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The future of accessibility in disaster conditions: How wireless technologies will transform the life cycle of emergency management

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The Future of Accessibility in Disaster Conditions[1]: How Wireless Technologies Will Transform The Life Cycle of Emergency Management.

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I. Introduction

This paper examines a "flash-forward" approach to how emergency managers can pro-actively integrate and empower people with disabilities and disability organizations to reduce risks in disaster contexts. To manage the discussion, a "life cycle" of emergency management will include, but not be limited to, examples of real technology trends (particularly wireless technologies) in emergency management. Worldwide, most emergency management professionals rely on phases to organize activities. While they are called different names, they all tend to encompass common activities and goals. To illustrate the phases and related technologies, this paper will consider questions within the life cycle of emergency management such as phases that include:

- *Preparedness*. How have wireless technologies enhanced preparedness efforts, particularly outreach to and education of people with disabilities and their community networks? How has it helped individuals take steps to prepare themselves, such as by using wireless technologies to acquire information, training, or ideas?
- *Response*. How have wireless technologies changed the warning process, sped the rescue process, reduced reaction and evacuation times, and reduced the need for shelters and/or extended sheltering times? What innovative practices are not only helping those experiencing survival challenges during response but also serving the first responders who seek to help?

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- *Recovery*. How do wireless technologies enable location of accessible shelters and housing? Given the integration of accessible design elements, how have shelters and post-disaster housing become both physically and technologically accessible? How does it help improve the pace of re-entry back into the community by providing the information to make decisions and help strengthen health and social support systems?
- *Mitigation*. In what ways have new codes and standards for use of elevators (e.g., "smart cabs"), and wireless technologies (among other features) become integrated into post-disaster reconstruction as a means to mitigate future risks for people with disabilities? Does such mitigation effort encourage resilience, or the ability to bounce back after disaster strikes?

By using several real examples of trends and practices emerging in 2015 and carrying them through to 2050, we will illustrate the potential outcomes if supported today. The paper will also review the transformative agents and conditions required for movement toward a newly-envisioned 2050. We rely on an eco-systems framework to reveal the agents of such transformative change, drawing from the questions used in the previous section.

There are other factors to keep in mind as we work through this paper. It is acknowledged that many other conditions can be overlaid with disability, thereby compounding the potential impact. These may include age, gender, cultural identity, historic patterns of racism and discrimination and literacy level, to list a few. But, in particular, income has a significant impact on the ability to obtain much of the technology discussed here on an individual level assuming, it is readily available. Carried through, that factor needs to be presumed by the organizational and governmental levels and budgeted into all phases of the emergency life cycle.

This example is true very broadly across the whole community but very relevant when crossed with disability. Consider that nearly half those with an annual household income under $15,000 have a disability or that 1 in 3 unemployed adults who are able to work have a disability[2]. For further examination of this, see Table 1.

Table 1. Snapshot of earnings and poverty in the U.S.

	People with disabilities	**People without disabilities**	**Source**
Median Earnings (12 month period)	**20,184**	**30,660**	*Source: 2012 American Community Survey, Table B18140 http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtmlpid=ACS_12_1YR_B18140&prodType=table*
People employed earning 100,000 or more	**4%**	**8%**	*Source: Disability Employment Tabulation, from 2008-2010 American Community Survey, Table Set 7A http://www.census.gov/people/disabilityemptab/data/*
Percent in poverty	**23%**	**15%**	*Source: 2012 American Community Survey, Table B18130 http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtmlpid=ACS_12_1YR_B18130&prodType=table*

Further, we recognize that disability is a spectrum. Disability can be chronic or episodic; visible or invisible; life-long or sudden onset; and an individual may have one defined disability or several at any given time. Within this paper we have selected but a few disabilities as examples

[2] http://www.cdc.gov/ncbddd/disabilityandhealth/infographic-disability-impacts-all.html Accessed on May 13, 2016.

to illustrate how technology might be applied but there are many more in real-time. While we focus on sensory and mobility disabilities, these represent the largest percentage of people with disabilities. According to the findings reported in the 2010 U.S. Census 7.6 million people 15 and older have a hearing impairment; 8.1 million people 15 and older have a vision impairment; and 30.6 million people 15 and older have a form of movement impairment affecting walking or climbing stairs. In 2010, this represented nearly 80% of people with disability (total 56.7 Million), which was also the last time the U.S. Census collected such specific data on people with disabilities. For further examination of this, see Table 2.

Table 2. Specific Disabilities

	Number of population (15 and older)	**Number of population (65 and older)**
Mobility disability: walking or climbing stairs	**30.6 Million**	**15.2 Million**
Mental Disability	**15.1 Million**	**3.0 Million**
Needing assistance: daily living, bathing, dressing, housework, meals	**12.0 Million**	**5.8 Million**
Uses cane, crutches and walkers	**11.6 Million**	**7.0 Million**
Vision disability	**8.1 Million**	**3.8 Million**
Hearing disability	**7.6 Million**	**4.1 Million**
Use a wheelchair	**3.6 Million**	**2.0 Million**
Cognitive disability: includes Alzheimer's disease and any form of neuro-cognitive disorder	**2.4 Million**	**1.6 Million**

Source: Americans with Disabilities: 2010 www.census.gov/prod/2012pubs/p70-131.pdf

This paper is designed to envision a transformed, mid-century view of emergency management and accessibility. Rather than presenting just an optimistic future view, the paper will lay out the route most likely to lead toward such an outcome. As such, the paper will reveal a groundbreaking vision coupled with a guide that compels forward movement.

2. The Life Cycle of Emergency Management

In this section, each phase of the disaster life cycle (commonly referred to globally as preparedness/readiness, response, recovery, and mitigation/reduction/prevention) is defined and illustrated. Following each definition, typical activities are presented to re-imagine a future in which wireless technologies dramatically lessen the impacts of disaster for people with disabilities. Some of the technology ideas presented here are already underway as prototypes or working theories that have been presented in trade publications, academic journals, or at conferences. Other ideas are pre-concept imaginations based on current technology abilities and the overwhelming disaster-related needs of people with disabilities. The goal of the discussion is not only to inform but to inspire and expand thinking about the ways in which technologies can be used with, by, and for people with disabilities and their supporting organizations, including emergency managers and first responders.

The *preparedness or readiness phase, which often includes planning,* usually includes activities that individuals, households, and organizations engage in prior to an actual disaster. These activities may include creating an action plan, participating in drills, and organizing disaster-ready kits. At the individual level, it is prudent to organize kits that include everything

from food and clothing to prescriptions, batteries, medical records, back-up assistive technology/durable medical equipment (AT/DME) devices, and important documents. The individual should be ready to live on their own without any help for at least three days. At the household level, each family member should have a disaster-ready kit. The collective family should also participate in drills, prepare a communications plan, and have a meeting strategy in place when unable to gather at home. At the organizational level, much like the household level, employees should participate in drills, have a communications plan, and create a reunion strategy as well as a business continuity plan to continue to serve and advocate for clients.

While individuals, households, and organizations prepare and plan, so do emergency management and first responder agencies. Historically, the most effective plans have included stakeholders from within the community, namely outreach to people with disabilities and advocacy or support organizations. Stakeholder participation can be one of the most important steps to inclusion of people with disabilities. It is at this point when first responders, emergency managers, and members of the community can come together to explain, learn, and incorporate each other's needs and resource assets in case of a devastating disaster.

In 2050, we anticipate all of these important first steps will continue to be viewed as prudent. Of particular importance, first responders or emergency managers must continue to become familiar with and know their whole community, meaning not only individuals but organizations that connect people to policies and practices. Many wireless technologies may make it easier for emergency managers to communicate with people with disabilities. For example, in 2004, an advocacy team reported on necessary improvements in the U.S. that would improve emergency communications among people who are Deaf and those with profound hearing loss (Stout, Heppner, & Brick, 2004). The team found that sending messages through

text messages on wireless devices would greatly improve the ability of those who are Deaf or hard-of-hearing to receive emergency messaging. In 2015, we have such as system, the Wireless Emergency Alerts (WEA) system. Maintaining open communication and direct contact remain especially important since the progression of technology is ever evolving, with no indications of slowing down. In and before 2015, however, some emergency management agencies and first responder organizations have been hesitant to fully incorporate new and burgeoning technology (Latonero and Shklovski, 2011). Furthermore, rules and regulations have also been unable to adequately keep pace with innovation. Social scientists describe this process as *cultural lag*, where people, communities, and even entire societies fall behind in adopting new ways of living (Ogburn 1966; 1957). In addition, technologies and related updates often outpace funding, further undermining the chances of widespread adoption.

Yet, many wireless technologies in development now may offer considerable impacts on the preparedness levels of people with disabilities. One such technology is *geo-fencing*, which creates a virtual fence around a geographic location. Such an application can allow for the hyper-localization of emergency preparedness and warning information to cross into or out of virtual barriers. Geo-fencing could be extremely useful for centers of independent living, congregate housing, schools, college campuses, or disability organizations with a significant geographical footprint. First responders and emergency managers can use geo-fencing to deliver targeted information, timely warnings, and public education. Other examples include the use of mobile apps to assist individuals gain information and skills necessary to enhance their own level of preparedness thus improving resilience and better ensuring independence and self-determination even in times of emergency.

The *response* phase occurs during and immediately after a disaster. Activities during the response phase typically include providing emergency assistance for casualties, search and rescue, securing buildings and structures to reduce secondary damage, and organizing resources for recovery operations. Also undertaken in this phase are notification, evacuation, and emergency shelter operations. Such work can expose first responders to significant levels of risk. In 2050, casualty assistance activities may be accomplished with decreased risk for first responders.

For example, wearable technologies may reduce risk and vulnerability for first responders, so that they may be safer when trying to search for and rescue people, regardless of disability. Wearable technology (or wearables) includes clothing or accessories that incorporate wireless computer-based devices. At its most basic level, wearables incorporate wireless technologies that a person can don. Examples of wearables include smart watches, health monitoring bracelets, USB-heated gloves, and smart shoes. Conceptual wearable technology may yet embed health and heat sensors into glasses to help first responders detect environmental threats (Otto, 2014; Chong, 2014). In the future, such wearables may support first responders when assisting people with disabilities. Wearables could assist by proving accessible information such as braille, text, voice, or ASL interpretation, which could assist first responders with communication. As a second example, drones (unmanned aerial systems) may supplement the effort to search for those who are injured, particularly in more remote locations. This novel use for drones is just beginning to emerge among many emergency management and non-profit agencies across the United States. Pennsylvania has outpaced other states in the use of drones during emergencies, in Beaver County a drone was used to search for a missing person off the Ohio River (Lepro, 2016). The current most common use for drones has been for real-time

information on floods, weather forecasts, and on-the-ground response activities (Smith, 2014; Doughterty, 2015; Crowe, 2015) Advancements in drone technology, combined with breakthrough communications technology, will also provide future benefits. A third illustration includes Robo-bugs that can enter confined spaces with sensitivity to faint sounds, smells, and heat, and subsequently transmit images. Robo-bugs can more quickly and accurately pinpoint trapped survivors of earthquakes, tornadoes, or post-explosion building collapses while providing real-time situational awareness of the space to responders.

As another example, gesture technology, along with big data analytics on the operations end, will provide an interactive and motion-based means of compiling and making sense of the massive amounts of data that will be sent from multiple drones, holograms, and wearable technologies (Rozenfeld, 2014; Kanowitz, 2015). Initially developed as a prototype for the movie, *Minority Report*, gesture technology is now a real commercial product. The technology uses hand movements and 'gestures' to connect seemingly disparate information; an example may include matching an image to video feeds of all public cameras along a specified route. The technology has been used by the military for on-demand, situational awareness and has applications for police and emergency managers (Kanowitz, 2015). Given the sheer amount of data analyzed and collected from multiple devices across several locations involving many collaborators, gesture (or gestural) technology enables wireless connectivity among an unlimited number of devices and screens with little-to-no integration (Kanowitz, 2015).

Furthermore, the increased interconnectedness of future technologies may communicate with any mobile phones, smart watches, or tablets (or future evolutions of such devices) on or near an individual needing to be rescued. Given that most cell phone users keep phones handy, check them frequently, and use them for information, emergency managers need to increase their

use of such devices[3]. Such technologies will ensure that responders have maximum critical information about the person prior to deployment into remote locations, thus enabling arrival with appropriate assets. The ubiquity of cell phones have made them an ideal medium for emergency messaging. In the U.S. alone, 90 % of adults have a cell phone and nearly 64% own a smart phone (Pew Research Center, 2014). Many low-income and ethnic minority households have become cellphone-only homes and use cellphone features more often than the ethnic majority (Blumberg and Luke 2007; Dutwin, Keeter and Kennedy, 2010; Smith 2010). Mobile apps have proven to be an efficient way to deliver information. However, the digital divide, which is income-influenced, will continue to need to be addressed. The benefits for people with disabilities in particular seem clear.

To illustrate further, hologram technology may provide the most useful way to communicate with Deaf and hard-of-hearing populations in American Sign Language (ASL) or face-to-face for lip readers. Many of the current emergency communications platforms do not adequately meet the needs of people who are Deaf and rely on ASL (Mitchell et al. 2014). Closed captioning, used for broadcast and cable television, may not provide a comprehensive message, nor appropriately convey the gravity of the emergency alert. ASL interpreters, sometimes used during press conferences, are often cropped out of the broadcast video. Furthermore, when shown, the channel's information ticker (usually placed at the bottom of the screen) covers closed captioning and ASL interpreters. ASL, as a visual language that includes not only hand movements but head tilts, eye gazes, and body motion, requires visually-based, non-verbal interaction (Bahan, 1996). Outside of televised emergency messaging, ASL interpreted alerts are not readily included in any other medium. Hologram technology may

[3] For more, see http://www.governing.com/templtes/gov_print_article?id=301149921.

improve the capability to disseminate ASL interpreted alerts in a broader way across multiple modalities for the Deaf and hard-of-hearing community.

A relatively new technology to reach a broader community is the Wireless Emergency Alert. Wireless Emergency Alerts (WEAs), first used in 2012, are non-subscription-based geographically targeted emergency messaging sent to mobile devices that are free of charge to the user. The messages are sent via cell broadcast technology through participating wireless carriers. Three types of messages are sent via WEA including Presidential alerts, emergency alerts (sent via National Weather Service or approved state and local emergency management agencies), and AMBER alerts (sent from the National Center for Missing & Exploited Children).[4] Research has shown that these messages are generally well received; however, the public and alert authorities do not feel that WEAs provide enough information to guide immediate protective action, given the 90 character limitation (Author et al., 2014; Author, 2015; Wimberly, 2015). According to research, many people with disabilities would like to see WEAs include maps and images in the future (Author, 2015). The National Weather Service (NWS) is in the process of creating clickable online maps that will provide the public with more information on potential hazards in their neighbourhood (Kaye, 2015). Perhaps in the near future we may see an incorporation of NWS's clickable map features in WEA mobile messages. In the distant future, we may see holograms with ASL and geo-fencing incorporated in WEA mobile messages.

As evident with the popularity of social media, the public will use what is most convenient for them. Therefore, emergency managers and alert authorities need to be flexible enough to keep up with the progression of technology to consistently disseminate information where people are most likely to receive it. As stated by FEMA administrator, Craig Fugate, in

[4] For more, see: http://www.fcc.gov/guides/wireless-emergency-alerts-wea

2011, "rather than trying to convince the public to adjust to the way we at FEMA communicates, we must adapt to the way the public communicates by leveraging the tools that people use on a daily basis." Each of the technologies mentioned above (and many more) can provide significant means to advance the future of emergency response and minimize the vulnerability of people with disabilities, if properly implemented by 2050.

Recovery is often thought of as the set of activities that take place following a disaster to secure, move, or restore people, homes, buildings, organizations, and communities, as needed. These activities take place over the short- and long- term. During recovery many socially vulnerable populations (including some people with disabilities) may struggle, in terms of individual household recovery, access to health, advocacy, information and referral services, and in relocating into suitable housing. It is not unusual, for example, that survivors with disabilities experience extended shelter stays, problems securing accessible temporary housing, and issues with re-establishing and/or identifying new health care and other supportive services. Often these types of recovery issues create additional stressors and trauma impacting health, mental health, and overall length of time to recover (Phifer & Norris, 1989; Norris, Friedman & Watson, 2002; Davidson & MacFarlane, 2006; Weems et al., 2007). Conversely and in a 2050 future scenario, post-disaster housing reconstruction experience for people with disabilities may also be particularly challenging although the recovery time frame also provides opportunities for utilitarian change.

To illustrate the future 2050 scenario, wireless technologies may ease the burden for many people with disabilities during the recovery phase. Robots may provide assistance to individuals, service animals, and pets needing to quickly move from a dangerous location to a shelter area. These disaster robots, while useful to the general population, will serve a unique

purpose in moving individuals who have permanent or temporary mobility challenges made difficult by a disaster-disrupted terrain and promote continued independence and self-sufficiency.

Future advancements in social media may produce a new and improved means to increase social connectedness during the recovery phase. Social ties enhance resilience, thus technologies that facilitate positive social interactions may prove beneficial. Social media platforms, paired with holographic technology, can provide many with the face-to-face communications they desire from their disaster-disbursed social network. Such technology could also prove useful for medical health professionals, social service providers, recovery program providers, and advocacy organizations who may need to continue providing services to clients over the course of their disaster recovery. Enabling a more consistent interaction with clients may help to lesson stress and trauma and improve service delivery.

Social media-based crowd sourcing efforts could be paired with drone technology and satellite imagery to accurately map resources. The map can also provide the most direct route for response agencies to help citizens following a major disaster or catastrophe, much like what is being done in Nepal following the 2015 earthquake.[5] These same drones may also be used to deliver aid immediately following an event.[6] A similar drone initiative was just approved by the FAA in Maine. The Down East Emergency Medicine Institute will be piloting search and rescue operations through drones, with the ability to live stream the data. Similar use is ongoing in Beaver County, Pennsylvania (Lepro, 2016) Future efforts will also investigate delivery of medications, automatic defibrillators, and other medical resources (O'Donnell and Ungar, 2015).

[5] For more information, see: http://www.citylab.com/weather/2015/04/another-way-to-help-humanitarian-efforts-in-nepal-start-mapping/391523/?utm_source=SFFB

[6] For more information, see: http://www.bbc.com/news/technology-28964260

The design of "smart shelters" could be useful if they rely on multiple means by which to communicate with a diverse population. Universal and technologically-oriented architectural designs could be included as well, such as: bathroom rails with height adjustment, dedicated wireless access for temporary residents, solar powered light sources, and at least one room with holographic projection technology. In emergency shelters, way-finding technology which "talks" the routes of travel and can provide instruction in any language of choice are examples of resources that in 2050 may increase independence, improve the delivery of information, offer enhanced social interactions, and provide navigable environments. Holographic rooms, for example, could generate soothing rooms for people with behavioral or neurological disabilities. The recovery time period also provides opportunities to reduce risks, which is the focus of the mitigation phase in the life cycle of emergency management.

Mitigation includes efforts undertaken to directly lessen the impacts of disasters and is sometimes referred to as prevention or reduction. Ultimately, the goal of mitigation is to foster resiliency against repeated impact and/or the ability to bounce back faster from a disaster shock. The efforts are typically either structural (physical changes to the built environment) or non-structural (changes in human behavior). Wireless technologies can significantly impact this phase of disaster management as well.

In 2050, the structural changes to our buildings, bridges, and dams could incorporate sensor and radar technology to inform civil engineers of construction-based deterioration that has occurred over time (Kamble and Vatti, 2015). The same system of technology placements can, in real-time, notify drivers during an evacuation of detours, etc. Another structural change could be made regarding the evacuation of individuals with mobility or other disabilities that affect abilities to evacuate independently during emergencies. Perhaps interior sensor technologies

described above could be used to help way-find independently evacuation out of a high-rise, for example to mark on the exterior of the building, where people inside the building may need assistance to identify where first responders should focus their efforts.

By 2050, the elevator industry will have incorporated new technology and made standard "smart cabs" whereby each elevator cab will communicate with the building command team board and responders such that automatic recall to the lowest entry floor is a thing of the past.[7] These structurally hardened cabs, in specially designed shafts, can relay information such as the number and condition of occupants, bypass danger floors, evaluate safety before opening doors, and route passengers into the fastest elevator with the most direct route to safety. This means that by 2050, anyone unable to self-ambulate via the designated staircase or fire escape can self-evacuate using elevators (under safe conditions to do so) rather than waiting in designated rescue areas. Thus, evacuation may occur at a quicker rate thereby decreasing risks to first responders and people with disabilities.

Non-structural mitigation can address a number of ways to reduce risks. Non-structural mitigation includes building codes, which may task public officials and code inspectors with designing, legislating, and enforcing codes that consider the disaster needs of people with disabilities. Often, participation of people with disabilities in mitigation planning and assessment is the starting point. As stakeholders, people with disabilities should be incorporated in mitigation risk assessments and vulnerability mapping and invited to help with prioritizing both structural and non-structural measures that a community may fund. Technologies can involve people with disabilities through a range of ways to participate – ways already mentioned so far include holographs, crowdsourcing, and social media, as well as new uses for robots and

[7] For more information on the conception http://blogs.microsoft.com/firehose/2014/07/16/the-internet-of-things-gives-the-worlds-cities-a-major-lift/

drone technology. For example, drone technology can be used to search for individuals with disabilities and potentially provide unique assistance until emergency services personnel could reach and rescue the individual. In 2014, engineering students tested a concept drone capable of carrying and delivering a defibrillator to remote locations (Starr, 2014). This idea could be extended to other types of equipment including crutches, life-saving medicine, or specialized communications equipment (O'Donnell and Ungar, 2015).

To spur such non-structural mitigation, the needs of people with disabilities have to be incorporated into legislation related to the advancements of wireless technology, as well as emergency management related guidelines. Additionally, people with disabilities should be considered necessary stakeholders in disaster planning of all kinds. It is the inclusion of people with disabilities that will make a difference with visualizing and implementing future technologies effectively.

3. Transformative Change: The Sources and Strategies

Given the above descriptions of how the future looks for people with disabilities who will face disasters, how did such transformative change take place? While technologies will continue to evolve, will cultural lag prevent implementation? To reach the 2050 scenario that we see possible may take significant cultural change. This section of the paper will suggest how a transformation may have occurred by using an eco-system framework.

The change framework initiates from face-to-face interaction where individuals at the *micro-level* made a difference through their individual and household actions. The *meso-level* then describes how organizations worked together to launch initiatives that altered the future for those at the micro-level and those operating within organizations. The *exo-level* is considered as

well, as the location at which key policy change took place based on the input of a wide array of participants. Finally, this paper reveals the ways in which the broader social, political, economic, and cultural levels changed to foment a *macro-level* culture of safety with and for people with disabilities (see Table 3).

Table 3. Agents of Change

Eco-System Level	Definition	Example
Micro-level	Household, face-to-face	Children as change agents for households (reverse socialization)
Macro-level	Inter-organizational interaction	Top-down approach to changing the organizational culture
Exo-level	Policy Initiatives	Legislation that is explicit in the implantation of inclusive emergency planning and response
Macro-level	Culture of Change	Previous levels combine to transform how people think, behave, and act

(Based in part on Brofenbrenner, 1979; Garbarino, 1992).

3.1 Micro-Level Transformation

- *Micro-Level Change*. At the individual (and household) level children are often the most effective change agents. Several researchers have proposed the idea of using children to influence adult decision making (Wingert et al., 2014, Mitchell et al., 2008). Known as *reverse socialization*, social scientists define this as the process of transmitting information, new ideas, and technologies to older generations. For households with children, using the youth as change agents could influence the use of wireless technologies, cultural perceptions of disability, and household awareness of preparedness, response, and recovery activities. Barring any significant socio-economic barriers, children could conceivably influence adoption rates of new technology and serve as change agents. By involving children, families could reduce the vulnerability in their homes and contribute to a transformative change in the way people with disabilities are

considered in everyday activities. Currently there is very little data on people with disabilities and dependent children. Often there is an assumption that all people with disabilities live alone and are elderly. While the U.S. census did not ask (or connect) those questions, there is preliminary evidence that may people with disabilities live independently but not alone, In a 2014 study on the assessibility of Wireless Emergency Alerts, a survey of 1830 people, 321 respondents self identified as having a disability (per U.S. Census definitions) and 202 of them also identified as being a caregiver to someone else with a disability (Author, 2015). This study is rare in that it identifies that all people with disabilities do not live alone and that they in fact can also be a caregiver to someone else with a disability.

- In the United States, the Disability website[8] maintains a list of organizational resources for people with disabilities to find and pay for assistive technology. This website should be maintained and expanded. Currently, the focus on assistive technology may be unnecessarily restrictive, in that it may always include universally designed technology. Furthermore, as a government resource, this website may not always included technology on the forefront of innovation, such as those mentioned in this paper.
- Equally important, households with people with disabilities would need to become more aggressive in addressing disaster risks. Threats posed by disasters would need to be seen as important, and as an essential part of seasonal if not daily preparedness and planning efforts. Moreover, this becomes a means to ensure continued independence as an active participant in one's own survival and not be a passive victim. Households with people with disabilities would likely have been supported in raising their awareness by

[8] For more information see: https://www.disability.gov/?s=&fq=topics_taxonomy:%22Technology%5E%5EFinding+%26amp%3B+Paying+for+Assistive+Technology%5E%5E%22

governmental and community based organizations that shouldered responsibility for public education, resourcing, and advocacy.

3.2 Meso-Level Transformation

- *Meso-Level Change*. Which inter- and intra-organizational arrangements led to new configurations of emergency management practice by 2050? What were the roles of disability and accessibility organizations in meso-level change?
    - In terms of research, the birth of emergency management as an interdisciplinary field of study has and will lead to theoretical and applied research to move forward emergency management practice and influence relevant legislation. Our future lies in the ability to research and explore ideas outside of the boundaries of practice to surpass where we are, contribute to the improvement of disaster management on the ground, and inform relevant, necessary policy changes. For example, researchers are currently studying communications platforms that may best benefit people with sensory disabilities and influence social and behavioral responses to emergency messaging. Other researchers are evaluating the guidelines and procedures that first responders follow to determine if there may be a better way. Still others are examining structural improvements to buildings and communities that may lessen the impacts of certain disasters. As a result of ongoing efforts, in 2050 we foresee the evolution of the discipline of emergency management such that researchers and practitioners become complementary units in a balanced, interdisciplinary meso-level.
    - In terms of practice, inter-organizational collaborations that spread beyond the typical first responder or emergency management agencies to include disability

organizations will improve relations between first responders and the disability community. Intra-organizational practices should include readily hiring people with disabilities. Additionally, organizational cultures unable to adopt and include new technologies, either because of lack of funding or reluctance to prioritize, should reassess that position and incorporate technologies that extend the reach of emergency alerts and warnings, improve emergency response, facilitate less prolonged and traumatic individual recovery, and provide effective mitigation solutions.

- Organizations will have also built new partnerships with each other to leverage their resources, insights, and understanding with and for people with disabilities (National Council on Disability, 2009). Disability advocates will be trained in disaster preparedness and response, and will have served in emergency operations planning and emergency operations centers. To make this happen, emergency managers will have reached out to disability organizations in order to increase capacity and connect to the micro-level. For example, an emergency management agency built a program with and for people with disabilities that tapped into their language, culture, and social interactions to build awareness, preparedness and resilience. As one example, Community Emergency Response Team (CERT) training seeks to educate and prepare people for emergency situations. At Gallaudet University (an academic institution for the Deaf Community), CERT training was focused to include the Deaf community.[9] Often underserved prior to and during disasters, the Deaf and hard-of-hearing community will by 2050 have been included in the preparedness and planning process as would the emergency

[9] http://www.gallaudet.edu/news/gallaudet_cert_training.html

managers that serve them (Engleman et al., 2013). Such inter-organizational partnerships meant that people with disabilities became a routine group of people considered in every phase of the practice of emergency management leading to collaboration over adversarial dogma.

- Institutionalized as a core element emergency planning, organizations need to increase allocations in their budgets, whether by public or private funding initiatives allowing such activity such that disaster planning becomes part of their mission. This results in personalized preparedness as part of case management, continuity of operations plans, and integrated community resilience.

3.3 Exo-Level Transformation

- *Exo-Level Change*. What kinds of innovative policies mandated or enforced transformative change (e.g., permitting prescription/insurance coverage of emergency stockpiles or alternatively early refills, and for devices used in an evacuation including stair descent evacuation devices)? How were the policies leveraged to modify realities of the early century? What policy modifications were required by the time that emergency management reached mid-century? What were the impacts of various types of disasters on policy-making? How did people with disabilities and disability organizations influence policy design and implementation?
    - More than a dozen Federal level Executive Orders, statutes, rulemakings and regulations have been put in place to further the goals of assuring that emergency alerts and warning are inclusive of people with disabilities. The American Disability Act (ADA) has framed, and the Federal Communications Commission (FCC) and the Federal Emergency Management Agency (FEMA) in particular,

have helped guide the process so that emergency information and alerts are accessible for people with disabilities. While there are legislations that mandate the inclusion of and considerations for people with disabilities, very few incorporate explicit rules specific to disaster situations. Aside from a couple of executive orders, legislations that specifically mention people with disabilities have occurred after major events such as Hurricane Katrina and Super Storm Sandy. The mass media coverage of such events, with distressing images of people with disabilities, elderly, and other socially vulnerable populations in harm's way, have contributed to the push in legislation. As examples of legislation that served as models for new policies, *Executive Order 13347: Individuals with Disabilities in Emergency Preparedness* was issued by the President to ensure that Federal level planning actions were in place to protect the lives of people with disabilities. The Post-Katrina Emergency Management and Reform Act of 2006 established the National Advisory Council which requires adequate representation by individuals with disabilities. The Warning, Alert, and Response Network Act (WARN Act) of 2006 established a National Alert System which must specifically include technologies that will ensure that members of the public with disabilities receive the alerts.

- Many of the wireless technologies useful in 2015 are often not implemented prior to, during, or after emergencies due to liability concerns, legal ramifications, or prohibitive policies. Conversely, some of the concern for people with disabilities are overlooked because of overly vague legislation or regulations so specific to a particular type of disability it leaves out others. For example, in an attempt to be

inclusive and non-discriminatory, the ADA often avoids naming specific disabilities. Additionally, by providing suggestions and not mandates, the Federal Emergency Management Agency (FEMA) guidelines are too vague to be fully implemented at the state and local level. Further, without tying funding to mandates local authorities struggle with supporting unfunded mandates, a requirement that changed before 2050. Sometimes this reality is the basis of allegations of neglect such as after the legislation in 2006, legal action has been taken on behalf of people with disabilities following disasters. Two lawsuits in Los Angeles, California, and New York City, New York have specifically mentioned lack of considerations for people with disabilities (Kim, 2011; Santora & Weiser, 2013).

- Around 2015, litigation in the form of class actions was widespread as a means to direct change for people with disabilities in the area of emergency planning and response. As these were brought one by one against local jurisdictions and adjudicated by different counts, the outcomes were very different and with different implementation results. But by 2050, it was realized that this piece-meal corrective decision making from the bench was not only inefficient and costly, it was undermining the emergency management system's ability to operate. So recognizing this unintended earlier application but agreeing with the goal of fully inclusive emergency management, changes were made and applied across the board so a national standard of inclusive emergency management developed.

3.4 Macro-Level Change

- *Macro-Level Change*. How was a culture of preparedness as a means to offset vulnerability for people with disabilities achieved? What conditions fostered movement into a new future, such as demographic shifts, new economic circumstances, heightened risk awareness, or cultural adaptation? How did various disasters influence awareness, increase funding for accessibility initiatives, and transform world views? What were the roles of people with disabilities and disability organizations in inspiring widespread social and cultural change?
    - At each level of our ecosystem, change agents inform us and influence our culture. At the micro level children can inform households. At the meso-level, organizational management sets the tone for the culture of the organization. At the macro-level the media and other agents of socialization may influence the coverage of an event which may push legislation to the forefront. So, around 2015 the STEP (Student Tools for Emergency Planning) program was introduced inconsistently nationally but very successfully in Fairfax County, VA, to highlight one noteworthy success, where every June over 4000 fourth graders in 30 schools received a completely organized emergency go-bag as the culmination of a yearlong age appropriate school-based training[10]. We envision by 2050 preparedness has become part of the core curriculum from kindergarten through high school eliminating the patch-work successes of programs such as STEP and all high school graduates are now required to be certified in basic first aid. CERT participation for a three year minimum term upon graduation from college now equates to a percentage of loan forgiveness. And further, inclusion of disability

[10] http://www.fairfaxcounty.gov/oem/step/ Accessed May 13, 2016.

issues and an understanding of a functional model is standard in the entire curriculum.

- Without real cultural change, our legislation, policies, regulations, and design of innovative technologies will be heavily reliant on statistical data that display significant population counts of people with a permanent disability. Unfortunately this approach does not consider many who may have a temporary disability in the future.
- By 2010-15 a long-standing dialog about definitions have culminated in a shift in the language used by disability advocates, individuals with disabilities, and emergency managers. But by 2050 this is all but a settled standard operating protocol taking what was previously "people with special needs" and then became "vulnerable populations" and ultimate moved to "people with disabilities and others with access and functional needs.[11]" The shift represents not only a change in terminology but also a change in perspective and approach. Gone are the days of attempting to identify vulnerability based solely on someone's demographic profile or diagnosis and organizations now identify the functions that a person must perform in order to maintain health and well-being before, during, and after an emergency. Using a functions-based perspective clearly delineates areas where preparedness intervention can reduce disaster vulnerability and risk to the whole community and, in turn, this approach supports an integrated planning process for the whole community vs. labeling a portion of the community as "special" or "vulnerable" as in the past.

[11] Federal Emergency Management Agency. 2011. *Planning for the whole community: Integrating and coordinating the access and functional needs of children and adults with disabilities in preparedness, response recovery and mitigation*. Accessed May 13, 2016. https://www.fema.gov/pdf/about/odic/all_hands_0411.pdf

- Significant consequence will result in 2050 without change. For example, if a new law is not passed requiring certain changes in prescription medication coverage, many across affected populations still cannot afford a basic tenet of personal preparedness: to have a few days' supply of medications available at all time. This, in turn, has a positive or negative impact across all the phases of a disaster.

4. Summary and Conclusion

In this article, we explored ways in which emergency managers will be able to empower people with disabilities and integrate disability related organizations with the assistance of future wireless technologies across the life cycle of disaster with a benefit actually to the whole community in doing so. We reviewed new trends and concepts available in 2015 and illustrated possible outcomes if maintained and supported through to 2050. The trends we show, revealed potential agents of change at each level of an ecosystem: micro-, meso-, exo- and macro- level.

At the micro-level, children are often agents of change for household preparedness measures. As youth are often the early adopters of new wireless technologies, emergency information sent through these technologies would influence households with children. At the meso-level, burgeoning wireless technologies, if adopted, may improve building structures, emergency alerts and warnings, and disaster response considering the needs of people with disabilities and other socially vulnerable populations.

At the exo-level, we noticed that transformative change has occurred only after major disasters have highlighted concerns for vulnerable populations, including people with disabilities. In terms of adoption of new wireless technologies, legislation, policy, and

regulations should not be prohibitive of their use among emergency management agencies. This may hinder prudent mitigation measures, as well as funding for certain recovery efforts.

Finally, we discussed issues with the motivation behind many current laws, rules, and policies. We note that without a significant cultural shift, at the macro-level, the known population count of people with disabilities will always be skewed to those with a permanent disability, as well as those that have full command of the written language in which most census surveys are prepared. These population counts are often used in statistics to justify the need for specific policies, the practice of considering the needs of people with disabilities in emergency management, and future research in emergency management for people with disabilities but we injected how a change in terminology can have a fuller impact of the whole community if the meaning behind the terms are fundamentally accepted.

The incorporation of wireless technologies may in-fact assist in improved preparedness, quicker and safer response, better recovery assistance, and enhanced mitigation techniques for people with disabilities and other socially vulnerable populations. It should be noted that wireless technologies should be included as a complement and not a supplement for traditional means of providing preparedness information, responding to emergencies, and assisting in recovery. Additionally, the most significant shift in emergency management, with respect to people with disabilities will occur at the macro-level. Current and future technologies will certainly help, but our cultural lens must be altered, regarding people with disabilities, in order to properly design and use technologies for emergency management with the *whole* community in mind as it is always understood that technology needs to be available and accessible to all.

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