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Elizabeth Gomez
New Jersey Institute of Technology

Kathleen Higginbotham
New Jersey Institute of Technology

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Elizabeth Avery Gomez
New Jersey Institute of Technology
eag4@njit.edu

Kathleen Higginbotham
New Jersey Institute of Technology
kh27@njit.edu

ABSTRACT

Individual preparedness within a local public health community is essential to support governmental initiatives surrounding the Center for Disease Control (CDC), Department of Health and Human Services (DHSS), and the Department of Homeland Security (DHS). The changing dimensions of local communities increase the need for individual preparedness of our health-related practitioners. Information communication technology (ICT) of low-richness medium for public health and community outreach practitioners is discussed as a means to initiate interoperable communications in these local communities for emergency response. We seek to answer: *What ICT devices do local public health and community outreach practitioners need to be individually prepared as front-line responders?* An assessment of front-line responder response characteristics are presented and reviewed to advance discussions surrounding the need for individual preparedness in a local community. Our assessment also compares the benefits of ham radio operations known for their longevity and reliability in crisis where communication protocols are established to modern ICT that are plug-and-play. The contribution of this research is to present a potential connection towards e-public health where health-related front-line responders could benefit.

Keywords

Public health, crisis management, e-public health, emergency response, healthcare, mobile technology, text messaging, ham radios, e-readiness, individual preparedness, morphology, community.

INTRODUCTION

E-Public Health centers on the use of information communication technology (ICT) in the public health sector and extends to community outreach with the ultimate goal of supporting community health, disease prevention, mental health and prolonged life (Gomez and Patten, 2006). First responders and front-line responders, such as public health and community outreach practitioners vary across a community. Being individually prepared to respond in one's roles of an emergency is essential. Having an interoperable communication device as the lowest common denominator is one factor that could serve as a base-line in achieving individual preparedness.

ICT usage is a pivotal point for e-readiness falling to the skills of the individual and therefore to the team as a collective unit. One important factor is the use of plain language (i.e. clear and effective communication) across an ICT device. Kaplan (1997) states that 50% of the communication problems are associated with individuals using the same words with different meanings and the 50% remaining are individuals who use different words with the same meanings.

Local communities as defined in our research are bound by a physical governmental jurisdiction that is at the lowest defined geographic boundary (i.e. city, village, and township). We posit that the physical distance between the front-line responder and the actual location of the health crisis can be mutually exclusive when normal resources are sustained. Establishing an ICT connection towards interoperability is essential to improve communication across front-line responders. Moreover, maintaining a state of electronic readiness (e-readiness) which is achieved through several dimensions (i.e. infrastructure, applications, institutions, people, and policy) is a challenge for the public health practitioner yet can be improved upon if standard communication protocols and practice in their everyday public health roles are utilized. Front-line responders in a local community can virtually perform as a command and control center for their respective communities of interest when health-related crises or warnings are imposed upon that do not interfere with public utilities (i.e. telecommunications, electric).

What ICT devices do local public health and community outreach practitioners need to be individually prepared as front-line responders? An assessment of front-line responder response characteristics are presented and reviewed to advance discussions surrounding the need for individual preparedness in a local community. Our assessment also compares the

benefits of ham radio operations known for their longevity and reliability in crisis where communication protocols are established to modern ICT that are plug-and-play.

LITERATURE REVIEW

A communications and coordination approach are presented in this paper, leveraging morphological analysis. Morphology is a sub discipline of linguistics associating a word to other words by rules. Working with words as the smallest unit in linguistics parallels to a local community as used in our research with the local community being the smallest geographic boundary and the association to rules connects the community with the governmental command and control organizations. Morphological analysis is a method for structuring and investigating the total set of relationships with multiple dimensions for problem complexes (Ritchey 2002; Zwicky, 1967). The process for solving these complex problems has a hard to follow audit-trail causing difficulty of traceability and reproducibility. Non-quantifiable and social-political dimensions are contributing factors in public-health crises and emergency response.

Task and team coordination are needed to address the dimensions introduced with an emergency response effort. Carmel and Agarwal (2001) present coordination as the act of integrating each task toward the overall objective organized by their respective organizational unit. Communication is a mediating factor for coordination where communication serves as the exchange of complete and unambiguous information enabling the sender and receiver to reach mutual understanding (Carmel and Agarwal, 2001). Malone (1990) mentions, good coordination is nearly invisible and is only noticed when lacking. Introducing front-line responders to the crisis response team introduces additional coordination due to the varying roles and different levels of training.

Coordination theory is defined "as a body of principles about how activities can be coordinated, that is, about how actors can work together harmoniously (Malone, 1990)." Malone (1990) associates common problems of coordination to: dividing goals into actions; assigning actions to groups or individuals; allocating resources among individuals; and the sharing of information to achieve the identified goal. Past research suggests that coordination mechanisms can encourage and facilitate communication (Ocker et al. 1996; Walther 1995). Teamwork is a known communication and coordination-intensive effort characterized by complex group dynamics and the potential for conflict (Putnam 1986; Rahim 1992; Steiner 1972).

Habermas (1998) introduces communication competence theory based on the information being communicated as a means for mutual understanding. Krashen's (1982) monitor model uses acquisition and learning systems together for language use and intends to link acquired and learned systems together for language use, but depends on three conditions: 1) time for learners to think and use the rules: 2) focus on form for both the how and what is being said: 3) knowing the rules of the learned system and practicing the associated skills to facilitate ease of use (Gass, 2001). Initiating a pattern while restructuring changes the internal representation, enabling components to interact in nonlinear ways which can provide a mental model, aiding in emergency response.

LOCAL COMMUNITY LANDSCAPES

Public safety service providers, such as EMS/medical, police, and fire typically comprise the role of local community first responders in an emergency (Firstgov, 2006). These three teams are dispatched with the majority of 911 calls. First responders are individually prepared through training, to use both provider specific resources and quick-response tactics. Moreover, these providers utilize communication devices regularly for all degrees of incidents, and are trained to communicate with their team throughout the emergency response effort.

As with any time-sensitive crisis, the community is the first to react and assist. This does not mean the community is the initial decision maker or the trigger of the message. The message could reach a community in many ways depending on the timeliness of the crisis. In a larger scale emergency, the public health practitioner or community outreach practitioner may serve as a front-line responder and complement first responders of a crisis response team (Gomez et al., 2006). Crisis response team responders could be physically or virtually located working a collective while responding (Gomez et al., 2006; Turoff et al., 2004; Hardeman, et al, 1998; Weick 1993, 1995).

Front-line responders are not called upon as frequently as first responders for incidents, inhibiting the cohesion and practice associated with an emergency response effort. Moreover, they do not have the same level of emergency response training as first responders nor use a designated communication device for their associated organization, making these responders vulnerable and limiting their ability and timeliness to respond with open communication in a crisis. The interactions across the community will vary on a case-by-case scenario basis. Ham and CB radio links may also be used to increase communication capabilities and coordination. One caveat is the disparity that exists within each community of interest.

Language barriers, special needs, and varying degrees of training, preparedness, and resources impose additional needs on front-line responders not to mention routine use to complement practice drills.

Today's everyday uses of ICT lend themselves to a plug-and-play nature indirectly bypassing the tendency towards standards and training. For example, training and licensing standards are not required for cell-phone voice or short-message service (SMS) use, otherwise referred to as text messaging in comparison to ham radio use. Communication devices of the past or those less commonly used, such as ham radios present a need for licensing and identified standards. Canada's successful rescue of 72 trapped miners can be attributed to individual preparedness with reports stating everyone followed safety procedures (Cotter, 2006). Moreover, the commercial paging and digital mail systems supplied just after the September 11 incident demonstrate that underlying technology relies on the process of setting up integration standards and system upgrades (Turoff 2004; Vatis 2002; Michaels 2001).

Figure 1. Emergency Response Local Community Team Landscape.

Interoperability across responders from different agencies remains a challenge. The lowest common denominator for these distinct teams of responders is the ability to make initial contact to enable further communication, collaboration and coordination. Leveraging today's ICT to make an initial connection or provide an alert notification for those who respond on the front-line is value added and becoming essential for successful and timely response (figure 1). Fostering e-readiness strengthens the technology and communication factors associated with any emergency response effort, lessening communication and coordination issues when an emergency presents itself, allowing these front-line responders to focus on their role within the emergency response effort.

HURRICANE KATRINA AND THE LOWEST COMMON COMMUNICATION DENOMINATOR

Examining hurricane Katrina in terms of public health response, communication and coordination highlight the importance and contribution of the crisis response team and the role of public health and community outreach. One prominent ICT community of interest who stepped forward with an invaluable service was the ham radio operators. Their role was deliberated by local officials before a ham radio operator was placed in two Louisiana State Hospitals restoring communication at a very basic level. These hospitals are two of the eight hospitals operated by the Louisiana State University Health Science Center (LSUHC), who lost all electricity, the use of landlines and cell phone communication.

Ham radio devices come in many different varieties, but the significant difference is between the 2-meter radio and the regular ham radio. For example, an FM radio is a "short wave" radio, whereas, 2-meter radios function in line-of-sight mode; about as far can you see. This line-of-sight restriction can be somewhat modified by putting repeaters on towers, such as those used by the television industry. Hurricane Katrina, for example, did not knock out the Hammond, LA repeater where one of the ham radio operators listened for weeks. Ham radio clubs are very active and are viewed expressly as a service organization as well as a hobbyist group; they prepare themselves for emergencies with training and practice, monthly meetings, service to community (i.e. coordination of parking at events such as university football games, Special Olympics, and local air shows). They have an emergency coordinator and expect to be called upon during emergency situations involving utility services outages. Ham radio operators clearly fit the profile of front-line responders. Table 1 compares the characteristics of local community practitioners as a front-line responder with the traits of ham radio operators, leveraging standards related information.

Public Health and Community Outreach Practitioners	Ham Radio Operators
High percentage of volunteers	Volunteer; cannot charge
Health information supplied to government organizations	Communicate with first responders (police, fire, etc.)
ICT training and practice needed	Ham radio training and ongoing practice
Passion for mission	Hobbyist
Community level assistance	Community level service
Disease outbreak spotters; regular activity	Weather outbreak spotters; regular activity
Regular collaboration recommended	Monthly meetings
Command and control recommended	Emergency coordinator
Integration with community crisis response team recommended	Agreement with National NGO's (Red Cross, Salvation Army)
Front-line responder	Front-line responder

Table 1. Front-Line Responder Comparison.

Ham radio operators do not require advanced skills because inexpensive short wave radios can be purchased in which translation to and from Morse code can be done automatically. The user has a keyboard and a printer or screen, but this means more power is required. 40-60 words per minute are reasonable. Keyed Morse code is from 5 to 20 words per minute; with 13 words per minute a more reasonable speed. Ongoing dress rehearsals to see how well the system will work in a short time frame are important. Ham radio operations can work when nothing else works as was evidenced during Katrina.

MORPHOLOGICAL ANALYSIS

The goal of achieving effective communication in an emergency is reached by making sure that a communication device is available for every possible pathway, by encouraging regular use of the device, and by having practice sessions. These multiple dimensions help increase e-readiness. During Katrina, landlines and cell phones failed, while satellite phones and ham radio setups remained operational. Ham radios have a protocol associated with their use. Satellite phones also have become a good communication candidate yet ham radios continue as a viable alternative offering other benefits. Ham radios employ wireless technology allowing communication near, far, and even to astronauts in outer space. Ham radios use a different frequency than cell phones and also different repeaters increasing the availability for communication. These technologies work well together where repeaters connected to the Internet can be accessed voice over IP (VOIP) and allow for a variety of communication configurations. Alternately, capitalizing on the benefits realized from ham radio operations and applying this premise to low-richness medium could potentially accommodate a larger scope of practitioners for alert notifications of upcoming disasters or health-related events that don't initially impact the use of ICT services. In a large-scale emergency where cell phone coverage is interrupted, emergency response plans are now including the distribution and use of satellite phones. We posit that increased ICT readiness, especially SMS messaging and the use of cell phones, for example, would enable front-line responders to adapt to satellite phones with little training when these devices are introduced during an emergency.

Habermas (1998) visualized commercial mass media as becoming a commodity for consumption, rather than a tool for discourse. Myerson (2001) take this a step further, replacing cell phone technology with mass media and arguing that much of the interaction with cell phones is consumption vs. communicative. In an emergency situation, where life and death are on the line, it may not be the quantity of communication, but the very act of communicating that is imperative. Examination of communication pathways must observe this distinction for creating viable systems.

We present a morphological analysis (figure 2) based on the scenario of the Canada miner incident (figure 2) on January 31, 2006 to demonstrate how training and prevention protected the health of the miners while emergency rescue efforts were taking place (Cotter, 2006; Isaacs, 2006). One of the interesting results was the preparedness of all parties involved ranging from the individuals impacted in the incident, the union workers, and emergency response teams. The training and availability of health-related supplies provided time for the emergency response effort to evolve. Ensuring the safety of the miners reduced the health-related threats while rescue efforts continued. Successful communication and coordination, including routine practice drills also contributed to the rescue efforts where communication patterns and contacts were established prior to the emergency.
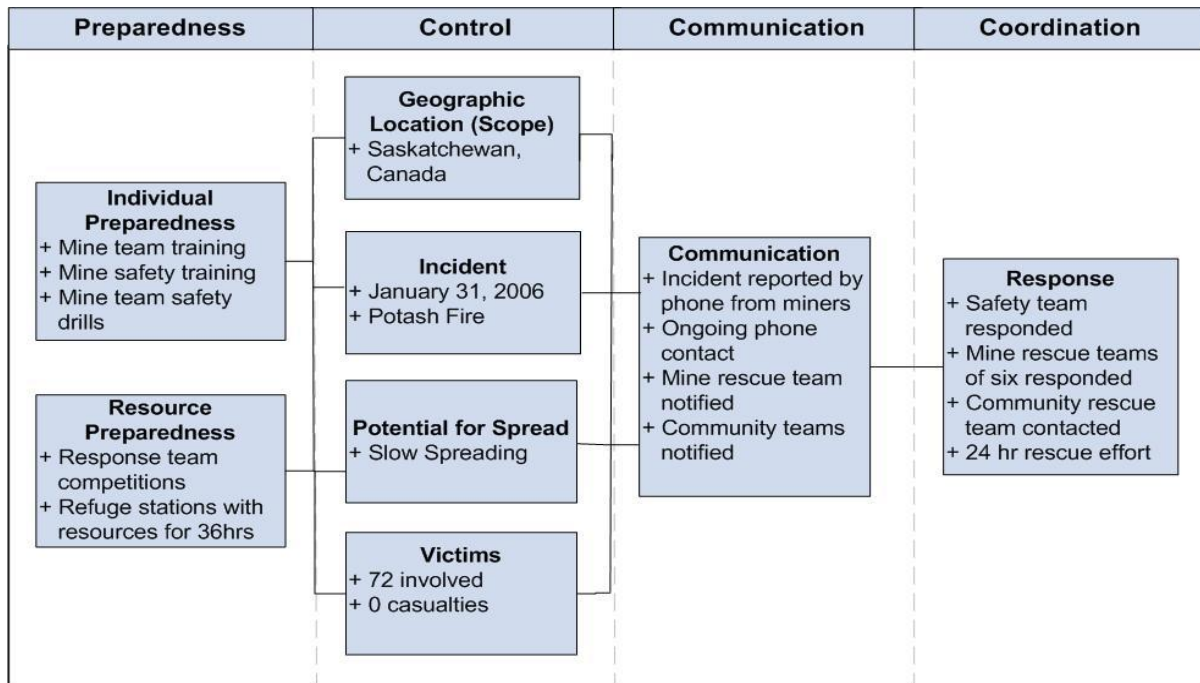
Figure 2. Morphological analysis based on Canada miner accidents January 30, 2006.

CONTRIBUTIONS AND CONCLUSION

Disasters such as Hurricane Katrina, Tsunami, and September 11 remind of how important individual preparedness and communication protocol standards are. Public health's challenge is keeping pace with first responders who are faced with frequent time sensitive emergencies ensuring protocol and ICT practice. Our research presents a need for communication protocols and practice to increase ICT readiness in local communities through routine events. Typically public health emergencies (i.e. epidemics, bioterrorism) do not revoke the use of public utilities and ICT yet have the potential for rapid spread crossing physical boundaries more so than a local based physical disaster, such as a hurricane or fire. Public health emergencies are often silent in nature and are airborne causing implications to a varying degree. Early detection and proactive communication lessen the risk and can be achieved by front-line responders who may not be physically located where the health-related emergency is taking place.

Future research suggests field interviews leveraging the positive characteristics of ham radios in Hurricane Katrina as a comparison to everyday low-richness communication mediums. We believe device independent communication protocols and practice sessions can be established enabling application usage and portability to various ICT devices increasing individual preparedness in a local public health community.

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