

2017

Continuing oncologic care in the wake of an environmental disaster

<https://hdl.handle.net/2144/26935>

"Downloaded from OpenBU. Boston University's institutional repository."

BOSTON UNIVERSITY
SCHOOL OF MEDICINE

Thesis

**CONTINUING ONCOLOGIC CARE IN THE WAKE OF AN
ENVIRONMENTAL DISASTER**

by

MEGAN MARIE MERRITT

B.A., Skidmore College, 2011
M.S. University of California, San Francisco, 2014

Submitted in partial fulfillment of the
requirements for the degree of
Master of Science

2017

© 2017 by
Megan Marie Merritt
All rights reserved

Approved by

First Reader

Thea James, M.D.
Associate Professor of Emergency Medicine

Second Reader

Oren Berkowitz, Ph.D., PA-C
Assistant Professor of Medicine

ACKNOWLEDGMENTS

I would like to take this opportunity to thank my advisor, Dr. Thea James, for her educated guidance, and Dr. Oren Berkowitz for his input while writing this paper. I would like to thank Christine Merritt for her flashes of brilliance and understanding as I worked through my thoughts. Special thanks to Kirsten Halsey for always being a sounding board for my ideas when I needed opinions that were not my own.

**CONTINUING ONCOLOGIC CARE IN THE WAKE OF AN
ENVIRONMENTAL DISASTER**

MEGAN MARIE MERRITT

ABSTRACT

Background

Chronic, non-communicable diseases (NCD), such as cardiovascular disease and cancer, have overtaken communicable disease as the leading cause of morbidity and mortality worldwide. However, despite the substantial toll these diseases have on populations, patients suffering from these illnesses are often overlooked in the aftermath of an environmental disaster. Without proper disaster preparedness, these populations are often left vulnerable: without access to disease-modifying treatments or life-saving therapies.

Objective

This is a proposed disaster event health initiative for incorporating oncology care into disaster relief services worldwide. This study hypothesizes that with increased access to providers, resources, and cancer therapies during a disaster event, interruptions in patient oncology care will be minimized.

Methods

This disaster event health initiative consists of a detailed proposal for deploying a specialized oncology unit alongside traditional disaster response teams in an effort to decrease interruptions in patient oncology care. Depending on the severity of the disaster, available adjunct healthcare facilities, potential length of stay, most commonly used cancer therapies, and traditional patient: provider ratios, this proposal will inform the

oncology unit assembly. Study measurables, such as how many patients seen, cancer diagnoses encountered, and most frequently used cancer therapies, will be collected using a standardized form. In addition, information regarding perceived patient satisfaction will be collected. System variable measures will be analyzed using frequency and average means whereas qualitative information will be coded for emerging themes. These measures of initiative efficacy will be used to revise and optimize future unit deployments.

Conclusion

Worldwide morbidity and mortality from non-communicable diseases, such as cancer, are steadily increasing. When acute environmental disasters strike, access to essential healthcare resources is disrupted, leaving these vulnerable populations without life-saving therapies they desperately need. These interruptions in cancer treatment plans result in poorer, long-term patient outcomes, compounding the effects of the disaster situation. By deploying a specialized oncology unit with disaster response teams during the initial recovery process, interruptions in cancer care will be minimized, ultimately decreasing long-term morbidity and mortality outcomes in this vulnerable patient population.

TABLE OF CONTENTS

TITLE.....	i
COPYRIGHT PAGE.....	ii
READER APPROVAL PAGE.....	iii
ACKNOWLEDGMENTS	iv
ABSTRACT.....	v
TABLE OF CONTENTS.....	vii
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF ABBREVIATIONS.....	xi
INTRODUCTION	1
Background.....	1
Statement of the Problem.....	1
Hypothesis.....	4
Objectives and specific aims.....	4
REVIEW OF THE LITERATURE	5
Overview.....	5
Existing research.....	15
METHODS	24

Study Design.....	24
Study population, sampling and recruitment	24
Intervention.....	26
Study variables and measures	31
Data collection	33
Data analysis	34
Timeline	34
Institutional Review Board	35
CONCLUSION.....	36
Discussion.....	36
Summary and Public Health Significance	38
APPENDIX 1	41
APPENDIX 2.....	42
LIST OF JOURNAL ABBREVIATIONS	43
REFERENCES	44
CURRICULUM VITAE.....	47

LIST OF TABLES

Table	Title	Page
1	Top four causes of global NCD-related deaths and their annual mortality rates	6
2	Classifying disaster events	7
3	Additional factors analyzed to determine their influence on access to cancer treatment for those with head and neck cancer after Hurricane Katrina and their statistical significance	18
4	Diagnoses that emerged in weeks three-five following the 2010 Haiti earthquake as compared to those diagnoses recorded in the year prior to the disaster event	20
5	Estimated number of patients with a cancer diagnosis in varying population sizes, as calculated using the 5 – year, word cancer prevalence rate, and the resulting clinical estimates for triaging and treating these patients under each disaster event scenario.	27
6	Medication and equipment resource considerations for deployment teams in both disaster event scenarios	30

LIST OF FIGURES

Figure	Title	Page
1A	Estimated age-standardized cancer incidence and mortality rates for men	11
1B	Estimated age-standardized cancer incidence and mortality rates for women	11
2	Estimated overall age-standardized cancer incidence and mortality rates for both males and females as reported by GLOBOCON 2012	12
3	Tent cities in Croix-des-bouquets, Haiti, 9 months post 2010 earthquake	13

LIST OF ABBREVIATIONS

B-FAST	Belgian First Aid and Support Team
BMP	Basic metabolic panel
CBC	Complete blood count
CHEs	Complex Humanitarian Emergencies
CVD	Cardiovascular disease
DALYS	Disability-adjusted Life Years
DOB	Date of birth
EMR	Electronic Medical Record
IDMC	Internal Displacement Monitoring Centre
IDP	Internally Displaced Persons
LMIC	Low and Middle Income Countries
MD	Medical doctor
MREs	Meals ready to eat
MSF	Medecins Sans Frontieres/ Doctors Without Borders
NCDs	Non-communicable diseases
NP	Nurse practitioner
PA	Physician assistant
PDSA	Plan, Do, Study, Act
QI	Quality Improvement
RDRTF	Renal Disaster Relief Task Force
RNs	Registered nurses

INTRODUCTION

Background

As the world continues to advance and evolve, with it comes a distinct transition in disease pathology. The healthcare field, once dominated by transmittable, communicable diseases, has been transformed. As of the last ten years, chronic, non-communicable diseases (NCDs) have now surpassed communicable disease as the number one cause of death worldwide.¹ And yet, despite this transition, global efforts to mitigate morbidity and mortality as they relate to NCDs, in the wake of an acute environmental disaster event, have yet to follow suit. While the incidence and frequency of global natural disasters, such as earthquakes and hurricanes, have steadily increased over the last quarter century, only minor consideration has been given to vulnerable populations, such as patients with cancer and other non-communicable diseases, that are suffering from chronic and often debilitating illnesses. In a world that now sees over 38 million deaths per year from NCDs alone², it is no longer enough to focus solely on the immediate result of the disaster event; we must also consider the specific needs of these vulnerable populations when planning, preparing, and responding.

Statement of the Problem

The incidence and frequency of global natural disasters has been steadily increasing over the last quarter century, leaving death and destruction in their wakes. Over 217 million people per year are affected as a result of these disasters,³ constituting a humanitarian crisis with no signs of alleviation. Environmental disasters such as hurricanes, floods, and

earthquakes have sparked the development of a global rapid response, with teams all over the world ready to deploy at a moment's notice. Much of the response to a natural disaster is centered on the acute phase; the initial response to urgent medical needs that have arisen as a consequence of the immediate event.^{4,5} While imperative, this phase unfortunately often excludes care for those in vulnerable subgroups; such as the physically or mentally disabled, the homeless, the elderly, and those with chronic or terminal illnesses that are often exacerbated and overlooked during an acute disaster.^{4,6}

A complete and thorough humanitarian response must incorporate all vulnerable subgroups; however, one particular group whose routine care is often interrupted and overlooked during a disaster event are those individuals with non-communicable diseases (NCDs). With the 'disease transition'⁶ from communicable diseases to NCDs as the leading cause of morbidity and mortality worldwide, global response to natural disasters must expand to incorporate these populations as well. Cardiovascular disease (CVD), cancer, chronic respiratory disease, and diabetes are four of the main NCD subgroups worldwide, accounting for 82% of NCD related deaths.² Deaths from cancer in particular total over 8.2 million per year, making cancer related mortality the second leading cause of NCD death, second only to CVD.²

Without specific considerations for patients with cancer when planning and responding to a disaster event, the effects are often devastating. Natural disasters impede access to and availability of clean water, food, proper sanitation, and "essential public health treatment options and equipment,"⁶ that leave these vulnerable populations with a profound decreased access to care and/or medication loss.^{4,6} Limited research has shown

that interruptions in or prolongation of cancer treatment plans in particular results in poorer loco-regional disease control, less disease-free survival years, and early death.⁶⁻¹⁰ Despite this knowledge, oncologic care has yet to be included in the preparation for, planning of, or response to a natural disaster, leaving this massive population of patients suffering from their illness without access to treatments, including chemotherapy, radiation therapy, pain control medications, and anti-emetics, that they desperately need.

While access to therapeutic interventions is paramount, it is also imperative that response teams consider the co-morbidities of those currently in treatment. Patients who have either received chemotherapy or radiation therapy, or suffer from an illness that compromises their immune system, are unable to fight off infection. The internal displacement monitoring centre (IDMC) estimates that more than 19.3 million people left their homes due to disasters in 2014 alone.¹¹ Those who are displaced are often forced into close quarters with thousands of others, and with limited access to shelter and clean sanitation, this situation is deadly for someone who is immunocompromised. Advanced planning and preparation can decrease the unnecessary morbidity and mortality for patients such as these.

The importance of the continuity of oncologic care in the wake of a natural disaster cannot be ignored; it is no longer acceptable to overlook this population when planning global preparedness or response. By incorporating an oncology component into the immediate disaster response, a large and vulnerable population receives the care and compassion they deserve.

Hypothesis

Deploying an oncology-focused component as part of a disaster response team during an acute disaster event reduces interruptions in oncology care in the affected cancer population.

Objectives and specific aims

A proposal will be developed for incorporating oncology care during the immediate response to a natural disaster event. The proposal will consider elements such as the severity of the acute disaster event, whether near-by healthcare facilities and resources remain functional, potential length of oncology unit stay in the recovery zone, most commonly used cancer treatments and resources needed for this specific patient population, and traditional patient: provider ratios, to inform the oncology unit assembly. Based on current guidelines and practices when deploying a disaster response team to provide aid, this proposal will incorporate an oncologic component to be deployed alongside these teams during the initial recovery response.

1. Develop a detailed proposal for incorporating oncologic care into the acute phase response to a natural disaster event
2. Adjust proposal efficacy using analysis of standardized project variables

REVIEW OF THE LITERATURE

Overview

With the 21st century came modern advancements in the healthcare field that have revolutionized not only the way we diagnose and treat medical illness, but have transformed the clinical profile of the patient considerably. While populations continue to live longer, their lifestyles have become more sedentary, their weight increasing dramatically. Over the past ten years, this change in patient lifestyle has led to a global “disease transition” where NCDs have now surpassed communicable, maternal, perinatal, and nutritional diseases as the leading cause of morbidity and mortality worldwide.^{1,2,6} Estimates believe NCDs are now responsible for between 60-65% of annual global mortality and greater than 54% of disability-adjusted life years (DALYs) globally.^{2,10,12} While most believe this burden lies solely in high-income countries, in-fact over 80% of NCD related morbidity and mortality occurs in low- and middle-income countries (LMIC); a direct reflection of the undeniable socioeconomic disparities that plague these populations.^{2,10,12}

As a consequence of their lower socioeconomic status, populations in LMIC have greater contact with and increased access to disease risk factors, such as tobacco and alcohol use, physical inactivity, and unhealthy food choices, that have led to an increased incidence and prevalence of NCDs.^{1,2} Specifically, risk factors such as these have led to a striking increase among the top four NCD killers (Table 1).

Table 1. Top four causes of global NCD-related deaths and their annual mortality rates as reported in GLOBOCON 2012²

NCD	Annual deaths (million)
CVD	17.5
Cancer	8.2
Respiratory Disease	4.0
Diabetes	1.5

Together, these four categories of NCDs account for over 82% of NCD – related deaths worldwide.² Increases in NCDs such as these cause excessive strain on household resources by commanding scarce and valuable income be allocated toward healthcare costs. Lack of financial resources perpetuates the cycle of poverty, disallowing these populations to escape the constraints of their socioeconomic status, ultimately increasing their risk for NCD – related deaths. And yet, while this cycle continues to hinder populations, worldwide, on a daily basis, the effects to these vulnerable patients’ health are detrimental when medical services and resources are acutely disrupted.

Over 217 million people per year are affected by disaster events.³ While many define the severity of a disaster based on their level of personal involvement, a disaster is often simply an “overwhelming and unforeseen event.”¹³ While war-time conflict and complex humanitarian emergencies (CHEs) are some of the most debilitating disasters, with mass effects on population morbidity, mortality, and country-wide economic outcomes, this focus of this paper rests with acute disaster events and the immediate recovery process. (Table 2)¹³

Table 2. Classifying disaster events

ACUTE EVENT	CHRONIC EVENT
<p><i>Disasters from forces in nature</i></p> <ul style="list-style-type: none"> Tropical storms (hurricanes, cyclones) Floods Droughts Extreme heat or cold Volcanoes Earthquakes Landslides Tsunamis 	<p><i>Complex Humanitarian Emergencies</i> (Armed conflict)</p>
<p><i>Disasters with humans as a factor</i></p> <ul style="list-style-type: none"> Mudslides from deforestation Famine Desertification 	
<p><i>Disasters caused by humans</i></p> <ul style="list-style-type: none"> Industrial events Transportation events 	

When attempting to define an acute disaster event, one must take into account not only the extent of the physical damage, but also the resulting effect on the global, local, and individual levels. For most, “there is no single measure of a disaster that can capture the full scope of a disaster.”¹³ While some may use the economic impact, others measure impact by lives lost. Regardless of the method of measure, in order to think critically about the effect of a natural disaster, one must look at both the immediate effects and long-term implications for these populations.

By and large the most frequent acute disaster events are those caused by forces of nature; tropical storms, droughts, and extremes in temperature top the list for loss events worldwide in 2014.¹⁴ From 2005-2014, China ranked highest with most disasters

reported; however, the US reported the most in damage, totaling over \$443 billion dollars as opposed to \$265 billion China reported over the same time frame.¹⁵ In 2015 alone, over 346 acute disaster events were reported, with over 22,000 deaths, 98.6 million people affected, and an economic toll greater than 66.5 billion dollars.¹⁶ While higher income countries like China and the US are reporting more disasters, unfortunately, the impact of a natural disaster event is often felt hardest in those LMIC; “LMICs face a greater burden of natural disasters...relative to high income countries as a result of relatively weak national health systems, higher levels of absolute and relative poverty, rapid urbanization, and associated planning deficiencies.” Those who are economically disadvantaged have traditionally been forced to overcome disparate numbers of obstacles in order to secure adequate healthcare protection; in a disaster situation, these obstacles become insurmountable. Knowing this, as well as knowing that an enormous burden of NCDs reside in LMIC, one must ask the question why NCDs are not yet a central focus of disaster recover efforts.

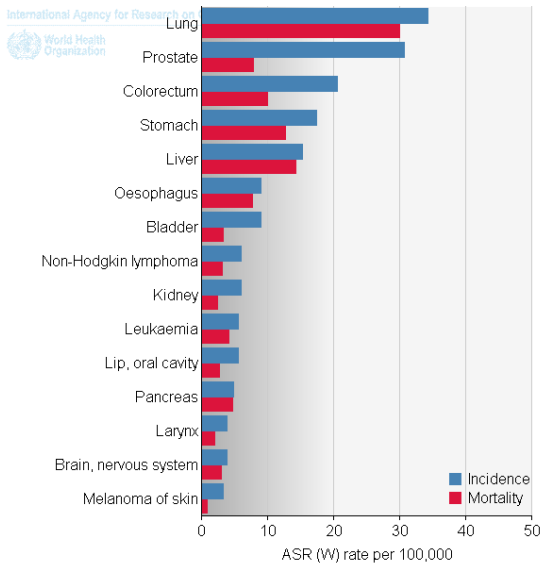
While acute trauma related injuries are the leading cause of morbidity and mortality in the immediate aftermath of the disaster, deaths in the weeks following are often secondary to poor hygiene and lack of sanitation, insufficient nutrition and food supply, and decreased access to healthcare services as a result of damage and destruction to healthcare infrastructure and resources.^{6,12,17,18} Acute disaster events present healthcare access problems that are multifactorial. A disaster situation strains any health system, altering the way in which populations utilize health services and medical resources.⁵ Not only do they disable available transportation services and dismantle economies, they

“lead to community-level breakdowns in health infrastructure, evoking disruptions in access to and availability of health services, pharmacies, medical provider supply, and medical equipment.”⁶ Because of this, natural disasters have compounding effects on the NCD burden; in populations where NCDs are now the leading cause of death, these factors interact synergistically, which results in an increase in NCD incidence, as well as progression of NCD diseases.¹² Without access to adequate nutrition, medical providers, and disease treatments, disaster events exacerbate existing NCDs, causing rapid clinical deterioration and acute complications.^{10,12} These complications ultimately result in poorer long-term prognoses, impaired quality of life and livelihoods, increases in morbidity of chronic diseased, and increased overall patient mortality.^{10,12,17}

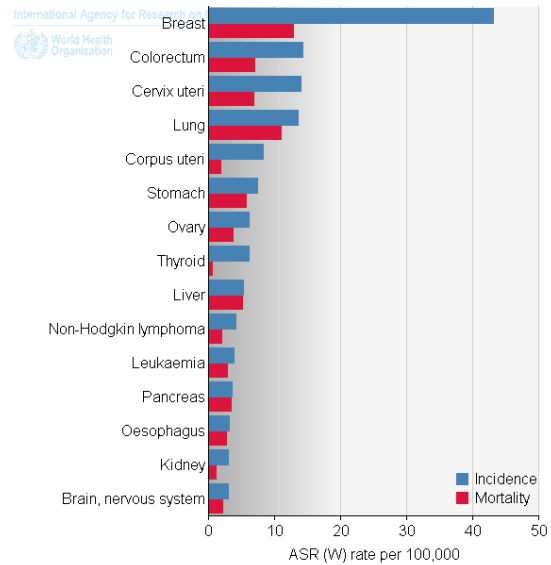
And yet, despite the disease transition and knowledge that areas with the highest prevalence of NCDs are hit hardest by acute disaster events, global efforts to mitigate morbidity and mortality in the wake of a disaster have yet to follow suit. Acute environmental disasters have generated development of multiple global rapid response teams. However, much of these response teams offer assistance that is centered on the urgent medical of the affected population.⁵ This initial response typically includes consideration for conditions such as trauma-related injuries, communicable diseases, like diarrheal and respiratory illnesses, and relatively recently, more emphasis on psychosocial and mental health care.¹⁷ However, “the provision of care for chronic diseases is rarely seen as a priority.”¹⁷ These disasters create a “secondary surge”⁵ in both medical need and unfortunately, patient casualties, as the patient profile shifts from those needing trauma care to those in need of “non-disaster health needs”¹⁷ and chronic

healthcare. As Demaio et al highlights, “the outcome is greater morbidity [and mortality] resulting from a lack of evidence-based guidelines and a resulting healthcare gap for populations with chronic disease during and following emergencies.”¹²

It is therefore imperative that, for a response effort to be considered truly successful, it must take into account care for those in vulnerable subgroups, such as the physically or mentally disabled, the homeless, the elderly, and those with chronic or terminal illnesses.^{4,6} Runkle et al defines the concept of “inverse care”, or those most in need of care are often the least likely to receive it in the weeks or months following a disaster, that affects these vulnerable populations.⁵ Cancer patients in particular fall victim to this theory, with chronic conditions that are often aggravated and overlooked in disaster preparedness and response. Globally, deaths from cancer total over 8.2 million per year, making cancer related mortality the second leading cause of NCD death, second only to CVD.² Worldwide estimates report that in men, lung cancer has the highest incidence and results in the greatest number of deaths (figure 1A), whereas for women, breast cancer tops the charts for both measures (figure 1B).¹⁹



A



B

Figure 1. (A) Estimated age-standardized cancer incidence and mortality rates for men.¹⁹ (B) Estimated age-standardized cancer incidence and mortality rates for women.¹⁹

In addition to worldwide variations among cancer diagnoses between males and females, incidence and mortality rates differed between the sexes across all regions of the world as well (figure 2). Estimates show that 57% of new cancer diagnoses and 65% of cancer deaths occurred in LMIC.¹⁹

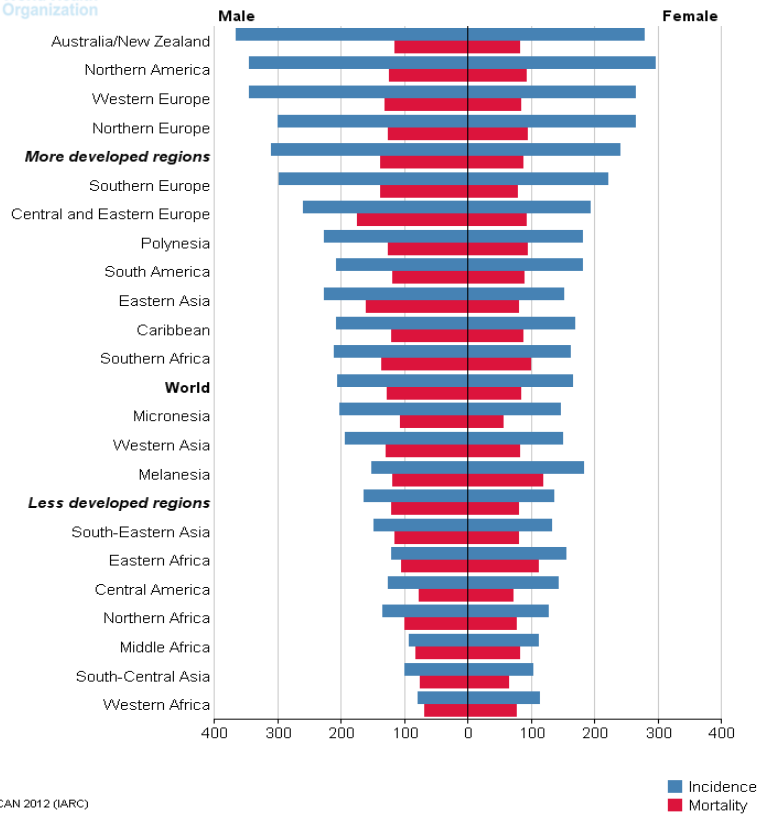


Figure 2. Estimated overall age-standardized cancer incidence and mortality rates for both males and females as reported by GLOBOCON 2012.¹⁹

Cancer incidence has increased as a direct result of “the increasing aging of the world population, the adoption of unhealthy habits, such as smoking, sedentary lifestyle, and poor diet, sexually transmitted infections, [and] lack of access to health services for early detection and treatment.”²⁰ Yet, despite this increase, this patient population is strikingly absent from policies and plans regarding the initial response to a disaster event.

The cancer patient, mid-treatment, is a frightening enigma to most providers during times of disaster relief. While access to healthcare is often threatened regardless of the environment, it is often unattainable in the post-apocalyptic scenario. Kim et al

describes that in a “normal, non-disaster environment”, cancer patients often experience delays in receiving care⁹, therefore it comes as no surprise that during a disaster situation, where the stakes are high, care for this patient population is often disregarded. As a result, these patients lose their physical connection with their once life-saving treatment regimens, leaving them suffering from their disease, its progression, and its complications.

While access to treatment is crucial, it is also imperative that response teams consider the co-morbidities and imminent complications of those currently in or have recently received treatment. Patients who have received chemotherapy or radiation therapy are often immunocompromised; their bodies are weak and unable to fight off infection. Disaster situations unfortunately cause increased overcrowding, inadequate access to sanitation and hygiene measures, insufficient shelter and decreased food supply, and water contamination that make these recovery zones increasingly unsafe for those with threatened immunity.^{12,21,22}



Figure 3. Tent cities in Croix-des-bouquets, Haiti, 9 months post 2010 earthquake.
Photo credit to paper author.

Patients with little to no immune system, forced to survive in crowded, makeshift shelters without proper sanitation, are at an astronomical risk for infection and imminent death.

Not only is concern for the immunocompromised patient a valid and important component to consider when planning and preparing to treat this population in a disaster event, but consideration for a patient's comfort level must be included as well. It is reported that between 30-90% of patients with cancer are affected by pain throughout their illness, and up to 80% of those patients with a terminal diagnosis.²⁰ These patients are reliant on medical therapies to alleviate their suffering. Yet, factors such as the inability to properly measure a patient's pain, the arrogance-ignorance paradox of the medical profession with regard to pain and palliative services, insufficient medical knowledge about opioids and pain treatment, lack of pain medication, and legal difficulties obtaining and prescribing pain medications, cause substantial delay in receiving pain management services in the aftermath of a disaster.²⁰ It is therefore essential that not only cancer prevention and current treatment modalities are an integral part of disaster response, but management of pain and palliation for those suffering must be considered as well.

Although many succumb to acute injuries during disaster situations, those with cancer, a catastrophe of their own, are left suffering with no tailored medical care. Which now brings forth the question; amidst chaotic physical destruction, it is too outrageous to allocate resources and energy on those with an already limited life expectancy? Have we have already triaged them aside into the pile too resource intensive to try and salvage? If

the answer is no, then the next logical step is to include this population in future disaster preparedness and response in an effort to mitigate undue morbidity and mortality for these patients.

Existing research

As aptly identified by Demaio et al in their Call to Action, “a full assessment of evidence-based practice in assessing and treating chronic disease in disasters may not be plausible in the classical sense since this is more of a “modern era epidemic.”¹²

Secondary to the relatively recent transition from communicable diseases to NCDs as the leading cause of death globally, limited research has been done to quantify or qualify the effects interruptions in NCD care may have on patients’ long-term morbidity and mortality. However, from what research is available with regard to interruptions in oncologic care specifically, it is evident that interruptions do have impactful negative outcomes in this patient population.

One retrospective cohort study, completed between 2005 and 2012, analyzed 750 patients with colorectal cancer, examining the impact of chemotherapy use and delay on patient oncologic outcomes after their initial surgical resection. The study found a statistical difference in 5-year survival rates between those patients who received no chemotherapy (39.5%), those who received chemotherapy greater than eight weeks post-resection (56.5%), and those who started adjuvant chemotherapy less than eight weeks post-op (80.1%) (p-value < 0.001).⁹ In addition, this study saw a significant difference in 5-year cancer recurrence-free survival rates between the three groups, with a rate of

44.8% in the group receiving no chemotherapy, 39.6% in patients who received chemotherapy greater than 8 weeks post-resection, and a rate of 71.2% in those who received chemotherapy before 8 weeks after their surgical resection (p-value <0.001).⁹

In one retrospective analysis out of Belgium, researchers aimed to evaluate local control rates for patients with laryngeal cancer after interruptions in their treatment course. Univariate analysis between those who received continuous radiation therapy for a variation of doses and treatment times, and those who received a split-course, or a 2-week interruption in radiation treatment, showed those who received a split-course schedule had significantly lower local control rates (p-value 0.001), highlighting the negative effect of treatment interruption on local disease control.²³ In addition, this study performed a multivariate analysis in an attempt to characterize the effects of overall treatment time on local disease control, finding that overall longer treatment times had a significant negative effect on local disease control (p-value 0.035).²³ While these authors caution that several prognostic factors, such as larger tumor size or poorer health prior to receiving treatment, could influence local disease control, it stands that many who experience an interruption in cancer treatment or are treated for longer overall do in fact experience negative long-term outcomes.

The findings in the aforementioned studies highlight how essential both access to and continuity of care are to a patient fighting cancer. Delays in initiating life-saving treatment modalities, interruptions in established oncologic treatment plans, or increased overall length of treatment have detrimental effects on both patients' morbidity and mortality outcomes.

While these studies have shown that interruptions in cancer care do in fact result in adverse effects on patient morbidity and mortality outcomes, the next question posed is whether an acute disaster event causes significant interruptions for these vulnerable populations. One study, aimed at evaluating factors that affected access to head and neck cancer care in the wake of Hurricane Katrina, reports cancer prevalence in New Orleans in the year prior to the Hurricane estimated at 3.7%; however, in the year following the disaster, cancer treatment was reduced by 32.6%, demonstrating what a large impact the hurricane had on access to care and subsequently, treatment availability.²⁴ This same study found that a reduction in access to cancer care following the Hurricane was significantly associated with difficulty obtaining cancer care when available (chi-square= 48, $p < 0.0001$),²⁴ highlighting the fact that of those who wished to access oncologic care in the wake of a disaster event faced significant difficulties in doing so. In addition, there was a significant association between those who felt there was less access to cancer care after the disaster and those who felt they would have sought care earlier if access had been improved (chi-square 32, $p < 0.0001$).²⁴ This association shows that affected populations will in fact seek out and utilize care options if presented with them in the wake of a disaster.

As highlighted in table 3, this study also found that factors typically considered prominent socioeconomic determinants of health were in fact not statistically associated with a patient's access to cancer care.²⁴ Despite traditional beliefs that those who are homeless, uninsured, or uneducated will have less access to healthcare regardless of the situation, this study shows that in disaster situations this is not always the case, stressing

a very real access problem with regard to cancer patients and the availability of their treatment options.

Table 3. Additional factors analyzed to determine their influence on access to cancer treatment for those with head and neck cancer after Hurricane Katrina and their statistical significance.

Factors influencing access to cancer treatment	P-value
Type of insurance	0.55
Homelessness	0.51
Access to transportation	0.85
Smoking or Alcohol use history	0.32
Level of education	0.18
Time of presentation to EKL post-hurricane	0.54

One systematic literature review looked at what this access problem entails. Done to characterize the impact of cyclone, storm, and flood related disasters on NCD management, this study found that healthcare access was impeded by factors such as “damaged transport routes, reduced health services, loss of power and evacuations.”⁶

From the research cited above, it can be inferred that as disaster events present specific challenges to accessing healthcare and management plans for those with NCDs, the resulting treatment interruptions will result in poorer patient outcomes. While many have identified the access problem at hand, few have sought to quantify the actual impact these access issues have on patient morbidity and mortality outcomes in the wake of a natural disaster. The few studies that have been conducted show irrefutable evidence to

suggest these vulnerable populations do in fact suffer tangible consequences to their health.

For some, the challenges NCDs pose are evident immediately following the disaster event. In the wake of the Sichuan earthquake in 2008, it was found that “up to 38% of survivors needed clinical management of their pre-existing chronic medical conditions before further surgical interventions could be performed for their physical trauma.”¹⁷ Without on-site personnel equipped to manage these chronic conditions, over one-third of patients face imminent death.

For others, the effects of the disaster situation unfold as the dust settles. One post-hoc comparison that was completed following the 2010 Haiti earthquake analyzed data from the Belgian First Aid and Support Team (B-FAST), that was collected during and immediately following the earthquake, as well as data from the Medecins Sans Frontieres/ Doctors Without Borders (MSF) data obtained in the year prior to the earthquake. This study showed that while 90% of diagnoses in the first two weeks were injury related, there was a significant increase in diagnoses unrelated to acute trauma injuries in the three to five weeks following the earthquake (Table 4).¹⁸

Table 4. Diagnoses that emerged in weeks three-five following the 2010 Haiti earthquake as compared to those diagnoses recorded in the year prior to the disaster event

Diagnoses	Percent diagnosed (%)	99% CI
Respiratory	16.5	14.8 – 18.4
Ophthalmologic	4.2	3.3 – 5.3
Digestive	10.7	9.3 – 12.3
Neurologic	2.5	1.8 – 3.4
Dermatologic	4.0	3.2 – 5.1
Psychological	2.5	1.8 – 3.3

This significant increase in diagnoses not related to acute trauma injury can be explained by understanding that the unique situation that results from disaster events, such as limited access to medical providers and medications, interruptions in treatment plans, and harrowing physical constraints from lack of food, shelter, and clean water, result in both exacerbations and increased incidence of NCD illnesses.

A systematic literature review aimed at quantifying the effect of natural disasters on the prevalence of acute coronary syndrome (ACS) linked multiple disasters with an exacerbation of cardiovascular events. Specifically, the study saw that as an effect of both the 1994 Northridge earthquake and the September 11th World Trade Center attacks, there was a significant increase in acute myocardial infarction (AMI) event admissions both on the day of the earthquake (RR 1.83, 95% CI 1.29-2.59) and in the 60 days following the attacks (p-value 0.01).²⁵ Additional results from the Ryan et al systematic

literature review describing the impact of cyclone, storm, and floods on NCD management found that disaster events increase the risk for severe exacerbation or disabling complications for those patients with cardiovascular disease, diabetes and chronic respiratory diseases.⁶ It was also found that for those patients with cancer specifically, a disaster event can impact access to transportation, providers, and medications, resulting in prolonged suffering and “an increased risk of premature death”⁶ for these patients. These studies highlight how detrimental a disaster event is on morbidity and mortality of those patients with NCDs, illuminating the need for personnel, trained in NCD management, to travel alongside the first responders and provide lifesaving treatment to these vulnerable populations, keeping them from being just an afterthought.

In addition to profound interruptions in treatment and management plans, disaster events pose additional obstacles for those patients with cancer. The very definition of a natural disaster is a summation of tribulations which threaten the life of an immunocompromised oncology patient. Researchers have found that “disasters can cause an exacerbation of NCDs or even death due to the limited access to treatment, care, medications, and transport; lack of food and clean water, and increased exposure to extremes of cold or heat.”⁶ Regarding the climate of post- 2010 Haiti earthquake has shown that a total of 37.8% (1057/2795) of patients developed features of an infection within the five weeks following the earthquake, almost twice the baseline number of infections recorded in the same period before and in the later years after the earthquake.¹⁸ With an astounding 1.5 million people displaced from their homes, tent cities grew, and it

is therefore understandable that of the 667 internally displaced persons (IDP) analyzed in one study, up to 71% (667/934) presented with features of an infection.^{18,26} With increasing infection rates, one cannot expect a patient to survive when their immune system has been destroyed secondary to their oncologic illness or the treatment used to treat said illness. It is therefore imperative that not only personnel are available to mitigate this risk, but supplies, possible sterile environments, and treatments are available for those with weakened immune systems.

While infection risk is a substantial and tangible complication of disasters that cancer patients face, their perception of pain as a direct result of their diagnoses and their ability to acquire the proper medications to treat their chronic pain, while less concrete, is nonetheless an important aspect of this population's care following a natural disaster that must be taken into account as well. Although often underreported, pain prevalence has been reported as high as 59% in those patients receiving active treatment, 33% of survivors after treatment, and 64% of those with advanced or terminal disease.²⁷ However, in disaster situations, patients are placed at risk when they are forced to evacuate an area "without sufficient supplies of medication [or] pharmaceutical scripts/re-fills,"⁶ leaving the majority of those patients in active treatment or those who have completed treatment experiencing uncontrollable pain symptoms.

In one qualitative study's attempt to characterize veteran patients' pain management after Hurricane Katrina, they found that there were major factors influencing a patients' ability to to access pain management services during and following the Hurricane. The study cites pain medication being changed to less potent

formulations, pain medications stopped without replacement, inability to see a pain specialist, problems filling pain medication prescriptions, and running out or rationing medications as the main themes hindering access to pain management.²⁸ Common themes that influenced whether or not a veteran rated their pain management services as “acceptable” or higher were cited as having access to their electronic medical record (EMR) as well as access to providers who were “willing to address their pain management condition with the same care as they addressed their medical and psychiatric issues, without undue fear of prescribing pain medications.”²⁸ This study highlights certain modifiable factors, such as access to up-to-date EMR systems and experienced pain and palliative care providers, that disaster preparedness and planning frameworks must take into account when deploying response teams with chronic pain management end-goals.

Despite the evidence that suggests acute disaster events cause interruptions in NCD care and management, few response-team interventions, employed to mitigate the resulting negative outcomes, have been implemented or studied. Despite being the second-leading cause of death globally, interventions with regard to cancer care management following a disaster event have yet to be employed, highlighting a very large and very real disaster relief gap. These patients require and deserve a primary response team whose initial thoughts are focused on them, their disease, their treatment course, and their pain. It is therefore essential that, moving forward, response planning and policies address this vulnerable population in an attempt to alleviate unnecessary morbidity and mortality.

METHODS

Study Design

This is a disaster event health initiative aimed at decreasing interruptions in oncology care during an acute environmental disaster event. This proposal will be used to aid in deployment of an oncology unit during a disaster event to promote continuity of oncologic care, as well as access to life-saving resources specific to this vulnerable population.

Study population, sampling and recruitment

The study population for this disaster event health initiative will be all patients with an oncology diagnosis whose previous oncology care is interrupted as a direct result of the disaster event. All eligible patients who present to the oncology unit will, at minimum, be seen by a clinical provider and provided with either additional educational or medical health services. Patients will be educated about these services by their primary oncologists prior to a disaster event. During the disaster event, patients will be recruited through word of mouth and necessity of medical services.

Inclusion criteria:

- All patients with a cancer diagnosis prior to the disaster event.

Exclusion criteria:

- Patients with no known previous cancer diagnosis

- Patients who have an oncology diagnosis but have not yet started treatment are not eligible for continued chemotherapy treatment plans
- Patients who are, by clinical diagnosis, too sick for continued treatment will be ineligible for chemotherapy; however, these patients will receive available comfort measures as they pertain to their specific needs (i.e. palliative pain medication, anti-emetics)
- Patients who are unable to answer medical questions for themselves, or do not have a next of kin available to answer medical questions, will be excluded from the post-hoc, qualitative analysis; however, these patients will still be eligible to receive medical treatment as deemed necessary by the clinical provider on-site

Though it would have been optimal to utilize purposive sampling to recruit participants from several locations throughout the disaster zone, of varying ages, cancer diagnoses, and past and/or current treatment regimens, it will not be feasible for this study due to the nature of a disaster event and the proposed study sample population. For this reason, the study sample will be one of convenience for the sake of the post-hoc initiative evaluation.

Study population estimates will be based on a calculated 5-year world prevalence rates for all cancers (excluding non-melanoma skin cancers) of 0.44% (Appendix 2). Using this prevalence rate, an estimate for number of patients with a cancer diagnosis in varying population levels will be determined. These estimates will then be used to inform the total number of clinical providers the oncology unit should expect to deploy based on

the severity of the disaster event (scenario one vs scenario two) and how many patients are estimated to be affected (Table 5).

Intervention

This study proposes specific elements to consider when assembling a specialized oncology unit to deploy with initial disaster recover efforts in the context of two disaster event scenarios. Scenario one considers an event that occurs in a high-income country, or in a region where healthcare infrastructure outside the disaster zone is optimal, whereas scenario two considers an event that occurs in a LMIC where oncology resources are scarce, or in a region where healthcare infrastructure outside the disaster zone is compromised or non-existent.

Personnel

Regardless of the disaster event scenario, the oncology unit will work under the incident commander and command staff team deployed with the disaster response team. The incident commander, logistics operator, safety officer, and administration officer will be trained prior to deployment in special considerations for oncology care in the affected patient population. In addition, a minimum of one supervising oncologist (MD) per disaster unit team must be deployed with each response unit. Lastly, if the event occurs in a region where English is not the primary language, the unit will deploy a minimum of one interpreter who speaks the region's native language and/or the deployment team will

have access to satellite interpreter phones and video capabilities through a partnering interpreter service.

With regard to the remainder of the clinical providers needed, using the calculated, 5 – year, world cancer prevalence rate of 0.44%, estimates for the number of patients with any cancer diagnosis (excluding all non-melanoma skin cancers) were determined for varying population sizes. For example, should an acute disaster event devastate a city with a population of 100,000 people, of that population, 440 patients will be expected to hold a cancer diagnosis. Using this, the number of additional personnel needed to triage and treat the estimated number of patients for each population size can be determined for each disaster event scenario (Table 5).

Table 5. Estimated number of patients with a cancer diagnosis in varying population sizes, as calculated using the 5 – year, world cancer prevalence rate, and the resulting clinical provider estimates for triaging and treating these patients under each disaster event scenario.

Population size of region affected (thousands)	Estimated # of patients with cancer diagnosis	SCENARIO ONE	SCENARIO TWO	
		Clinical Providers	Clinical Providers	Inpatient providers
< 100	< 440	2	2	4
100 – 200	440 - 880	2 - 4	2 - 4	4 – 8
200 – 300	880 - 1320	4 - 5	4 - 5	8 – 10
300 – 400	1320 - 1760	5 - 7	5 - 7	10 - 14
400 – 500	1760 - 2200	7 - 8	7 - 8	14 - 16
> 500	>2200	8+	8+	16+

For this initial proposal iteration, it will be assumed that one clinical provider can triage a maximum of 40 patients per day, spending an average of 15 minutes with each patient for a total of 10 hours a day. Clinical providers may be an MD, PA, or NP.

Estimates assume that the total number of patients with a cancer diagnosis will be triaged

within one week. For example, one provider may see 40 patients per day, for 7 days, for a total of 280 patients. Knowing this, in a population with less than 440 patients with an estimated cancer diagnosis, the oncology unit will need 2 clinical providers to see and triage all patients in that time.

The clinical providers deployed in scenario one, where patients are able to reach adjunct healthcare facilities, will focus on triaging oncology patients as they present to the disaster recovery zone. These providers will assess the severity of patient illness using patient illness history, including diagnosis and previous treatment modalities, current laboratory values, specifically immune and end-organ function, and their own clinical judgment. Patients needing immediate care, such as those with compromised immune systems, end-organ failure, or those in the middle of a treatment cycle, will be sent to participating adjunct healthcare facilities to receive this care. Participating facilities are those hospitals, clinics, and private oncology practices that, through prior state, federal, or national legislation, have agreed to see and treat patients with oncologic emergencies should a disaster event warrant relocation of oncology patients to their facility. For patients who have a current cancer diagnosis but are medically stable and are not currently receiving cancer treatment, clinical providers may provide illness education and information on when and where these patients can receive additional healthcare should they need it before their primary healthcare facility is fully operational again.

The clinical providers deployed in scenario two, where patients are unable to reach adjunct healthcare facilities, will focus on triaging oncology patients as well as providing the necessary oncology care for the duration of the disaster recovery to ensure

minimized interruptions in care. Patients who are triaged and in immediate need of oncology care will be placed “inpatient”. “Inpatient” oncology patients are those who are in need of continuation of their chemotherapeutics, boarding in a “clean zone” for those with compromised immune systems, or medical care for patients with unrelenting pain/suffering attributable to their oncology diagnosis. It is then assumed that an “inpatient” clinical provider will be responsible for a maximum of 20 patients per day. Should all patients that are triaged in each population size range need inpatient level of care, estimates for inpatient providers are in addition to the “outpatient” clinical providers needed for triage services (Table 5).

As with scenario two, for patients who have a current cancer diagnosis but are medically stable and are not currently receiving cancer treatment, clinical providers may provide illness education and information on when to return to the disaster recovery zone should they need additional oncology services.

With respect to pharmacological and nursing services:

Scenario one:

- One pharmacist per disaster unit team for overseeing anti-emetic and pain medication distribution, as well as for providing input to clinical providers regarding previous patient treatment regimens. No chemotherapeutics will not be brought with this recovery unit as part of scenario one as the hope is that patients who are in need of treatment continuity will be triaged to capable healthcare facilities nearby.

- The unit will deploy between three to five registered nurses to aid in patient care and organization, lab draws, medication distribution, and project variable collection

Scenario two:

- One pharmacist per 10 expected inpatient oncology patients per day for supervision of the distribution of oral/IV chemotherapies, pain medications, or anti-emetics. The team pharmacists will be responsible for inventory and distribution of these medications at all times.
- In addition to the registered nurses deployed to aid in “outpatient” care, based on the benchmark nurse to patient ratios as reported in the Labor Management Institute (2008)²⁸ for inpatient oncology services, the unit will deploy one registered nurse to every five expected inpatients per day for assistance with laboratory collection, medication distribution, and in-house patient management.

In addition to the personnel needed, table 6 outlines considerations for additional resources, such medications and special equipment, that the oncology unit must bring for successful completion of its task.

Table 6. Medication and equipment resource considerations for deployment teams in both disaster event scenarios

Resources	Scenario One	Scenario Two
Medications	Unit pharmacist: <ul style="list-style-type: none"> • Access to a functioning local pharmacy OR 	Unit pharmacist(s): <ul style="list-style-type: none"> • Anti-emetics • Pain medications

	<ul style="list-style-type: none"> • Deployed with anti-emetics and pain medications commonly used in the area of the disaster 	<ul style="list-style-type: none"> • Most commonly used oral/IV chemotherapeutics for the region of the disaster event.
Equipment	<p>Mobile triage site:</p> <ul style="list-style-type: none"> • Tents, cots, linens, gowns, hand-held instruments (i.e. stethoscope) • 1-2 mobile hematology testing devices and sterile phlebotomy equipment for CBC and BMP analysis • Food, such as meals ready to eat (MREs) and portable ultraviolet light water sanitation systems for staff/patients 	<ul style="list-style-type: none"> • Mobile triage site, as detailed in scenario one • Resources for a “clean zone” for patients with compromised immune systems. These resources may include tents, cots, linen, and other sanitizing or sterilizing equipment needed to prevent the spread of opportunistic infections

For both scenarios, providers will be asked to complete a standardized form with project measurables for every patient who is triaged and/or treated by the oncology unit. In addition, each patient will be asked to complete a form with their identification information, as well as a patient satisfaction questionnaire, for future analysis.

Study variables and measures

A standardized form (Form A) will be sent with providers from each oncology. The following are system variables that will be included on the standardized form:

System variables to be examined for each disaster site:

- Type of environmental disaster
- Patient identification number, to be given by the oncology provider on-site

- Length of time patient was without oncology care immediately following the environmental disaster
- Number of patients triaged by a provider specialized in oncologic care
- Number of referrals to an appropriate facility able to continue the patient's designated treatment plan during or after the disaster event
- Length of time spent with each patient
 - <10 minutes
 - 10-30 minutes
 - 30-60 minutes
 - >60 minutes
- Type and stage of cancer
- Treatment plans for patients designated prior to the disaster event
 - Day & cycle of their treatment plan
 - Prior surgical resections
- Treatments continued by a provider associated with the oncology unit (Dose, frequency, cycle number)

On a separate form (Form B), labeled with the patient identification number given to the patient by the oncology provider (Appendix 1), patients will be asked to write their full name, date of birth (DOB), primary address, and contact information. These data will be collected for patient follow-up; ensuring these patients receive adequate and continuous care throughout the recovery process.

In addition, qualitative information regarding perceived patient satisfaction will be addressed. Patients will be asked how they became aware of the oncology services offered, and what ways they believe would be most helpful in informing others of these services in the future. Patients will be asked how satisfied they were with the care they received; whether they were triaged appropriately and whether or not their oncologic needs were met and interruptions in their care were minimized. These questions will be short answer and copies in the patients' native language will be available.

Data collection

With regard to the standardized forms sent with the oncology unit, paper copies will be used while on-site in the recovery zone to minimize the need for electricity and ensure efficient reporting. Form A, the standardized form for system variables, is to be filled out by the provider who has direct contact with the patient. Form B and the patient satisfaction form are to be filled out by the patient or the patient's next of kin.

While on-site in the recovery zone, Form A and the patient satisfaction form will be stored separately from Form B to protect patient identity and healthcare information. Form A and patient satisfaction forms will be kept in a locked office while not in use. Form B will be kept in a locked safe in a separate location when not in use.

Upon return from the recovery zone, patient data from Form A will be coded and entered into REDCap software, using only the patient identification number, for further analysis. Once data is entered into the software program, paper copies of Form A will be shredded. The patient satisfaction form will be transcribed into a Word document on an

encrypted laptop for further analysis. Once transcribed, the data from the patient satisfaction forms will be shredded as well.

Data from Form B will be transferred to a Microsoft Excel spreadsheet on an encrypted laptop. Once these data are entered, Form B will be shredded as well. These data will be analyzed alongside the data from the country's cancer registry and updates to the registry will be made accordingly.

Data analysis

Using the system variables collected, analysis of patient demographics will be completed in an attempt to characterize the cancer populations receiving care as a direct result from this disaster event health initiative. Frequency distributions and percentages will be used to summarize categorical measurements, while median (with range) will be used to describe symmetric and skewed continuous measurements, respectively. Continuous variables will be analyzed using t-test for independent samples. Categorical variables will be compared using the Chi-square test.

A qualitative descriptive analysis approach will be used to analyze the patient satisfaction surveys. The primary researcher will code and recode the interviews until prominent themes and sub-themes emerged.

Timeline

As each disaster situation is unique depending on the type of disaster, the disaster severity, and the location and populations affected, the timeline for each initiative may

vary. The plan is for the oncology unit to be deployed with the initial disaster recovery team within 24 – 48 hours of the acute disaster event. The oncology unit will assemble in a central location alongside the response team, and will remain at the disaster site until healthcare infrastructure in the affected location can provide adequate oncologic care to the population. Oncology unit teams may be deployed in shifts lasting from 4 weeks to 6 weeks, with the option for remaining on-site for those medical professionals who wish to do so.

Institutional Review Board

This disaster event health initiative will be submitted to the Boston University Medical Campus Institutional Review Board (IRB) for full board review. This study will collect project system variables through direct patient interaction, qualifying this as a study with human subjects. Patient data will not be de-identified as this population requires close patient follow-up during and after disaster recovery. In addition, as a component of this health initiative, patients in need of continued oncologic care will be offered access to chemotherapeutics and narcotic pain medications. While it is the belief that the benefits of continuing oncology care outweigh the negative patient outcomes of not providing these therapies, there are risks of adverse effects from these medications that are not to be taken lightly. For this reason, study approval will have to undergo a full board review.

CONCLUSION

Discussion

As chronic and non-communicable diseases step to the forefront of healthcare, with it must come evolution in the way these diseases are cared for and managed in all scenarios, disaster events included. No longer is it enough to plan and prepare for the initial recovery surge only; consideration for long-term morbidity and mortality outcomes as a consequence of the disaster, and the disaster's effect on healthcare services and utilization, will shape the way response teams plan, prepare, and distribute healthcare throughout the entire recovery process. While imperative to continue to evolve all aspects of disaster response, it is the hope of this initiative that special considerations for vulnerable subgroups, specifically those suffering from cancer and its associated comorbidities, will bring much needed resources and relief to this population during and after a disaster event.

The largest strength with regard to this health initiative is the novel nature of the research. While research has shown that interruptions in cancer treatment plans ultimately lead to poorer patient outcomes, this idea has yet to be studied during a disaster event; a time when healthcare infrastructure is often at its weakest. In addition, the strength of this study resides in its methodology; collecting system variables and perceived patient satisfaction throughout this initiative allows for constant revision of the proposal in an attempt to optimize not only the resources allocated, treatments provided, and patients reached, but allows for careful monitoring of morbidity and mortality outcomes in future studies.

However, this study has several limitations to address. One of the largest limitations is the unpredictability of a natural disaster itself. Not being able to predict when or where a disaster event will occur, or how severe the event will be, makes it difficult to present a concrete, detailed plan for this initiative. However, it is the hope that through consideration for two broad disaster event scenarios, as well as the ability to evaluate system variables and patient satisfaction during and after each disaster event, the oncology unit assembly will become more detailed and comprehensive as the initiative continues.

In addition, this initiative proposes providing continued care for patients with a previously diagnosed cancer, excluding those who may have cancer but have not yet been seen by a primary oncologist. Due to ease of unit deployment, financial restraints, and proposal feasibility, this unit lacks diagnostic capabilities, leaving this sub-group without oncology care. In addition, because of the inability to confirm diagnoses, patients must be informed about their own illness, including diagnosis and previous treatments, or be ineligible for continued treatment as well. In areas where healthcare literacy is low, these constraints may exclude a large population of patients, decreasing the generalizability of the initiative. Countries where health literacy is high are often wealthier, with increased access to providers and other oncology resources at baseline. Data from these countries may show decreased interruptions in care leading to better morbidity and mortality outcomes; however, these data may be skewed as a result of this, missing the uninterrupted disparities in treatment continuity that exist in lower socioeconomic regions of the world.

Lastly, this proposal has limitations with regard to the study sample and patient recruitment. Due to the nature of this initiative, the sample population is one of convenience, which is not wholly representative of patients with oncology in disaster event situations, ultimately decreasing the generalizability of the initiative evaluation. In addition, recruitment for this initiative relies on both provider buy-in before the event occurs, as well as word of mouth during the recovery process. Those with poor primary follow up, or those isolated due to disaster destruction, may not be well informed of the services offered.

While this study has limitations from a research perspective, one of the largest obstacles anticipated from a logistics perspective is one of financial constraints. Depending on location and severity of the disaster event, budget allocation for the oncology unit may come from a local, state, regional, or global party. Financial considerations for personnel, resources, and medications need to be made, and reimbursements for hours worked and equipment utilized will need careful documentation³⁰; a task that is difficult when working in a recovery zone. However, while the cost of deploying a specialized oncologic unit to a disaster site may seem immense, the economic toll an NCD like cancer takes during and after a disaster event outweighs the upfront cost.

Summary and Public Health Significance

Cancer is now the second-largest cause of morbidity and mortality globally. Estimates from 2012 show that over 36.2 million individuals were living with a cancer diagnosis,

with over 8.2 million annual deaths as a result of cancer worldwide, and the numbers are only increasing.^{19,27} These numbers are astonishing, showing that, along with CVD, diabetes, and respiratory illnesses, non-communicable diseases have become an enormous burden to the healthcare field. And yet, few studies have examined the importance of complete and timely oncology treatment plans, and the effects interruptions in these plans have on long-term patient morbidity and mortality. However, from the ones that have been completed, it is evident that delays in both initiating treatment, as well as prolongation of or interruptions in treatment plans, lead to poorer disease control and less disease-free survival years. As this literature review highlights, disaster events do in fact cause widespread obstacles as they pertain to healthcare access, treatment availability, and exacerbation of disease and disease comorbidities. From this, it can therefore be concluded that acute environmental disaster events will generate barriers to cancer care access, interruptions in cancer treatment plans, and ultimately poorer morbidity and mortality outcomes for these patients.

Knowing this, this study proposes guidelines for incorporating oncology care into disaster relief situations in an attempt to decrease interruptions in treatment plans, provide necessary resources, such as anti-emetics and access to sterile environments in an attempt to decrease patient morbidity, and ultimately lessen long-term mortality in an already vulnerable population. While traditional disaster relief responses have focused on the tangible and immediate effects of an environmental disaster, this proposal forces global response efforts to consider those with debilitating chronic conditions when planning, preparing, and responding to an event as well.

Due to the novel nature of this research, there is much to be studied in the future. While this proposal hopes to decrease treatment plan interruptions, the initiative does not propose a way to evaluate the long-term intervention effects on morbidity and mortality. In addition, this initiative puts forth a proposal for oncology care in the wake of an acute disaster event; one where recovery commitments are shorter in duration. Additional proposals for providing care during CHEs must be researched and established to provide much needed care for those where the recovery process may take years.

However, despite what needs to come, this proposal places a vulnerable population at the forefront of the minds of those planning and responding to disaster events. With an increase in all non-communicable diseases, not just cancer, it is becoming more and more important to consider these patients and provide necessary recovery resources when primary healthcare access is acutely disrupted. In doing so, it is the hope that unnecessary morbidity and mortality may be prevented.

APPENDIX 1

Hypothetical standardized form layout for clarification regarding patient identification numbers

FORM A	Patient Identification Number 000-000-001
System variable questionnaire	

FORM B	Patient Identification Number 000-000-001	
Patient Name		
Date of Birth		
Address		
Contact Phone		

APPENDIX 2

Calculation for worldwide, 5-year prevalence rates for all cancers, excluding non-melanoma skin cancers.

$$\begin{aligned}\text{Worldwide, 5 – year cancer prevalence rate} &= \frac{\text{World, 5 – year cancer prevalence} *}{\text{World population estimate} **} \\ &= \frac{32,455,000}{7,380,000,000} \times 100 \\ &= 0.44\%\end{aligned}$$

* World, 5-year cancer prevalence¹⁹

** World population estimate³¹

LIST OF JOURNAL ABBREVIATIONS

AM J Public Health	American Journal of Public Health
Eur J Emerg Med	European Journal of Emergency Medicine
J Korean Soc Coloproctology	Journal of the Korean Society of Coloproctology
NEJM	New England Journal of Medicine
ODI HPN	Overseas Development Institute: Humanitarian Practice Network
PLoS Curr	PLoS (Public Library of Science) Currents
PLoS One	PLoS (Public Library of Science) One
Radiother Oncol.	Radiotherapy and Oncology

REFERENCES

1. untitled - ncd_report_full_en.pdf.
http://www.who.int/nmh/publications/ncd_report_full_en.pdf. Accessed December 31, 2016.
2. WHO | Noncommunicable diseases.
<http://www.who.int/mediacentre/factsheets/fs355/en/>. Accessed June 11, 2016.
3. Leaning J, Guha-Sapir D. Natural Disasters, Armed Conflict, and Public Health. *N Engl J Med*. 2013;369(19):1836-1842. doi:10.1056/NEJMra1109877.
4. Primary Care for Vulnerable People in Disaster Recovery. Medscape.
<http://www.medscape.com/viewarticle/774786>. Accessed June 5, 2016.
5. Runkle JD, Brock-Martin A, Karmaus W, Svendsen ER. Secondary Surge Capacity: A Framework for Understanding Long-Term Access to Primary Care for Medically Vulnerable Populations in Disaster Recovery. *Am J Public Health*. 2012;102(12):e24-e32. doi:10.2105/AJPH.2012.301027.
6. Ryan B, Franklin RC, Burkle FM, et al. Identifying and Describing the Impact of Cyclone, Storm and Flood Related Disasters on Treatment Management, Care and Exacerbations of Non-communicable Diseases and the Implications for Public Health. *PLoS Curr*. 2015;7.
doi:10.1371/currents.dis.62e9286d152de04799644dcca47d9288.
7. PLOS ONE: Effect of Prolonged Radiotherapy Treatment Time on Survival Outcomes after Intensity-Modulated Radiation Therapy in Nasopharyngeal Carcinoma.
<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0141332#pone.0141332.ref014>. Accessed June 14, 2016.
8. Yun J-A, Kim HC, Son H-S, et al. Oncologic Outcome after Cessation or Dose Reduction of Capecitabine in Patients with Colon Cancer. *J Korean Soc Coloproctology*. 2010;26(4):287-292. doi:10.3393/jksc.2010.26.4.287.
9. Kim IY, Kim BR, Kim YW. Factors Affecting Use and Delay (≥ 8 Weeks) of Adjuvant Chemotherapy after Colorectal Cancer Surgery and the Impact of Chemotherapy-Use and Delay on Oncologic Outcomes. *PLoS ONE*. 2015;10(9).
doi:10.1371/journal.pone.0138720.
10. Addressing non-communicable diseases in disaster risk reduction – an issue of equity. <http://www.sciencedirect.com/science/article/pii/S2210600615300617>. Accessed June 19, 2016.

11. IDMC » Global Estimates 2015: People displaced by disasters. <http://www.internal-displacement.org/publications/2015/global-estimates-2015-people-displaced-by-disasters/>. Accessed June 19, 2016.
12. Demaio A, Jamieson J, Horn R, de Courten M, Tellier S. Non-Communicable Diseases in Emergencies: A Call to Action. *PLoS Curr.* 2013. doi:10.1371/currents.dis.53e08b951d59ff913ab8b9bb51c4d0de.
13. Microsoft Word - 1_final 2008 forewordr.doc - Chapter_1_Disaster_Definitions.pdf. http://www.jhsph.edu/research/centers-and-institutes/center-for-refugee-and-disaster-response/publications_tools/publications/_CRDR_ICRC_Public_Health_Guide_Book/Chapter_1_Disaster_Definitions.pdf. Accessed December 29, 2016.
14. Loss events worldwide 2014 - Geographical overview - 41773_munichworldmapnaturalcatastrophes.pdf. http://www.preventionweb.net/files/41773_munichworldmapnaturalcatastrophes.pdf. Accessed March 22, 2017.
15. Disaster Statistics - UNISDR. <https://www.unisdr.org/we/inform/disaster-statistics>. Accessed March 22, 2017.
16. 2015 disasters in numbers - 47804_2015disastertrendsinfographic.pdf. http://www.unisdr.org/files/47804_2015disastertrendsinfographic.pdf. Accessed March 22, 2017.
17. Including chronic disease care in emergency responses - ODI HPN. <http://odihpn.org/magazine/including-chronic-disease-care-in-emergency-responses/>. Accessed January 2, 2017.
18. Berlaer G, Staes T, Danschutter D, et al. Disaster preparedness and response improvement: comparison of the 2010 Haiti earthquake-related diagnoses with baseline medical data. *Eur J Emerg Med.* 2016;0(0).
19. Fact Sheets by Cancer. http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx. Accessed March 21, 2017.
20. Miranda B, Vidal SA, Mello MJG de, et al. Cancer patients, emergencies service and provision of palliative care. *ResearchGate.* 2016;62(3):207-211. doi:10.1590/1806-9282.62.03.207.
21. Noji EK. Public health in the aftermath of disasters. *BMJ.* 2005;330(7504):1379-1381.

22. Watson JT, Gayer M, Connolly MA. Epidemics after Natural Disasters. *Emerg Infect Dis.* 2007;13(1):1-5. doi:10.3201/eid1301.060779.
23. Van den Bogaert W, Van der Leest A, Rijnders A, Delaere P, Thames H, van der Schueren E. Does tumor control decrease by prolonging overall treatment time or interrupting treatment in laryngeal cancer? *Radiother Oncol.* 1995;36(3):177-182. doi:10.1016/0167-8140(95)01597-A.
24. Loehn B, Pou AM, Nuss DW, et al. Factors affecting access to head and neck cancer care after a natural disaster: A post-Hurricane Katrina survey. *Head Neck.* 2011;33(1):37-44. doi:10.1002/hed.21393.
25. Hayman KG, Sharma D, Wardlow RD, Singh S. Burden of cardiovascular morbidity and mortality following humanitarian emergencies: a systematic literature review. *Prehospital Disaster Med.* 2015;30(1):80-88. doi:10.1017/S1049023X14001356.
26. Haiti Earthquake Fast Facts - CNN.com. <http://www.cnn.com/2013/12/12/world/haiti-earthquake-fast-facts/>. Accessed January 3, 2017.
27. Cancer Treatment & Survivorship Facts & Figures: 2014-2015 - acspc-042801.pdf. <http://www.cancer.org/acs/groups/content/@research/documents/document/acspc-042801.pdf>. Accessed January 3, 2017.
28. Potash MN, West JA, Corrigan S, Keyes MD. Pain Management after Hurricane Katrina: Outcomes of Veterans Enrolled in a New Orleans VA Pain Management Program. *Pain Med.* 2009;10(3):440-446. doi:10.1111/j.1526-4637.2007.00331.x.
29. The Advisory Board Company - Nurse to Patient Ratio for Inpatient Oncology Units. <https://www.advisory.com/research/oncology-roundtable/oncology-rounds/2010/04/nurse-to-patient-ratio-for-inpatient-oncology-units>. Accessed March 24, 2017.
30. Microsoft Word - 2011 Reimbursement procedure & forms - reimburse.pdf. <https://www.in.gov/dhs/files/reimburse.pdf>. Accessed March 27, 2017.
31. Population Clock. <https://www.census.gov/popclock/>. Accessed March 27, 2017.

CURRICULUM VITAE

