Communication devices and multiple platform streams can be harnessed to act as force multipliers in crisis response, say **Silas W Smith, Matthew Williams** and **Ian Portelli**

Social hazard resources

SOCIAL MEDIA AND NETWORKING applications have profoundly affected the exchange of information. Historically, mass communication content has been top-down, with information being subject to censorship, manipulation and temporal delays required for acquisition, confirmation and forwarding prior to dissemination. Social media has expanded beyond being internet-based applications that enable people to communicate and share resources and information, to include multiple network and technology platforms. Grassroots organisations in the US and abroad have highlighted the advantages of these capabilities to gather and disseminate vast amounts of user-created content rapidly.

The popularity of social media platforms such as Facebook, Twitter, and YouTube, each with millions of users, has raised interest in social media tools in disaster planning and management, with the potential to revolutionise communication and response to emergency situations. Several low- or no-cost, scalable and versatile applications have been developed with the goals of facilitating information management, organisational awareness and response adaptability. They may augment disaster management when used in concert with a flexible and robust disaster mitigation plan.

The Sahana Software Foundation's Eden and Vesuvius programs are free open-sourced products developed following the 2004 Sri Lanka tsunami. These programs support messaging between first responders, hospitals, relief organisations and the general public using email, SMS, Twitter and Google Talk. Eden allows for rapid communication between team members, without reliance on cellular networks. Distribution groups can be organised so that team-specific messages can be sent simultaneously to multiple users, improving response co-ordination. Real-time mapping enables visualisation of any location-based data, facilitating resource deployment to critically affected areas. By enabling the sharing of relevant information across responding organisations and the tracking of both requests for assistance and response efforts, Eden potentially allows more effective and efficient disaster response.

Family reunification

Vesuvius uses social media and other messaging tools to accept public reports of missing persons, and has advanced filtering and search capabilities to support family reunification. The program was developed for US hospital-focused disaster response, supporting the exchange of data across hospital facilities. Both local and remote hospital triage management are central components of Vesuvius, allowing for digital image capture and transmission and electronic notifications of patient intake records. This sharing of triage information across multiple facilities within a given jurisdiction expedites the allocation of medical resources to hospitals before patient arrivals.

> While the ubiquity of mobile communications makes them useful for disaster mitigation, such use may be problematic. Telecommunications infrastructures may be overwhelmed by volume or compromised by disasters themselves

Sahana software has been deployed by individuals, NGOs, and governments in events including Chile's 2012 wildfires, Japan's 2011 earthquake and tsunami, the 2011 Christchurch earthquake, Pakistan's 2010 floods, and Haiti's earthquake in 2010. The US National Library of Medicine (NLM) uses Vesuvius to support disaster preparedness and response with the Bethesda Hospitals Emergency Preparedness Partnership, and has supported public use during the Haiti and Christchurch earthquakes and the Japanese tsunami for missing family members searches across medical facilities. An additional product, Mayon, which supports emergency scenario, facility and staff management, has been used by New York City's Office of Emergency Management to manage its all-hazards sheltering plan, and was employed to manage the city's response to 2011's Hurricane Irene. Mayon's public release is anticipated in 2012.

Innovating Support to Emergencies, Diseases, Disasters (InSTEDD) developed the online program, Geochat, to permit communication between a command centre and public or private group members via web, SMS, email, and Twitter messaging. Group members may link via international and local cellular networks or the internet. Geochat triangulates the user's SMS transmission location, which is then identified on GoogleMaps. Text delimiters can be employed to break up messages to populate datasets. Geochat has been primarily utilised as a public health tool, although adoption for disaster mitigation could be envisaged. The ability for a command centre to send and receive information to forward-positioned individuals in near-real-time might increase flexibility, adaptability, and effective response, as well as provide an information verification capacity. Visualisation and monitoring location reports, potentially in combination with InSTEDD's resource map dynamic tool, might facilitate resource allocation and vulnerable area identification.

Although Geochat requires relatively little training for effective use, the system may present limitations. Transmitted information is not stored on an outside server, which might compromise confidentiality. As with all communication methods requiring advanced technology and infrastructure, the system is vulnerable. Catastrophic damage to cellular and telephonic service could limit or possibly preclude communication. However, communicating through Geochat using Twitter and email provides a redundancy. Additional limitations include duplication of Twitter posts (retweets), in which old posts circulate as new information. This was encountered following the Haiti earthquake – concerned Twitter users attempted to assist by forwarding requests for assistance. Geochat ameliorates this issue by allowing only approved group members

Innovating Support to Emergencies, Diseases, Disasters (InSTEDD) developed Geochat to permit communication between a command centre and public or private group members via web, SMS, email, and Twitter messaging. Here, after brief training, a village volunteer in Cambodia successfully retrieves and reads the incoming messages on her cell phone

InSTEDD / Chamkar Leu

to communicate, providing organisational control of delimited information sources.

Medic Mobile (formerly FrontlineSMS:Medic) software allows team members (as well as patients) to communicate using text message. FrontlineSMS permits laptop communication via mobile phone, text communication, and contact group management among clinical and field staff. Originally developed to assist communication among community health workers in Africa, Medic Mobile co-ordination proved useful in disaster response in the 2010 Haiti earthquake. Reports for responders were created using text messages containing information regarding casualties, patient status, and geo-tagged location. PatientView provides a patient electronic medical record system database in areas with minimal IT infrastructure.

Mobile Medic could potentially improve communication and data management during organisational response from triage through resolution of a mass casualty incident. FrontlineForms permits the creation of simple forms which can be utilised in the field and returned via FrontlineSMS as a compressed text message in real time. In the context of previously demonstrated responder dispatch reports, these could be conceived for use by first responders to transmit triage information to facilitate a more rapid and appropriate response. PatientView could be integrated into a disaster management plan to allow for patient monitoring during location, extraction, and transfer, although compatibility issues with FrontlineSMS updates may require resolution prior to incorporation into new projects.

HealthMap was created in 2006 by Children's Hospital Boston to combine information from numerous sources to track the occurrences, development, and global trends in public health issues. The site combines different sources of local and global public health information available on the Internet via news sources and public health agencies with verified reports from workers in the field in order to present a current description of global public health issues. Listed data sources include the World Health Organisation, World Organisation for Animal Health, EuroSurveillance, Program for Monitoring Emerging Diseases, GeoSentinel, Google News and Chinese news aggregation services. Multilingual monitoring and self-updating capacity provide users with currently available information. This allows HealthMap to present comprehensive and current public health information on both global and local levels very efficiently.

This platform's disaster management potential would include detection and evolution of primary or secondary chemical or biological threats prior to official reporting. Early detection was demonstrated during the 2009 H1N1 pandemic. HealthMap distinguished illness in Mexico prior to English language news reporting, and provided early data of suspected cases. During the 2010 Haitian cholera outbreak, HealthMap's informal data correlated with official sources and was available up to two weeks earlier. HealthMap could enhance early detection of more slowly emerging threats such as intentional chemical or biological food or water contamination or post-event disease spread.

The open-source Ushahidi platform was first developed in 2008 to map reports of

post-election violence in Kenya, and has subsequently been used in crises throughout the world including the Haiti earthquake, the Japanese tsunami, and the Christchurch earthquake. The program attempts to harness the power of crowdsourcing to support humanitarian and disaster response missions. Like Eden, Ushahidi supports real-time, interactive mapping of user-generated data. Social media reporting is the cornerstone of this software, which has the capability to accept reports from text message, email, web forms, and social media sites including Twitter and Facebook. The generation of publicly sourced, data driven maps permits improved decision-making capacity regarding resource allocation and co-ordination between responding groups. The program's heavy reliance on mobile phones to both send and receive crisis information and notifications is particularly relevant in areas where internet access is often limited or nonexistent.

Human filtering

Potential difficulties arise with the use of crowdsourced information during disaster response. Veracity and the relative importance of individual reports may hinder confirmation, complicating response decisions and planning. In the context of limited resources confronting those responding to disasters, identifying where those resources are most needed is a critical component. The Ushahidi developers sought to address these issues with their Swiftriver Platform. This program enables real-time data gathering from multiple data streams, including Twitter, SMS, email, and RSS feeds. Following data integration, both automated and human filtering assist users to better ascertain report significance and authenticity. Tools like Swiftriver that support verification of assistance requests permit more effective resources deployment during crises, targeting and triaging aid decisions.

In April 2012, the Federal Emergency Management Agency (FEMA), the Federal Communications Commission and participating US cellular service providers were planning implementation of the Personal Localised Alerting Network (PLAN), also known as Commercial Mobile Alert System (CMAS). The system is designed for text-like messages to be sent to dedicated receivers in compatible cellular devices to alert users of local safety threats. Authorised officials at multiple jurisdictional levels can utilise PLAN. Official alerts will be authenticated; the authorised sender verified and then warnings 'pushed' to geographically targeted areas using cell towers in designated areas. Presently, three circumstances will trigger PLAN alerts: Amber alerts; imminent threats (tornadoes, terrorist acts, etc); and Presidential messages through the Emergency Alert System (EAS).

PLAN has several useful qualities, the first being that users do not need to sign up. The four major wireless providers in the US and others will participate, creating a large target population. The system avoids issues of data congestion by using a signal different from voice calls and SMS text messages. Lastly, the system is designed with geographical relevance in mind. However, language barriers, hearing and visual impairment, scope and gradation of warnings, network and transmission concerns and actual subscriber reach will require ongoing evaluation.

Crowdsourcing is a quick, easy, and cost-effective data collection method that uses existing data sets to compile a large amount of desired information. Cell-All, a research, development, testing and evaluation effort funded by the Department of Homeland Security, aims to enhance environmental threat detection using sensor systems implanted on smart phone platforms. As envisaged, upon chemical signal detection, alerts would be sent to first responder and other related monitoring agencies. Potential benefits include extended and ongoing chemical detection capabilities, threat analysis, individual warnings, and scaled and focused response (based on detection and geospatial characteristics). Cell-All sensors could additionally enhance detection of public health and workplace hazards, and complement disaster response in environments with ongoing environmental threats. Given the transmission of personally identifiable information and location data, network security and encryption, marketing and 'effective' deployment, technological and privacy solutions await resolution by the development community and end-user stakeholders.

Information validation during a disaster is important but difficult when using open sources. The internet's anonymity compounds this issue, although features built into HealthMap, Mobile Medic software, and Geochat allow for identification and control of contributing data. Establishing reliable, unique (ie non-mirroring) reporters and receivers increases prospects for actionable intelligence, robust situational analysis and response. While the ubiquity of mobile communication devices makes them useful tools for disaster mitigation, such use may be problematic. Both cellular and terrestrial telecommunication infrastructures may be overwhelmed by volume, or compromised by disasters themselves, resulting in failed calls and delayed text messages.

Cellular traffic jams significantly reduce the utility of programs that rely upon traditional text messaging. While text messages exceed calls in efficiency as they can form queues for later delivery, instead of failing, a disaster could create significant delays. Since the ability to communicate in real time is essential in the evolution of an effective disaster mitigation plan, programs relying on relatively fragile communication pathways may be better suited for the less emergent situations for which they were designed.

Social media and networking applications have further extended mobile health (mHealth) into the realm of disaster medicine and public health preparedness. Just as mHealth has improved efficiencies in healthcare delivery and education in areas of low health care workforces, the power of mobile communication devices and multiple information streams can be harnessed to act as force multipliers in disaster response. Successful integration of evolving technologies will require ongoing organisational awareness and co-operation between stakeholders. CRJ

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