

URBAN TO RURAL EVACUATION: PLANNING FOR RURAL POPULATION SURGE

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Executive Summary

To date, rural emergency planning efforts have focused more on addressing the needs of rural residents and have not accounted for potential population surge from neighboring urban areas in the event of disaster. In many areas, rural infrastructure and capacities are likely to be stretched thin or possibly overwhelmed.

For this study a comprehensive literature review, qualitative, and quantitative analyses were conducted to assess the likelihood of urban evacuation to rural areas and to provide recommendations for rural planning and response. Qualitative analyses were based on key informant interviews with 17 preparedness experts and planners; six were at the national level, five represented urban communities, and six represented rural communities. Urban and rural planners were paired so rural planners represented communities in close proximity to urban planners' communities. Quantitative analyses were based on a national survey of 1,505 urban residents to assess their intended actions following a dirty bomb or pandemic influenza scenario, as well as likely travel destinations and distances.

SUMMARY OF KEY FINDINGS

- The behavior of urban residents will largely depend on how the threat is presented by the media, the government, and/or word-of-mouth.
- Urban residents' reactions to disasters and public health emergencies will depend on the content and delivery of official messages and recommendations.
- Traffic flow will likely be a significant issue; spontaneous evacuations can result in sudden, unexpected traffic jams and blockages, particularly in areas with limited access or road capacity.
- While residents might evacuate *to* rural areas, an additional concern is the large number who may evacuate *through* these areas, consuming fuel, food, water, and sanitation resources as they travel to their destinations.
- Limited health care and public health infrastructures are critical weaknesses in rural communities. Evacuees exposed to radiation, chemical, or biological threats will likely overwhelm the health systems of small communities, and may also precipitate health consequences among the local population.
- While a larger overall number of evacuees may go to other urban areas in many scenarios, it will take fewer evacuees to overwhelm smaller, rural community systems. In addition to considering raw numbers of evacuees, an analysis of the ratio of evacuees to existing population is an important planning consideration.

- Rural planning would benefit from estimates of numbers of evacuees that might arrive following disaster events, characteristics of those evacuees, such as percentages who are children, elderly, or disabled, and numbers of evacuees arriving with special medical needs and/or pets.
- Many urban residents will evacuate their homes and communities following a disaster or public health emergency. Survey results suggest that close to 40% of urban residents intend to evacuate against governmental advice, and between 77% and 91% of urban residents intend to evacuate if the government suggests or orders an evacuation.
- In both scenarios presented in the survey (dirty bomb and pandemic influenza), 55% of respondents indicated that they would be likely to travel to a rural destination. The potential to overwhelm rural systems is significant, particularly related to medical needs and the potential for further spread of infectious disease.
- Black and Hispanic respondents reported a greater intent to evacuate, both following government recommendations *to* evacuate and government orders *not to* evacuate. Results were statistically significant as compared to white respondents.
- The distinction between risk communications efforts advising people *not to* evacuate versus instructing people *to* shelter in place is important. Despite a similar end goal, compliance rates appear quite different based on how the order is framed, with compliance much higher for shelter-in-place direction than for direction not to evacuate.

Based on these findings we offer the following recommendations:

Recommendation 1: Rural communities in close proximity to urban centers should consider the issue of urban to rural evacuation among preparedness concerns.

Findings from both the qualitative and quantitative studies clearly demonstrate the potential for significant population surge in rural communities following an urban disaster. Fifty-five percent of survey respondents specifically note that they would likely travel to a rural community should they evacuate. While the number of evacuees who settle in a specific rural community may reflect only a small percentage of the evacuating urban community, those evacuees nevertheless will represent a significant population increase in a rural area likely having limited resources.

Recommendation 2: Rural communities should engage in regional planning to pool resources in preparation for a potential urban evacuation. Likewise, urban preparedness plans should also include nearby rural areas and provide information on potential numbers of evacuees and evacuee needs.

Communities in rural areas should develop coalitions to facilitate planning and communication among multiple counties, and should seek to plan in conjunction with nearby urban centers. Regions surrounding urban centers should consider establishing predetermined reception sites for evaluating evacuees' needs and distributing limited resources efficiently. Urban public health and preparedness officials should include

surrounding rural areas when developing disaster response plans and generate information that can be used in estimating numbers of evacuees and evacuee needs.

Recommendation 3: Rural communities should consider the potential consequences not only as an evacuee destination, but also as evacuees travel through their communities on their way to other urban and rural destinations.

Many evacuees will travel great distances on their way to urban and rural destinations, exhausting resources along the way. As part of their planning, rural communities should consider the potential for depletion of supplies and resources by people evacuating through their communities. Resources, including food, fuel and sanitation facilities, should be deployed in strategic locations along evacuation routes to facilitate continued movement of evacuees and to minimize the loss of already limited rural resources.

Recommendation 4: Tools, trainings, and technical assistance should be developed to support rural preparedness planning to address issues of population surge following urban evacuation.

When asked why they had not developed plans for rural population surge, key informants reported that they had no basis on which to plan; that is, they had no information on the numbers of evacuees to expect, nor potential evacuee needs. Tools and trainings should be developed to inform rural preparedness planning efforts. Specifically, information on estimated numbers of evacuees and likely evacuee needs is needed to provide a frame for the development of rural plans¹. In addition to this information, training is needed to assist rural planners in identifying resources and developing appropriate plans.

Recommendation 5: Risk communications professionals should carefully consider the desired evacuation behavior of urban residents and messages should be designed accordingly.

A consistent theme in the key informant interviews was the importance of effective risk communications. Many key informants indicated that they believed that urban residents would likely follow government orders if the messages were crafted appropriately. This was further reinforced by the survey findings; when comparing respondents' intentions to adhere to instructions to shelter in place to their intentions to adhere to advice not to evacuate, responses to the former question demonstrated significantly higher levels of compliance. Compliance is clearly affected by how the message is framed.

Recommendation 6: Federal and state guidance for preparedness planning should prompt communities surrounding urban centers to plan for the reception of evacuees, and the use of preparedness funding to support such planning should be encouraged.

Given the proportions of evacuees who will likely evacuate following urban disasters, the proportion that will travel to rural communities, and the proportion that intend to evacuate

¹ With separate funding from the Western New York Public Health Alliance Advanced Practice Center, NORC collaborated with the Pennsylvania State University Center for Environmental Informatics to develop a prototype evacuation modeling tool to begin to address these needs, as well as an evacuation planning guide for rural communities likely to receive evacuees. These resources can be accessed via <http://walshcenter.norc.org>.

against government advice, rural planning to address population surge issues is critical. Rural key informants noted concern about these issues, but reported little actual planning in response. Rural counties already receive funding to support preparedness planning activities. They should be encouraged to use these existing resources to appropriately plan for population surge related to urban evacuation. The NORC Walsh Center/Western New York Public Health Alliance (WNYPHA) tool and planning guide should facilitate this planning. These resources can be accessed via <http://walshcenter.norc.org>.

Recommendation 7: Resources are needed to strengthen the health care and public health infrastructures of rural communities to address issues related to population surge, as well as to enhance overall preparedness through effective disease surveillance and containment, health communications, and the delivery of quality health care services.

Limited health care and public health infrastructures are widely acknowledged as a critical weakness in rural communities. Evacuees exposed to radiation, chemical, or biological contaminants will likely overwhelm the health systems of smaller communities, and may also precipitate health consequences among the local population. Robust health care and public health systems are necessary to effectively respond to issues such as population surge following an urban evacuation, and are also needed to ensure overall preparedness efforts through effective disease surveillance and containment, health communications, and the delivery of quality health care services.

Recommendation 8: Cultural competency information and training should be provided to assist destination communities in addressing the needs of diverse urban populations.

Survey respondents identifying themselves as Black or Hispanic were almost twice as likely to say that they would evacuate as compared to respondents identifying themselves as White. Rural communities are likely to be less heterogeneous than urban communities and may not have appropriate staff and resources to effectively address the needs of culturally and linguistically diverse populations. This concern was reinforced in discussions with urban preparedness planners.

Recommendation 9: Further study is recommended on urban evacuation intent and behavior.

Much of the prior research on urban evacuation was conducted before the war on terrorism and the 2005 hurricane season. It is likely that events such as Hurricanes Katrina, Rita and Wilma, September 11th, and the 2001 anthrax attacks, have changed the overall propensity of urban citizens to evacuate. While the NORC Walsh Center survey findings reflect this new environment, additional studies are recommended to validate and expand on NORC survey findings.

1. Introduction

While rural communities receive funding to support community preparedness planning, based on the authors' prior work with rural emergency planners, it is clear that rural planning efforts have focused more on addressing the needs of rural residents and have not accounted for potential population surge from neighboring urban areas in the event of disaster. Further, prior NORC Walsh Center research investigating the status of the rural public health infrastructure has indicated that, in many areas, rural infrastructure and capacities are insufficient. Should urban residents evacuate to or even through rural communities, this limited infrastructure is likely to be stretched thin or possibly overwhelmed.

For this study a comprehensive literature review, qualitative review of stakeholder interviews, and quantitative analyses of new survey data were conducted to assess the likelihood of urban evacuation to rural areas and to provide recommendations for rural planning and response. The report is organized into four main sections. The first section (section 2 of the report) presents a review of the evacuation literature, with particular emphasis on the implications for urban to rural evacuation. Following the literature review, we present a qualitative analysis derived from key informant interviews with 17 preparedness experts at the national and local levels (both urban and rural). Section 4 contains findings and analyses from a national survey of urban residents designed to assess their intended behavior following dirty bomb and pandemic influenza scenarios, as well as potential evacuation destinations and distances. And finally, in the last section we present a set of policy and planning recommendations based on the overall study.

2. Review of Pertinent Literature

Introduction

It is important to define the use of the term "evacuation" in this report, as much of the post-Katrina focus has been on government-mandated evacuations and related needs to transport and shelter large numbers of evacuees. While these are critical issues, they were not the focus of the research conducted in this study. Rather, the purpose of this study was to investigate the issue of spontaneous evacuation, in which individuals evacuate themselves and their families. The majority of evacuees in any evacuation scenario (including Katrina) will leave on their own, using their own transportation. These evacuees may disperse in any direction, will travel varying distances, and will not likely seek public shelter. Perhaps most importantly, these individuals may choose to evacuate with or without government orders or recommendations, and may also choose to evacuate against government mandates to shelter in place. The implications of spontaneous evacuation are significant to communities surrounding affected urban centers.

Within the context of rural preparedness planning, there has been little focus on planning for spontaneous evacuation from nearby urban centers. Rather, planning efforts have generally focused on the needs of area residents following local disaster or emergency situations. The possibility of flight from urban areas during such an event necessitates a better understanding of

rural capacities, and the likely impact of evacuations on surrounding communities. Whenever evacuation occurs, the resources of destination communities can be overwhelmed by the ensuing population increase. In smaller communities with limited resources, even small numbers of evacuees can represent sizeable increases in population, and can jeopardize the integrity of resources and infrastructure. In order to plan accordingly for this potential surge in population, it is important to understand evacuation intent and behavior. While little of the pertinent literature focuses specifically on the impact on rural communities, much is available related to intended actions, destination and distance, and related traffic concerns, all of which can influence the secondary impact on surrounding rural communities.

Intended Post-Event Behavior

Evacuation intentions have generally been studied as they pertain to a single specific type of disaster, including: natural disasters such as hurricanes (e.g., Riad & Norris, 1998); nuclear accidents such as the Three Mile Island incident (e.g., Zeigler, Brunn, & Johnson, 1981; Zeigler & Johnson, 1984); and acts of terror, such as the hypothetical detonation of a dirty bomb (e.g., Dombroski & Fischbeck, 2006).

Riad and Norris (1998) demonstrated in the case of hurricanes that perception of risk is most strongly correlated with evacuation. This finding echoes the Fitzpatrick and Mileti (1991) definition that evacuation is largely a function of people defining themselves as being in danger and believing that leaving the area in question is beneficial. Factors that increased perceived risk were, therefore, also shown to increase the likelihood of evacuation. One such factor is gender, as women have been shown to be significantly more likely to evacuate than men (Bateman & Edwards, 2002; Riad & Norris, 1998). Another factor is home ownership, with owners less likely to leave and more concerned about looting, perceiving the risk to their property to be of greater significance than the risk to their persons. Interestingly, in contrast to popular disaster notions, Riad and Norris (1998) found that neither economic resources nor the presence of pets were predictors of evacuation (Table 1 presents a list of beliefs related to evacuation decision and asked of respondents in the Riad & Norris study). The authors suggest that this may be explained by the fact that evacuation studies typically collect data via retrospective self-report, and that respondents who should have evacuated but did not may find that by citing a lack of resources they can reduce the amount of cognitive dissonance they feel.

Zeigler and Johnson (1984) conducted an examination of evacuation behavior in response to a nuclear power plant accident - the accident at the Three Mile Island (TMI) nuclear generating station in March of 1979. The study compared the actual behaviors in response to TMI with intended behaviors in response to a hypothetical incident at the Shoreham Nuclear Power Station. Zeigler and Johnson concluded that, unlike evacuation behavior during non-nuclear emergencies—in which individuals and families seem to evacuate based on direct sensory evidence of danger or explicit, convincing messages of impending danger—“the behavioral response to nuclear accidents appears to be quite different from responses to other emergencies” (p.213). Specifically, and perhaps most notably, the study revealed a marked “evacuation shadow,” or evacuation of persons outside of the intended evacuation area. Based on the fact that pregnant women and children under five years of age within 5 miles of TMI were advised to evacuate, approximately 500 pregnant women and 3000 pre-school children should have left the area following this declaration. In actuality, approximately 144,000 people within a 15-mile

radius of the plant chose to evacuate. Further, 9% of persons in communities as far as 25 miles from the reactor also evacuated. In a separate study, Johnson and Ziegler (1983) found distance from the reactor to be the single most important determinant of evacuation rates. As in the case of hurricanes, the perception of risk—seeing the situation as dangerous—during the TMI incident was the most common reason for evacuating, reported by 82% of evacuees in a study by Bartlett, Houts, Byrnes, and Miller (1983). Notably, this perception of risk was not limited to perceiving danger from radiation, but also included a more generalized fear, that was “heavily influenced by the example of friends and neighbors” (p.29). Table 2 presents examples of reasons why evacuees and non-evacuees left or did not leave, respectively, following the incident at TMI.

Table 1: Beliefs and Experiences Related to Evacuation Decision-Making		
Beliefs and Experiences	n	Percentage
You have enough time to leave.	93	97.9
Believe your survival is under your control.	84	88.4
Experience with hurricanes.	79	83.2
Believe whether you survive is God’s will.	79	83.2
Believe your house is structurally safe.	78	82.1
You have a place to go.	74	77.9
Believe the hurricane is a serious threat.	72	75.8
You have a car.	66	69.5
Your family is together in one place.	61	64.2
Believe the hurricane will be bad.	61	64.2
Believe the hurricane is coming.	53	55.8
Experience with evacuation.	50	52.6
Have to protect your home from the storm.	43	45.3
Have to protect your home from looters.	42	44.2
Your family wants to leave.	30	30.6
You want to leave.	27	28.4
You have to stay to care for your pet.	5	5.3
You are too sick to leave.	3	3.2

Riad, J. K. & Norris, F. H. (1998). Hurricane threat and evacuation intentions: Analysis of risk perception, preparedness, social influence, and resources. (Preliminary Paper No. 271) Newark, DE : Disaster Research Center, University of Delaware.

Evacuation behavior in response to an incident at a nuclear power plant is often generalized to other radiological incidents, including the use of a radiological dispersion device (RDD), commonly referred to as a “dirty bomb” (e.g. Dombroski & Fischbeck, 2006). This may be attributable, in part, to the fact that the general public confuses radiological weapons with nuclear weapons (Levi & Kelly, 2002) and might act on that basis rather than official advisories. Dombroski and Fischbeck (2006), in an attempt to integrate both the actual physical dispersion characteristics of a dirty bomb and the behavioral response of the affected public into a risk assessment model, make several observations that distinguish an incident involving a dirty bomb from a nuclear accident. First, Dombroski and Fischbeck assume that the detonation of a dirty

bomb would be planned to occur in the most densely populated area at the time of highest population concentration: in a city on a weekday, and possibly during a peak commute time. (In the paper, downtown Pittsburgh, PA, was chosen as a hypothetical site.) The authors note that the population in U.S. cities changes dramatically during a typical workday, owing to travel from home to work, school, or retail areas, which may result in markedly different evacuation behavior of commuters as compared to residents. Second, it is likely that because the media monitor emergency radio frequencies, the public would gain knowledge of the possibility of a radiological release shortly after HAZMAT teams are notified. Third, it is assumed that while some individuals will evacuate, some will also choose to shelter-in-place in their current location. Additionally, the authors note that the relative success or failure of an evacuation—in terms of both radiation harm and trauma fatalities as the result of the bomb explosion or traffic accidents—can depend largely on the magnitude of evacuation ordered by officials, and how individuals react to those official communications. Lastly, the authors call for further research to more accurately predict the differing behaviors of parents wishing to find their children, homeowners worried about vandals, or commuters in a downtown office building in the event that a dirty bomb is detonated.

Table 2: <u>Reasons for Not Evacuating</u>	
Reasons	Percentage of Evacuation Units
Concerned about safety	91
Conflicting reports from government and utility-company officials	48
Conflicting reports from utility=company officials	26
Conflicting reports from government officials	24
News media	20
Everyone was evacuating	7
Ordered to evacuate	4
<i>Source: MSU Survey</i>	
Reasons	Percentage of Non-Evacuees
No order to evacuate was issued	62
Too many conflicting reports	42
No apparent reason to evacuate	38
Home was a safe distance from plant	31
Fear of looting	24
No children involved	23
Could not leave job or business	21
No one else in area evacuated	16
Needed to take care of farm livestock	6
No place to go	5
Too old to evacuate	3
Handicapped	2
<i>Zeigler, D. J., Brunn, S. D., & Johnson, J. H. Jr. (1981). Evacuation from a nuclear technological disaster. Geographical Review, 71, 1-16.</i>	

Evacuation Destination and Distance

There is consensus in the disaster literature that individuals choose overwhelmingly to evacuate to the homes of family or friends if available. Hotels and motels comprise a second-best evacuation destination, with public shelters being the option of last resort.

Southworth (1991) observes that an evacuee's choice of destination tends to be modeled in one of four ways:

- Evacuees are assumed to exit the at-risk area by heading for the closest destination (in terms of distance and/or expected travel time);
- Evacuees will display some degree of dispersion in their selection of area exit points, depending on such factors as the location of friends and relatives and the speed of the hazard onset;
- Evacuees will head for pre-specified destinations, according to an established evacuation plan; and
- Evacuees will exit the area on the basis of traffic conditions on the network at the time they try to leave the area.

Zeigler and Johnson (1984) argue that, in the case of a radiological emergency, evacuees flee longer distances than in other types of disasters. They cite the Mississauga, Canada train derailment in 1979, which caused the evacuation of approximately 250,000 people who generally remained within the Toronto-Hamilton corridor, only a few miles' distance from the spreading chlorine gas cloud. Similarly, they note that in natural disaster situations such as floods, evacuees tend not to travel farther than the projected high water line. At the time of their writing, the longest median evacuation distance on record in response to a Gulf Coast hurricane was 79.5 miles. The authors cite various studies that found the median evacuation distance in response to TMI to be 85 mi, 100 mi, and 112 mi (Zeigler, Brunn, & Johnson, 1981; Flynn, 1979; Barnes, Brosius, Cutter, & Mitchell, 1979, respectively). More recently, Dow and Cutter (2002) observe, in the context of South Carolina hurricanes, that distance traveled during evacuations has increased over time, with 15% of evacuees leaving the state during Hurricane Bertha in 1996, 28% leaving during Hurricane Fran, and 38% leaving during Hurricane Floyd. The average distance this out-of-state group was considered to have traveled was 250 miles. The three reasons given by evacuees for traveling outside of their home county were:

- 1) friends and family that they could stay with lived further away;
- 2) the danger from the storm was great; and
- 3) it was necessary to travel that far to find available lodging. (U.S. Army Corps of Engineers and the Federal Emergency Management Agency, 2000).

Traffic Issues

There is consensus in the disaster literature that when evacuation occurs, families generally evacuate as units and that personal vehicles comprise the majority of evacuation transportation. Media coverage of the traffic backup during the Houston evacuation prior to Hurricane Rita in 2005 suggests that planning for traffic congestion may be an important component of successful evacuation planning and modeling. Traffic congestion during a disaster scenario might cause a number of significant negative effects, including preventing emergency vehicles and personnel from effectively responding (Dombroski & Fischbeck, 2006), effectively trapping evacuees in a zone where they can be harmed by radiation (Dombroski & Fischbeck, 2006) or an impending hurricane or other natural disaster, or simply bringing evacuation progress to a standstill. Interestingly, Aumonier and Morrey (1990) conclude that while heavy traffic flow might occur in an evacuation scenario, risks to evacuees from traffic accidents or injuries are actually less than under normal road conditions, likely because speeds are lower, traffic is generally unidirectional, and there are fewer incidences of speeding or drunk driving, both of which contribute to a large percentage of accidents. Additionally, speeds are further reduced by the tendency to heavily load vehicles or to pull trailers during evacuations (Wolshon, 2001). Also contrary to popular belief, evacuating populations generally do not appear to enter a state of panic and subsequently cause road fatalities (Aumonier & Morrey, 1990).

While there have been a number of traffic modeling programs used over the past two decades, a technical discussion of these models and their strengths and weaknesses is beyond the scope of this review. However, there are several significant characteristics of traffic in evacuation situations that warrant mention. Sinuany-Stern and Stern (1993) observed that diffusion and preparation time—that is, the staggered rate at which vehicles enter the road network—initially affect evacuation time before the road network is fully utilized, but that evacuation rate subsequently depends more on bottleneck capacity of road networks than on time delay. Route choice, models of which have existed for over five decades, may also play an important role in the dispersion of evacuees over the road network (Southworth, 1991). Southworth (1991) notes that the most significant variable in modeling route selection is the level of myopia versus pre-planning. The concept of myopia recurs in the evacuation traffic literature, and can be defined as the tendency of a driver to exit a roadway when he or she perceives a bottleneck ahead. Pre-planning can take the form of planning while the event is occurring (i.e., selecting a destination and route immediately prior to departure) or prior evacuation planning. [Riad and Norris (1998) demonstrated that prior evacuation experience—a so-called “evacuation repertoire”—and evacuation planning and preparedness were both positively correlated with evacuation.] In general, bottlenecks tend to occur at intersections (Sinuany-Stern & Stern, 1993) rather than merge areas, likely due to the fact that at merge areas traffic flows in only one direction.

Recently, Dow and Cutter (2002) examined emerging hurricane evacuation issues. The authors noted that the size and intensity of an event (in this case, Hurricane Floyd) is an obvious variable in determining the likelihood of gridlocked traffic. Dow and Cutter (2002) found that 25% of evacuating families took more than one vehicle, of which 48% were families of five or more, 31% were families of three or four, and 21% were just two individuals. The authors also confirmed that the Interstate system was used heavily by evacuees, with approximately 30% reporting using either I-26 or I-95. This marked preference for the interstate was not due to a lack of knowledge of alternate routes—although about two-thirds of survey respondents had

maps in their vehicles, only about one-third actually used them to plan their evacuation route. The authors note that anecdotal information on radio call-in programs during the incident indicated that evacuees were concerned about the availability of services, isolation in the case of emergency, and a lack of wireless coverage away from the Interstate corridor if they were to take alternate routes. Perhaps the most interesting finding in Dow and Cutter's (2002) study was that a significant number of non-evacuees cited traffic concerns as their reason for not evacuating, although the authors caution that these concerns may have been cited as a result of elevated media reporting, which began commenting on traffic before all evacuees were on the road, highlighting the important effect that communications may have on evacuation behavior.

References

- Aumonier, S. & Morrey, M. (1990). Non-radiological risks of evacuation. *Journal of Radiological Protection*, 10(4), 287-290.
- Barnes, K, Brosius, J., Cutter, S., & Mitchell, J. K. (1979). Responses of impacted population to the Three Mile Island Nuclear Reactor Accident: An Initial Assessment. (Discussion Paper No. 13) New Brunswick , NJ : Dept. of Geography, Rutgers University .
- Bartlett, G. S., Houts, P. S., Byrnes, L. K., & Miller, R. W. (1983). The near disaster at Three Mile Island . *International Journal of Mass Emergencies and Disasters*, 1, 19-42.
- Bateman, J. M. & Edwards, B. (2002). Gender and evacuation: A closer look at why women are more likely to evacuate for hurricanes. *Natural Hazards Review*, 3(3), 107-117.
- Dombroski, M. J. & Fischbeck, P. S. (2006). An integrated physical dispersion and behavioral response model for risk assessment of radiological dispersion device (RDD) events. *Risk Analysis*, 26(2), 501-514.
- Dow, K. & Cutter, S. L. (2002). Emerging hurricane evacuation issues: Hurricane Floyd and South Carolina . *Natural Hazards Review*, 3(1), 12-18.
- Fitzpatrick, C. & Mileti, D. (1991). Motivating public evacuation. *International Journal of Mass Emergencies and Disasters*, 9, 137-152.
- Flynn, C. (1979). Three Mile Island Telephone Survey: Preliminary Report on Procedures and Findings. (Report NUREG/CR1093 prepared for U.S. Nuclear Regulatory Commission). Temple , AZ : Mountain West Research, Inc.
- Johnson, J. H. Jr. & Zeigler, D. J. (1983). Distinguishing human responses to radiological emergencies. *Economic Geography*, 59(4), 386-402.
- Levi, M. A. & Kelly, H. C. (2002). Weapons of mass disruption. *Scientific American*, 287(5), 76-81.

- Riad, J. K. & Norris, F. H. (1998). Hurricane threat and evacuation intentions: Analysis of risk perception, preparedness, social influence, and resources. (Preliminary Paper No. 271) Newark , DE : Disaster Research Center , University of Delaware.
- Sinuany-Stern, Z. & Stern, E. (1993). Simulating the evacuation of a small city: The effects of traffic factors. *Socio-Economic Planning Sciences*, 27(2), 97-108.
- Southworth, F. (1991). Regional evacuation modeling: A state-of-the-art review. (Report ORNL/TM-11740 prepared for the US Department of the Army Office of the Assistant Secretary, Installations, Logistics and Environment). Oak Ridge , TN : Center for Transportation Analysis, Oak Ridge National Laboratory.
- U.S. Army Corps of Engineers and Federal Emergency Management Agency USACOE. Hurricane Floyd Assessment. Tallahassee , FL : Post, Buckley, Schuh, & Jernigan, Inc.
- Wolshon, B. (2001). "One-way-out: Contraflow freeway operation for hurricane evacuation. *Natural Hazards Review*, 2(3), 105-112.
- Zeigler, D. J., Brunn, S. D., & Johnson, J. H. Jr. (1981). Evacuation from a nuclear technological disaster. *Geographical Review*, 71, 1-16.
- Zeigler, D.J., & Johnson, J. H. Jr. (1984). Evacuation behavior in response to nuclear power plant accidents. *Professional Geographer*, 36(2), 207-215.

3. Qualitative Analysis (Key Informant Study)

To identify the major issues surrounding potential evacuations of urban areas into rural communities, and to provide recommendations for how rural planners might prepare their communities for a population influx, we interviewed 17 preparedness stakeholders, including six national preparedness experts and 11 local emergency preparedness planners (five representing urban communities and six representing rural communities). Urban and rural planners were paired so that rural planners represented areas surrounding the urban planners' jurisdictions.

3.1 Project Approach

Key informant interviews were conducted to inform the development of a national survey of urban residents to assess evacuation intentions (see section 4), and to provide data to support components of a tool to model urban-to-rural evacuation and population surge.² To ensure that a variety of perspectives were collected, key informants were classified as urban, rural, or national experts.

3.1.1 Research Questionnaire

Semi-structured interview protocols were developed based on project objectives. Interview questions encompassed three categories: urban residents' evacuation behavior; rural issues related to an urban evacuation; and strengths and weaknesses of current preparedness planning. The first set of questions included such issues as the types of events that could precipitate an urban evacuation, differences between spontaneous and mandated evacuations, compliance with shelter-in-place directions, and evacuation direction, distance, travel time, and destination. The second category solicited opinions on the information needed by rural planners to prepare for a population influx, and the major challenges for rural areas receiving evacuees. The final set of questions assessed current preparedness planning and cooperation at the local, state, and national levels. Most questions were open-ended, designed to guide the discussion in a conversational manner. While this approach tends to elicit responses that are fairly subjective, it can be quite useful as a tool for identifying themes within broader topic areas.

3.1.2 Selection of Key Informants

National experts, representing academia, government and the private sector, were identified through a review of the preparedness literature and recommendations from project advisors. To incorporate representation from varied geographic regions and city sizes, urban and rural

² With separate funding from the Western New York Public Health Alliance Advanced Practice Center, NORC collaborated with the Pennsylvania State University Center for Environmental Informatics to develop a prototype evacuation modeling tool, as well as an evacuation planning guide for rural communities likely to receive evacuees. These resources can be accessed via <http://walshcenter.norc.org>.

counterparts were chosen from six major U.S. metropolitan areas and associated rural counties ranging from twenty minutes' to four hours' distance from the urban center. Interviewees were public health directors or emergency preparedness coordinators for their jurisdictions.

3.2 Findings and Implications

Interviews were conducted in a semi-structured fashion, allowing subjects to respond conversationally to open-ended questions. Interviews were typically 30 to 45 minutes in length and were conducted by phone. In presenting findings, we classify responses by respondent type: national preparedness experts; urban preparedness planners; and rural preparedness planners.

3.2.1 National Preparedness Experts

Six national preparedness experts were interviewed, comprised of professionals in government, academia, and the private sector. The national experts generally concur that in the event of a disaster or public health emergency, the behavior of urban residents will largely depend on how the threat is presented by the media, the government, and/or word-of-mouth. They note that in past disasters, person-to-person information transmittal significantly influenced evacuation, and they highlight effective media communication as a critical component of a successful evacuation. Interview findings also suggest that traffic would be a major issue. While a mandated evacuation allows for preemptive efforts like traffic lane reversals (i.e., traffic contraflow), spontaneous evacuations can result in sudden, unexpected traffic jams and blockages, particularly in areas with limited access or road capacity.

National experts are split in their predictions of whether pandemic flu will precipitate spontaneous evacuations; some feel the public will perceive safety in rural areas with lower population density, while others believe most urban residents will adhere to governmental directions for social distancing and sheltering in place. Most agree that citizens would be more likely to follow such directions if the government provided assurances regarding job security and continued availability of necessities such as food and water.

In the event of an urban evacuation, there are several issues national experts identify as particularly problematic for rural regions. While residents might evacuate *to* rural areas, an additional concern is the large number who may evacuate *through* these areas, consuming fuel, food, water, and sanitation resources as they travel to their destinations. Several experts highlight water and sanitation as critical but often overlooked aspects of evacuation planning. They note that many rural areas have preexisting water supply and sanitation capacity issues, and any additional population will likely overwhelm these systems.

The most consistently cited critical weakness of rural communities is their limited health care and public health infrastructures. Evacuees exposed to radiation, chemical, or biological threats will likely overwhelm the health systems of small communities, and may also precipitate health consequences among the local population. An additional concern is rural health systems' lack of capacity to provide care for evacuees with special medical needs. The national experts suggest

that reception sites be set up along evacuation routes where evacuees can be triaged and directed appropriately rather than allowed to travel to their various destinations before seeking medical care. In this way, officials can provide care to those most in need and utilize resources accordingly.

3.2.2 Urban Preparedness Planners

Urban experts also feel that city residents' reactions to disasters and public health emergencies will depend on the content and delivery of official messages and recommendations. In addition, urban experts note that information must be tailored to distinct demographic groups within the city if messages are to be successful. They believe that citizens will cooperate with shelter-in-place directions if the message is delivered appropriately and the entity delivering the message is trusted. In a pandemic flu scenario, urban experts agree that financial incentives, promises to compensate for lost workdays, and guarantees that sufficient food, water and energy supplies will be provided are requisites to persuading citizens to shelter in place.

Several urban experts maintain that urban residents are unlikely to evacuate to rural destinations. Rather than prepare for an influx of evacuees, they emphasized that rural preparedness efforts should focus on the ability to provide adequate food and fuel for the large numbers likely to travel through rural regions to reach family, friends, second homes, hotels, and familiar sites in other metropolitan areas. Urban informants frequently raise issues relating to culture and acclimation. They observe that urban populations are ethnically, culturally, and socio-economically diverse, whereas rural regions tend to be more homogeneous. The interviewees also indicate that rural communities might not welcome or accept urban evacuees into their communities, echoing opinions expressed by several national experts. Urban interviewees also suggest that city residents may not feel comfortable in rural areas, which lack familiar conveniences and infrastructure. While interviewees acknowledge that some evacuees would settle in rural areas, they feel that preparedness efforts should consider that evacuees will travel to nearby cities, which have greater capacity for absorbing them. Several urban experts note coordination and planning efforts with other urban areas that might serve as potential evacuation destinations, but few report similar coordination with surrounding rural communities.

3.2.3 Rural Preparedness Planners

Rural experts are greatly concerned with the issue of urban-to-rural evacuation, although this does not appear to have translated into specific planning to address a potential population surge. The majority of ongoing preparedness activities in the represented counties involve the use of all-hazards approaches to plan for locally occurring disasters, as well as pandemic flu planning. When asked about the lack of planning to address urban evacuation, rural planners note the lack of population surge estimates as a barrier to effective planning.

Rural planners share urban and national experts' concerns about their health system capacities for evacuee absorption. Community hospitals generally run above 90 percent capacity and are much smaller than urban hospitals. In the event of an evacuation, rural hospitals will need to

discharge patients to accommodate evacuees. Rural estimates of available absorption capacity of evacuees with health care needs ranges from five (in a county of approximately 82,000) to several thousand (in a county of approximately 30,000). Clearly, interviewees perceive the concept of accommodating evacuees with health needs differently, and this variation suggests a need for standardization and preplanning for evacuees with a variety of medical needs.

Rural planners highlight that while greater numbers of evacuees will likely go to other urban areas in many scenarios, it will take fewer evacuees to overwhelm smaller, rural community systems. In addition to considering raw numbers of evacuees, these planners recommended analyzing the ratio of evacuees to the existing population. In light of the already limited resources in smaller communities, the potential for small numbers of evacuees to quickly deplete available resources is great.

Rural counties also vary in their degree of regional coordination. Although three of the represented counties have communicated or coordinated in some way with nearby urban centers, the other three have not. All counties, however, have activities, planning efforts, or standing meetings with other nearby counties. Despite the variation in the extent of planning around preparedness issues, the rural counties express concerns about the lack of information surrounding urban evacuation and find it difficult to plan for potential population influxes when they have so little information with which to plan.

Interviews reveal that the following types of information would be particularly helpful for rural planners: estimates of numbers of evacuees that might arrive in their areas following particular disaster events; characteristics of those evacuees, such as approximate percentages of the evacuating population who are children, elderly, or disabled; and numbers of evacuees arriving with special medical needs and/or pets.

3.3 Summary

Rural preparedness officials face significant informational, organizational, and infrastructural constraints in their abilities to prepare for a potential population surge. In particular, the rural health care delivery infrastructure is ill-equipped to absorb evacuees with medical needs and those with special medical needs in particular. Hospitals generally operate close to capacity and would need to discharge patients to accommodate evacuees. Additionally, few rural counties have triage centers or other plans for receiving evacuees with health problems or with potential health risks. Most informants agree that addressing these and other health-related concerns should take priority in rural communities' preparedness plans.

In the event of a disaster, the manner in which the threat is presented by the media, government, or word-of-mouth will influence urban citizens' reactions and behavior. Adherence to shelter-in-place directions will depend upon trust in the source of those instructions. Urban citizens who do evacuate will likely go to family and friends, second properties, or hotels. Although a significant portion of evacuees may not stay in rural areas, they will travel through these regions, straining fuel, food, water, and sanitation resources. Those who do stay in rural areas have the potential to overwhelm already strained infrastructure.

Finally, rural communities would benefit from regional planning among rural communities, but also including urban areas that may serve as the locus of an evacuation. Information that would be useful in developing rural preparedness plans to respond to such events would include estimates of numbers of evacuees that might arrive following disaster events, characteristics of those evacuees such as approximate percentages who are children, elderly, or disabled, and numbers of evacuees arriving with special medical needs and/or pets.

4. Quantitative Analysis (National Survey of Urban Residents)

To supplement the Walsh Center's work on urban-to-rural evacuation, a national survey was fielded to assess the evacuation intentions of urban citizens following emergency scenarios. Included scenarios were the detonation of a radiological device (i.e., dirty bomb) and an influenza pandemic. Respondents were asked whether they would be likely to evacuate under various conditions, whether they would be likely to follow governmental instructions to shelter in place, and to identify travel distances and possible destinations. Evacuation to rural areas was of particular interest because these regions likely would be overwhelmed by the relative increase in population.

4.1 *Project Approach*

The survey was developed based on information gathered during the literature review and key informant interviews, with intentions of addressing existing gaps in knowledge of evacuation behavior.

4.1.1 Survey Instrument Content

A 15-item survey instrument was designed to assess respondents' intentions to evacuate following the detonation of a dirty bomb or during an influenza pandemic under varying conditions of external influence, as well as likely evacuation distance and known destinations.

Respondents were asked whether they are "likely to evacuate" or "not likely to evacuate" following detonation of a dirty bomb or the occurrence of pandemic influenza under each of the following conditions:

- Hearing reports from television or radio media, yet the **government makes no recommendation as to what citizens should do.**
- Hearing reports from television or radio media, the government makes no recommendation as to what citizens should do, but **a trusted friend or relative urges the respondent to evacuate.**
- The **government advises residents not to evacuate.**

- The **government suggests that residents evacuate.**
- The **government orders residents to evacuate.**

The survey also included questions related to intended travel distances (i.e., *are you likely to travel less than 50 miles, 50 to 150 miles, 150 to 250 miles, or more than 250 miles?*) destinations (i.e., *are you more likely to travel to another urban destination or to a rural destination?*), and whether respondents have a family evacuation plan (i.e., *do you have a family evacuation plan?*). Urban and rural were self-defined based on the perceptions of respondents; specific destinations were not captured and verified as urban or rural.

4.1.2 Survey Methodology

Survey respondents were a nationally representative sample of 1,505 adults living in urban and suburban metro areas. Respondents were reached by telephone in March, 2007 as part of the EXCEL³ National Telephone Omnibus Study, conducted by International Communications Research (ICR) of Media, PA, which also collects standard demographic and classification data for each respondent household.

4.2 Findings and Implications

In presenting findings, we report results by precipitating event (i.e., dirty bomb, pandemic influenza), intended evacuation destination (urban vs. rural), likely evacuation distance, intention to follow governmental shelter in place orders, and findings related to racial and ethnic differences in intended evacuation behavior.

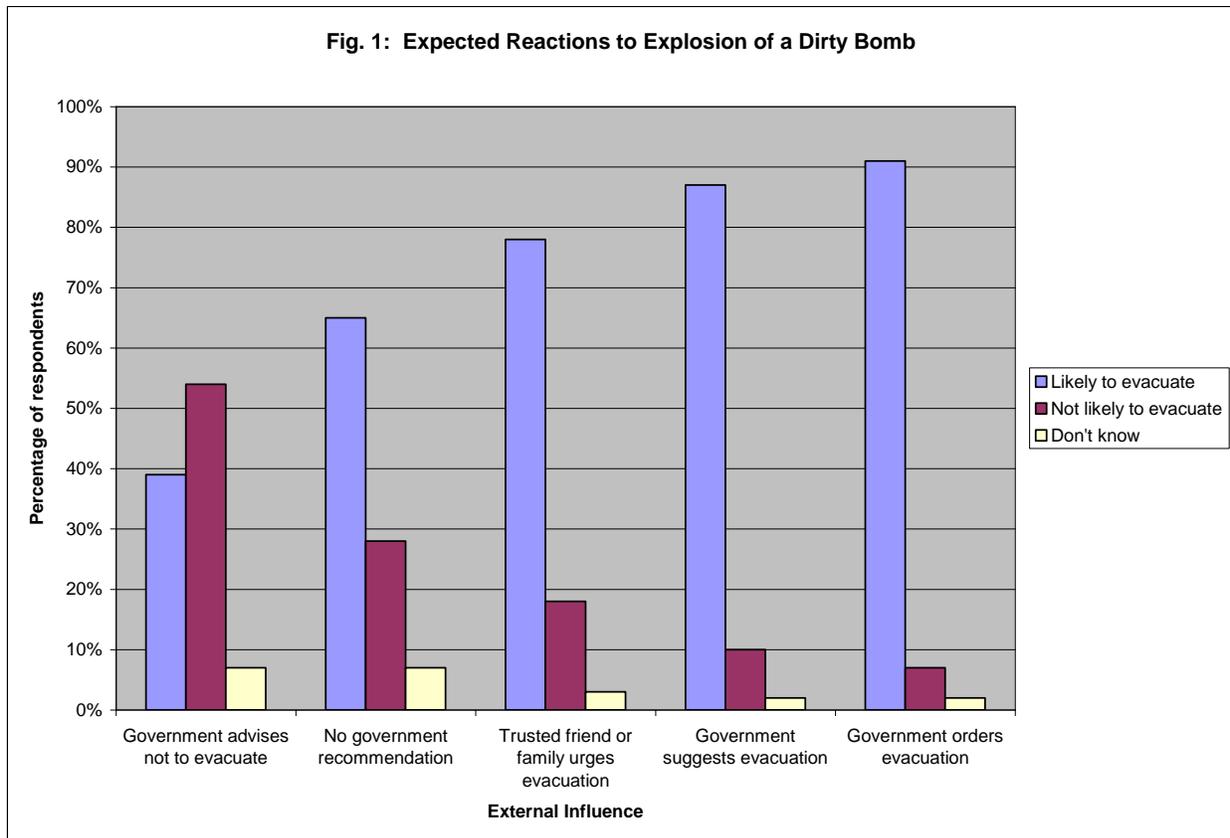
4.2.1 Dirty Bomb

Experts generally agree that the intended effect of a dirty bomb would be to cause fear and panic and not necessarily to cause a significant loss of life, as dirty bombs produce only a fraction of the explosion or radioactive fallout of a nuclear bomb. As such, dirty bombs are sometimes referred to as “weapons of mass disruption.” In considering the potential consequences of the explosion of a dirty bomb, however, a significant concern is that the general public may confuse “dirty bomb” with nuclear bomb.

To minimize the possibility that respondents might ask the interviewer for a definition of “dirty bomb,” and to ensure that each respondent had equal priming, the dirty bomb question included the following single-sentence explanation: “A dirty bomb is a conventional bomb that also spreads radioactive material.” In designing the question, we felt that this explanation would not

³ EXCEL uses a fully-replicated, stratified, single-stage random-digit-dialing (RDD) sample of telephone households.

only provide a consistent definition, but also provide the best approximation to an individual hearing about a dirty bomb for the first time if such an incident did occur. Figure 1 displays the overall responses for each of the five conditions of external influence.



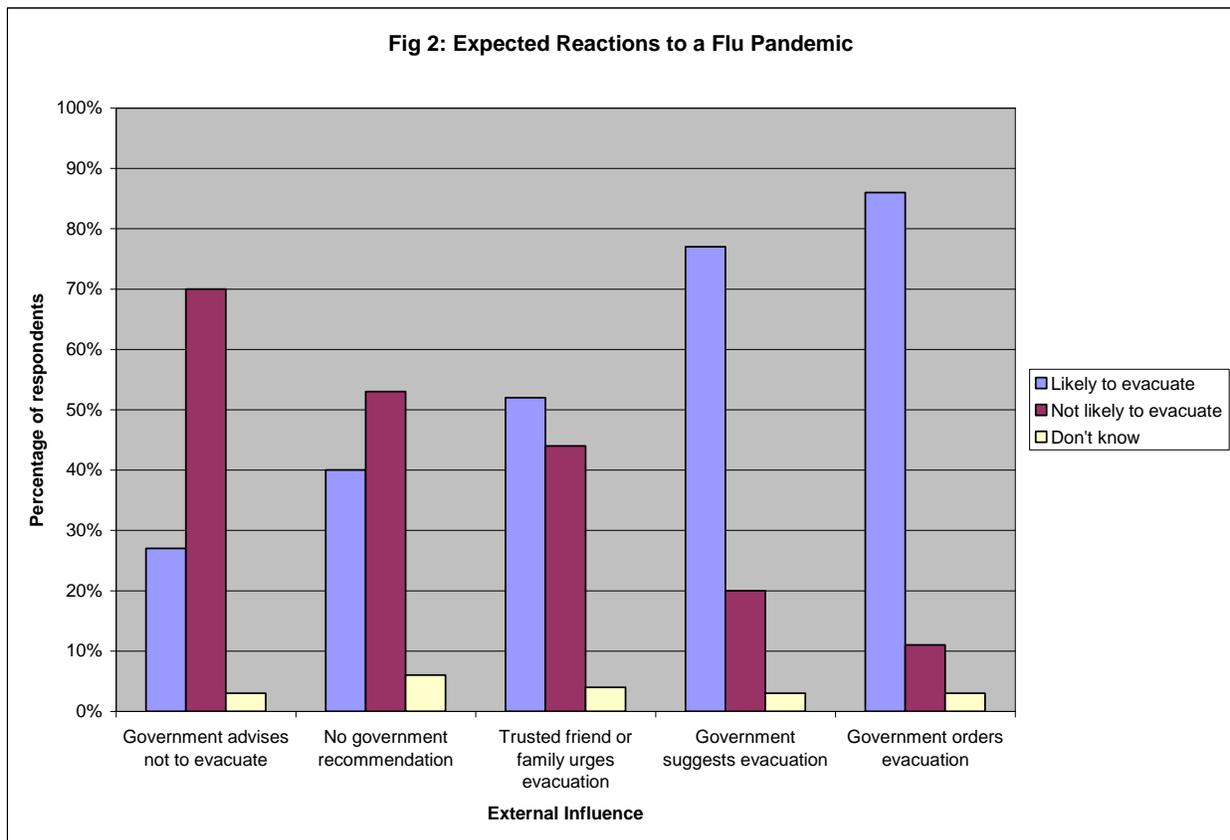
As external influence to evacuate increases, respondents' stated intentions to evacuate show a corresponding increase. Several results deserve particular attention. When presented with a scenario where the government advises residents not to evacuate, only 54% of respondents indicated that they would follow this advice, while 39% indicated they would evacuate *against* the government's advice (7% responded that they "don't know"). When presented with a scenario in which the government makes no recommendation, but a trusted friend or family member urges evacuation, 78% reported they are likely to evacuate, while in scenarios where the government suggests or orders evacuation, the number of respondents who indicated they are "likely to evacuate" increases to 87% and 91%, respectively, which suggests that the government may have only a moderately stronger influence than a trusted friend or family member on an individual's decision to evacuate. Most importantly, in four of the five scenarios, two-thirds or more of urban residents indicated they would evacuate following a dirty bomb, and when advised by the government *not* to evacuate, more than a third of urban residents would still evacuate.

A potential limitation that should be considered in interpreting these figures is that because respondents knew that they were participating in a survey of intended evacuation behavior, they may have considered evacuating in situations that they otherwise would not. This may result in somewhat higher stated intention to evacuate. However, given the high proportion of individuals

that report an intention to evacuate, the potential to overwhelm rural community capacities clearly remains even if overall numbers of evacuees were less than demonstrated by the survey.

4.2.2 Pandemic Influenza

In light of media reporting on pandemic influenza (avian flu) and coverage of the Severe Acute Respiratory Syndrome (SARS) epidemic in 2002, we were interested in whether urban residents would leave their communities in an infectious disease scenario. Indicating that “[a] flu pandemic could be the result of bird flu or avian flu,” respondents were again asked if they would be “likely to evacuate” or “not likely to evacuate” given each of the five conditions of external influence. Figure 2 presents the results of this question.

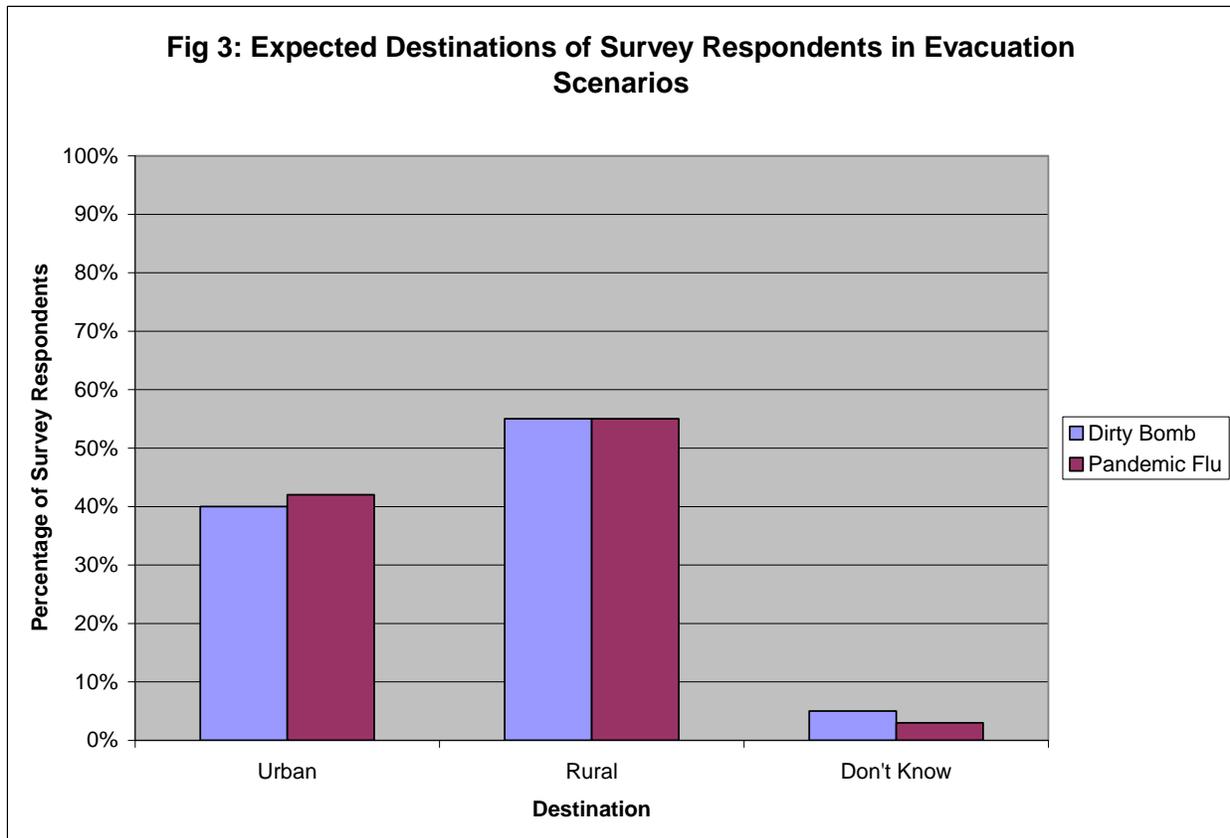


Similar to respondents’ stated intentions following a dirty bomb, in the event of an influenza pandemic respondents show increasing intention to evacuate as external pressure to evacuate increases. However, evacuation intentions overall are lower for a pandemic influenza than for a dirty bomb. Seventy percent of respondents indicated that they would follow the government’s advice if told not to evacuate, but 27% indicated that they would still be likely to evacuate despite the government’s advice. The percentage of respondents who indicated they would evacuate on the urging of a trusted friend or relative (52%) was substantially lower than either a government suggestion or order to evacuate, with 77% and 86%, respectively, indicating they are likely to evacuate.

As with the dirty bomb scenario, it important to recognize the potential study limitation related to participating in a survey of intended evacuation behavior, likely leading to somewhat higher estimates of intention to evacuate. As before, given the high proportion of individuals that report an intention to evacuate, the potential to overwhelm rural community capacities clearly remains even if overall numbers of evacuees were less than demonstrated by the survey. This may be particularly true for pandemic influenza, where the safest response is likely remaining in the home.

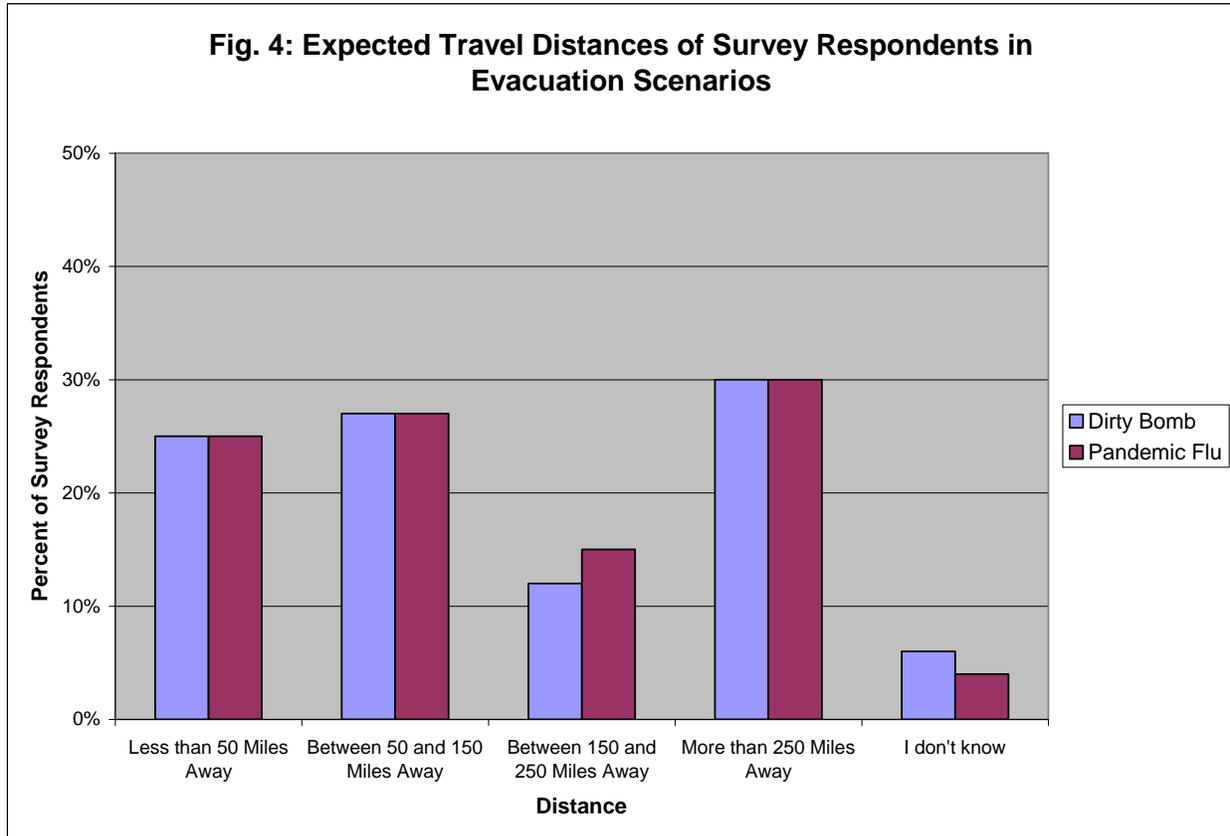
4.2.3 Evacuation Destination

In both scenarios, 55% of respondents indicated that they would likely travel to a rural destination. For the dirty bomb scenario 40% indicated that they would likely travel to an urban destination, while 42% indicated that they would likely travel to an urban destination in the pandemic influenza scenario. Figure 3 displays likely evacuation destination by scenario.



4.2.4 Evacuation Distance

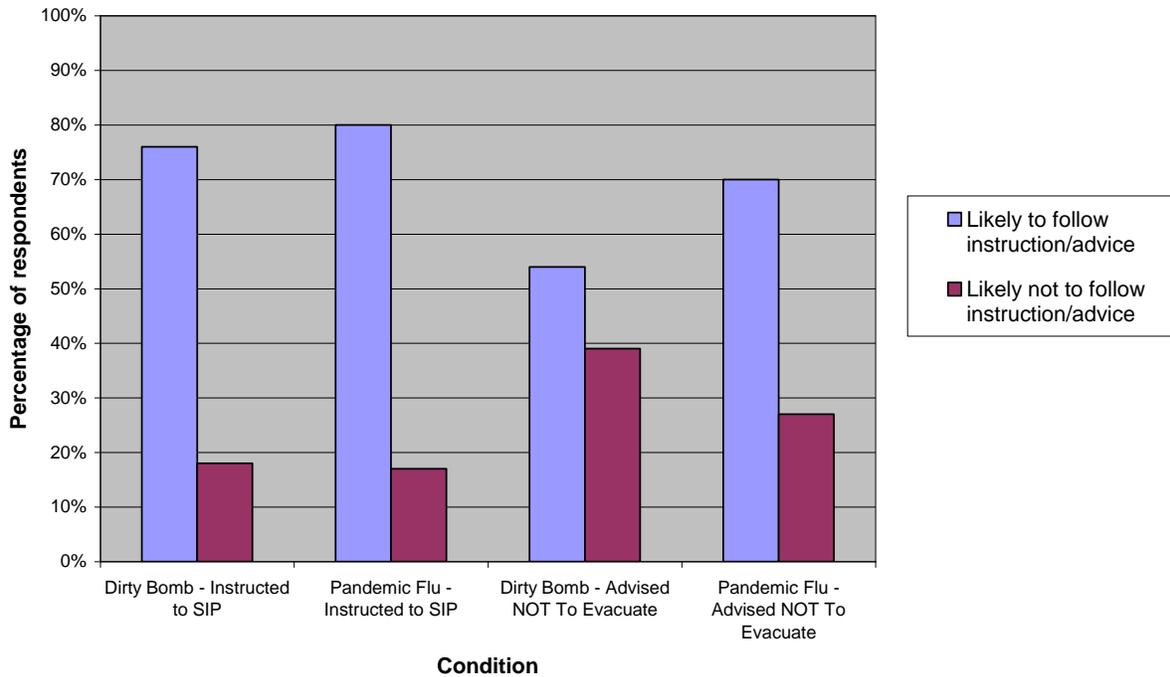
In the dirty bomb scenario, 25% of respondents report that they would travel less than 50 miles; 27% between 50 and 150 miles; 12% between 150 miles and 250 miles; and 30% more than 250 miles to reach their intended destination. Results are similar for the pandemic influenza scenario, with 25% reporting that they would travel less than 50 miles; 27% between 50 and 150 miles; 15% between 150 miles and 250 miles; and 30% more than 250 miles to reach their intended destination. Figure 4 displays likely evacuation distance by scenario.



4.2.5 Sheltering in Place

The dirty bomb and pandemic influenza questions were each followed by a question intended to assess whether respondents would follow governmental instructions to shelter in place. Respondents were asked, “If a [dirty bomb explodes / a flu pandemic is affecting your community] and the government instructs citizens to stay in their homes or workplaces—known as ‘sheltering-in-place’—would you be likely or not likely to follow these instructions?” Figure 5 displays the overall responses to this question and also presents the percentages of respondents reporting whether they would evacuate if the government advises residents not to evacuate.

Fig 5: Likelihood of Following Instructions to Shelter-in-Place and Advice Not to Evacuate



Following a dirty bomb or during an influenza pandemic, 76% and 80% of respondents indicate they would likely follow government instructions to shelter in place. This rate of compliance with official directives is higher than the reported intention to comply with government advice not to evacuate, to which 54% and 72% of respondents indicated they would not be likely to evacuate. A likely explanation is that people are more compliant when told what *to* do rather than what *not to* do. This may suggest an important risk communications strategy in helping to limit evacuation or exposure. The distinction between advising people *not to* evacuate versus instructing people *to* shelter in place is important, as compliance rates are quite different based on how the order is framed and either instruction could be used to achieve a similar aim.

4.2.6 Racial and Ethnic Differences

We also examined the survey results to investigate differences in propensity to evacuate based on respondent characteristics. The data reveal that under both the dirty bomb and pandemic influenza conditions, respondents who identified themselves as Black or Hispanic are significantly more likely to evacuate under all five conditions of external influence:

- Following media reports of the explosion of a dirty bomb, respondents identifying themselves as Black or Hispanic are almost twice as likely to evacuate as compared to respondents identifying themselves as White.

- If an influenza pandemic was affecting their community, respondents identifying themselves as Black are more than three times as likely as White respondents to evacuate; respondents identifying themselves as Hispanic are approximately 2.5 times as likely as White respondents to evacuate.

Table 3: Likelihood of Evacuation by Race/Ethnicity, Odds Ratios*				
	Black	p	Hispanic	p
Dirty Bomb	1.84	0.010	1.96	<0.001
Pandemic Influenza	3.18	<0.001	2.49	<0.001

* Note that white survey respondents (equivalent to 1) served as the reference group for this odds ratio analysis.

Although the overall evacuation will be greater following a dirty bomb explosion, Blacks and Hispanics are significantly more likely to evacuate as compared to Whites following a pandemic influenza scenario. Survey data also indicate that although Black and Hispanic respondents are less likely to follow government advice not to evacuate, they are more likely to follow a government suggestion or order to evacuate, suggesting a greater overall propensity to evacuate regardless of official communication.

No significant difference between White and Black respondents emerged in their intentions to follow government instructions to shelter in place. Results observed among Black and Hispanic respondents may reflect a post-hurricane propensity towards evacuation among racial and ethnic populations most affected by Hurricanes Katrina, Wilma and Rita.

4.3 Conclusions

Many urban residents will evacuate their homes and communities following a disaster or public health emergency. Close to one-third of urban residents intend to evacuate against governmental advice, and between 77% and 91% of urban residents intend to evacuate if the government suggests or orders an evacuation. In each scenario, 55% of respondents indicated that they would be likely to travel to a rural destination. The consequences of such an evacuation of an urban area could be disastrous, and particularly so for surrounding communities with limited infrastructure, which would quickly be overwhelmed by even a small fraction of an evacuating urban population. The high likelihood of evacuation following an infectious disease scenario such as pandemic influenza only heightens these concerns and presents specific potential threats to the healthcare and public health infrastructures. Even considering the limitation of prompting respondents to consider evacuation through their known participation in a survey of intended evacuation behavior and the likelihood of this producing an overestimate of actual evacuation behavior, the volume of likely evacuees clearly has the potential to overwhelm already limited rural infrastructure and capacities.

The mass exodus of such a large number of people, potentially similar to what occurred during Hurricanes Katrina and Rita, presents a multitude of challenges. Roads and highways are not designed to accommodate such a large percentage of the vehicle population at any one time, and can back up miles, trapping evacuees where they are vulnerable to natural or manmade dangers. Gas stations, rest stops, grocery stores, restaurants, and sanitary facilities are also not designed to handle so many travelers at once, resulting in shortages of fuel, food, and hygienic facilities. Evacuees who eventually reach destinations away from the affected urban area will require water, sanitation, food, shelter, medicine, treatment for chronic conditions, and may require immediate medical attention for acute needs related to the incident that prompted evacuation.

5. Recommendations

Based on the findings from the literature review, qualitative and quantitative analyses, we offer the following policy recommendations:

Recommendation 1: Rural communities in close proximity to urban centers should consider the issue of urban to rural evacuation among preparedness concerns.

Findings from both the qualitative and quantitative studies clearly demonstrate the potential for significant population surge in rural communities following an urban disaster. Fifty-five percent of survey respondents specifically note that they would likely travel to a rural community should they evacuate. While the number of evacuees who settle in a specific rural community may reflect only a small percentage of the evacuating urban community, those evacuees nevertheless will represent a significant population increase in a rural area likely having limited resources.

Recommendation 2: Rural communities should engage in regional planning to pool resources in preparation for a potential urban evacuation. Likewise, urban preparedness plans should also include nearby rural areas and provide information on potential numbers of evacuees and evacuee needs.

Communities in rural areas should develop coalitions to facilitate planning and communication among multiple counties, and should seek to plan in conjunction with nearby urban centers. Regions surrounding urban centers should consider establishing predetermined reception sites for evaluating evacuees' needs and distributing limited resources efficiently. Urban public health and preparedness officials should include surrounding rural areas when developing disaster response plans and generate information that can be used in estimating numbers of evacuees and evacuee needs.

Recommendation 3: Rural communities should consider the potential consequences not only as an evacuee destination, but also as evacuees travel through their communities on their way to other urban and rural destinations.

Many evacuees will travel great distances on their way to urban and rural destinations, exhausting resources along the way. As part of their planning, rural communities should

consider the potential for depletion of supplies and resources by people evacuating through their communities. Resources, including food, fuel and sanitation facilities, should be deployed in strategic locations along evacuation routes to facilitate continued movement of evacuees and to minimize the loss of already limited rural resources.

Recommendation 4: Tools, trainings, and technical assistance should be developed to support rural preparedness planning to address issues of population surge following urban evacuation.

When asked why they had not developed plans for rural population surge, many respondents reported that they had no basis on which to plan; that is, they had no information on the numbers of evacuees to expect, nor potential evacuee needs. Tools and trainings should be developed to inform rural preparedness planning efforts. Specifically, information on estimated numbers of evacuees and likely evacuee needs is needed to provide a frame for the development of rural plans. It should be noted that the NORC Walsh Center for Rural Health Analysis has developed a tool to address these needs in collaboration with the Western New York Public Health Alliance Advanced Practice Center and the Pennsylvania State University Center for Environmental Informatics, as well as an urban-to-rural evacuation planning guide for reception communities; these resources can be accessed via <http://walshcenter.norc.org>. In addition to these resources, training is needed to assist rural planners in identifying resources and developing appropriate plans.

Recommendation 5: Risk communications professionals should carefully consider the desired evacuation behavior of urban residents and messages should be designed accordingly.

A consistent theme in the key informant interviews was the importance of effective risk communications. Many key informants indicated that they believed that urban residents would likely follow government orders if the messages were crafted appropriately. This was further reinforced by the survey findings; when comparing respondents' intentions to adhere to instructions to shelter in place to their intentions to adhere to advice not to evacuate, responses to the former question demonstrated significantly higher levels of compliance. Compliance is clearly affected by how the message is framed.

Recommendation 6: Federal and state guidance for preparedness planning should prompt communities surrounding urban centers to plan for the reception of evacuees, and the use of preparedness funding to support such planning should be encouraged.

Given the proportions of evacuees who will likely evacuate following urban disasters, the proportion that will travel to rural communities, and the proportion that intend to evacuate against government advice, rural planning to address population surge issues is critical. Rural key informants noted concern about these issues, but reported little actual planning in response. Rural counties already receive funding to support preparedness planning activities. They should be encouraged to use these existing resources to appropriately plan for population surge related to urban evacuation. The NORC Walsh Center/Western New York Public Health Alliance tool should facilitate this planning.

Recommendation 7: Resources are needed to strengthen the health care and public health infrastructures of rural communities to address issues related to population surge, as well as to enhance overall preparedness through effective disease surveillance and containment, health communications, and the delivery of quality health care services.

Limited health care and public health infrastructures are widely acknowledged as a critical weakness in rural communities. Evacuees exposed to radiation, chemical, or biological contaminants will likely overwhelm the health systems of smaller communities, and may also precipitate health consequences among the local population. Robust health care and public health systems are necessary to effectively respond to issues such as population surge following an urban evacuation, and are also needed to ensure overall preparedness efforts through effective disease surveillance and containment, health communications, and the delivery of quality health care services.

Recommendation 8: Cultural competency information and training should be provided to assist destination communities in addressing the needs of diverse urban populations.

Survey respondents identifying themselves as Black or Hispanic were almost twice as likely to say that they would evacuate as compared to respondents identifying themselves as White. Rural communities are likely to be less heterogeneous than urban communities and may not have appropriate staff and resources to effectively address the needs of culturally and linguistically diverse populations. This concern was reinforced in discussions with urban preparedness planners.

Recommendation 9: Further study is recommended on urban evacuation intent and behavior.

Much of the prior research on urban evacuation was conducted before the war on terrorism and the 2005 hurricane season. It is likely that events such as Hurricanes Katrina, Rita and Wilma, September 11th, and the 2001 anthrax attacks, have changed the overall propensity of urban citizens to evacuate. Additional studies are recommended to validate and expand on NORC survey findings.