REDUCING PUBLIC HEALTH RISK DURING DISASTERS: IDENTIFYING SOCIAL VULNERABILITIES

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ABSTRACT

Amy Funk Wolkin: Reducing Public Health Risk during Disasters:
Identifying Social Vulnerabilities
(Under the direction of Sandra B. Greene)

All regions of the US experience disasters; many of these disasters are responsible for negative public health consequences, such as increased morbidity and mortality. Previous research has demonstrated that populations with higher levels of social vulnerability are more likely to experience negative consequences to disasters [1, 2]. Social vulnerability is defined as the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a discrete and identifiable event in nature or society [1]. Because the impacts from a disaster are expressed differentially across and within communities, emergency managers must be aware of the social vulnerabilities within their community to mitigate risk [3]. The purpose of this study was to understand how emergency managers are currently identifying social vulnerabilities within their populations.

I used a qualitative research paradigm to understand their approach and to inform a plan for change. Key informant interviews were conducted with emergency managers and a follow-up workshop with additional stakeholders was conducted to gain a deeper understanding of the barriers and facilitators to current approaches. Findings suggest that despite the need to identify social vulnerabilities, currently emergency managers lacked the awareness of how to and the technical capacity to adequately identify at-risk populations. Although public health tools have been developed to aid emergency planners in identifying at-risk populations, the majority of emergency managers were not aware of these tools and none had used them. My plan for change

proposes the development of a guidance document to provide emergency managers with critical information, strategies, and resources they need to improve their ability to identify at-risk populations. To institutionalize the approaches outlined in the guidance, new behaviors and policy should also be introduced. Because vulnerability is an important cross-cutting preparedness topic it should be addressed by multiple national preparedness frameworks and should be a required public health preparedness core capability. Through these approaches and opportunities for change, public health and emergency management can begin to effectively mitigate vulnerabilities and reduce losses and enhance outcomes for a broader population of those at risk.

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LIST OF ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
CDC	Centers for Disease Control and Prevention
COIN	Community Outreach Information Network
EOC	Emergency Operation Center
FEMA	Federal Emergency Management Administration
GIS	Geographical Information Systems
GRASP	Geospatial Research, Analysis & Services Program
HVS	Hazard Vulnerability Score
IRB	Institutional Review Board
OMB	Office of Management and Budget
PAHPA	Pandemic and All Hazards Preparedness Act
SES	Socioeconomic status
SoVI	Social Vulnerability Index (Susan Cutter)
SVI	Social Vulnerability Index (CDC/ ATSDR)
UNC	University of North Carolina
US	United States

STUDY OBJECTIVE AND AIMS

The frequency and magnitude of natural disasters is rising in the US. With climate change, this trend is expected to continue [4]. All regions of the US experience disasters; many of these disasters are responsible for negative public health consequences, such as increased morbidity and mortality. Previous research has demonstrated that socially vulnerable populations are more likely to be adversely affected in disasters [1, 2]. Social vulnerability is defined as the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a discrete and identifiable event in nature or society [1]. The term socially vulnerable is interchangeable with at-risk and is compatible with the *National Response Framework* definition of special needs populations [5]. Researchers have developed approaches and specific tools designed to assist emergency managers in identifying social vulnerabilities within populations [6-8]. These approaches and tools enable communities to identify geographic areas with higher levels of social vulnerabilities. Identifying social vulnerabilities is the first step in developing mitigation and prevention strategies that address these populations [6].

The purpose of this study was to understand how emergency managers are identifying social vulnerabilities within their populations. I used a qualitative research paradigm to understand their current approach and to inform a plan for change to address barriers to identifying these populations. The research objective was to answer the following question and

sub-questions: What approaches, if any, are emergency managers using to identify at-risk populations within their jurisdiction?

- What tools or processes do emergency managers use to identify at-risk populations?
- What are the barriers to identifying socially vulnerable populations?
- What would facilitate the identification of these populations for emergency managers?

To explore these questions, the research examined three aims.

Aim 1: To determine the extent to which social vulnerability tools are used in disaster research. A systematic literature review was conducted to determine recent applications of tools used to identify social vulnerabilities. The literature review also determined how the information about social vulnerabilities is used in disaster research and response.

Aim 2. To identify current approaches, if any, used by emergency managers to identify social vulnerabilities within their community. I conducted key informant interviews with nine emergency managers to determine if and how emergency managers currently identify at-risk populations within their jurisdiction. During the interviews, I identified approaches and tools emergency managers were currently using, the frequency of updating information on at-risk populations, and barriers and facilitators. I also conducted a follow-up workshop with additional stakeholders to gain a deeper understanding of current approaches. The results from the interviews and the workshop were used to address Aim 2.

Aim 3. To develop a plan for change that improves approaches to identifying social vulnerabilities. Identifying social vulnerabilities within a community is the first step in

mitigating disaster-related risks for at-risk populations. The goal of Aim 3 is to propose a strategy to improve current approaches. Although this research does not address the underlying causes of social vulnerabilities, the research can be used to inform mitigation strategies for reducing risk among those with social vulnerabilities. I used the literature review, key informant interviews, workshop results, and leadership principles and frameworks to develop a plan for change.

Proposal Contribution and Significance

The findings from this research have the potential to improve the public's health. Being able to identify socially vulnerable segments of the population can enable emergency managers to focus mitigation and planning efforts, rather than take a broad-brush, one-size-fits-all approach that currently exacerbates risk.

CHAPTER 1: INTRODUCTION

Statement of Issue

According to the Federal Emergency Management Administration (FEMA), in 2011 there were 99 Presidentially Declared Major Disasters, an increase from 45 declared major disasters in 2000 [9]. With the increase in precipitation and rising seas associated with climate change, this trend is expected to continue [4]. Most natural disasters have major public health consequences. Hurricane Katrina, for example, resulted in more than 1,800 deaths and at least 7,500 injuries and illnesses and destroyed most of the areas' health and public health infrastructure [10].

Socially vulnerable segments of communities are at particular risk for negative health effects from disasters and are disproportionately affected by disasters [1]. Within communities there is a heterogeneous spread of social characteristics that produces unequal exposure to disaster risks, making some people more prone to disaster-related morbidity and mortality. During the past few decades, researchers have discovered that a person's vulnerability to disasters is essentially a social and community construct [2]. The conditions and social factors that limit a person's everyday abilities to cope with daily life also make them vulnerable to the effects of disasters [1]. Previous research has demonstrated that socially vulnerable populations are more likely to be adversely affected in emergencies [7, 11]. Therefore, planning and

implementation of mitigation strategies should focus on the vulnerable segments of the population to reduce the public health impact of disasters [12].

Significance

Although there is strong evidence that vulnerable population groups are at greater risk during a disaster, few emergency preparations focus on at-risk population groups and their special needs in emergencies [13]. These social vulnerable populations, also referred to as at-risk groups and special needs populations, require special considerations. By knowing vulnerabilities within a community, emergency managers can better design and implement community-based efforts to mitigate and prepare for disasters [12]. For example, if emergency managers know social vulnerabilities *a priori,* they can plan more efficient evacuations for people who need transportation or special assistance, such as those without a vehicle.

The devastation following Hurricane Katrina raised serious public policy issues in disaster management, prompting a Congressional investigation [14]. The Hurricane Katrina Congressional Investigation committee reported that "many of the problems we have identified can be categorized as 'information gaps'...Better information would have been an optimal weapon against Katrina. Information sent to the right people at the right place at the right time." The committee also concluded that "issues of race and class were central" to the disaster's consequences [14]. Emergency managers can better anticipate the needs of their communities by knowing the types of vulnerabilities in their community and providing this information to the right people at the right time.

Background

Disaster management is the set of strategic management processes used to reduce the impact of disasters on people and property [12]. For most of the twentieth century, disaster management attributed disaster-related morbidity and mortality solely to the physical aspects of the disaster (e.g., hurricane winds, flood waters). The dominant view was that disaster-related morbidity and mortality were caused by people being in the wrong place at the wrong time [1, 15, 16]. Those who believed in this fatalistic view perceived that there was little one could do to prevent the occurrence, and consequently the effects, of disasters. More recently, disaster research has recognized that the interaction of a wide range of physical (i.e., meteorological, environmental, technological) and social factors threaten society during a disaster. Disaster management uses the following formula to estimate the risk of health, social, and economic consequences of a disaster:

$$\text{Risk} = \text{Hazard} * \text{Vulnerability},$$

where *risk* is the likelihood of a specific disaster event occurring and its probable consequences (i.e., impact on people and property); *hazard* is the potential threat to humans and their welfare; and *vulnerability* is characteristics of a person or group and their situation that influences their capacity to anticipate, cope with, resist, and recover from a hazard [6, 7]. Previously, disaster management excluded the influence of social vulnerabilities on risk; however, social vulnerabilities should be included in the risk equation [8].

Social vulnerabilities arise from differences in social conditions and are rooted in at least six broad categories: socioeconomic status, race and ethnicity, age, gender, disability, and English language proficiency. Socioeconomic status (SES) is one of the largest categories of social vulnerability and includes employment, income, and education levels [1, 17, 18]. Within

the US the poorest people living in the poorest conditions are the most vulnerable [12].Those with lower socioeconomic status are more likely to have problems related to the crowding, poor housing structures, lack of home ownership, and lack of access to resources [19]. The poor also spend a greater percent of income on housing, which limits their money available for other necessities. During Hurricane Katrina, many of the poor were displaced and sheltered significant distances from New Orleans impairing access to their social networks. Social networks are an important aspect of recovery, particularly among the poor who depend on social networks for child care, food transportation, and support [19].

Race and ethnicity also contribute to social vulnerabilities [8, 17, 20]. It is not necessarily race and ethnicity that create the increased risk to disasters; rather it is how race and ethnicity are interpreted by society and the structures that surround race and ethnicity that relate to vulnerability [19]. Race and ethnicity are intrinsically tied to issues of SES. During Hurricane Katrina more than half of poor blacks did not have transportation to evacuate compared to 17% of poor whites [19]. Without transportation many blacks sheltered in the Superdome and comprised the majority of the 30,000 people evacuated to the Superdome [19]. Follow-up studies found that black male residents had a higher mortality rate than whites relative to their population distribution [7, 21]. Race and ethnicity also play a role in recovery. Some areas of New Orleans, such as the French Quarter, recovered quickly after Hurricane Katrina, whereas the predominantly poor black neighborhoods continue to struggle [19].

Age is another social vulnerability. The elderly are more likely to have co-morbidities, less mobility, and greater dependencies (e.g., medication, supplemental oxygen) that increase their risk to hazards. Further, many elderly have physical or cognitive disabilities that prevent them from hearing prevention messages and warnings, being able to evacuate, or engaging in

protective behaviors [8, 22, 23]. Many elderly are also poor which may prevent them from engaging in protective behaviors. For example, the majority of fatalities in New Orleans following Hurricane Katrina were elderly people over age 75 years, despite the fact that only 6% of the pre-hurricane population was older than 75 years of age [7, 21]. The elderly are also more difficult to reach with communication messaging and warnings due to their isolated living situations and because they are less likely to use advanced communication technologies, such as email, social media, texting and automatic telephone alert notifications [19]. Additionally, most elderly people live at home (90%); however, many evacuation plans for the elderly are geared towards nursing homes and other assisting living facilities [19]. On the other end of the age spectrum, young children are more susceptible to injury and disease due to greater sensitivity to poor hygiene conditions, lack of safe water, and lack of access to proper diet (e.g., breast milk, baby food) [24] .

Gender is also an important component of social vulnerability. Gender does not necessarily indicate vulnerability or disadvantage; however, gender can intersect with social patterns and inequalities can arise from gender differences [19]. During a disaster, females may be more vulnerable due to differences in employment, lower income, and family responsibilities [8]. However, females also have capacities that may mitigate risk, such as being a stronger influence in mobilizing a response to a warning. Females are more likely to be strong risk communicators in their capacity as active participants in the community and may be more knowledgeable of “neighborhood information” that can assist emergency managers [19]. While most families evacuate together, it is not uncommon for males to stay back to guard the property or continue working as the family provider. Men are also likely to be risk-takers and may not heed warnings [19]. During the Chicago 1995 heat wave, men were more than twice as likely to

die as women in the same age group. This finding has been related to “the gender of isolation” reflecting norms of isolation and independence that result in less social and familial ties [19]. During the Chicago heat wave, those who did not leave home daily were 6.7 times more likely to die and those who lived alone were 2.3 times more likely to die in the heat wave [25].

Disability is another social vulnerability that impacts risk. The American with Disabilities Act of 1990 (ADA) defines disability as physical, sensory, or cognitive. This category also includes special needs populations (i.e., function-based needs irrespective of diagnosis or status) and persons with medical conditions (e.g., cancer). For many with disabilities, the ability to respond to a warning is impaired. Further, people with mobility impairments may not be able to move independently or require special vehicles for transportation. Continuity of care is also important as it can be difficult for those with disabilities to separate from their caregivers or treatment (e.g., medication). During the Chicago 1995 heat wave, those were confined to bed were at increased risk for death (odds ratio=5.5) and those who were unable to care for themselves were also at increased risk of death (odds ratio= 4.1) [25].

Limited English language proficiency is another component of social vulnerability. The number of people in the US who do not speak English or speak English as a second language is increasing. In the US, at least 18% of those older than 5 years of age speak a language other than English at home [19]. If warnings are not understood or are culturally insensitive, then they are not received. While some emergency managers are making efforts to translate warning messages, most translate only to Spanish despite the prevalence of diverse migrant populations in the US [19]. Additionally, foreign-born residents are likely to cluster in urban and coastal regions prone to natural disasters. In the congressional report *Silent Victims of Hurricanes Katarina and Rita and Immigrant Communities* the author states that Hurricanes Katrina and Rita clearly

demonstrated that the nation's basic and critical human services delivery systems had no infrastructure for meeting the linguistic and cultural needs of many Americans [26]. Prior to Hurricane Katrina, Louisiana was home to over 50,000 Asian Americans, of which more than half were Vietnamese [26]. The report documents that prior to Katrina, there were no health or mental health service provider agencies with Asian language services in the Gulf States of Louisiana, Alabama and Mississippi. This resulted in many unmet health and mental health needs for Asian Americans in the communities affected by Hurricane Katrina [26]. Language proficiency also ties in with other social vulnerabilities; those with language barriers tend to have less political power and less access to public services [8, 19].

Conceptual Framework

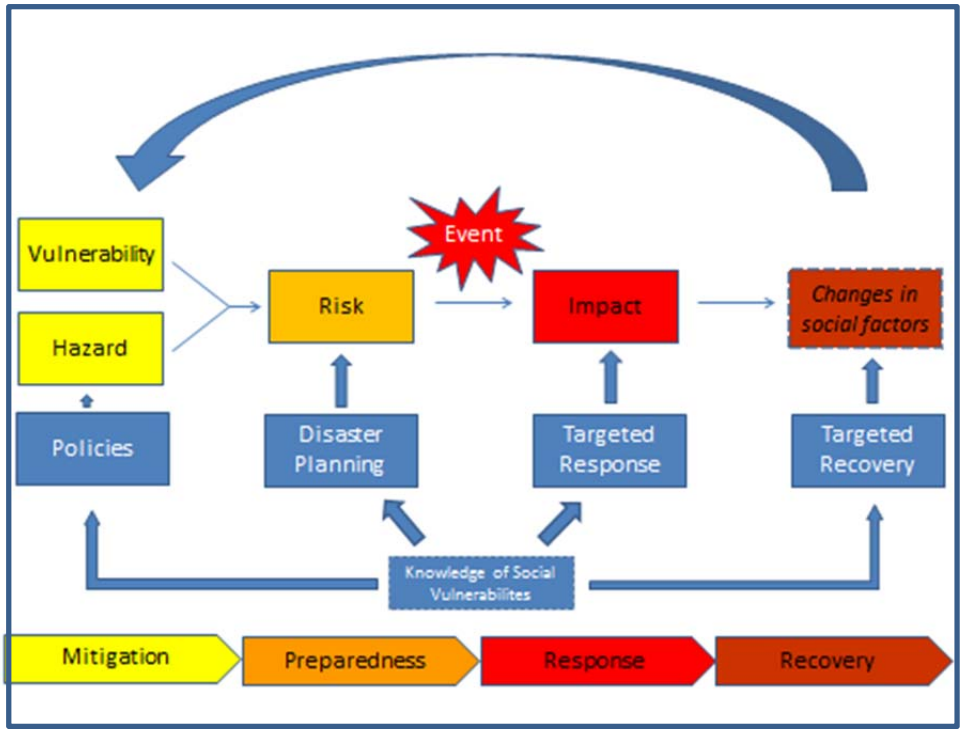
Disasters are often thought of as a cycle (Figure 1). The four phases of the disaster cycle are preparedness, response, recovery and mitigation [12, 27].The preparedness phase takes the form of plans designed to save lives and to minimize damage when a disaster occurs. The

Figure 1. The disaster cycle.

response phase is defined as the actions taken to save lives and prevent further damage in a disaster [28]. The recovery phase includes the actions taken to return the community to normal following a disaster such as repairing, replacing, or rebuilding property [28]. Mitigation is the

sustained action or policies that reduce or eliminate risk to people and property from disasters [28]. The conceptual framework in Figure 2 depicts the influence of social vulnerabilities on each phase of the disaster cycle and its intersection with the disaster risk equation. R*isk* represents the intersection between hazard and vulnerability and *vulnerability* includes both physical and social vulnerabilities. Knowledge of social vulnerabilities can diminish risk during each disaster phase. During the preparedness phase, emergency managers need to know which groups are less likely to prepare for disasters and which groups are least likely to have critical response items available (e.g., first aid kits, bottled water) [12]. During the response phase, emergency managers need to know which groups are least likely to hear, understand and react to warnings, which groups will have greatest difficulty following evacuation orders, which groups will need emergency medical care or continuation of medical care, and which groups are least likely to have access to emergency services. During the recovery phase, emergency managers need to know which groups are most likely to have suffered a debilitating impact, experienced problems with economic or emotional recovery, or have altered social factors requiring additional resources. During mitigation, policies can ensure emergency managers are aware of the social vulnerabilities in their community and require that resources are made available to reduce the risk to these populations [2].

Figure 2. Conceptual framework



Research Question

The objective of this research is to answer the following question and sub-questions: What approaches, if any, are emergency managers using to identify at-risk populations within their jurisdiction?

- What tools or processes do emergency managers use to identify at-risk populations?
- What are the barriers to identifying socially vulnerable populations?
- What would facilitate the identification of these populations for emergency managers?

CHAPTER 2: LITERATURE REVIEW

In 2006, the Pandemic and All Hazards Preparedness Act (PAHPA) was enacted and singled out preparedness as an essential public health capability requiring state and local health departments to implement disaster plans. PAHPA required the disaster plans "to integrate the needs of at-risk individuals on all levels of emergency planning, ensuring the effective incorporation of at-risk populations into existing and future policy, planning, and programmatic documents" [29].

To assist emergency managers in identifying social vulnerabilities, researchers have developed approaches and tools to quantify and geographically visualize social vulnerabilities within populations [13]. Susan Cutter's Social Vulnerability Index (SoVI) was one of the first tools developed to assist with the identification and visualization of social vulnerabilities. The SoVI is based on 42 US census variables and examines social vulnerabilities at the county level, such as socioeconomic status, gender, occupation, family structure, and education [6]. The SoVI is an operational index for empirically determining social vulnerability. Despite the requirement to integrate the needs of at-risk populations and the availability of tools to assess social vulnerabilities, it is unclear if emergency managers are identifying social vulnerabilities. This literature review will answer the following question:

> How are social vulnerabilities identified and to what extent are social vulnerability indices being used in disaster research?

The objectives of this systematic literature review were the following: 1) describe recent applications of social vulnerability assessments in relation to disaster research; 2) identify which social vulnerabilities indices (or similar assessments/metrics) are being used, and 3) present lessons learned on applying social vulnerabilities indices to disaster research.

Definitions

Disaster- a serious disruption of the functioning of society, causing widespread human, material or environmental losses, that exceeds the local capacity to respond, and calls for external assistance.

Disaster plan- The ongoing plan maintained by various jurisdictional levels for responding to a wide variety of potential hazards. Also referred to as "emergency" or "all-hazards" plan.

Disaster management- strategic management processes used to protect communities from negative consequences of disasters.

Emergency manager- the person who has the day-to-day responsibility for coordinating all aspects of a jurisdiction's emergency management program and activities.

Social vulnerability- the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a discrete and identifiable event in nature or society.

Social vulnerability assessment- a quantitative and/or qualitative analysis used to identify socially vulnerable populations, to more completely understand the risk of hazards to these populations, and to aid in mitigating, preparing for, responding to, and recovering from that risk.

Vulnerable populations- those groups whose needs are not fully addressed by traditional service providers or who feel they cannot comfortably or safely access and use the standard

resources offered in disaster preparedness, relief, and recovery. Also referred to as at-risk populations.

Methods

This purpose of this literature review was to aggregate and analyze articles on the application of social vulnerability tools used in disaster research. This literature review will guide additional research on the identification of social vulnerabilities for disaster planning, as well as identify current and/or best practices, gaps, and barriers to applying social vulnerability assessments to disaster research. A broad search was conducted to identify published articles on this topic. This literature review included published case studies, review articles, and preparedness reports from credible US federal, state, and local government, academic and private sector sources.

Sources

A systematic review was performed using PubMed and Google Scholar. PubMed captured all published articles that had a health component on this topic and Google Scholar captured relevant articles that were not published in a medical journal. I limited my Google Scholar review to the first 100 articles returned. Bibliographies of relevant articles and reports were searched to identify additional research not found through the searches.

Search Strategy

The PubMed search strategy reflected the concepts and MeSH search terms included in Table 1; the Google Scholar search included the MeSH terms and relevant key words.

Table 1. Concepts, MeSH terms, and key words used for systematic review

Concepts	**MeSH terms**
Social vulnerability	Social vulnerability OR vulnerable population OR at-risk
AND	
Disasters	Disasters OR disaster medicine OR public health emergency
Concepts	**Key Words**
Social vulnerability index	Social vulnerability index OR SoVI
Social vulnerability assessment	Social vulnerability assessment OR vulnerability assessment

Selection Criteria

Four inclusion criteria were used for this review. First, the article had to be published in English and refer to social vulnerabilities and natural disaster research within the US. Because the construction of indices typically used in the US is dependent upon the US Census, indices are not replicable outside of the US. Second, the article had to describe the application of social vulnerabilities to research or response work. Third, the article had to be from the past ten years (2002-present). Fourth, the articles were limited to the application of social vulnerabilities assessments for natural or man-made disaster scenarios (as defined previously).

Articles were excluded for any of the following reasons: 1) the article focused solely on hazard vulnerability assessments (which include only hazards to the physical environment and excludes social vulnerabilities), 2) the article described a social vulnerability index or framework without including an application of the data, 3) the article solely described an application conducted outside of the US, 4) the research was limited to climate variability (predictions of future climate change), or 5) the research focused on pandemic flu. Pandemic flu was excluded

because social vulnerability indices are based on the Hazards of Place models which conceptualize the inputs to social vulnerability within the broader physical hazards paradigms and are not applicable to infectious diseases [6]. Further, this review did not include individual state or local emergency plans.

The titles and abstracts or summaries (when available) of each paper identified through PubMed and Google Scholar were first screened for relevance and to determine if they meet selection criteria. If the abstract met the criteria, then the entire article was examined for content relevant to the research question.

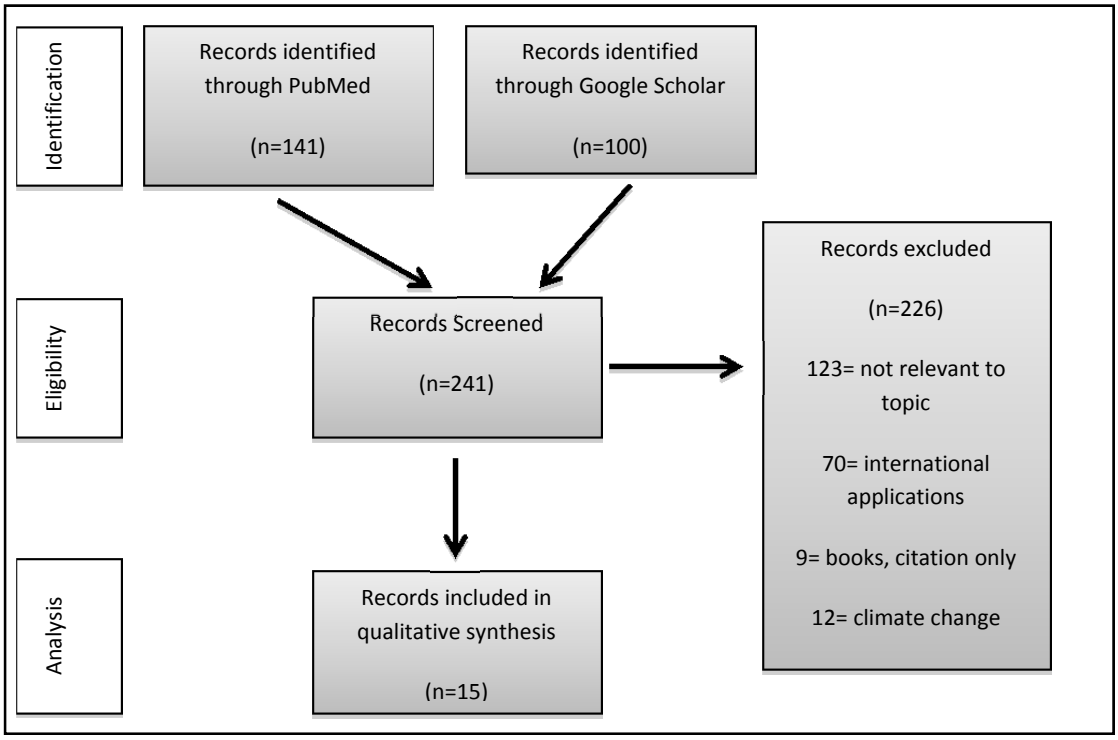
Review Strategy

I recorded all relevant articles in an Excel database. I tracked the relevant studies and included the title, brief abstract (if available), journal, date, authors and their affiliations, article objectives, application location (e.g., southern coastal communities, Los Angeles), geographic context (i.e., regional, state, local), disaster type assessed (e.g., hurricane, earthquake), method for conducting social vulnerability assessment, specific social vulnerability index or framework utilized, data source, and lessons learned, including results, limitations, and successes. Further, I noted common themes and identified gaps in the application of social vulnerability indices in relation to disaster research.

Results

Figure 3 describes the study selection process for the systematic review. The PubMed search resulted in 141 articles. An additional 100 studies were returned in Google Scholar. The 241

Figure 3. Article selection process for the systematic literature review



articles were first reviewed by reading the title and abstract (when available). If necessary, the complete article was reviewed to determine selection status. The majority of the articles were excluded from this review because they were not relevant to the topic (n=123). Many articles were also excluded because the work was not domestic (n=70). Fifteen articles met the selection criteria; the majority of articles were captured in Google Scholar. Table 2 describes a summary of the articles. The majority of the authors were academics; 40% (n=6) were from the University of South Carolina's Hazard and Vulnerability Research Institute. Only five articles were co-authored by non-academics, including four from government agencies. Most articles focused on a specific natural disaster type, with hurricanes (n=4) being the most common disaster type addressed. The assessments were conducted for jurisdictions all over the country; the type of jurisdiction ranged from county to region. The 15 articles focused on two general topics:

mitigation (n=10) and recovery (n=5). The articles on mitigation examined spatial variability of social vulnerabilities to potential disaster impacts, test the application of specific indices to disasters, or overlay social vulnerability scores with physical hazard scores to determine the geographic distribution of vulnerabilities. Articles focusing on recovery assessed the relationship between social vulnerability and recovery patterns, migration, economic losses, or resiliency.

Seven different indices were used to assess social vulnerability. Most authors used Cutter's SoVI (n=10) or slight modifications of Cutter's SoVI. Because many of the indices were based on the SoVI, the social vulnerability concepts and variables used to construct the indices were similar. Table 3 lists the 10 most common variable concepts used in the 15 assessments. Although Cutter's original SoVI recommends a set of 42 variables, some researchers chose a subset of these variables appropriate for the areas they were assessing and most researchers eliminated variables due to multicollinearity. Most of the articles did not include the concepts of disability (20%) and English language competency (27%). Most of the articles used social vulnerability data from the US Census. Other data sources included GeoLytics Neighborhood Change Database, FEMA HAZMUS, and the National Atlas.

Several themes emerged from the 15 articles included in this analysis, including: 1) the general role of social vulnerability and its impact on disaster risk; 2) the utility of social vulnerability assessments; and 3) limitations and gaps of current social vulnerability assessments. The most prominent theme discussed in these articles was the general study of social vulnerability and its impact on disaster risk. The majority of articles state that populations are differentially affected by disasters due to three factors: 1) physical and geographic landscape in which people live, 2) physical risks to which they are exposed, and 3) underlying social determinants. For example, Burton and Cutter stated that spatial differences in vulnerability are

"based on the characteristics of the communities," as well as the physical risk of disasters [3]. Many of the articles concluded that geographic discrepancies in social vulnerability necessitate different mitigation and recovery actions. Specifically, Cutter and Emrich state that a "one-size fits all approach to preparedness, response, recovery, and mitigation may be the least effective in reducing vulnerability or improving local resilience to hazards" [6]. Azar and Rain made similar conclusions stating that "awareness of vulnerability is the first step toward action by any interested individual or party" [30].

The majority of authors concluded that the social vulnerability indices are useful tools for mitigation and recovery activities and suggested that the tools would also be useful for preparedness and response activities. The information provided by the indices allow disaster planners to identify pockets of vulnerability, make quick comparisons across and within communities, and determine geographical areas where improvements in mitigation plans and recovery actions should occur. For example, Meyers et al. concluded that the social vulnerability index "provides an important diagnostic tool for policymakers interested in identifying the factors that place communities at differential risk to disaster and that influence response and recovery efforts in their aftermath"[31]. Chakraborty et al. cited that the index "combines physical and social vulnerabilities to create a picture of the country's present overall vulnerability"[32].

Table 2. Summary of articles assessing application of social vulnerability (SV) assessments (n=15)

Article	Year	Geographic Context	Topic	Natural Disaster Type	Objective	Index*	Results/Lessons Learned
Azar and Rain[30]	2007	City	Mitigation	Hydrological	Test the applicability of two SV indices for analysis of hydrological disasters	SoVI SVAI	High correlation between different indices; awareness of vulnerability is first step in mitigation
Burton and Cutter[3]	2008	Regional	Mitigation	Flooding	Examine spatial variability in SV of residents to potential levee failures	SoVI	Detected spatial differences in vulnerabilities based on underlying social characteristics; one size fits all approach would not address needs of region; pockets of vulnerability within community should warrant concern
Chakraborty, Tobin, et al.[32]	2005	County	Mitigation	Hurricane	Examine spatial variability in evacuation assistance needs as related to hurricanes	SVEAI	Geophysical risks and SV can produce different spatial patterns that complicate mitigation; different measures of SV confound evacuation strategies as there are different vulnerabilities that affect communication versus vulnerabilities that affect transportation
Cutter, Burton, et al.[17]	2010	Regional	Recovery	General natural Disasters	Provide and test methodology and set of indicators for measuring baseline characteristics of communities that foster resilience; apply to southeastern US as proof of concept	BRIC	Baseline indicator index can be replicable and robust; index can be used to determine disaster resilience of places
Cutter and Emrich[6]	2006	Regional	Recovery	Hurricane	Describe SV of areas affected by Hurricane Katrina to determine effect on resiliency	SoVI	Dissimilarity in ability of areas to adequately respond from Hurricane Katrina; recovery follows SV index score

Finch, Emrich, et al.[33]	2010	City	Recovery	Hurricanes	Use index to measure how SV affects the geography of recovery in New Orleans from Hurricane Katrina	SoVI	SV was an important indicator for recovery, but not as important as flood height; communities with higher SV scores have slower recovery rates
Gaither, Poudyal, et al.[34]	2011	Regional	Mitigation	Wildfires	Address wildfire risk and its intersection with SV	SoVUP	SV populations have longer distances to wildland fire mitigation programs than areas with low SV; useful to use SV index to explore relationship between social status and wildland fire risk
Kleinosky, Yarnal, et al.[35]	2007	Regional	Mitigation	Flooding	Assess overall vulnerability to flooding by multiplying flood risk scores with SV scores	SoVI	Areas likely to experience storm-surge flood same areas where most SV populations lives
Myers, Slack, et al.[31]	2008	Regional	Recovery	Hurricanes	Assess relationship between SV and migration after hurricanes	SoVI	Places with greater proportion of disadvantaged populations, housing damage, and densely built environment more likely to have outmigration after hurricane; SV index useful as diagnostic tool for policy makers to consider both biophysical and social characteristics
Peacock, Grover, et al.[27]	2011	Regional	Mitigation	Hurricanes	Identify and test methods to target areas with natural disaster risks due to both physical and SV	SV index	Determined Cutter's SoVI not conducive for community-based planning and developed new approach for disaster planners to effectively identify areas within their communities which have high levels of SV that will affect resiliency
Schmidtlein, Deutsch, et al.[36]	2008	City	Mitigation	General natural disasters	Conduct sensitivity analysis of SoVI to address changes in index construction, scale at which applied, set of variables used, and various geographic contexts	SoVI	Subset of indicators produced similar findings to full set; index robust for minor changes in scale; index was sensitive to construction and required local expert knowledge to correctly apply
Schmidtlein,	2011	City	Recovery	Earthquake	Examine spatial linkage	SoVI	In each model, the physical event

Shafer, et al.[37]					between SV and estimated earthquake losses for differing magnitudes		parameters were more important than SV measures; there was a relationship between earthquake losses and SV; SV index can be used to predict relative losses
Simpson, Deutsch, et al.[38]	2008	State	Mitigation	General natural disasters	Identify and test method for Kentucky to conduct vulnerability assessment based on hazard vulnerability score (HVS) which includes SV and hazard scores	HVS	Compiled repository of state-level data that includes social and physical hazard vulnerabilities; state can use new technology for comprehensive vulnerability assessment at state level for natural hazards, however, exceeds technical capacity at local level
Wood, Burton, et al.[39]	2010	Regional	Mitigation	Earthquake and tsunami	Assess spatial variability in SV of Oregon coast residents to potential earthquake and tsunami impacts	SoVI	Certain groups and individuals living on the Oregon Coast are likely to differ disproportionately due to difference in SES and other demographics unrelated to natural disaster physical impact; need to include place-based characteristics to fully understand hazard risk; not useful for exhaustive inventory of individuals with high SV, rather useful for comparative purposes
Wu, Yarnal, et al.[40]	2002	County	Mitigation	Flooding	Assess the vulnerability of Cape Cod, MA coastal community to flooding and relationship with social construction	SoVI	Most of the barrier islands have SV because of a high concentration of elderly people; areas of SV due to poverty are congregated near larger towns; useful to overlay SV, hazard risk, and resources in GIS to assess overall vulnerability picture

*SoVI=Cutter's Social Vulnerability Index; SVAI=Social Vulnerability Averaged Index; SVEAI=Social Vulnerability for Evacuation Assistance; BRIC=Baseline Resilience Indicators for Communities; SoVUP=Social Vulnerability Index (developed by Gaither et al.[34]); SV index= Social Vulnerability Index (developed by Peacock et al.[27]); HVS=Hazard Vulnerability Score

Table 3. Ten most common concepts included in the 15 social vulnerability assessments

Concept	Number (%) of articles which assessed concept
Age (e.g., % population < 5 yrs old, % population 65 years or older)	14 (93%)
Education (e.g., % population >25 years old with <12 years of education)	10 (67%)
Employment status	9 (60%)
Female head of household	10 (67%)
Hispanic immigrants	10 (67%)
Housing ownership (e.g., % renters)	10 (67%)
Housing structure (e.g., % mobile homes, median house value)	14 (93%)
Poverty (% below poverty)	13 (86%)
Population (total or occupied housing units)	13 (87%)
Transportation access	12 (80%)

Despite the resounding conclusion in these articles that social vulnerability indices provide useful information, there were several limitations discussed regarding the actual application of the social vulnerability assessments. Several of the articles cited that social vulnerability mapping does not adequately represent the true nature of components contributing to the vulnerabilities at a particular place. Finch et al. suggested that "without understanding the underlying causes that contribute to disparities it is difficult to address the vulnerabilities in disaster planning" [33]. In addition, the social vulnerability indices only capture a "snapshot" of a single period and do not explore the longitudinal nature of disasters and vulnerabilities. Chakraborty et al. suggest that social vulnerability is not a static measurement for at least two reasons. First, people move, therefore, the distribution of those with need will change over time. Second, measures of need change with different types of disasters [32]. Another limitation discussed is the dependency on national data to construct the indices. Much of the data used to construct the social vulnerability indices were based on the US Census, which is only updated

every 10 years. Cutter et al. stated the reliance on national data "may be inadequate to characterize local circumstances and does not include important indicators, such as, community capacity (e.g., volunteerism)" [17]. A few of the articles found the sensitivity of the construction of the index to be significant. There was some disagreement on whether to use a subset of or the full set of variables recommended by Cutter, as well as on how to construct the index (e.g., weighting the variables, use of additive models). Finally, several articles mentioned that the level of technical capacity needed to construct these complex assessments was a major limitation and noted that they would be difficult for emergency managers to implement. For example, Simpson et al. suggest that "a majority of state mitigation staffs will not have the expertise or the time to complete these time and labor-intensive plans" [38].

The most common gap discussed within the context of social vulnerability assessment was the lack of a qualitative counterpart to the quantification of social vulnerabilities. Quantitative assessments provide summary characteristics but do not provide a complete understanding of the driving forces underlying social vulnerability or its distinct landscape, which require qualitative assessments to understand. Schmidtlein et al. emphasized that "we must be careful when employing numerical vulnerability indices to realistically represent the underlying vulnerability, and not other hidden or related phenomena"[36]. Schmidtlein et al. assert that "in-depth qualitative analysis, such as case-studies, can provide the context necessary for applying the quantitative index constructions. These studies could provide better information on the actually manifestation of vulnerabilities within a study area and provide additional information on the appropriate design of mitigation and response strategies" [31, 36].

Discussion

Findings

Three major findings emerged in the literature, including the general role of social vulnerability and its impact on disaster risk, the utility of social vulnerability indices, and limitations and gaps of current methodologies.

There was universal acceptance that social vulnerabilities place certain populations at greater risk of illness and death during many types of disasters. The role of social vulnerabilities presented in the articles supports findings from previous disasters. For example, previous studies have shown that hurricanes disproportionately affected the poor, elderly, and female heads of households [18]. During Hurricane Katrina, African Americans and elderly populations were disproportionately affected [21, 41]. Most of the articles assessed a set of social vulnerabilities consistent with broader disaster literature; however, disability, literacy, and English language competency were not included in the majority of these articles despite evidence in the literature of the importance of these vulnerabilities [11, 18]. These variables may have been excluded because it is difficult to ascertain this information at the community level. The majority of studies used US Census data, which do not have variables for disability and literacy at the level of analysis (i.e., census tract). Further, race was often excluded despite strong evidence in previous research that non-whites are affected disproportionately by disasters. Race was likely not included because of its strong correlation with other variables, such as poverty and social class. Several authors noted that it is difficult to separate the source of increased vulnerability when race is included in the indices.

The second finding in this review centered on the utility of social vulnerability indices. All of the articles concluded that the application of social vulnerability indices was useful in

predicting who and where disasters would impact and recovery patterns. The articles highlighted that knowledge of where vulnerabilities are concentrated within communities and the nature of the vulnerabilities is an important criterion of effective disaster management. However, based on the minimal number of studies identified (n=15), there is little evidence that practical applications of social vulnerabilities assessments are frequently, if at all, included in disaster management. All of the articles were published by academics and only four of the articles included government authors (i.e., state and local health or emergency staff). This may suggest that while academics recognize the importance of identifying social vulnerabilities for effective disaster management, it may not be conducted in practice.

The final finding highlights the limitations and gaps in the current social vulnerability assessment methodologies. Several authors claimed that social vulnerability indices ignore the underlying causes of vulnerabilities, which are often rooted in the structure of society itself. An opposing view from other authors stressed the recognition of increased vulnerability of these populations alone can lead to solutions for addressing these problems, suggesting knowledge of social vulnerabilities is an important first step. Another major limitation addressed by several of the authors was the technical capacity necessary to conduct social vulnerability assessment. The current indices require expertise in statistics and geographical information systems (GIS); these skills may not exist among emergency managers. Further, a few of the authors highlighted the need for local information, which can provide the context necessary to understand the manifestation of vulnerability within their communities, to properly interpret the quantitative assessments. Without having both the technical capacity and the local expertise, the social vulnerability assessments cannot be conducted properly.

Implications

The main implication of this literature review is that identification of social vulnerabilities is important; however, emergency managers are likely not using existing tools to identify social vulnerabilities. All of the articles found on social vulnerability assessments were published by academics and none were published in public health or emergency management journals. I hypothesize several reasons for this finding.

First, the study of social vulnerabilities has historically been conducted by geographers who tend to publish in geography or social science journals. Socially vulnerability research concentrates on the role of "place" in disasters and requires sophisticated geographic information systems (GIS) to map social vulnerabilities. Another hypothesis is that the field of public health has not wholly adopted the role of social vulnerabilities in disasters, which would have a much broader implication on the research question. If emergency managers and planners do not recognize the role of social vulnerabilities in disasters, then it is difficult to motivate them to adopt the use of social vulnerability indices.

Directions for Future Research

Future research should address the gap between the existence of social vulnerability assessment methodologies and utilization of social vulnerability assessments by emergency managers. The technology and methodology exist to determine social vulnerabilities in communities; however, emergency managers likely are not utilizing these tools. Research that closes this gap would add greatly to the current practices in the disaster preparedness and response community. One solution is the development of a simpler tool that allows emergency managers to identify social vulnerabilities within their communities. Another solution is educating emergency managers about these tools. Before a solution can be found, the following

information must be learned: 1) acceptability of social vulnerability assessments in disaster management; 2) emergency managers' attitudes regarding the usefulness and effectiveness of social vulnerability assessments; and 3) current feasibility in conducting these assessments (e.g., statistical capability, GIS proficiency) at the local level.

Limitations

There are two overarching limitations of this review. The first is the quality and limitations of the articles included in this review. The quality was weak in several areas. Many articles did not describe the social vulnerability variables they ideally would have included had the data been available. Because many of the articles used US Census data, they were limited to the variable provided by the Census. Variables that have been found to significantly affect disaster risk, such as disability, were not included in the analysis or even mentioned in the articles. Another weakness is that the studies promote the usefulness of social vulnerability assessments, but stop short of describing how and if emergency managers were using the information provided by the assessment. Additionally, five of the articles were conducted by researchers from academic institutions located outside the jurisdiction they were studying and did not include co-authors from the study areas. Because social vulnerability assessments must be interpreted with local knowledge, the quality of their interpretations may be dubious.

The second limitation is my ability to collect all examples of social vulnerability assessments. Ideally, I wanted to capture all applications of social vulnerability indices in disaster research to address my research question. My chosen methodology only captured published material and articles to ensure data quality. I attempted to capture additional articles by using Google Scholar in addition to PubMed. Based on this literature review there is very little research on the application of social vulnerability assessments. However, it is possible that the

applications are being conducted but the results are not being published. The majority of articles were by academics which could mean that academics are the only researchers conducting social vulnerability assessments or academics are the only ones publishing their social vulnerability assessment results.

Additionally, 40% of the articles had the same co-authors, which may have led to an overestimation of the current use of social vulnerability indices. Conversely, publication bias may have led to underrepresentation of social vulnerability assessment utilization. Individual social vulnerability assessments are not generalizable; therefore, articles on this topic may not be selected for publication in peer-reviewed journals.

A review of individual state, city, or county disaster plans would have provided additional information on who is conducting social vulnerability assessments. However, this would have been extremely time intensive and could have led to spurious results since the mention of social vulnerability assessments within a disaster plan does not indicate the assessments are being conducted, nor would the plan indicate the quality or usefulness of the assessment.

Conclusions—Aim 1

The important role of social vulnerabilities in disasters has been widely accepted; however, approaches to incorporating social vulnerability into emergency management practices are not known. This review suggests that social vulnerability indices as part of a broad approach to emergency management has the potential to significantly reduce losses and improve outcomes. Because the literature did not provide much information on current practices, qualitative research is needed to fully understand how emergency managers are identifying social

vulnerabilities. Future research should determine current approaches and determine ways to assist them in using existing methodologies and technologies.

CHAPTER 3: METHODS

This study used a nonexperimental, descriptive design. I applied qualitative methods to understand what, if any, approaches emergency managers are using to identify social vulnerabilities. Key informant interviews were conducted with emergency managers to understand the current approaches in disaster management for identification of social vulnerabilities. Because the literature did not provide much information on current practices, the interviews were used to elicit this information. A follow-up workshop with additional stakeholders was also conducted to gain a deeper understanding of current approaches. The results from the interviews and the workshop were used to address Aim 2 (identify current approaches used by emergency managers to identify social vulnerabilities) and Aim 3 (develop a plan for change that improves approaches to identifying social vulnerabilities).

Data Collection and Data Sources

Nine key informants were identified through purposive sampling. Emergency managers were selected from a wide variety of jurisdiction sizes and regions. At least one emergency manager was selected from each of the five US regions (Northeast, Southeast, Midwest, Southwest and the West). Additionally, I selected at least two emergency managers from the following population sizes: small (less than 50,000); medium (50,000-175,000); and large (greater than 175,000). Table 4 displays the region and jurisdiction sizes of the nine key informant interviewees. To identify potential participants, I worked with several national

organizations including the National Emergency Managers Association, International Association of Emergency Managers, Disaster Epidemiology Community of Practice, and Council of State and Territorial Epidemiologists' Disaster Epidemiology Subcommittee.

Table 4. Region and jurisdiction size of key informant interviewees

Region	**Jurisdiction Size**			**Total**
	Large (total population greater than 175,000)	Medium (total population between 50,000and 175,000)	Small (total population less than 50,000)	
Northeast			1	**1**
Southeast	3	1	1	**5**
Midwest		1		**1**
South	1			**1**
Northwest		1		**1**
Total	**4**	**3**	**2**	**9**

I sent potential participants a recruitment email (see Appendix A). Interested participants were then scheduled for a 30 minute telephone interview. During the interview, I read the informed consent over the phone and participants were asked to verbally consent to participation and recording of the interview. All interviews were conducted using a semi-structured interview guide (see Appendix B) between June and August 2013. After each interview, I wrote memos and summarized the content of each interview (including date/time of interview, main points expressed, and how long the interview lasted).

Each interview was transcribed and transcripts were reviewed for quality assurance. Transcription was conducted by GMR Transcription (GMR Transcription, Atlanta, GA). Once the transcriptions were complete a second person read through each while listening to the recording to ensure accuracy and made revisions where necessary based on my memos and

notes. I reviewed each transcript as well for accuracy. Each transcript was then coded by a researcher at SciMetrika (SciMetrika, Research Triangle Park, NC) using ATLAS.ti (version 6.2.28, Atlas.ti Scientific Software Development GmbH, Berlin). Coding allowed the data to be systematically read for themes. Deductive codes based on the interview questions were applied to all transcripts, as well as inductive codes based on themes observed by me during the interview. Not all themes were found across all interviews. Codes were organized in a codebook (see Appendix C) based on the conceptual framework, research questions, and interview guide. The Atla.ti© software coded emergent themes that were common across interviews and SciMetrika conducted a systematic analysis of the codes.

To delve deeper into understanding the themes that emerged in the interviews, I hosted a workshop—Emergency Managers and Social Vulnerability Workshop— at CDC on July 11-12, 2013 to gather additional information from informants and other stakeholders. Workshop participants included local-level emergency managers (of which, seven were also key informant interviewees), state-level emergency managers, academic researchers, public health and human resource practitioners, and representatives from CDC. The workshop agenda included demonstrations of social vulnerability tools and breakout sessions to discuss the themes that emerged from the key informant interviews (see agenda Appendix D). Workshop participants were asked to share their personal knowledge and experiences with the group during the discussion groups. To capture information from the workshop, note takers took notes throughout the entire workshop and audio recorded each session. SciMetrika summarized the meeting notes and verified the notes using the audio recordings of the meetings.

Limitations

This study was limited to nine participants for the key informant interviews due to the Office of Management and Budget (OMB) Paperwork Reduction Act which requires approval from the OMB for federally sponsored data collections. Because I am an employee of the CDC and data collection for this project is federally sponsored, the OMB Paperwork Reduction Act would have applied to this research had I included 10 or more participants in the survey. Therefore, the interview portion of this study was limited to nine emergency managers. The nine interviews and the additional information gathered from the workshop were sufficient to inform future work. The nine also provided enough information to reach saturation on all areas of inquiry.

This study was not representative of all emergency managers across the country and was limited to the experiences, perceptions and practices conveyed by study participants. In alignment with the principles of qualitative research, participants for this study were purposefully selected. The idea behind purposefully selecting participants in qualitative research is to help the researcher understand the research question and does not imply a random sample or a large number of participants was used [42]. This research was not designed to be representative of a larger population and generalizability was not a goal of this study.

Institutional Review Board and Confidentiality Issues

I sought and received IRB approval from CDC. CDC reviewed the protocol in accordance with expedited review process, determined that the study poses no greater than minimal risk to subjects, and approved the request for waiver of documentation of informed consent. CDC granted IRB approval on June 6, 2013. I also sought IRB approval from UNC.

UNC reviewed the submission and determined the study to be exempt from further review on May 22, 2013.

Respondent information was kept confidential. Names were not recorded on the transcripts. Each interview was assigned a code, all written materials summarizing the interview content, including the transcripts, were designated by this code, and the master sheet linking the participant and the code were kept separately in a locked cabinet. Electronic and hard copies of interview notes and other data were stored on a password-protected computer. Access to electronic and hard copies of notes were restricted to the researchers only. All notes, tapes and transcripts will be destroyed upon the completion of the study and after the dissertation is approved by my dissertation committee.

Data are only presented by jurisidction size and geographic region. The primary risk to subjects participating in this study was breach of confidentiality. However, because all study materials were secured, this breach was unlikely.

CHAPTER 4: RESULTS

Results are based on key informant interviews and the workshop. Throughout the results select quotations from key informants are included in blue boxes. These quotations were selected based on the clarity with which they illustrate the emergent themes. At the end of each quotation, the source (i.e., the region and jurisdiction size) of the quotation is identified.

Description of in-depth interview participants

The nine key informants were all local-level emergency managers. Emergency managers described working in their current positions on average nine years, with a range of 1-18 years. Several emergency managers worked in the emergency management field before starting their current role increasing the average time working in emergency management to 19 years.

Definitions of at-risk populations

Emergency managers in the key informant interviews and the workshop were asked how their jurisdictions defined at-risk populations. All the emergency managers had broad definitions of at-risk populations. Most often the definition included all persons that may not be able to evacuate in the event of an emergency, including individuals with medical or functional needs, individuals with special needs including physical or cognitive disabilities (e.g., mental illness, vision impaired, hearing impaired), low socioeconomic status, those with no transportation, homeless populations, those who spoke English as a second language or were non-English

speaking, and immigrants. One emergency manager specified using the Federal Emergency Management Agency (FEMA) definition of at-risk which includes "those individuals specifically recognized as at-risk in the statute, i.e., children, senior citizens, and pregnant women, as well as those individuals who may need additional response assistance such as those with physical or mental disabilities and those with limited English proficiency." Several emergency managers created their own definitions.

> "Anybody that doesn't have the ways and means to get out of harm's way is an at-risk population. I mean it's pretty broad from that perspective. So you can't leave no body behind, you have to be prepared to handle any and all situations."
>
> (Large jurisdiction, Southeast)

> "We look at anyone who is outside of the mainstream population, meaning if you have a set of people who you know you can give a set of directions and they're going to understand your directions and follow those, you assume they are your mainstream population. Anyone outside of that would be a special needs person, whether that's because they have physical limitations or because they speak a different language."
>
> (Medium jurisdiction, Northwest)

One definition also included tourists, farm workers, and populations that live in mobile homes. Another included sex offenders as a "special needs" population since during emergencies they require accommodations that are separate from the general population.

Identification of at-risk populations

Emergency managers reported two main methods for identification of at-risk individuals: registries and partnerships.

Registries

Some emergency managers described a self-identification process for the registration of at-risk populations. Several counties maintained a registry or database where people needing special assistance could register year round either by phone, online, or by mail.

> "Our communication department now does Smart911, which people can call into the 911 center and provide information that tells them if they have something like they're on oxygen, or they need special assistance."
>
> (Medium jurisdiction, Midwest)

> "[We have] a number that is included in our emergency guide or hurricane guide that goes out every year. We do have individual applications that we will mail out. We provide them at a number of different government offices. It is on our website, so people can register at the website. They can also call our local county 311 and request information over the phone."
>
> (Large jurisdiction, Southeast)

In several instances, this self-identification process was combined with additional assistance from various community organizations or groups. Local organizations often referred people that needed assistance to the state. In some cases, there was a website or a hotline for registration, but local organizations could call in on behalf of people that needed assistance or register for them online.

> "We have formed an alliance with our faith-based organizations to help us identify people within a community that meet any criteria, whether it be a special needs or an aging population or without transportation problem to get us that information so that we can pair them up and send them to the appropriate locations."
>
> (Large jurisdiction, Southeast)

While some emergency managers support the use of registries, some cited concerns with the accuracy of the registry information as it can quickly become outdated.

> "We're going the partner route because trying to develop a registry and maintain it and keep it up to date is really kind of an overwhelming task, and I think as soon as you create your registry it's gonna be out of date."
>
> (Medium jurisdiction, Northwest)

<u>Partnerships</u>

All emergency managers reported partnering with other agencies, organizations, or groups to assist with identification. Partners often differed based on the targeted population. Some emergency managers worked with partners that were considered trusted networks to the at-risk population as illustrated in the following quotes.

> "I'm a firm advocate of faith-based organizations because they know the elderly more so probably than anybody, sometimes even more so are aware than some of their family members. We have formed an alliance with our faith-based organizations to help us identify people within a community that meet any criteria, whether it be a special needs or an aging problem or without transportation problem to get us that information so that we can pair them up and send them to the appropriate locations."
>
> (Large jurisdiction, Southeast)

> "We thought if we really reach out to all the groups who already know who those people are that way we can get that word out and we know then. They've identified and they've got these people. They can also go out there and they can talk to them about why it's important to know what are the hazards, how they can be better prepared, how they need to respond and recover and that sort of stuff within the jurisdiction."
>
> (Medium jurisdiction, Midwest)

> "We're going the partner route and what we want to be able to do is develop relationships with the various human service agencies and bring them in as partners, and so when something happens, then we can push information out to them and they can push it out to their service populations because they're already a trusted voice and a trusted source by those target populations."
>
> (Medium jurisdiction, Northwest)

Emergency managers identified a number of key partners in their communities. Partners included: local churches, community agencies, health departments, county and state agencies, local businesses, and advocacy groups. Several emergency managers reported that have developed coalitions comprised of partner organizations to communicate information to their clients or members during before, during and after an emergency.

> "We've worked to build a [Community Outreach Information Network] that allows us to access those trusted networks that our at-risk populations are already engaged with so that we don't have to maintain a registry. Instead we have this communication system setup that we send a message into the [network] and the [network] then distributes the message amongst their clientele or their different constituents."
>
> (Small jurisdiction, Northeast)

<u>Frequency of updates</u>

For counties that had registries, emergency managers were asked how often they updated the information in the registries. Information was usually checked twice a year with persons

being able to register at any time during the year. Some counties conducted calls to verify that people still needed to be on the registry. One county required participants to re-register on an annual basis.

> "Information is pushed out all year long, so as we get new applications, we're constantly updating it. What we do to verify that the people on the registry still need to be there, we do two call downs a year, typically one before the start of hurricane season, another one either mid-year or thereabouts."
>
> (Large jurisdiction, South)

Tools or processes used by emergency managers

Emergency managers were asked if they were aware of specific social vulnerability tools that have been developed to assist emergency managers in identifying at-risk populations. Only half had heard of the social vulnerability tools. However, the majority had not received any training on how to use the tools available. Several emergency managers mentioned using census data or Geographic Information Systems (GIS) to track vulnerable populations. One emergency manager described using tools to identify areas with at-risk populations in order to be able to target resources to areas with a higher percentage of those in need.

> "If there was a specific area of the county that was impacted greater than others, we would look at those that fall within those different vulnerability areas to see what percentage of those are in that impacted area so we can focus on the specific types of resources those groups might require."
>
> (Large jurisdiction, South)

<u>Future use of tools</u>

Emergency managers not currently using the specific social vulnerability tools were asked if they would use such tools in their current practice if they were available. Several not currently using social vulnerability tools stated that such tools would be helpful to them. One stated that having a verifiable data source for the tools would be important in order for the data to be useful.

> "Only a fool would not use better tools than you have in your toolbox, only a fool would not utilize the ability to collect more and better accurate information, updated information."
>
> (Large jurisdiction, Southeast)

Some emergency managers felt that while tools would be useful there are concerns that the tools were highly technical and would require training. Further, the amount of data that the tools provide could be overwhelming.

Another concern was the funding needed to sustain long-term use of these tools. Emergency managers suggested expanding the use of the tools to areas beyond preparedness for cost sharing and to justify the investment in time, money and training. Emergency managers mentioned specific features they would like to see in future tools (i.e., common operating platform, web-based, ability to overlay other hazard information, accessible in Google Maps©). One emergency manager suggested that in the absence of the tool being provided, the information from the tool be provided to emergency managers and educating others on how to use the data.

Current barriers to identifying at-risk populations

Emergency managers discussed several barriers or challenges faced by their jurisdiction in trying to identify at-risk populations. The most commonly cited barrier was difficulty with outreach to certain at-risk populations. There were several emergency managers who discussed the lack of willingness of some individuals and organizations to share information for various reasons, such as distrust of government.

> "Locating them and communicating with them and getting them to buy into the emergency management concept. For example, we feel like some of the non-English speaking, some of the transient, some of the poverty levels, most likely don't have confidence in the government."
>
> (Medium jurisdiction, Southeast)

> "We've encountered some significant cultural challenges with some of our immigrant populations. We have some populations here who are flat-out distrustful of the government, and when neighboring jurisdictions have had flooding and they open a shelter at the police department, the people won't come because they don't trust the police."
>
> (Medium jurisdiction, Northwest)

Another challenge is that many individuals are not affiliated with any organization nor do they self-identify.

> "But you're always worried that somebody is gonna slip through the gap, I say not slip through the gap because we forget them, I say slip through the gap because we don't know about them."
>
> (Large jurisdiction, Southeast)

> "We're a county of two and a half million. But with regards to things like our special needs registry and how many would need evacuation assistance, our registry hovers around 2,500 to 3,000 people, which is nowhere close to what we would expect it to be based on the census numbers."
>
> (Large jurisdiction, South)

> "We're trying to do the best we can, I know where my senior citizen housings are but it's those onesie-twosies that end up adding up in a population of 80,000 that are probably the biggest issue for us, that we're not able to reach out to them because they have their own support system, they may not even go through a trusted network."
>
> (Small jurisdiction, Northeast)

Emergency managers mentioned complacency as a barrier in terms of people self-identifying themselves as at-risk.

> "People say, "I don't need to call in. I'm not worried about it." And at the 11th hour they're going to call in. They think "I don't need to put myself on this list. We're not going to have a hurricane this year." Or "No, we'll register when the time comes."
>
> (Large jurisdiction, Southeast)

Emergency managers mentioned that some people do not self-identify as at-risk because they do not consider themselves a member of a vulnerable population.

> "Some of these individuals don't want to be considered a vulnerable population. Some of them don't want you to look at them in that way or they don't feel that urgency or that need to really be planned for. A lot of times it's really difficult to get people to fully

understand what the risks are and what they need to do."

(Medium jurisdiction, Midwest)

Emergency managers also cited lack of resources such as staff time and funding as barriers to identifying at-risk populations. Some emergency managers were concerned about the constant updating and intensive resources need to maintained registries and that registries are not all-encompassing; some registries are limited to those with medical special needs.

Facilitators needed to identify at-risk populations

Emergency managers mentioned the following facilitators needed in order to address barriers or challenges faced in identifying at-risk populations.

- ***Increase partnerships with organizations or community groups that serve at-risk populations***. Several emergency managers stated that engaging partners in emergency preparedness was important to help identify at-risk populations, help to increase general knowledge in the community about emergency preparedness resources, and to help improve messaging and communication efforts to at-risk groups. Some emergency managers take advantage of the strong link between some organizations and community groups with at-risk population to improve their ability to identify at-risk individuals.

  "We might have a church that tells us, 'Hey listen, Aunt Bea over here she's getting a little elderly, now she walks with a walker. You need to send somebody to go check on her and see if she's gonna need help with a storm.'"

  (Large jurisdiction, Southeast)

- ***Improve messaging and communication***. Emergency managers described the need for improved messages and communication to identify and communicate with at-risk populations.

  "More partnerships to pool resources and share common messages would be a good thing. Initiatives like [Community Organized to Respond in Emergencies] and 'whole community' where we're just engaging a lot of non-traditional

> stakeholders in disaster preparedness and response to share our information and our messaging and just getting it out to more people."
>
> (Large jurisdiction, Southeast)

Further, emergency managers noted the importance for individual community members to spread the word about preparedness among themselves in the community.

> "I remember hearing what kind of pushes more people's preparedness is not what we as an emergency management organization tells them to do but what they might hear from a neighbor or a friend or a relative with regards to their own personal preparedness. So I guess the more we can get people in the community to talk about these things the better."
>
> (Large jurisdiction, Southeast)

- ***Account for populations that do not self-identify in emergency planning.*** Emergency manager discussed how their planning accounts for populations that have not been registered or identified.

> "How many folks are registered? I think they'd tell you somewhere in the number of 300. Our planning is 600."
>
> (Large jurisdiction, Southeast)

- ***Additional resources and tools.*** Additional resources were needed in order to engage community groups, increase education outreach efforts, and hire additional staff to accommodate the increased outreach efforts. Emergency managers expressed the need for better tools to assist with identification of at-risk populations.

How at-risk data is used

Emergency managers mentioned different ways that information on at-risk populations was being used by their jurisdictions.

> "We try to look at the census data and the information provided to us by our stakeholders to be able to plot that with GIS…So for instance, if there was a specific are of the county that was impacted greater than others, we would look at those that fall within those different vulnerability areas to see what percentage of those that are in that impacted area so we can focus on the specific types of resources those groups might require."
>
> (Large jurisdiction, Southeast)

> "We've got an excellent hazard mitigation plan that we update regularly using the [information]. That is also included within our evacuation timelines."
>
> (Large jurisdiction, Southeast)

The table below describes how emergency managers are using the information in each disaster phase.

Table 5. Use of information on at-risk populations

Phase	Use of information
Preparedness	Create evacuation and contingency plans Conduct community outreach and engagement Determine resource needs and allocation
Response	Determine resource allocation Provide targeted data to decision-makers and first responders Prioritize response efforts Tailor communication messages
Recovery	Determine resource allocation Identify subpopulations that are the least resilient Track recovery and identify ongoing problems
Mitigation	Develop hazard mitigation plans Determine where to set up permanent community shelters Develop structural planning and policies

Additional themes

Two additional themes emerged from the key informant interviews: responsibility and information sharing.

Responsibility

Emergency managers discussed who was responsible for identifying at-risk populations. Some emergency managers felt that the "whole community" was responsible, not just emergency management.

> "The whole thing cannot be shoved off on emergency managers because that is setting us up to fail. And when we say 'whole community', that's great that we can plan for the whole community, but the whole community has to participate in their own preparedness because if they don't, if they just say 'Well, you're gonna take care of us' nobody's gonna be happy and we're gonna fail."
>
> (Medium jurisdiction, Northwest)

Emergency managers also noted the importance of engaging individuals in their own self-preparedness.

> "We are trying to get the disability community and the vulnerable populations more engaged in self-preparedness so that they don't rely on state and county and local resources and not prepare at all."
>
> (Large jurisdiction, Southeast)

Other emergency managers recognized the need for a "whole community" approach to planning for emergencies.

> "If we work on meeting the needs of individuals that are at-risk and families as a whole we really meet the needs of everybody. I think that over this next period of time as we work on the challenges of doing a better job of incorporating into our planning programs this whole community concept where we're really bringing everybody on board, I think that ten years from now we won't be having this conference call, that it could be from an overall community standpoint we'll be better prepared and more inclusive in our process."
>
> (Small jurisdiction, Northeast)

> "We're fortunate that the groups that we work with are very good. All the response agencies, the private sector and the community based organizations, we all come together to do what's best for the community."
>
> (Medium jurisdiction, Midwest)

While some felt the "whole community" approach was appropriate they were concerned that this approach might discount the role of the individual.

> "It's educating every one of the importance of preparedness and having plans… and so that message needs to get to everybody and they need to start acting on it. It can't all fall on emergency management because there's no way we can hold it all."
>
> (Medium jurisdiction, Northwest)

Improve communications

Some emergency managers expressed the importance of information on at-risk populations to improve communications. Emergency managers discussed the development of outreach tools such as brochures, booklets, and videos targeted at their at-risk populations.

> "I guess the main thing is the challenge to communicate with them [at-risk populations] and how do we overcome that?"
>
> (Medium jurisdiction, South)

> "[We] maintain a communications hub, we've all agreed to the fact that when public health or emergency management sends a message [our network] will turn it around and put it back to our clients or our program individuals that we're working with and it gives us a wider net and allows us to push information out."
>
> (Small jurisdiction, Northeast)

Conclusions—Aim 2

The objective of Aim 2 was to identify current approaches used by emergency managers to identify social vulnerabilities and determine how to improve these approaches. These results provide a snapshot of *who* emergency managers consider to be at-risk in their jurisdictions, *how* they identify these at-risk populations, tools they are currently using or may use in the future to assist with identification of at-risk populations, and barriers and facilitators to finding at-risk populations. In general, the majority of emergency managers had broad, encompassing definitions of at-risk populations. Some emergency managers used community partnerships to identify at-risk populations, others depended on registries. Despite the fact that the majority of emergency managers were not using social vulnerability indices or tools to help with the

identification of at-risk populations, the majority felt that more information on at-risk populations would be useful. When asked about future use of tools, the majority felt that without both the technical capacity and resources they would be unable to take advantage of existing methodologies. To address these needs, emergency managers requested guidance on available tools and resources that can be used to identify at-risk populations.

CHAPTER 5: PLAN FOR CHANGE

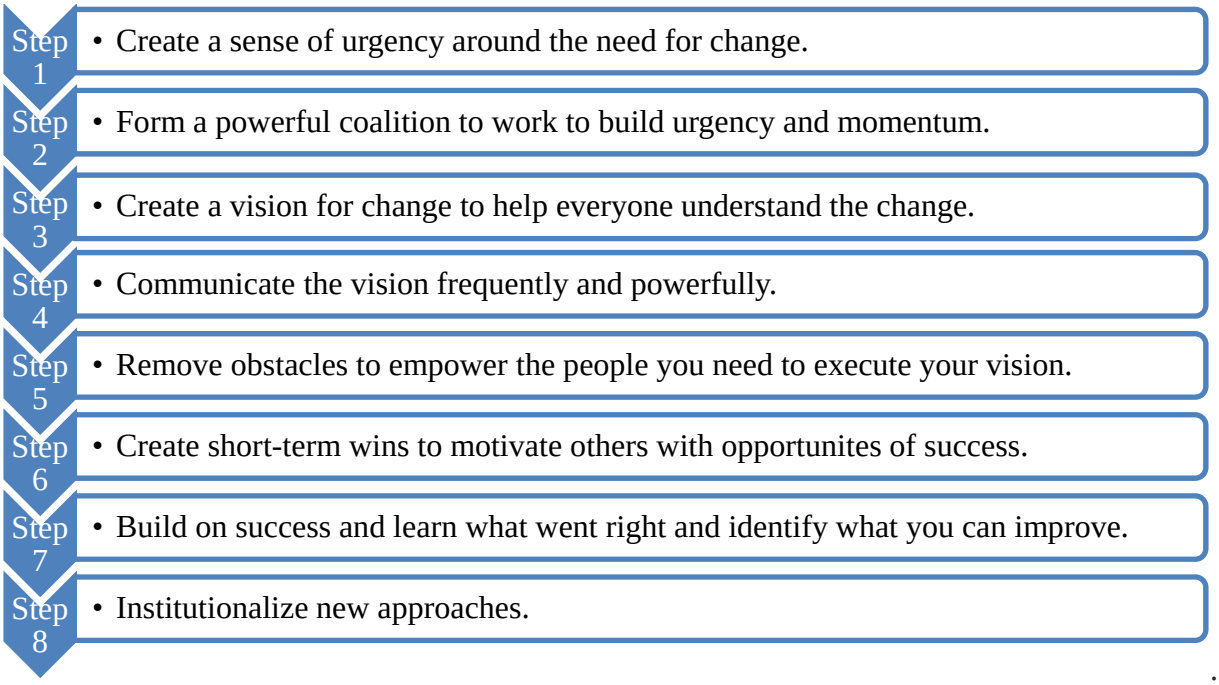
I propose the development of a guidance document that provides practical strategies to identify at-risk populations. Table 6 summarizes the steps to implement the plan for change, identifies their link to the research and leadership principles, and describes the specific actions for change. The guidance document, along with policy changes at the federal level will aid in institutionalizing the practice of identifying social vulnerabilities into emergency management. In other words, its purpose is to help move emergency management toward mitigating risk by increasing the number of emergency managers actively identifying at-risk populations.

Leadership Principles

I applied three leadership principles or frameworks in devising the plan for change, including John Kotter's eight steps for leading change, Jim Collin's leadership principle of transformation, and Donella Meadows' approach of leveraging points in a system [43-45].

Kotter's eight steps for leading change provide a roadmap for instituting systematic changes [43]. Kotter developed an 8-step change model to avoid common obstacles that often lead to failure (Figure 4). The process starts with creating a sense of urgency around the need for change [43, 46]. As I implement the plan for change, Kotter's work will be integrated into my efforts (Table 6). Some of his steps were already accomplished during the workshop (steps 1-3); however, change is iterative and it will be important to consider these steps throughout the change process.

Figure 4. John Kotter's 8-step change model



Source: Kotter, J. P. Leading Change: Why Transformation Efforts Fail. *Harvard Business Review*, 1995 (March-April), 59-67.

The second leadership principle that I applied, attributed to Jim Collins, is a leadership principle of transformation that promotes "getting the right people on the bus" before determining the "direction of the bus" [43]. Collins recommends that the *who* questions come before the *what* decisions. Collins suggests if you have the right people on the bus, you will have a team who have personal values that closely align with the transformation, people who will hold themselves accountable for results, and people who are self-motivated. To ensure I had the right people on the bus, I worked closely with national professional organizations to recruit emergency managers. The key informant interviews provided additional information on *who* we should be talking to during the workshop. The workshop expanded the *who* to include other stakeholders recommended by the emergency managers, such as public health and social services professionals and academic researchers. During the workshop we let the "right" people decide

which direction to move the bus and plan to have workshop participants continue to be engaged (Table 6).

Table 6. Action steps for change

Plan	Link to Research	Link to Leadership Principles/DrPH Curriculm	Action Steps for Change
Receive buy-in for identification of at-risk populations into emergency management practice	Literature review Key informant interviews Workshop	Kotter's 8 steps for leading change Establish sense of urgency Form a powerful coalition Create a vision Collin's leadership principle of transformation Meadows' Leverage Points 2 and 5	Engage stakeholders Understand current practices Identify barriers/facilitators Identify best practices Create sense of urgency Find common goal among stakeholders and create vision
Develop guidance for organizational change	Key informant interviews Workshop	Kotter's 8 steps for leading change Communicate the vision Plan for and create short term wins Collin's leadership principle of transformation	Engage stakeholders in development and review of guidance Develop guidance document
Explore policies to institutionalize change	Key informant interviews Workshop	Kotter's 8 steps for leading change Empower people to execute the vision Institutionalize new approaches Meadows Leverage Point 5	Empower those who can implement vision (i.e.,) emergency managers, community leaders, federal partners CDC lead by example and incorporates new approach in federal plans and responses CDC require new approach be used by grantees and included in state preparedness plan language Incorporate language in the National Response Framework

The third leadership principle I applied is Meadows' "Places to intervene in a system." Meadows proposes that within any system there are leverage points where a shift in one thing can produce big changes in the entire system [45]. In other words, making a small change in how emergency managers identify at-risk populations can make a big difference in the public health outcome of a disaster. Meadows also recommends that before any shift can be made one must understand the paradigm that underlies the system [45]. Here, the underlying issue is that emergency managers feel they cannot identify at-risk populations, despite the strong desire to prepare for at-risk populations. Thus, their efforts are not fully realized. The guidance will provide information and tools to enable emergency managers to appropriately identify these populations shifting the paradigm (Table 6). This paradigm shift will enable emergency plans to be more effective at saving lives by mitigating risk for those with social vulnerabilities.

Action Steps

Receive buy-in to support integration of social vulnerabilities into emergency management practice

Engaging stakeholders was important in gathering information and will remain important throughout the development of the guidance and implementation of the plan for change. Stakeholders included subject matter experts from emergency management, public health, and academia. The majority of these actions in this step has already been started and will continue. The literature review demonstrated that social vulnerability tools are seldom used by emergency managers; however, the interviews and workshop demonstrated that there was a strong desire for data from these tools. Current approaches for identifying at-risk populations were varied and included identification at the individual and population level. During the workshop, several researchers demonstrated tools that are available to assist emergency managers with identifying

at-risk populations. There was strong interest from emergency managers in using these tools; however, the majority felt they lacked the technical expertise to use the tools available.

Develop guidance for organizational change

During the workshop, we asked stakeholders how CDC could assist them in their approach. Based on the interviews and workshop, emergency managers expressed the desire for guidance on how to identify at-risk populations and how to incorporate this information into each disaster phase. There was a strong desire for more information at both the individual level (e.g., registry information, trusted networks) and population level (e.g., census data).

Emergency managers requested guidance on how to converge both approaches. The proposed guidance document will pull together resources that have been previously published to provide emergency managers with the knowledge and technical capacity to use the available tools. The document, specifically written for emergency managers, will demonstrate how to use information from both of the approaches, individual and population, to develop a more comprehensive picture of social vulnerabilities in their community. The proposed guidance document would be divided into three parts: individual approach, population approach, and best practices.

Individual approach

CDC recently published the document *Public Health Workbook To Define, Locate, and Reach Special, Vulnerable and At-Risk Populations in an Emergency* [47] to describe a process to help public health define, locate, and reach at-risk populations in an emergency. The process recommends local public health develop a Community Outreach Information Network (COIN)—a grassroots network of people and trusted leaders who can help with emergency response planning and delivering information to at-risk populations in emergencies. The document focuses

on COINs as a way to engage a strong network of individuals who are invested in their community's well-being and have the ability to respond in an emergency [47].

The process outlined aligns with basic community engagement principles, such as comprehensive preparedness and integration of knowledge and skills of governmental and local public service providers, community-based organizations, and faith-based organizations [47, 48]. The COINs can also be used by emergency managers to engage community leaders in the process of identifying at-risk individuals. During the interviews, only one emergency manager mentioned using the COIN process; however, several emergency managers mentioned using trusted networks and coalitions to engage community leaders to assist with identifying at-risk populations. Including the COIN process in the proposed guidance for emergency managers will provide a clear and consistent process for community engagement for the emergency managers. Because some emergency managers still relied on the use of special or functional needs registries, it is important that the guidance also discuss the use of data from registries. Further, there are other sources of data that the emergency managers could use to identify at-risk individuals that should be outlined, such as community surveys and inventory of social services. The guidance document will also need to address current gaps that need to be addressed in order to be able to identify at-risk populations at the individual level. Several emergency managers identified the need for a central system within a jurisdiction to collect data, the need to reduce technical barriers to data sharing, and the need to unify different agencies that are collecting similar information.

Population Approach

Emergency managers also identified the need for population level data. Population statistics, such as US Census data, provides a snapshot of the community and provides profile

information to estimate the number of people in different population segments within communities. The population data can be used to create indices of vulnerability. CDC/ATSDR's Geospatial Research, Analysis & Services Program (GRASP) has created a tool, the Social Vulnerability Index (SVI), to ranks census tracts by level of social vulnerability [7]. These ranks or indices are used to identify and map at-risk populations. The SVI uses U.S. Census data to determine the social vulnerability of every Census tract and ranks tracts on 14 social factors, including socioeconomic status variables, household composition, disability, race/ethnicity, language, housing and transportation. Each tract receives a separate ranking, as well as an overall ranking. CDC/ATSDR recently released a website that allows emergency planners to use the SVI tool [49]. The SVI tool is web-based and accessible to any emergency manager. On the website emergency managers can choose to use prepared county level maps, removing the technical capacity barrier. The website also has interactive tools that allow the user to select which variables to score. Data from the website can be downloaded for use locally and the GIS maps can be merged with individual level data to create a more comprehensive picture.

Integration of data

Information from both the individual level and population level can be merged to understand the "big picture." Emergency managers can use the census data to see where the organizations overlap or to estimate what percentage of the population their registry is capturing. Emergency planners can used the SVI to find where they need key community contacts and potential partners. By overlaying individual level information and information on trusted networks on SVI maps, emergency managers can identify gaps in coverage. While identifying and quantifying at-risk populations is important, the data will only be helpful if it is used to reduce risk. As described earlier knowledge of social vulnerabilities can be used by emergency managers in all

phases of a disaster. The guidance document will provide information on how and when to use information on at-risk populations. For example, information on social vulnerabilities can answer the following questions:

- What is the best way to evacuate people, accounting for those who have special needs, such as people without vehicles or the elderly? Is there adequate emergency transportation available to account for this number of people?
- How many people likely had difficulty hearing and understanding the warning messages? Do emergency managers have access to organizations that can target these people?
- Which groups will need emergency medical care or continuation of medical care?
- Which groups are least likely to have access to emergency services? Do community or faith based organizations have access to these groups?
- How many emergency supplies like food, water, medicine, and bedding will be needed? Which trusted networks can help deliver these supplies?

Using the key findings from the individual and population approach, emergency managers can enhance their existing communication plans to include at-risk population groups and to designate appropriate, trusted spokespersons [2, 7].

Explore policy development to institutionalize change

The final step is to institutionalize this approach by using language, new behaviors and policy to embed change into the emergency management culture [50]. The favorable reactions to and enthusiasm of each of the emergency managers included in the interviews and workshop is promising and can inform national policy and emergency management practice. CDC can play a

key role in institutionalizing the approach. CDC can set the example by making the change in its own emergency preparedness and response operations.

To make this change, I am working with the CDC's Office of Public Health Preparedness and Response to create an At-risk Populations Coordinator position within the CDC Emergency Operation Center (EOC). Using information collected for this dissertation, we are creating a set of resources for the coordinator. The coordinator will also have access to the CDC *Public Health Workbook to Define, Locate, and Reach Special, Vulnerable and At-Risk Populations in an Emergency* and the newly created guide for emergency managers. I am also working with the EOC to create exercise scenarios that require assessment of at-risk populations to improve CDC's capability in assisting states and locals in identifying at-risk populations.

CDC can also institutionalize this approach by requiring state and local grantees to address at-risk populations in their preparedness plans and require the use of the approaches outlined in the guidance document. CDC's public health preparedness grantees are currently required to achieve core capabilities to receive funding. CDC outlines the core preparedness capabilities in the document, the *Public Health Preparedness Capabilities: National Standards for State and Local Planning* which was designed to assist state and local public health departments in their strategic emergency planning and to ensure that federal preparedness dollars are directed to priority areas [51]. The core capabilities are categorized under five domains: biosurveillance, community resilience, countermeasures and mitigation, incident management, and information management. Currently, six of the 15 capabilities address vulnerable populations: community preparedness, emergency public information and warning, mass care, medical countermeasure dispensing, medical surge, and public health surveillance and epidemiological investigation.

While it is recommended grantees address vulnerable populations, currently the capabilities document does not provide tools to do this. Further, the capabilities do not require public health personnel to work with emergency managers to address vulnerable populations. Because the capabilities document is updated every few years, there will be an opportunity to change the language to provide a set of tools and approaches to address vulnerable populations for each of the 15 capabilities and add a requirement for state and local public health to work with their respective emergency managers to address vulnerable populations.

I also plan to disseminate results of this dissertation through both oral and written presentations. The results of this dissertation will be presented to the CDC Disaster Epidemiology Community of Practice, which includes internal and external partners, during one of their webinars. I am also presenting the results of the interview and workshops at the National Association of County and City Health Officials Annual Preparedness Summit, the Council for State and Territorial Epidemiologist Annual Conference, and the International Association of Emergency Manager's Annual Conference. Additionally, I will publish these results in a peer-reviewed manuscript. Once the guidance document is complete, we will host a series of webinars and publish a concepts paper to increase awareness of the guidance document.

Because vulnerability is an important cross-cutting preparedness topic it should be addressed by multiple national agencies. Language on addressing at-risk populations should also be included in the *National Response Framework*. FEMA created the *National Response Framework* as a set of guiding principles to enable all response partners to prepare for and provide a unified national response to disaster and emergencies [52]. Including language describing the recommended approaches for identifying at-risk populations in a federal

document is necessary to ensure universal successful implementation and exchange of information across jurisdictions [52].

Conclusions—Aim 3

Previous research has demonstrated that populations with higher levels of social vulnerability are more likely to experience negative consequences to disasters. Through the approaches and opportunities for change listed above, public health and emergency management can begin to effectively mitigate vulnerabilities, reduce losses, and enhance outcomes for a broader population of those at risk. This dissertation aimed to provide insights to current barriers to identifying at-risk populations and practical solutions to addressing those barriers. However, if public health is to achieve its full potential to eliminate social vulnerabilities, then we must initiate broader social change to address the underlying social characteristics that permit social vulnerabilities to persist.

APPENDIX A. PARTICIPANT RECRUITMENT LETTER/E-MAIL

Dear [insert participant's name],

Greetings! I am Amy Wolkin, and I work for the Centers for Disease Control and Prevention. As part of my responsibilities, I am exploring emergency managers' use of social vulnerability assessments to reduce the public health risk to disasters. I am also a Doctoral student at the University of North Carolina at Chapel Hill in the Gillings School of Public Health. I am writing to request your participation in a research study I am conducting to understand how emergency managers identify and locate at-risk populations in their communities. At-risk populations include special needs population and individuals in need of additional response assistance which may include those with disabilities, low socioeconomic status, minorities, elderly, young children, and limited English proficiency. Your voluntary participation in this effort would involve a discussing your current practices for identifying at-risk populations. The interview would take place over the telephone at a time that is convenient for you. The interview will last about 30 minutes.

Background:

The frequency and magnitude of disasters is rising in the US. With climate change, this trend is expected to continue. All regions of the US have experience disasters; many of these disasters are responsible for negative public health consequences, such as increased morbidity and mortality. Socially vulnerable or at-risk populations and those with special needs are at greater risk for negative public health effects from disasters and are disproportionately affected by disasters. To assist emergency managers in identifying at-risk populations, researchers have developed tools to identify at-risk populations. This project will assess what approaches emergency managers take to identify at-risk populations within their communities.

A Request for Your Participation: In order to learn how emergency managers identify at-risk populations in their communities, I am conducting a series of interviews with emergency managers like yourself. I am the only person who will have access to your responses if you choose to participate in an interview. Your name and county will not be disclosed to anyone and will not be used in any report or summary that comes from this interview. Records of the interview will be stored electronically in password protected files and any hardcopy information linked to an individual's responses to interview questions will be stored in a locked file.

Thank you for considering participating in this study to discuss how your county identifies at-risk populations. Please contact me at ajf9@cdc.gov or 770-488-3402 if you have questions or would like to participate in an interview. I will follow-up with a call to schedule an interview in the next week or so. I know that you are very busy, and I greatly appreciate your time and help with this effort. Thank you very much for your consideration of this request!

Sincerely,

Amy Wolkin, MSPH

Lead, Disaster Epidemiology and Response Team

National Center of Environmental Health/Centers for Disease Control and Prevention

And

University of North Carolina DrPH Doctoral Student

APPENDIX B. INTERVIEW GUIDE

Hello! I am Amy Wolkin, a doctoral student in the University of North Carolina's Gillings School of Global Public Health. I also work at the U.S. Centers for Disease Control and Prevention in the area of disaster epidemiology and response. Thank you for agreeing to participate in this interview to discuss your at-risk populations in disasters. As I indicated in the introductory letter, the information I collect as a part of this study is for my dissertation research and is also related to my work at CDC.

The purpose of this interview is to learn how emergency managers identify at-risk populations in their communities. I am defining at-risk populations as a group of people who have a greater risk to the negative impacts of disasters. This includes special needs population and individuals in need of additional response assistance which may include those with disabilities, low socioeconomic status, minorities, elderly, young children, and limited English proficiency.

Nine local-level emergency managers from around the country are participating in the study. The interview should take about 30 minutes. The interview will be completely confidential and any information that you provide will be released only as group summaries. Your name will not be connected to your answers in any way. In order to fully capture your responses today, I would like to record our conversation. Please know that, if you wish, I can turn the audio recording off at any time. I will destroy the recording and transcriptions of the recording after I incorporate the information into the larger study. Please know as we go through the questions in this interview, that there is no "right answers" to the questions, rather I want to learn in as much detail as possible about your experiences. Also, please know that you do not

have to answer any question that you choose not to answer. We will just skip that question and go on to the next one.

If you have questions about this research, you may contact Amy Wolkin (770-488-3402, ajf9@cdc.gov) or Sanda Greene (919-966-0993, sgreene@schsr.unc.edu).

If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu

Are there any questions that you have about the research study or the interview?

May I record the interview?

Do I have permission to start asking you questions?

Interview Questions

1. To start off, I would like to ask a little about you. What is your job title?
2. How many years have you had this job?
3. Have you responded to a natural disaster or other emergency response in a professional capacity in the last five years?

   If yes, please describe.

Overview of disasters and at-risk populations

4. How does your county currently identify at-risk populations? [*If necessary prompt: Do you have a special-needs registry? Do you have a maps or lists of vulnerability scores or indices?***]**
5. How often does your county update its lists, maps, or registries of at-risk populations?

6. There are a number of tools that have been developed to assist emergency managers in identifying at-risk populations, what tools have you heard of, if any? [*if necessary prompt: Social Vulnerability Index, SNAPS, , Oxfam maps,Hazard Vulnerability Analysis*]

   If none, skip to question **6**.

   a. **If yes:** Do you use any of these tools to identify and locate at-risk populations? [**If no**, skip to question **7**]
   b. **If yes:** What tools do you use?
   c. How have you used the information from these tools?

7. If you are *not* currently using tools to assist you in identifying at-risk populations, do you think your county might consider the use of these tools in the future?

   a. **If yes:** How do you anticipate that you will you use them? [**Skip to 8**]
   b. **If no:** We are interesting in learning about county decisions to use or not use these tools. Can you say more about why your county might not use these tools?

8. What are current barriers your county faces in identifying at-risk populations?
9. What gaps need to be addressed to help your county identify at-risk populations?

Closing

10. Are there any additional comments you would like to make about at-risk populations and disasters?
11. Is there someone else in your organization that might be able to answer some of these questions?
12. Do you have any questions for me at this time?

Thank you for taking the time to discuss how your county identifies at-risk populations. Please feel free to contact me if you think of anything else that could inform this exploration.

APPENDIX C. KEY INFORMANT INTERVIEW CODEBOOK

Primary Codes

The primary codes are deductive and are based on the key informant interview guide questions, as well as the project research questions.

Code	Definition
Definition of at-risk populations	Any response to the question, "How does your jurisdiction define at-risk populations?"
Identification of at-risk populations	Any response to the question, "How does your jurisdiction currently identify at-risk populations?" Sub-codes: *Self-identification* (organizations are dependent on personal level information rather than population based information for identification of at-risk populations) *Trusted networks* (organizational approach to identifying at-risk populations through trust networks, i.e. community agencies, coalitions)
Frequency of updates	Any response to the question, "How often does your county update its lists, maps, or registries of at-risk populations?"
Tools used	Any response to the question, "There are a number of tools that have been developed to assist emergency managers in identifying at-risk populations. What tools have you heard of, if any?" Sub-codes: *Description of tools used* *Training received on tools* *How tools used*
Future use of tools	Any response to the question, "If you are not currently using tools to assist you in identifying at-risk populations, do you think your county might consider the use of these tools in the future?"
Current	Any response to the question. "What are current

Code	Definition
barriers	barriers your county faces in identifying at-risk populations?"
Gaps to address	Any response to the question. "What gaps need to be addressed to help your county identify at-risk populations?"

Secondary Codes

Secondary codes are inductive and are based on common themes that emerged across key informant interviews. In addition, if minor themes emerge they will be reflected in the report, but they will not require additional coding of the raw data.

Code	Definition
Responsibility	Discussion of who holds responsibility to get people registered, identified, and taken care of during an emergency. i.e. personal, family, community (discussions of whole community), or specific agencies
Improve communications	Discussion about using information to improve communication with at-risk populations

APPENDIX D. WORKSHOP AGENDA

Emergency Managers and Social Vulnerability Workshop, July 11-12, 2013, Atlanta Georgia

DAY 1

8:00-8:30	**Arrival & Registration**		
8:30-9:00	Welcome & Introduction		Michael McGeehin
9:00-9:30	Presentation	Social Vulnerability: Definition and Impact throughout Disaster lifecycle	Amy Wolkin
9:30-10:00	Presentation	Overview of Public Health Risk Based Pilot Project	Todd Talbert
10:00-10:15	**BREAK**		
10:15-11:00	Round-Table Small Group Discussions	Discussion: 5 groups of 8 participants Current approaches to identifying social vulnerabilities	Small group facilitators
11:00-11:30	Large Group Discussion	Entire group discusses approaches	Michael McGeehin
11:30-1:00	**LUNCH and NETWORKING**		
1:00-2:45	Panel Demonstrations	Demonstration of Social Vulnerability Tracking Tools – ATSDR Demonstration of Social Vulnerability Tracking Tools – North Carolina Demonstration of Social Vulnerability Tracking Tools – Texas Demonstration of Social Vulnerability Tracking Tools – Pennsylvania	Sherry Burrer
2:45-3:00	**BREAK**		
3:00-4:00	Round-Table Small Group Discussions	Discussion: 5 groups of 8 participants Current use of tools and potential use of tools to identify at-risk populations	Small group facilitators
4:00-4:30	Round-Table Large Group Discussion	Entire group brings together ideas from individual small groups	All

DAY 2

8:00-8:30	**Arrival & Registration**		
8:30-9:00	Demonstration	DSHS EM	Sue Bush
9:00 -10:30	Round-Table Small Group Discussions	Review of yesterday Discussion: 5 groups of 8 participants Use, barriers, and solutions for identifying at-risk populations	Small group facilitators
10:30-10:45	**BREAK**		
10:45-12:15	Round-Table Large Group Discussion	Entire group brings together ideas from individual small groups Discuss Next Steps	All
12:15-12:30	Closing Remarks		Mike McGeehin Amy Wolkin
12:30-1:45	**Lunch on your own**		
1:00-1:30	Group 1 EOC Tour		
1:15-1:45	Group 2 EOC Tour		

Discussion Questions:

Day/Time	Discussion questions
Day 1, 10:15-11:00	Current approaches to identifying social vulnerabilities • What agency/office in your jurisdiction is responsible for assessing at-risk populations? • What approaches are you using to identify at-risk populations? • How do you use at-risk population information?
Day 1, 3:00-4:00	Current use of tools and potential use of tools to identify at-risk populations • What tools are you currently using to identify at-risk populations? • Are these tools useful? Are their barriers to use? • If not using tools, after hearing about the ones discussed this afternoon, would you consider using these tools in the future? • If not using tools, what barriers do you anticipate in using these tools?
Day 2, 9:00 -10:30	How can CDC assist states and locals in identifying at-risk populations?

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