


# RETRACTED—Lessons Learned from a Medical Response Team 45 Days Post-Hurricane Maria in Puerto Rico

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## ABSTRACT

**Introduction:** Describe the lived experience of a grassroots, nongovernmental disaster medical team (DMT) through a research lens and share practical lessons learned based on the DMT's experience to support and inform future response teams.

**Method:** Forty-five days after Hurricane Maria, a nongovernmental DMT provided primary medical care by means of community-based pop-up clinics and home visitations in 5 different areas of Puerto Rico. Observational data, photo images, and debriefing notes were collected and documented in the response team's daily activity log. Field notes were coded using a descriptive coding method and then categorized into 2 domains specific to public health and medical diagnosis.

**Results:** Medical aid was provided to nearly 300 ( $N=296$ ) residents. Field note observations identified exhaustion related to living conditions and the exacerbation of underlying conditions, such as reactive airway diseases, diabetes, hypertension, and depression due to the compounding effects of multiple post-disaster triggers. During home visitations, feelings of sadness and helplessness were identified secondary to natural disaster trauma and current living conditions.

**Conclusion:** Our nongovernmental DMT displayed similar characteristics demonstrated by federal DMTs post-natural disaster. Several strategic lessons learned emerged from the public health intervention important to future nongovernmental DMTs.

**Key Words:** disaster medical teams, Hurricane Maria, public health, Puerto Rico

On September 20th 2017, Hurricane Maria made landfall causing significant destruction and mass flooding in Puerto Rico. While the true influence of the predisaster situation in Puerto Rico is unknown, medical needs in the immediate aftermath of natural disasters commonly range from treatment of minor injuries to infectious diseases and preventative services.<sup>1</sup> The National Disaster Medical System (NDMS) primarily coordinates the organization of medical aid to areas impacted by the crippling effects of such natural disasters. These services include the deployment of federal multidisciplinary Disaster Medical Teams (DMT) to provide medical treatment in affected areas through field hospitals or brigades.<sup>2</sup> Despite having the infrastructure, the mobilization of federal aid in the acute phase of Hurricane Maria was reported as being delayed with heartbreaking stories that referenced significant physical and psychosocial trauma to Puerto Ricans, coupled with rising death tolls.<sup>3</sup>

Under these circumstances, the solicitation and inclusion of nongovernmental organizations (NGO) has been known to be effective in providing health services.<sup>4</sup> Still, gaps in the literature address that there is paucity in research pertaining to DMTs. This is

especially true among DMTs that are NGO based or independent from the NDMS. To add to this knowledge base, the objective of this report is to: (1) describe the lived experience of a nongovernmental DMT through a research lens and, (2) share practical lessons learned based on the DMT's experience to support and inform future response teams.

## METHODS

### Design

The descriptive design included observational data collected by a multidisciplinary, grassroots nongovernmental DMT 45 days post-Hurricane Maria through pop-up health clinics and home visitations over 5 days. The DMT from the mainland included a pediatric nurse practitioner, medical technologist, street medic, public health educator, International Board Certified Lactation Consultant (IBCLC), and a physician living and practicing in Puerto Rico.

### Setting

By leveraging an existing partnership, a professional network between colleagues on the mainland and the island led to the selection of 2 NGO community

leaders in Vega Baja. The municipality of Vega Baja is located 30.9 miles west of San Juan. Before the hurricane, the municipality was home to 52,436 persons with a median household income of \$16,453 and 50.6% of persons below the poverty line. Sixty percent of the population was between the ages of 18 and 65, with 52% women.<sup>5</sup> Based on the community leaders' needs assessment, 5 lower income areas with no power were selected for medical relief: Los Naranjos, Sabana, El Ojo de Agua, Sandin, and a local residential addiction rehabilitation center.

**Protection of Human Subjects**

Participation in this public health intervention was minimal risk. Residents seeking medical attention signed a waiver of liability upon registration at pop-up clinics. Minors under the age of 18 were seen with a parent or legal guardian present. No participant identifiable information was collected. Verbal consent was obtained from members of the DMT before the first debriefing meeting to participate in discussions and documentation of the lived experience.

**Medical Aid Procedures**

Pop-up clinics were open during daytime hours to maximize daylight in case there was no access to electricity (ie, Monday thru Thursday from 9 AM to 3 PM). On Friday, hours were set from 9 AM to 1 PM to allow time for the DMT to prepare for departure. Extended health-care services were provided to local homebound residents identified by community leaders after scheduled clinic hours. Set up for each clinic day included designated areas for registration, vitals, laboratory testing, health education, supply distribution, and medical consultation for private exams and treatments such as nebulizers. Promotion of pop-up clinics were announced by means of mobile loudspeaker announcement.

**Response Team Debriefings**

The response team held 4 semi-structured debriefings that lasted approximately 30 min after public health interventions. The lead of the response team served as moderator, and the public health educator primarily recorded responses in the response team daily log. At the close of each debriefing session, images and debriefing notes were reviewed by the team for accuracy and corrections.

**Data Analysis**

From registration data provided by one of the community leaders, Microsoft Excel software was used to determine descriptive statistics for sample size, age, and gender. Field notes were manually coded by 2 members of the team using descriptive coding methods<sup>6</sup> to identify primary topics of field note excerpts. After reviewing coded data, items were categorized into 2 domains. Domain 1 referred to public health observations, and domain 2 referred to medical diagnoses, triggers, and treatment observations.

TABLE 1

District Area Sample Descriptive Statistics (N = 246)			
District and Age Category	Sample Size	Min - Max Age in Years	Mean Years of Age
Los Naranjos			
< 19 years	12	0 - 17	7.5
19 - 65 years	30	23 - 69	47.3
> 65 years	2	70	70
Sabana			
< 19 years	21	0 - 17	6.4
19 - 65 years	35	24 - 63	44.8
> 65 years	19	61 - 81	71.2
Ojo de Agua			
< 19 years	21	0 - 18	7.6
19 - 65 years	27	19 - 65	39.7
> 65 years	9	66 - 83	71.6
Female			
Sandin			
< 19 years	10	2 - 14	7.7
19 - 65 years	31	20 - 62	44.8
> 65 years	31	66 - 94	73.0

0 = less than 1 years old; rehabilitation center (N = 25) and home visits (N = 23) not included.

**RESULTS**

Medical aid was provided to nearly 300 (N = 296) residents. The minimum and maximum age range per district is provided in Table 1. The majority of residents that received medical attention were between the ages of 19 and 65. There were more adults (n = 184) than children (n = 64) and slightly more females (n = 169) than males (n = 103). All but 2 members of the DMT were of Puerto Rican descent and 4 of the 5 spoke fluent Spanish.

**Public Health Observations From the Field**

Field note excerpts were divided into 11 public health categories (Table 2 and Figure 1). Lack of access to medical care, difficulty securing transportation, severed communication, unemployment, damaged housing, school closures, and cost of living were salient items. Excerpts of exhaustion, lack of support from the Federal Emergency Management Agency (FEMA), and frustration related to the extended period of time residents suffered lack of access to basic needs (ie, food, water, and electricity) accounted for the major findings.

“The people need food and supplies. FEMA and Red Cross came once and it was chaos. There is an extreme feeling of exhaustion and people are fed up with their living conditions.” - IBCLC, DMT member

Apart from these less supportive items, a strengthened social network and community support did emerge.

“We see community connection is very valuable and comforting.” - Public Health Educator, DMT member

TABLE 2

Public Health Observations From the Field	
Category	Field Note Excerpts
Access to food and water	<p>"The people need food and supplies. FEMA and Red Cross came once and it was chaos."</p> <p>"There is an extreme feeling of exhaustion and people are fed up with their living conditions."</p> <p>"Overall lack of water"</p> <p>"There are many factors. If no gas stove, can't cook. If no job, then no money, then no buying of water."</p> <p>"Today we asked: are you here for vitals, pizza, or both?"</p> <p>"At one restaurant they serve food to more than 120 people every day."</p>
Shelter and housing	<p>"They have holes in their homes."</p> <p>"An older woman reports she and 70 others were stranded on her roof during the flooding."</p>
Employment	<p>"Public offices have re-located or are short-staffed."</p> <p>Due to unemployment "One man told us he sold his vehicle to have enough money to feed his family and buy other supplies."</p>
Access to medical care	<p>"A woman with three types of cancer cannot get to her doctor for treatment."</p> <p>"Doctor offices are not open...pharmacies don't have the necessary medicines."</p>
Transportation	<p>"Gas prices are going up, costs of driving is going up."</p>
Communication	<p>"The whole world knows what's happening in Puerto Rico, but Puerto Rico doesn't know. There's no electricity to run TVs and no phones. Info occasionally comes from relatives outside of Puerto Rico."</p>
School/education	<p>"Several teachers and employees from Head Start came today. They say they are going home to home for 90 minutes to teach. Schools are expected to open in January."</p>
Cost of living	<p>Per one of the community leaders "He who was poor is one thousand times poorer now."</p> <p>"We saw a 3500W generator for sale at a gas station. The price is \$1400. An online search shows it typically sells for \$400-700. Who is inflating the price?"</p> <p>"One man spent \$1000 or more each month on food and supplies for a family of four."</p>
Mosquito-borne disease prevention	<p>"People are desperate for more bug spray; many complaints about mosquitoes."</p> <p>"We had to make another stop for bug spray. We spent \$140 for 25 bottles."</p>
Safety and security	<p>Police officers were seen directing traffic for major intersections due to non-working traffic lights - See <a href="#">Figure 1</a>.</p>
Social and community support	<p>"Community members who arrive at the pop-up clinics to receive medical care often stay to volunteer with us."</p> <p>"We see community connection is very valuable and comforting."</p>

FEMA = Federal Emergency Management Agency.

**Medical Diagnoses, Triggers, and Treatment Observations in the Field**

Common medical diagnoses were categorized in 11 areas and linked to post-disaster triggers and treatments in [Table 3](#). Among participants with underlying conditions, the response

team observed exacerbations of reactive airway diseases, diabetes, hypertension, and depression associated with post-disaster triggers. These triggers included limited access to health care due medical facility closures, no availability of nutritious foods, heat exhaustion, and humidity because of lack of power as well as damaged homes with continuous roof leakage, and generator noise triggering sleep disturbance.

Poor medical adherence was identified as one of the major items that impacted medical health due to the compounding effects of post-disaster conditions. For instance, unemployment directly affected transportation. No transportation led to no access to care. No access to care generated the omission of medication, thus exacerbating medical health. These compounding effects in addition to other triggers identified were often associated with the DMT's observations of recurring mental health concerns reported daily.

"High rates of depression, and grief...anxiety and stress" - *Public Health Educator, DMT member*

**Observations From Home Visits**

A total of 23 home visitations were conducted. Sixteen homes were missed in Sandin because names and addresses were not provided. The majority of patients seen were elderly, bedridden, and stable. Images collected by the DMT provided further information regarding living conditions. The streets were lined with piles of debris, full-sized furniture, mattresses, tree branches, and trash compared with other metropolitan areas ([Figure 2](#)). Power lines were broken, and traffic lights were not working. Homes that experienced mass flooding had bare walls with chipped paint and visible water lines 6 to 8 feet high. In 1 house, the bedrooms were stripped with only mattresses on the floor. No mold was observed at the time of the assessment. Trauma was commonly reported from hurricane survivors and caregivers in the home.

"Many elderly traumatized by the loss of their homes, items of sentimental value [and] death of family." - *Public Health Educator, DMT member*

The DMT's response regarding home visits included feelings of sadness, helplessness, as well as joy.

"Sad to see so many people not living in their houses. Some don't even want to go back because it is so depressing, some have nightmares and can't sleep. Wish I could do more but I had to accept that I couldn't fix it and bring joy and compassion in the moments we had together." - *Medical technologist, DMT member*

**DISCUSSION**

Observations stemming from this report highlight the lived experience of a multidisciplinary nongovernmental DMT

**FIGURE 1**

**Officers Directing Traffic at a Busy Intersection Due to Non-Functioning Traffic Lights and Widespread Power Outages.**



**FIGURE 2**

**Debris and Damaged Furniture Observed by a DMT Member (See side view mirror) During a Home Visitation.**



TABLE 3

## Medical Diagnosis, Triggers, and Treatment Observations from the Field

Category	Diagnosis	Post-Disaster Triggers	Observations	Treatments
ENT	Conjunctivitis	Debris, allergens		Tobramycin/dexamethasone ophthalmic drops
Respiratory	Rhinitis	Debris, dust, allergies, climate		Saline nasal spray, antihistamines, decongestants
	Respiratory infections	Winter season, illness exposure		Expectorants and decongestants
	Reactive airway/asthma	Humidity, generator fumes, dust/allergen/mold exposure		Bronchodilators via nebulizer in pop up clinic or prescribed via inhaler
Cardiac	Sinusitis/bronchitis	Chronic rhinitis		Antibiotics (amoxicillin, cephalexin)
	Hypertension	Medication not accessible, adherence*		Losartan, referral to PCP and cardiology
Breast	Cancer	Breast cancer remission, adherence*		Vitamins, referral to oncologist
Infectious Disease	HIV	Need for follow up due to limited access to care, adherence*		Continuation of antiviral medications, vitamins, condoms given for prevention, referral to PCP
Endocrine	Diabetes	No medications, diet modification, adherence*		Insulin, glyburide, glucose monitoring, referral to PCP/endocrinology
Musculoskeletal	Muscle strain	Increase manual labor for household chores or debris clean up, lack of warm water for muscle relaxation		Muscle rubs (methyl salicylate topical), nonsteroidal anti-inflammatory drugs (diclofenac potassium, ibuprofen) prednisone, acetaminophen, massage
	Arthritis/bursitis	Humidity, flare-ups, injury		Cold compress, anti-inflammatories, rheumatology referral
Gastroenterology	Reflux	Diet, fried foods, less access to nutritious options, no electricity for refrigeration or cooking, adherence*		Famotidine, omeprazole, ranitidine, esomeprazole, diet modification to reduce caffeine, acidic and fried foods
Maternal Child Health	Acute diarrhea	Diet, food intolerance, unclean drinking water		Probiotics for children, anti-diarrheal for adults
	Prenatal & postpartum care and infant feeding difficulty	Limited access to health care and WIC Special Program, misinformation about quality of breastmilk due to stress		Counseling, prenatal education, artificial infant milk as needed
Mental Health	Depression, grief, suicide ideation	Loss of homes, limited communication ability, family deaths post storm, unemployment, poverty		Psychology referral, counseling, social support, prayer, pharmaceuticals (sertraline)
	Sleep disturbance	Ruminating, fatigue, generator noise, anxiety		Melatonin, clonidine, guided imagery
Dermatology	Insect bites	Humidity, mosquitos, open water		Bug repellent, anti-itch cream with hydrocortisone
	Dermatitis	Humidity, impaired hygiene, heat		Antifungal cream
	Scabies	Mite infested mattresses or sheets, flooded homes		5% Permethrin cream, treatment of home
	Cellulitis/abscess	Limited access to care, impaired hygiene, adherence*		Antibiotics (ciprofloxacin, cephalexin)

\*Poor medical care adherence.

ENT = ear, nose, and throat; HIV = human immunodeficiency virus; PCP = primary care physician; WIC = Women Infant and Children.

45 days post-Hurricane Maria in Puerto Rico. The age and gender of our sample was representative of the population of Vega Baja based on demographic data obtained from the most recent U.S. census. The inclusion of a physician living in Vega Baja as well as DMT members of Puerto Rican descent maintained a community connection and culturally competent care, an important factor commonly reported post-Hurricane Maria.<sup>7</sup>

The widespread impact of Hurricane Maria significantly influenced public health conditions that exacerbated medical health. The public health intervention of pop-up clinics helped mobilize medical relief to low income areas still in need after the storm. Similar to a nongovernmental DMT that provided mobile medical care post-Hurricane Katrina, our DMT also encountered chronic medical problems, including hypertension, diabetes, and asthma.<sup>8</sup> In contrast to the Katrina DMT, the Puerto Rico DMT emphasized the need for mental health support due to encounters of depression, grief, or suicide

ideation. Considering the Katrina DMT response occurred less than 30 days post-disaster and the Puerto Rico DMT responded greater than 30 days, it is likely that the amount of time post-natural disaster could be a determining factor for the exclusion of mental health. Longitudinally, studies post-Hurricane Sandy support the significance of mental health well beyond 6 months after the storm.<sup>9</sup>

A limitation of this recommendation is the lack of quantifiable data eligible to determine the frequency of medical diagnosis. Pop-up clinic forms were not retrieved to protect the identity of participants. The descriptive design of his report also lends to the lack of quantifiable measures. Also missing was the analysis of field notes through computer-assisted qualitative data analysis. While the purpose of the design did not require it, future research should transcribe field notes through computer programs to enhance grassroots DMT theory development. Submission for expedited review through the Institutional Review

Board (IRB) would have been ideal before departure but not feasible due to time constraints and severed communication with community leaders on the island. Policies to accommodate IRB approval and research development post-natural disaster may help narrow the gap and paucity of research related to DMTs. Despite the challenges and limitations discussed, our DMT portrayed similar characteristics commonly found among government DMTs by being adaptable, flexible, creative, and innovative as referenced in the following practical lessons learned.<sup>10</sup>

### Lessons Learned

1. *Adaptability* - Conduct a predeparture community needs assessment with community leaders on the ground to adapt and prepare for the community's needs.
2. *Creativity* - Set up pop-up clinics in creative areas to provide accessible medical care to the community post-disaster (ie, local community centers, faith-based organizations, or restaurants).
3. *Flexibility* - Expect access to minimal resources and exhaustion experienced among the people secondary to living conditions. Be prepared to tend to hurricane survivors of all ages.
4. *Innovation* - Provide innovative options for delivery of care to promote medical adherence (ie, home visits). Include multidisciplinary team members on the DMT and train in emergency mental health or suicide prevention trainings predeparture.

### CONCLUSION

Observations from the DMT mimic that of Hurricane Katrina and Hurricane Sandy with common medical and mental health exacerbations as well as underlying issues of lack of trust among government agencies that create significant disparities in low-income populations. When challenged with obstacles associated with environmental conditions, severed communication, and time constraints, our nongovernmental DMT displayed similar characteristics demonstrated by federal DMTs post-natural disaster. The application of a research lens provided insight on the experience of DMT pop-up clinics and the need for future research that supports the deployment of such teams. Applying lessons learned offers future grassroots nongovernmental DMTs a means to prepare for deployment post-natural disasters.

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### Acknowledgments

We thank Willmarie and Diana Negrón for their assistance in coordinating our team's disaster relief efforts in Vega Baja; Marcos Cruz Molina, Alcalde de el Municipio de Vega Baja for providing security for our team and marketing of disaster relief activities within designated district areas; and Jimmy Dunson with Mutual Aid Disaster Relief and Pastor Russel Meyer, St Paul Lutheran Church, for aid and financial support.

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