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### **Population Segments with Disabilities**

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As a whole, scholars suggest that individuals with disabilities are disproportionately affected by disaster (Fox, White, Rooney, and Rowland, 2007; Hemingway and Priestley, 2006; McGuire, Ford, and Okoro, 2007; National Council on Disability, 2009; Peek and Stough, 2010). However, few empirical studies have been conducted on the effects of disasters on individuals with disabilities, and to our knowledge, no published data is available on the effects of tornadoes on this population. However, we believe findings from research conducted on the elderly can be reasonably extrapolated for two reasons. First, the two groups share commonalities in how they are vulnerable to disasters. For example, both individuals with disabilities and elderly adults often evidence similar specific physical disabilities, such as mobility disabilities or sensory impairments. Both also experience socio-economic vulnerabilities, such as poverty, unemployment, or living in housing prone to disaster hazards at disproportionately higher rates. In addition, these types of vulnerabilities are often “layered” in these two groups leading to cases in which individuals are exposed to multiple risk factors. Second, individuals with disabilities and elderly adults do not represent two distinct groups. In fact, most adults will acquire a disability, if only temporarily, at some time during their lifetime. In addition, as adults age, they tend to acquire disabilities, such as hearing losses, visual impairments, and cognitive disabilities, and the severity and number of these disabilities tend to increase with an individual’s longevity. Finally, given recent advances in medical science, individuals with disabilities are living longer and increasingly joining the elderly adult demographic. As a result, the two groups overlap substantially, while sharing similar vulnerabilities. We argue here that research is particularly warranted on the effects of tornadoes on individuals with disabilities given the large prevalence of this population throughout the world, the intensity of their social vulnerabilities in disaster, and recent federal mandates that specify equal access for individuals with disabilities to emergency preparedness and response services.

## **Defining Vulnerable Populations**

### **The Social Vulnerability Paradigm**

The social vulnerability perspective of disaster has been primarily developed by researchers from the field of sociology (see Cutter, Boruff, and Shirley, 2003; Peacock and Ragsdale 1997; Philips and Morrow, 2007), and provides a useful theoretical framework for examining the effects of disaster on populations with disabilities. While disasters are usually perceived as random events, the social vulnerability perspective argues that some groups are placed disproportionately at risk to disaster due to a combination of societal, economic, and political factors (Cutter et al., 2003; Fothergill and Peek, 2004; O’Keefe, Westgate, and Wisner 1976; Wisner, Blaikie, Cannon, and Davis, 2004). The social vulnerability perspective argues that societies collectively determine who lives in disaster-prone areas and who will subsequently have limited defenses against disasters (Hewitt 1997). From this perspective, disasters not only affect some groups differentially, but expose pre-existing inequalities that lead to disproportionate damage, loss of property, or even death (Wisner et al., 2004). Women, children, immigrants, minorities, the poor, as well as people with disabilities have been identified as particularly vulnerable to the impacts of disaster (Cutter et al., 2003). For example, the low cost of mobile homes makes it more likely that people living in poverty will rent or buy this type of housing. As a result, when tornadoes occur, those that are poor are more likely to be harmed when they take cover within their home, while those of more affluent means, living in better built structures, are less likely to experience personal or material harm (Daily, 2005). In addition, the affluent have more economic and social capital upon which to draw when reconstructing their homes, while socially vulnerable populations tend to struggle post-disaster and take longer to recover. The social vulnerability paradigm thus serves as an appropriate theoretical lens through which to interpret the joint experiences of individuals with disabilities and individuals who are aging. It also allows for the concept of “layering” of vulnerabilities these two populations experience economically, socially, and politically.

### **Individuals With Disabilities Defined**

*Disability* as a classification is not consistently defined. Its definition varies across the different medical groups, professional organizations, and governmental agencies that focus on disability issues. Existing research on the effects of disaster on individuals with disabilities similarly has defined disability in a variety of ways (Peek and Stough, 2010). For example, mental health researchers use criteria from the American Psychiatric Association’s Diagnostic and Statistical Manual to define types of psychological disabilities. Disaster researchers who focus on physical or mobility impairments tend to

use the Americans with Disabilities Act (ADA) 1990 definition of disability as being “a physical or mental impairment that substantially limits one or more of the major life activities of such individuals” (PL 101-336 104 Stat. 327). Epidemiologists rely on the U.S. Census Bureau definition of disabilities in order to conduct statistical analyses on populations. The emergency management field has traditionally classified individuals with disabilities, together with children, non-English speakers, and the elderly, as “special needs” populations. More recently, the *functional-needs approach* to defining disability-related needs during disaster was adopted by the Federal Emergency Management Agency (2010) in its Comprehensive Preparedness Guide 101 and in the National Response Framework (FEMA, 2010). The functional needs approach uses a five-part taxonomy of needs in the areas of communication, medical health, functional independence, supervision, and transportation (Kailes and Enders, 2007), rather than specifying types of disabilities. For example, individuals with auditory limitations may need modifications in how they receive emergency communications, while individuals with memory or decision-making difficulties may require some supervision while in a shelter. Perhaps the most universal definition, however, is that of the World Health Organization’s (WHO) International Classification of Functioning, Disability, and Health (ICF) (2001), which conceptualizes disability as resulting from the interaction between the health condition of an individual and that individual’s personal and environmental setting. The WHO definition is also compatible with social vulnerability theory in that it includes the environmental affordances and barriers as part of what becomes disabling for individuals in particular contexts or societies. Disability, like disaster, in this view is a result of societal inequalities rather than a result of bad fortune.

### **Older Adults Defined**

Terms for older adults include “seniors,” “elderly,” and “aged” and these terms are tied to a chronological age. Other terms such as “frail elderly” or “fragile elderly” are usually used to denote a health, mobility, or health impairment in addition to advanced age. While disability and aging are usually discussed as two separate types of populations, there is actually considerable overlap between the two. Individuals with disabilities, due to medical advances in the last thirty years, are living considerably longer and an estimated 32-36% of the population with disabilities are over 65 (Altman and Bernstein, 2008). In addition, as people who may have previously not had a disability age, there are natural declines in physical and cognitive ability. Declines in vision (e.g., acuity, contrast sensitivity), hearing (e.g., speech discrimination), and fine motor control are all common (Ivy, MacLeod, Petit, and Markus 1992). Cognitive changes take place as well, including the decline of text comprehension, poorer performance on memory tasks, and greater difficulty in focusing attention on relevant stimuli (Park and Schwartz, 2000). In addition to the natural waning of physical and cognitive abilities, chronic disease-related

conditions (e.g. osteoarthritis, diabetes, hypertension, Alzheimers) also take their toll. Approximately 80% of all U.S. seniors have one chronic condition and 50% have at least two (Arslan, Atalay, and Gokce-Kutsal, 2002) thereby increasing the number of “fragile elderly” suffering from multiple comorbidities. These additive consequences of normal aging and disease combine with other social factors to make older adults particularly vulnerable to disaster (Flanagan, Gregory, Hallisey, Heitgerd, and Lewis, 2011; Mayhorn, 2005; McGuire, Ford, and Okoro, 2007).

## **Demographics and Prevalence**

### **Individuals With Disabilities**

The prevalence of individuals with disabilities that occurs within a particular geographic location depends on the definition chosen. Individuals with disabilities constitute a broad spectrum of the population and live in areas vulnerable to disaster throughout the world. According to the WHO (2005), roughly 600 million people—10 percent of the global population—have some type of disability. Disability is highly correlated with poverty, and as many as 80 percent of all individuals with disabilities live in developing countries. In the United States, approximately 16.7 percent of the non-institutionalized (not living in nursing homes, assisted living, or group homes) population reports an illness or condition that substantially limits one or more of their activities of daily living, such as walking or bathing (Brault, 2008). The U. S. Department of Education (2005) reports that 13.8 percent of school-aged children in the United States have a diagnosed disability—a number which highlights that people tend to acquire disabilities as they age. It is estimated that over 200 million children worldwide have some type of disability (UNICEF, 2007).

### **Older Adults**

Consistent with a global trend, the American population is aging at an unprecedented rate (Mirkin and Weinberger, 2000). In 2010, those aged 65 or older numbered 40.4 million, which represents an increase of 15.3 percent since 2000. By 2030, demographic projections reported by the U. S. Administration on Aging (AoA) suggest that there will be about 72.1 million older persons- which is over twice the number reported in 2000 (AoA, 2011). Not only is the percentage of the older adult population increasing but some of the largest growth is in the older cohorts, with those aged 75-84 numbering 13.1 million and those aged 85 or older numbering 5.5 million.

Levels of independent functioning for both the aging population and the population with disabilities are often assessed in terms of Activities of Daily Living (ADLs). ADLs are specific clusters of activities such as eating, dressing, bathing, ambulating, and

toileting that classify whether specific persons require help in terms of promoting functional independence (Lawton 1990). In 2010, 36.7% (approximately 14.3 million) of those 65 or older indicated that they were living with a disability that impacted their ADLs (Houtenville and Ruiz, 2011). Moreover, an examination of age by disability type suggests that some types of disability are more associated with advancing age than others (Altman and Bernstein, 2008). For instance, seeing and hearing difficulty was more likely to be reported by those 65 or older (37.3%) than people aged 18-44 (26.9%). Cognitive difficulties including but not limited to Alzheimer's disease were reported by 44.4% of those 65 or older compared to 22.7% of the 18-44 age group. Movement difficulty was also more likely to be reported by those 65 or older (36.2%) compared to those aged 18-44 (24.6%).

Census data collected in 2010 indicates that 37% of older adults reported some type of disability (i.e., loss of hearing, vision, difficulty with walking, etc.) that impacts daily independent living (AoA, 2011). Severity and frequency of reported disabilities tends to increase with age such that 56% of those aged over 80 reported severe disabilities and 29% of this group reported needing assistance with personal needs. Consistent with the concept of layered vulnerability, the presence of a severe disability within this older population is also associated with lower levels of income and educational attainment that may cascade to impact housing and the presence of social support.

### **Disability and Aging Interface**

From a prevalence perspective, it is unclear how the functional characteristics of aging and disability interact. For instance, what portion of this disabled older adult group developed new disabilities as a result of growing older and what portion was disabled at an earlier age? This distinction in terms of time of onset may be important as people who have been disabled for a longer period of time may develop coping strategies that allow them to adjust to their functional limitations thereby enabling compensatory behavior much faster than those diagnosed more recently (Baltes and Smith, 2003). Because disability type likely differs by age of onset as well (Altman and Bernstein, 2008), it is possible that people disabled at an earlier age will acquire new age-related disabilities in an additive fashion such that they may be able to compensate for "old" disabilities but not for newly acquired age-related disabilities. In this manner, disaster response may differ substantially between groups of older adults with disabilities. For instance, someone who experienced vision loss at an early age may have compensated by learning to rely on her hearing at a younger age. When normal age-related changes in hearing impact auditory sensitivity, this person may find herself differentially disadvantaged when she has to interpret the meaning of a tornado siren or the auditory component of a televised warning.

On the other hand, individuals born with a disability or who acquire a disability during the developmental period include populations with intellectual disabilities (formerly termed “mental retardation”) as well as those with genetic or multiple disabilities, and constitute a large part of the approximately 1% of the U.S. population with severe or significant cognitive disabilities (Smart, 2009). In addition, disabilities that occur during the developmental period tend to be accompanied by physical and perceptual disabilities, adding to the supports that are needed by these individuals. In addition, individuals with intellectual disabilities, by definition, are significantly restricted in their ability to comprehend, evaluate, and remember and usually cannot cognitively compensate for these limitations. Although the life expectancy of those with developmental disabilities is usually significantly limited, we can anticipate that the acquisition of age-related disabilities would further decrease their level of function and subsequent ability to prepare for and respond to disasters.

### **Geographic and Residential Factors**

#### **Individuals with Disabilities**

Most individuals with disabilities live and work in the community, as do their counterparts without disabilities. The rate of home ownership is lower, however, for households that include a family member with a disability, due to the relative poverty level of these households (Emerson, Graham, and Hatton, 2006; Harrison and Davis, 2001). For the same reason, individuals with disabilities are more likely to live in substandard housing or in mobile homes (Cooper, O’Hara, and Zovistoki, 2011). In addition, the 2009 American Community Survey found that 856,425 people with disabilities live in homeless shelters, group homes, and other non-institutional group quarters facilities. In addition to this group, it is estimated that more than 400,000 or more non-elderly people with disabilities are living in nursing homes and public mental health institutions (Cooper et al., 2011). An important factor for both community-dwelling and institutionalized populations is that caretaker and medical supports are available to provide continuity of care during the disaster event (National Council on Disability, 2009). Caretaker supports are also essential in the case of young children and school-aged children with disabilities who may need supervision from day care providers or teachers, as well as provisions for medical and special nutritional needs during disaster. Similarly, employers who provide supported work environments need to consider needs of their employees with disabilities should a disaster occur during the work day. In both congregate housing and work environments, an accessible built environment (Christensen, Collins, Holt and Phillips, 2007) is an important element to consider when designing areas in which to shelter-in-place.

## **Older Adults**

In 2010, 56.5% of older adults aged 65 or older lived in 11 states: California (4.3 million), Florida (3.3 million), New York (2.6 million), Texas (2.6 million), Pennsylvania (2 million), and Ohio, Illinois, Michigan, North Carolina, New Jersey, and Georgia each had more than 1 million (U.S. Census Bureau, 2010). Alabama was one of twelve states where poverty rates for elderly residents exceeded 10% in 2010. Moreover, a growing trend in seniors' attempts to balance affordable housing with maintaining independence has resulted in an increased movement for older adults in the Midwestern and Southern United States to occupy mobile homes (George and Byland, 2002). Apparently these efforts to age-in-place have been successful because only approximately 4% of older Americans live in nursing care (McGuire, et al, 2007).

To further illustrate the concept of layered vulnerability, it is well understood that older adults are likely to “age-in-place” such that they are less likely to move once they have financially and emotionally invested in a home (Blake and Simic, 2005). Some estimates indicate that as many as sixty percent of older adults have been living in the same homes for at least 20 years (Hermanson and Citro 1999). In 2007, 23.1 million older homeowners were surveyed and results suggested that the elderly were living in older homes with a median construction year of 1970 and 4.3% reported that their homes had significant physical problems (AoA, 2011). Other findings indicate that older adults are less likely than younger adults to make home repairs within the last two years (Hermanson and Citro 1999) thereby placing this segment of the population in substandard housing that makes them vulnerable to strong storms (Tierney, 2006).

## **Research on Disasters and Population Segments with Disabilities**

### **Individuals with Disabilities**

The bulk of the limited research literature on disability and disaster has focused on evacuation and the disaster impact. Studies completed post-Katrina (see White, Fox, Rooney, and Cahill, 2007; White, B. 2006) have found that systems of emergency notification, for example television and radio broadcasts, were inaccessible to many individuals. In an early work, Tierney, Petak, and Hahn (1988) suggested that people with physical disabilities are at risk when quick evacuation is required to avoid disaster impact. Similarly, Morrow (1999) suggested that older adults who are physically frail and who require assistance to evacuate are at-risk. Evacuation barriers for people with physical disabilities are seen as compounded by building design that requires the ability to descend stairs, exit windows, or open doors (Christensen, Blair, and Holt, 2007). Households usually evacuate together and evacuation behavior has been found to be affected when a household member has a disability: Data from Hurricanes Bonnie, Floyd,

and Dennis revealed that households with people with disabilities both delayed evacuation and evacuated at a lower rate than did households without a member with disabilities (Van Willigen, Edwards, Edwards, and Hesse, 2002). Most of these households identified a lack of transportation or of adequate sheltering facilities as primary reasons for their reluctance to evacuate. A survey of 680 evacuees from Hurricane Katrina found 38% of those who did not evacuate before the storm either were physically unable to leave or were caring for someone physically unable to leave (Kaiser Family Foundation, 2005). Similarly, 9% of households with members with disabilities located near a chemical weapons storage site needed evacuation assistance during disaster, however 60% reported that they did not have adequate assistance to do so and 59% reported they did not have adequate evacuation transportation (Metz, Hewett, Muzzarelli, and Tanzman, 2002).

A few studies have focused on disaster impact and the response phase following disaster. Households with a family member with a disability experience significantly more damage to their homes during hurricanes, in part as they are more likely to live in a mobile home (Van Willigen, Edwards, Edward, and Hesse, 2002). The costs of these damages were also significantly higher for these households, representing 80% of their monthly per capita income, four times that of households without a family member with disabilities. Services that individuals with disabilities receive post-disaster also differ. Parr (1987) found emergency personnel and voluntary service organizations failed to consider supports needed by individuals with disabilities in post-disaster exercises. Similarly, Byrne and Davis (2005) reported that volunteers using wheelchairs or portraying a visual impairment during a drill scenario were passed over, ignored, or responded to inappropriately by emergency responders.

Two studies have examined the long-term recovery phase and individuals with disabilities. Van Willigen and colleagues (2002) studied 559 households one year following Hurricane Floyd. Respondents in inland households with a person with a disability were significantly more likely to report that their lives were still disrupted one year later. In contrast, sixty-seven percent of households without a member with a disabilities reported their lives were completely back to normal; whereas, only 58% of households with a member with a disabilities reported things were back to normal a year after the hurricane. Similarly, 65% of households located in coastal counties that included a member with disabilities reported that their lives were completely back to normal; whereas, 75% of households without a disabled member were completely back to normal several months after Hurricane Floyd. In another study, Stough, Sharp, Decker and Wilker (2010) interviewed 54 disaster workers providing case management post-Katrina. Barriers to disaster recovery for individuals with disabilities included a lack of accessible housing, transportation, and disaster services. Findings suggested that the disaster recovery process is typically more complex and lengthy for individuals with disabilities

and requires negotiation of a service system that is sometimes unprepared for disability-related needs.

### **Older Adults**

In contrast, there is a wealth of previous literature within the hazards research that has evaluated how older adults fare before, during, and after exposure to a natural disaster. By no means is this work comprehensive but it does identify older adults as a vulnerable segment of the population because they are more likely to become casualties during disasters in general (Friedsam 1962; Hutton 1976). For example, Bourque, Siegel, Kano, and Wood (2006) found forty-seven percent of the deceased as a result of Hurricane Katrina were over the age of 75. This finding is particularly true for tornado hazards (Ashley, 2007; Eidson, Lybarger, Parsons, Maccormack, and Freeman 1990). Post disaster, when compared to younger victims, older adults typically underutilize aid from community disaster relief resources (Kilijanek and Drabek 1979) as well as suffer from more long term psychological distress and somatic symptoms (Phifer 1990). Potential explanations for this observed pattern of vulnerability vary from social isolation (Klinenberg, 2002) to mobility and sensory impairments resulting in a decreased likelihood of encountering a disaster warning (Eldar 1992). Although evidence suggests that older adults are just as likely to attempt to comply with disaster warnings (Perry and Lindell 1997), they have special needs that must be considered when developing emergency preparation plans (Lafond 1987). Likewise, the special needs of older adults with disabilities may limit the availability of protective actions such as evacuation if shelters are not equipped with medical equipment or at least have the space to accommodate such equipment (McGuire, Ford, and Okoro, 2007).

After disaster has struck, it is noteworthy that older adults tend to be slower in their economic recovery across a variety of hazard types (Bolin and Klenow 1983). Previous research that investigated the utilization of post-tornado disaster assistance indicates that older adults are less likely than others to seek assistance (Bell, Kara, and Batterson 1978). When assistance was sought, some of the elderly reported being “confused, intimidated, and frustrated by time delays, complicated forms, and procedural regulations” (Bell et al 1978, p. 80). As the Census data suggests, disability and age are correlated with lower socioeconomic status; thus, the added financial costs of recovery may have lasting effects especially when considered against the context of lower assistance seeking.

## Research on Tornadoes

### Individuals With Disabilities

As previously noted, we found no published studies on the effects of tornadoes on individuals with disabilities. However, extrapolating from the above studies, we anticipate that in sudden onset disasters that permit little forewarning, such as tornadoes or earthquakes, individuals with disabilities may have more difficulty in quickly taking protective actions and evading impact. For instance, individuals with cognitive impairments may not understand emergency communications or understand impending signs of danger (Kailes and Enders, 2007) or become anxious and confused in response to emergency alerts (Scotti et al., 2007). In addition, emergency procedures during tornadoes would be likely distressing for most individuals with autism, who typically find changes in routine difficult to manage and become easily agitated and disoriented by stimuli such as flashing lights or loud noises. Deaf individuals may not receive warning signals at the same time as hearing individuals when sirens or radio announcements are used for alerting. In addition, given that English is, in fact, a second language for Deaf individuals who use American Sign Language, captions on television screens or written notices distributed through social media may not be well understood by them. In sum, communicating tornado alerts in a manner in which individuals with disabilities can access them is an area of considerable concern.

Again, extrapolating to predict post-disaster needs, individuals with mobility limitations may be incapable of moving downstairs into a basement and, following a tornado, be unable to use a wheelchair to move around disaster debris. For individuals with visual impairments, navigating the post-tornado environment could be particularly hazardous in that familiar landmarks may have been destroyed or relocated. Individuals with autism or other cognitive disabilities may find the changes in their housing and neighborhoods particularly disorienting and distressing. Individuals across the disability spectrum who use durable medical equipment, such as walkers, wheelchairs, hearing aids, or who require medical supports may be placed differentially at-risk post-disaster when these supports are lost or discontinued. While individuals without disabilities may encounter similar challenges as described here, populations with disabilities are more likely to live in poverty, have smaller social networks, more likely to have experienced damage to their housing, and have fewer personal affordances with which to cope post-disaster. As a result, their ability to recovery post-disaster is of considerable concern.

### Older Adults

From work with hurricanes (Mayhorn and Watson, 2006), it is known that older adults generally face a number of barriers that impact their abilities to respond to protective action recommendations such as evacuating or sheltering-in-place. For instance, the

decision to evacuate is reliant on the financial variable of whether one owns a car or has access to transportation and likewise, a social cost must be realized because there has to be a destination for evacuation. As hurricanes are often preceded by warning periods that last for days, it is likely that older adult response to rapid onset hazards such as tornadoes may be more pronounced because warning time may be limited to as little as five minutes (Balluz, Holmes, Malilay, Schieve, and Kiezak, 2000). Consider the physical challenges of urgent, quick action that must be utilized to seek shelter in such a situation. Given statistics that indicate that approximately 32% of American adults aged 70 or older report difficulty walking (McGuire, Ford, and Ajani, 2006) with 3.8% needing the use of a wheelchair and 13% indicating that they use some other assistive device such as a cane or walker (U. S. Census Bureau, 2001), it is likely that many of these disabled older adults will be unable to comply with tornado warnings. Thus, there is a critical need for future research that specifically targets the development and testing of tornado warnings that take these disability and age-related factors into consideration. An added benefit to this line of warnings research is the realization that these universal approaches to design typically result in more user-friendly products and environments that benefit people of all abilities and ages (Vanderheiden 1997).

### **Tornadoes and “Layered Vulnerabilities” of Individuals of All Ages with Disabilities**

Given the aforementioned disability prevalence statistics and described shifts in demographics, the need for further disaster research on disability is clear. While this research is generally sparse for all hazard types, even less is known about how the characteristics of a specific hazard might differentially impact those with disabilities. For instance, unlike other natural hazards such as hurricanes and wildfires, the protective action for tornadoes does not entail evacuation but rather procedures for sheltering in place. Compounding the issue, short lead times of warnings that precede the arrival of the hazard often necessitate that compliance decisions be made quickly and safety-related actions be taken swiftly.

With tornadoes, disabled and elderly segments of the population will be faced with challenges at every stage of the event. At the warning stage, these people may be at a particular disadvantage because they will have difficulty interacting with a warning. For instance, poverty may influence whether or not someone has access to emergency messages transmitted via specific media. Likewise, even if a message is received, shortcomings in auditory or visual perception may reduce the likelihood that the message will be interpreted accurately (Mayhorn, 2005). Moreover, the understanding of message content may be further hampered for those with intellectual disabilities or normative age-related declines in cognition in older adults.

If message content is understood and an active decision is made to comply with “shelter-in-place” recommendations, elderly and disabled individuals may have difficulty finding cover from an approaching tornado. Because both aging and disability are correlated with lower socioeconomic status, these segments of the population might be likely to live in mobile homes or substandard housing (Blake and Simic, 2005; George and Bylund, 2002). Thus, it is also likely that neither segment of the population will have access to safe locations such as a basement or underground shelter. Previous research indicates that access to these locations is essential in complying with shelter-in-place instructions (Balluz, et al., 2000; Schmidlin, Hammer, Ono, and King, 2009). These at-risk individuals may be even further endangered due to social isolation (Klineneberg, 2002) as evidence suggests that people will be less likely to seek shelter even when available when they do not know the people who own the structure (Schmidlin et al., 2009).

Should elderly and disabled people gain access to sturdy, safe locations where they can shelter from a tornado, they will be faced with even further physical challenges. Due to reductions in their motoric capabilities, many older and disabled people may lack the ability to physically respond quickly (Vercruyssen 1997). Even if someone lives in a home with a basement and they receive plenty of warning prior to tornado arrival, people with mobility impairments or visual impairments may find it difficult to descend a flight of stairs quickly or to lower themselves into the protection of a bathtub.

### **Legal Requirements for the Inclusion in Emergency Planning, Response, and Recovery**

Individuals with disabilities in the U.S. are entitled to equal access to emergency services, including evacuation procedures and sheltering. The Stafford Act, which gives the Federal Emergency Management Agency (FEMA) the responsibility for coordinating government-wide disaster efforts, specifies that the needs of individuals with disabilities be included in the components of the national preparedness system (FEMA, 2007). Title II of the Americans with Disabilities Act requires modifications to policies, practices, and procedures to avoid discrimination against people with disabilities. This requirement also applies to programs, services, activities provided through third parties, such as the American Red Cross, private nonprofit organizations, or religious entities. Specifically, entities must make reasonable modifications and accommodations, cannot use eligibility criteria to screen out people with disabilities, and must provide effective communication to individuals with disabilities (American with Disabilities Act, 2008). Recent attention on national policies concerning the needs of individuals with disabilities has resulted in changes to the Stafford Act and led to the inclusion of the functional needs approach in the U.S. The C-MIST definition of the functional needs approach to disability is as follows:

Populations whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to: maintaining independence, communication, transportation, supervision, and medical care. Individuals in need of additional response assistance may include those who have disabilities; who live in institutionalized settings; who are elderly; who are children; who are from diverse cultures; who have limited English proficiency or are non-English speaking; or who are transportation disadvantaged (FEMA, 2010b).

Thus, all individuals with disabilities, including those who have a life-long disability, as well as those who have acquired a disability in senescence, are entitled to equal access and inclusion across all phases of disaster management.

### **Critical Research Needs**

Given the scarcity of empirical literature that has examined the effects of disaster in general, and tornadoes specifically, on individuals with disabilities, it can be argued that any research on this population would be a contribution to the field. However, we make the following suggestions as primary:

- Large-scale epidemiological studies that include disability as a demographic characteristic. The U.S. Census, and on a more detailed level, the American Community Survey, allow for analysis of disability as a demographic factor. A limitation is that disabilities can manifest with considerable variability, so that the category of *mobility impairments*, for example, does not distinguish what proportion of those in this category require the use of a cane or the use of a wheelchair.
- Similarly, there is a need for large-scale epidemiological research that distinguishes between different types of elderly populations, specifically elderly adults who have disabilities of different types. Some elderly adults are easily able to take protective action whereas others would need substantial support to do so. Using age as a variable without qualifiers masks the difference amongst individuals in this population.
- Few studies have focused on the post-disaster challenges unique to individuals with disabilities. While we can extrapolate that impact and mortality is probably greater for this population, the longest phase of disaster is the recovery phase. In households that include a family member with a disability, what differential supports are needed to support recovery and what is the differential cost of this recovery? Such research would be helpful in understanding the needs of poor communities and developing countries that tend to have a larger percentage of individuals with disabilities.

- The majority of the scant disability research is on individuals with mobility impairments and individuals with mental health needs. Research on individuals with intellectual disabilities and autism, as two of the most prevalent disabilities, is almost absent in the literature, and sorely needed.
- Research on individuals with disabilities has the potential to inform social vulnerability theory. To date, research on the effects of disaster on people with disabilities has almost exclusively focused on how physical or cognitive impairments intersect with disaster experiences rather than upon the how disability is affected by social and environmental factors (Peek and Stough, 2011). For example, wheelchair use only becomes a differential vulnerability factor in a building that does not take into account how people with mobility impairments may evacuate if elevators are not running. Research on the multiplicative effects of social vulnerabilities experienced by population segments with disabilities would contribute to the construction of disaster theory.

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