Community Healthcare Delivery Post-Hurricane Sandy: Lessons from a Mobile Health Unit

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ORIGINAL PAPER

Community Healthcare Delivery Post-Hurricane Sandy: Lessons from a Mobile Health Unit

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Abstract In the aftermath of Hurricane Sandy the North Shore LIJ Health System (NS-LIJ HS) organized and launched its first mobile health unit (MHU) operation to some of New York's hardest hit communities including Queens County and Long Island, NY. This document describes the initiation, operational strategies, outcomes and challenges of the NS-LIJ HS community relief effort using a MHU. The operation was divided into four phases: (1) community needs assessment, (2) MHU preparation, (3) staff recruitment and (4) program evaluation and feedback. From November 16th through March 21st, 2013 the Health System launched the MHU over 64 days serving 1,160 individuals with an age range of 3 months to 91 years. Vaccination requests were the most commonly encountered issue, and the most common complaint was upper respiratory illness. The MHU is an effective resource for delivering healthcare to displaced individuals in the aftermath of natural disaster. Future directions include the provision of psychosocial services, evaluating strategies for timely retreat of the unit and methods for effective transitions of care.

Keywords Mobile health unit · Healthcare and natural disaster · Displaced populations · Healthcare delivery and outreach

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Background

Mobile health units (MHU's) serve an integral role in providing episodic care to populations with limited access to medical care. MHU's have enabled medical teams to deliver healthcare services to marginalized individuals affected by homelessness and poverty [1], as well as populations displaced by geographic challenges such as migrant farmworkers [2, 3] and persons living in rural areas [4]. Healthcare facilities have increasingly utilized MHU's for the delivery of targeted services such as immunizations [5] and cancer screening [6, 7] and several Veteran Administration health systems have effectively incorporated MHU's in the community as a central source of primary care services for elderly and displaced veterans [8, 9]. The mobile health clinics' accessibility to displaced or isolated individuals and versatility in the setting of a damaged healthcare infrastructure makes it an ideal strategy to provide emergency medical relief [10, 11]. Recent reports of emergency medical operations describe the role of mobile health clinics in delivering healthcare to populations affected by natural disaster [10, 12–14]. This document describes the operations, outcomes and challenges of a community-based health system's effort to rapidly organize a mobile medical unit team, and to effectively deliver medical services to populations affected by natural disaster.

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Introduction

In the wake of Hurricane Sandy, a massive and deadly post-tropical cyclone that swept across the U.S. East Coast in October of 2012 [15], North Shore LIJ Health System (NS-LIJ HS) deployed a MHU to meet the needs of some of New York's hardest hit communities. Significantly damaged areas included Queens County and Long Island, NY where fires, lethal flood waters [16] and power outages in over 1.1 million homes [17] left individuals and families out of work, homes or adequate medical care. On November 16th, within a week of the storm's retreat NS-LIJ HS launched the Community Hurricane Response Team to coordinate community recovery efforts in the wake of Hurricane Sandy. The team consisted of leadership and key personnel from NS-LIJ HS, the largest health system in the region consisting of 16 hospitals, 300 ambulatory facilities and over 40,000 employees. Physician and Ambulatory Network Services (PAANS), an organization that oversees all ambulatory services at NS-LIJ and its physicians played a vital role in the hurricane relief mission. Leadership personnel from PAANS including its regional executive director, senior administrative director and medical director as well as the senior administrator, supply coordinator and schedule coordinator formed the core of the Hurricane Response Team. The team's objective was to provide urgent healthcare services to vulnerable populations affected by Hurricane Sandy.

The hurricane response mission consisted of four phases: (1) community needs assessment: a precise and widespread assessment of communities affected by the hurricane in order to effectively allocate the health system's resources, (2) MHU preparation: coordinating sufficient and appropriate stocking of medications and supplies as well as optimizing healthcare capabilities on the unit, (3) staff recruitment: health professional and personnel recruitment to deploy a well-trained workforce directly to the communities, and (4) program evaluation and feedback: optimizing the mobile unit's functionality by conducting both pre-deployment and on-going resource needs assessments.

Community Needs Assessment

The team initially reached out to key local and governmental organizations to identify those communities with the greatest needs, as well as readily available resources and services. Communications with national and regional organizations including Federal Emergency Management Agency (FEMA), the American Red Cross, Deployed Disaster Medical Assistance Teams (DMAT), Medical Reserve Corps, New York State, New York City, Nassau and Suffolk County Departments of Health, and the Queens Borough President's office helped identify locations where healthcare was compromised. Local groups including faith-based organizations, libraries, health, police and fire departments as well as individual community physicians actively serving their communities in shelters were valuable resources to gain a more detailed understanding of the communities' existing infrastructure.

Deployment locations for the MHU team were identified and prioritized based on the extent of disruption to healthcare access. The team identified seven potential locations for MHU deployment. Two team members conducted on-site evaluations in order to ensure the safety, practicality and functionality of the MHU team at each site which stretched across the south shore of Queens, Nassau and Suffolk Counties. Those locations were sites that had already become gathering grounds due to availability of food, clothing and supply donations. One week after the team first convened, three sites within two communities were selected for MHU deployment: American Legion Hall in Broad Channel, New York, Long Beach City Hall, and the Long Beach Recreation Center in Long Beach, New York.

Mobile Health Unit Preparation

The MHU vehicle's availability became evident in the initial phase of the Hurricane Response Team's operation. A van the size of a large recreational vehicle, formerly used as a mobile dental unit had been sitting in a garage for 2 years at one of 16 hospitals in the Health System. The unit was equipped with two patient examination tables and a small space to serve as a waiting and administrative area. Due to the lack of prior experience operating a mobile unit and without guidelines to follow, the team recognized that the effort would be a novel endeavor. Several important challenges were identified early in the mission including how to secure enough supplies and medications, how to preserve specific medications such as insulin and vaccines on the unit, how to determine what services could be safely provided on the unit, whether restrictions should be made for the type of medications supplied, and how to obtain proper permission to function as an emergency response vehicle and team. Personnel with emergency medicine, urgent care and DMAT experience helped formulate a medication and supply list for the unit. Vaccines and medical supplies were donated from pharmacies within two of the largest hospitals in the Health System, Long Island Jewish Medical Center and North Shore University Hospital. Rapid procurement of medications, suture kits, vaccines and other supplies in the days prior to deployment contributed largely to the success of the MHU operation.

Several operational policies were implemented from day one. Individuals seeking healthcare services were not asked to provide insurance information, and all medications and

healthcare services were provided at no cost to the individual. In addition, the operation required collection of a simple, one page hand-written medical record on all patients evaluated on the unit. These records were used for the purpose of conducting on-going needs assessments. Physicians dispensed prescriptions to those patients who presented with empty pill bottles due to pharmacies closings. Lastly, practitioners were prohibited from dispensing any controlled substances during the operation.

An important aspect of each deployment was to have every team on the unit take responsibility for daily record-keeping and to communicate the information to the operations team. Records kept included the number of patients seen, their ages, medical diagnoses, and the name and number of medications and supplies dispensed. Based on these daily reports the team kept a detailed record of operational statistics and conducted semi-weekly meetings to address ongoing challenges for subsequent deployments.

Staff Recruitment

An operations team was formed to coordinate the MHU's daily functions, to provide medical supervision and guidance as well as to provide administrative support. The team was comprised of individuals recruited from the Health System including a medical director, senior administrative director, administrator, supply coordinator, and data analyst. As the initial step the team recruited a security officer with a commercial driver's license by contacting the Human Resources Department. The security officer not only managed the unit's mechanics and medical capabilities such as refrigeration and running water, but also safely delivered all healthcare teams to their destinations and helped create an atmosphere of safety. The team also recruited medical staff to work on the MHU by contacting the Departments of Medicine, Emergency Medicine, Pediatrics and Family Medicine as well as a nursing agency. Within days the team received positive responses from individuals eager to participate. The participation was considered part of regular working hours, thus time spent on the MHU did not count towards personal or vacation days. Many staff members were experienced emergency personnel, while others were new to mobile emergency relief work including internal medicine chief residents, internists, pediatricians, and medicine subspecialists. The daily MHU medical team consisted of one to two physicians from various specialties, a registered nurse, a driver who also served as a security officer and one administrative staff. A list of Emergency Department and subspecialty department contacts was available on the MHU for consultation needs.

Program Evaluation and Feedback

As the MHU effort unfolded operational challenges began to emerge. A protracted period of post-hurricane recovery contributed to staff fatigue and emotional burnout, raising concern as to whether adequate and appropriate staffing for the MHU unit may be sustainable. Additionally, as healthcare needs changed in the community the MHU operation also required daily reassessment in order to ensure adequate resource availability. Thus, the daily feedback system was critical for the operation's effectiveness and work flow. This required physicians and/or nursing staff on the unit to communicate the number of individuals evaluated at each site, the types of medical or psychosocial issues encountered and supply deficits. In response, the MHU operations team adapted new strategies and services to meet the communities' needs such as changing or adding deployment sites (Table 1), implementing a social work consult service and restocking medical supplies.

Results

From November 16, 2012 through March 21, 2013 the MHU was deployed daily for 64 days to selected neighborhoods. Over 100 individuals including physicians, nurses, administrative staff and other personnel were deployed on the MHU. At the end of the 64 days a total of 1,160 patient encounters were recorded with an age range of 3 months to 91 years. Conditions of varied acuity and severity were evaluated (Fig. 1), and many patients presented with multiple complaints. Vaccination requests were the most commonly encountered chief complaint accounting for 537 visits (44.2 %). A total of 476 influenza vaccines and 79 tetanus vaccines were dispensed during the 64-day period. The most common presenting complaint was upper respiratory illness including nasal congestion, sinusitis, unspecified viral illness and cold symptoms which were encountered on 194 visits (16.0 %). Pulmonary or respiratory chief complaints such as COPD or asthma exacerbation, bronchitis, cough and chest congestion were evaluated on 81 visits (6.7 %). There were 127 encounters (10.5 %) related to diabetes, hypertension or hyperlipidemia, 74 encounters (6.1 %) for traumatic injury or musculoskeletal complaints, 52 encounters (4.3 %) for eye, ear, nose and throat complaints, 48 encounters (4.0 %) for medication refills or wellness-check visits and 37 encounters (3.0 %) for disorders of the skin such as rashes, burns and local skin irritation or infection. Thirteen patient encounters (1.1 %) related to symptoms of anxiety or depression. Fifty-one patient encounters (4.2 %) involved a miscellaneous group of complaints including fever, UTI,

Table 1 Number of patient encounters at six mobile health unit deployment sites

Date	Location	Female	Male	Not specified	Total
11/16/2012	BC	18	13		31
11/17/2012	BC	16	14		30
11/18/2012	BC	8	8		16
11/19/2012	BC	15	9		24
11/20/2012	BC	11	9		20
11/21/2012	BC	13	14		27
11/23/2012	BC	12	8		20
11/24/2012	LB	8	11		19
11/25/2012	LB	29	19		48
11/26/2012	LB	5	8		13
11/27/2012	BC	6	10		16
11/28/2012	LB	11	10		21
11/29/2012	BC	15	9		24
11/30/2012	LB	21	8		29
12/3/2012	LB	14	7	2	23
12/4/2012	BC	11	11		22
12/5/2012	LB	17	13		30
12/6/2012	BC	18	10		28
12/7/2012	LB	9	8		17
12/8/2012	LB	5	3		8
12/10/2012	LB	4	7		11
12/11/2012	BC	7	5		12
12/12/2012	LB	6	9	1	16
12/13/2012	BC	12	8		20
12/14/2012	LB	3	5		8
12/17/2012	BC	2	3		5
12/18/2012	BC	1	5		6
12/19/2012	LB	8	6		14
1/2/2013	BC	5	12		17
1/3/2013	LB	5	1		6
1/7/2013	LH	37	18		55
1/8/2013	LB	21	11		32
1/9/2013	BC	10	6		16
1/10/2013	LB	29	14		43
1/14/2013	FP/SF	13	8		21
1/15/2013	LB	44	21		65
1/16/2013	BC	9	11		20
1/17/2013	LB	10	9		19
1/22/2013	LB	10	6		16
1/24/2013	LB	5			5
1/26/2013	SI	22	24		46
1/28/2013	LH	23	18		41
1/29/2013	LB	4	1		5
1/30/2013	BC	3	2		5
1/31/2013	LB	1	2		3
TOTAL	45 days	556	414	3	973

This table only includes MHU deployment data through January 31st, 2013

BC Broad Channel, *FP* Freeport, *LB* Long Beach, *LH* Lindenhurst, *SF* Seaford, *SI* Staten Island

dental problems, gastrointestinal complaints, issues with the genitourinary tract or breast as well as allergic, infectious and neurological issues.

Expenses for operating the MHU were monitored and included costs for staffing the unit, costs for medical and surgical supplies, as well as miscellaneous costs including fuel and maintenance (see Table 2).

Discussion

Reflection on Hurricane Relief

The NS-LIJ HS mobile health operation provided healthcare to patients who were both geographically isolated and economically challenged in the aftermath of Hurricane Sandy. Similar organized mobile health clinic teams were deployed in the aftermath of both Hurricane Katrina and Hurricane Wilma in 2005 to serve the short-term [10, 13] and long-term [14] healthcare needs of displaced populations. However, these mobile health clinic operations compared to that of NS-LIJ HS post-Hurricane Sandy differed in their initial operation logistics, target population size and patient characteristics.

The NS-LIJ HS mobile health initiative targeted communities hit hardest by the storm. Selected areas for healthcare outreach included Nassau County in Long Island and Queens County, New York with a total population of over 3 million individuals [18, 19]. These areas are both part of an island and geographically isolated from the main land by transportation limitations. In comparison, following Hurricane Katrina, the Operation Assist program supported by the Children's Health Fund (CHF) deployed two MHUs [10] serving Harrison County in the Gulfport-Biloxi metropolitan area of Mississippi with a population estimate of 186,530 [20]. In October 2005 in Broward County, Florida, just 3 days following Hurricane Wilma the Broward County Health Department dispatched nine MHUs to meet the healthcare needs of approximately 1.7 million residents [13]. Unlike the aforementioned mobile

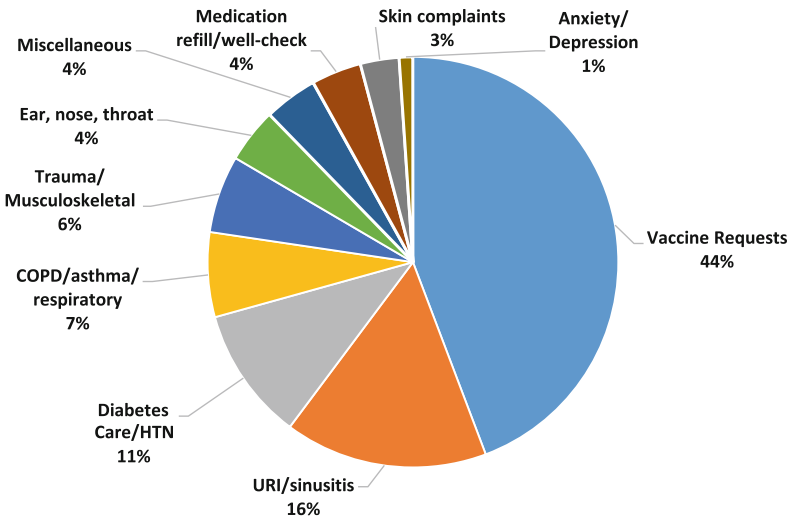

Fig. 1 Medical conditions evaluated on mobile health unit

Table 2 Operating costs for mobile health unit

Expense	Total cost	Cost per day
Staffing	$68,802	$1,966
Medical and surgical supplies	$6,553	$187
Medications	$7,108	$203
Miscellaneous	$1,519	$43.40
Total	$83,775	$2,393

health operations, the NS-LIJ mobile health project was a new endeavor with no existing infrastructure to facilitate the MHU's deployment. Faced with the challenge of providing healthcare to displaced individuals in a densely populated island region, the health system uncovered unique needs of populations afflicted by natural disaster in the community it serves as well as lessons in the initiation, organization and maintenance of a mobile health clinic operation.

The mobile health operation performed effective community surveillance and outreach to identify the needs of displaced individuals, facilitated resource allocation and enforced collaboration with relief organizations in the community in order to optimize care. Equipped with knowledge from their experience with the hurricane, the health system has acquired an important resource that will allow timely strategic planning in the event of a future natural disaster. Several factors have contributed to the health system's rapid and effective response to disaster. These include: (1) the NS-LIJ HS leadership's full endorsement of the humanitarian mission, (2) community outreach and needs assessments, (3) contribution and willingness of healthcare professionals to provide services, (4) the collaboration among various departments and facilities across the health system, and (5) ongoing feedback of involved personnel in order to assure quality care.

The health system regarded the provision of services on the MHU as a medical relief mission; its recognition and support of this mission formed the underlying foundation to successfully deploy the MHU. Medical instruments, medications and fuel for the unit were readily and rapidly supplied. Partnerships between hospitals, emergency facilities and both medical and administrative departments provided an avenue for communication to help coordinate the relief effort. Although such factors did help contribute to the overall success of the mission, there were also important lessons learned.

Challenges and Lessons Learned

The NS-LIJ HS mobile health operation reinforces the utility and value of a MHU in serving large, displaced populations in communities following a natural disaster. Conducting a thorough community needs assessment to identify locations most in need of additional healthcare services and securing a safe and practical space to provide healthcare were the two key challenges in the initial phase of mobile unit deployment. Allocating staff and resources and sufficiently stocking medical supplies were some of the major challenges encountered in maintaining the MHU's functionality after initial deployment. In both the initiation and maintenance of the unit, the current mission emphasizes the importance of effective communication. Frequent communication between staff on site and personnel from the Hurricane Relief Team was essential to conduct a thorough and timely needs assessment, and to ensure sufficient stocking of supplies, medications and services. Communicating the location and hours of operation of the

MHU to local communities helped recruit patients and also to establish a plan of care for those patients who required follow-up. At every deployment site, communicating with relief organizations such as FEMA and the Red Cross helped coordinate medical, psychosocial and financial relief efforts.

One limitation to the care provided was a lack of continuity and follow-up for the patients. Adjusting medications, introducing new medications and uncovering new diagnoses in the setting of a temporary healthcare facility caused uncertainty as to whether adequate treatment was provided, and raised concerns of inadequate follow-up to manage chronic medical conditions. The temporary nature of the MHU also presented the challenge of an effective transition to medical care in the community when access to care is not yet readily available. The CDC identifies the provision of care for chronic medical illness in disaster relief as a public health priority especially in the elderly [21]; how to effectively manage chronic medical illnesses on a MHU remains an area of improvement for future missions. The relief effort also uncovered substantial mental health effects of the hurricane. Patients presented with physical and psychological complaints suggestive of anxiety and depression, however provisions to treat such commonly encountered disaster-related conditions such as PTSD [22] were inadequate. Identifying and treating high-risk patients such as relief workers, children and the elderly is critical for preventing long term negative mental health effects and remains an objective for future disaster relief work. The Broward County MHUs during relief efforts for Hurricane Wilma reported effective use of social services working with the units to provide home care, elderly care and mental healthcare services to patients [13]. Incorporating these services on the MHU may benefit patients in the future.

Ongoing Efforts and Future Plans

As hospitals, emergency rooms and physician offices resumed operation in local communities, the current and future role of the MHU came into question. The unit's role shifted from acute disaster relief to preventive and chronic health care services. While recovery of the public health infrastructure unfolds, individuals who visit the unit remain uninsured or under-insured, unemployed and homeless due to the effects of the hurricane. Such socioeconomic consequences of the hurricane are interrelated with healthcare needs. In the year following Hurricane Katrina, the New Orleans adult population experienced a significant increase in rates of physical and mental impairment as well as overall disability [23]. This rise in disability can be attributed to a significant decline in return of displaced individuals post-Hurricane Katrina, largely due to housing damage [24] as well as high employment rates in the short-term period following the hurricane [25]. As lasting mental health effects emerge in the aftermath of Hurricane Sandy [26], physical impairment and disability rates may also rise causing an influx of vulnerable individuals in need of medical attention. Six months after Hurricane Sandy the Long Beach Medical Center, a central healthcare facility on the island of Long Beach remained closed leaving individuals seeking alternative resources to meet their healthcare needs. Although free services on the MHU provided a short-term alternative, transition of care for such individuals to a medical home is needed and the sustainability and utility of a mobile van in the community is challenged. Determination of the optimal time for retreat calls for effective communication and collaboration with government, health department and community leaders. Assessing the MHU's role and the impact of its withdrawal from the community, as well as increasing advocacy efforts to protect those communities void of emergency relief remain important goals for future recovery efforts from natural disaster.

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Conflict of interest None.

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