infrastructure changes	Food Access	"In this county, people don't really have access to steak or chicken or stuff like that."	RN	
		"People came into the ER and they didn't have [food]. I would give out boxed lunches, which was a sandwich and some apple sauce."	RN	
		"I was looking for them to have a good source of complex carbohydrates such as fresh fruits and vegetables, which we did not have access to at all during Hurricane Matthew."	RN and Professor	
			"We have a program in the school system that will pack a bag lunch for a kid over the Cajun weekend. I mean if a kid can't eat over the weekend, what will they do over five days?"	RN
	Community	"[For Hurricane Florence] they brought along people from other organizations. The Army were here for four or five days... you didn't see that during Hurricane Matthew."	RN	
	Disparities	"Definitely [some] areas were hit harder. I mean MLK [was hit] so bad and well no one can afford to be flooded, but that area definitely couldn't afford [it]."	RN	
		"Jim Crow segregation: [Certain] populations around the county... have been pushed to the less desirable, low-lying areas of the county and were more affected by the storm."	RN	
	Utilities	"Yeah I think most people would agree that water is more important than electricity because you can't take a shower, you can't flush your toilet..."	RN	
		"There was a large tower carrying lots of power lines in a low-lying swamp that collapsed. The power was out for everywhere and it was nearly a week before they got it back up."	Community Center Leader	
		"Most of the grocery stores were closed due to the lack of power."	Community Center Leader	
	Flooding	"[For Matthew] the river was rising in South and West Lumberton, people were pulled from their houses by helicopter and boat."	Community Center Leader	
Clinical Access and Resources	Medications	"[When those with a chronic disease] don't get their meds, [they] go through withdrawals."	RN	
		"No, I don't think people packed emergency kits. I worked in the ER and people were coming in and wanted their HIV medicines, insulin was a big one, and Lasix for heart patients. Another is oxygen, people came in to [use] our oxygen because they didn't have it at home."	RN	
		"It's tough for shelters to dispense medications because they aren't a pharmacy..."	RN	
		"Most of our folks who were flooded may not have had access to their insulin for weeks."	RN	
		"It's hard for someone who lives day to day to prepare. They may be buying medications a week at a time [and] may not have insurance. They had trouble with transportation."	RN	
		"We had several patients that their only way out is to go to the emergency room because they are in DKA and the only way to get medications would be to go to the emergency room."	RN	
		"I can't imagine being a mother and your child just came out of DKA and [now you] are wondering how they are going to get their medications or keep them cool. The insulin analogs will stay viable up to 28 days, [but] knowledge about that... is key."	RN	
		"I couldn't help you if you didn't know the name of your medications. Many of them came with no medications [and] often they didn't know the name or dosage of the medications."	RN	
		"When you just refilled your prescription last week, so you can't refill your prescription for another month, but it just went bad, that's when you have to evacuate your home."	Community Center Leader	
			Disparities	"Now for Florence, those who have wealth were more prepared and able to go out and spend some of that money that was socked away for a rainy day."
		"Folks who had 400% below federal poverty guideline were the ones that got it so bad [with Matthew]. The folks tended to be uninsured, so they don't necessarily have access to medications all the time, not just during a natural disaster."	RN	
		"Medical care was hindered for the entire population, [but] more critical for those with symptoms related to kidney and renal diseases because health care was non-existent during Hurricane Matthew. The hospital wasn't open. For Florence, most clinics were closed."	RN and Professor	
	Food Access	"Patients were on a specific dietary regimen and doing well, and then boom, they would eat whatever they could eat and then complain about their high [blood sugar] numbers."	RN	
Emergency Shelters	Medications	"[Shelters provided] food, water, and things like that, but medications and supplies... no."	RN	
	Community	"Matthew, we staffed shelters. Florence was not as bad, structurally, for many of the clinics."	RN	
		"Shelters were set up [in precaution], and staff thought they would only need them for very few days. We did not think Hurricane Matthew [would] actually impact our area much."	RN and Professor	
		"The purpose of the shelters isn't to provide medical services. The way they're putting [them] up, according to the law, they're doing a good job. I think the law is inadequate."	RN and Professor	
	"I strongly disagree [that emergency shelters provided adequate resources]. I think [the emergency shelters] did a terrible job. In my opinion they did not provide adequate resources."	RN and Professor		
		Flooding	"Matthew affected more people and put more people out of their homes and into shelters."	RN
	Food Access	"[Shelters] tend to have one simple menu that does not address the needs of the diabetic. I think we need to stop and have a different type of program for those populations."	RN and Professor	

Participants included three registered nurses (across the Southeastern Health system), one professor from UNC- Pembroke, and one community leader (n = 5).

FIGURE 1.
Timeline and Overview of Hurricane Matthew and Hurricane Florence and Research Study Approach



Note. This graphic shows the timeline of hurricane landfalls in North Carolina and a mixed methods approach to understanding changes in self-management and health outcomes for individuals with diabetes. Abbreviations: EHR - Electronic Health Record.

some community support in the form of free water provided at fire stations or canned foods at churches, but not enough specifically catered to the needs of those with diabetes. It's worth noting that due to delayed and limited FEMA funding, some individuals faced financial difficulty rebuilding their homes after the storm [16].

Health Outcomes From the Storm

Although the cross-sectional panel study design is insufficient to make the causal claim that Matthew directly worsened health outcomes in those with diabetes, it has been noted that Matthew may have had a negative impact on health outcomes, self-management, and care provided for individuals with diabetes. Furthermore, Fonseca and coauthors found a similar relationship when investigating Katrina, noting worsening mean HbA1c values after the storm comparatively, thus suggesting a similar relationship between natural disasters and the health outcomes of those with

diabetes [6]. Many registered nurses noted that although the damaging results from Matthew were often worse than those from Florence, the amount of resources and supplies available to take care of those individuals was much larger than for Florence. Given this fact, they suggested that health outcomes from Florence could be worse than for Matthew. Further, one key informant noted the effects of post-traumatic stress and hormone response and seemed convinced this would further impact the health outcomes of those who experienced another storm after Matthew. One study looked into these similar trauma markers following Katrina and their subsequent psychological sequelae on those who experienced the storm [17]. They found that the majority of those who participated (62%) met the criteria to be diagnosed with acute stress disorder [17]. Another study looking into the effects of stressors on low-SEP individuals who experienced Katrina found that increased hurricane-related stressors and loss led to worse health outcomes [18]. From these

TABLE 3.
Demographic Clinical Data from Southeastern Regional Medical Center EHR Data

	6 months BEFORE Hurricane Matthew (n = 3,057)	6 months AFTER Hurricane Matthew (n = 2,940)	P-value
Mean Age (years)	64	64	0.3991 Wilcoxon Signed-Rank Test used (non-normal residuals)
Sex			0.5935
Male	1,342 (43.9%)	1,288 (42.0%)	
Female	1,715 (56.1%)	1,651 (57.8%)	
Race			0.369
White	1,060 (34.7%)	971 (34.3%)	
Black or African American	703 (23.0%)	716 (21.7%)	
American Indian or Alaska Native	579 (18.9%)	608 (21.4%)	
Asian	116 (3.8%)	110 (3.2%)	
Native Hawaiian or Other Pacific Islander	1 (<1%)	1 (<1%)	
Other	598 (19.6%)	534 (18.1%)	

studies, it seems plausible that those in Robeson County who experienced Matthew may have had a psychological impact that worsened health outcomes when faced with Florence. Future studies should first examine the impacts Florence had on diabetes outcomes. Our study took place in a highly vulnerable population with a high diabetes prevalence and a high percentage of the population below the poverty line [8, 19]. Future studies should further examine specific sub-populations where resource access is inherently low.

Practical Recommendations for Community Intervention

With the number and strength of named storms increasing over the past 50 years, those living near coastal North Carolina face a unique challenge [20]. To prevent negative outcomes to vulnerable populations, providers have pointed to diabetes education, specifically for individuals with diabetes, and storm preparation packing. Some also argue that individuals may still be in shock from having just lost everything and not able to find post-disaster education useful. Education prior to a storm is ideal.

Limitations

Individuals within the focus groups often had difficulty distinguishing between experiences with Matthew and Florence, leading to possible recall bias. Furthermore, focus groups lacked racial diversity (compared with racial diversity seen in EHR analysis and other literature sources) and one focus group (n = 5) had only members of the same immediate family. The fact that some residents possibly had enough fiscal resources or other means to leave Robeson County before or during the storm and not return, even at the time of the study, likely will impact the results seen in both qualitative and quantitative aspects of this study.

The key informant interview data rely on opinions and experiences of a select and limited number of leaders identified as representing the community of Robeson County, and no prescribers (MD, DO, NP, PA) were interviewed. Results from this data should be interpreted with other Lumberton County data. It is often difficult to generate consistent analy-

sis from qualitative data, as the quotes and themes that are representative of the views of the entire group of individuals are open to interpretation of the analyzers. Although two individuals reviewed qualitative themes, more individuals reviewing qualitative data may have produced more representative themes.

Despite focus groups and key informants reaching saturation, defined as no additional data being found on a specific topic so that characteristics of a certain variable can be described, generalization to all groups in the population would not be appropriate, as some groups were not well represented at focus groups or reached with key informant interviews [21].

The cross-sectional panel's approach to understanding clinical characteristics of those with diabetes after Matthew has limitations because the same individuals were not followed over time.

Conclusions

Robeson County is a low-income county with many individuals facing barriers to proper health care even without a hurricane. For individuals who previously struggled to pay their bills or purchase more than a week's worth of medication at a time, a hurricane takes the situation from bad to worse. Perceived access to diabetes-specific food, medications, and supplies was limited for individuals with diabetes during both Matthew and Florence, compared to usual access. Emergency shelters currently do not appear to provide adequate accommodations for individuals with diabetes to appropriately manage their condition. Thus, future interventions should improve resources available specifically for those with diabetes in emergency shelters such as healthful foods, diabetes medications, and useful supplies.

From focus group discussions and key informant experiences, it is apparent that Matthew made long-term impacts on those with diabetes and influenced the way they prepared for Florence. NCMJ

Kevin R. Travia, BSPH clinical research assistant, Department of Nutrition, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Anna R. Kahkoska MD/PhD candidate, University of North Carolina School of Medicine, Chapel Hill, North Carolina.

Daria Igudesman, MS doctoral student, Department of Nutrition, University of North Carolina School of Medicine, Chapel Hill, North Carolina.

Katherine J. Souris, MPH clinical research assistant, Department of Nutrition, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Cherry Beasley, PhD distinguished professor of nursing, Department of Nursing, University of North Carolina at Pembroke, Pembroke, North Carolina

Elizabeth J. Mayer-Davis, PhD distinguished professor of Nutrition and Medicine, chair, Department of Nutrition, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina

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TABLE 4.
Southeastern Regional Medical Center Quantitative Data from Before and After Hurricane Matthew

Time Period	Mean HbA1c (SD)*	Frequency of DKA (%)
Within 6 months before the storm (n = 3,057)	8.34 (1.87)	39 cases out of 4,025 admissions -1.00%
Within 6 months after the storm (n = 2,940)	8.31 (1.93)	87 cases out of 3,779 admissions -2.30%
Independent T-test (P-value)	0.54	< .0001

*If an individual had more than HbA1c measure, the data point that was further away, based on date, from the storm landfall in North Carolina (October 8th, 2016) was chosen

**Significant P-value calculated

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