

## Mobile applications in crisis informatics literature: A systematic review



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### ABSTRACT

How members of society interact during disasters has significantly changed because of technological innovations and new media evolution. The modality changes in crisis communications, such as the popular rise of mobile applications use, may pose risks to the public if not properly studied, with results adopted and utilised. Crisis informatics, as an emerging field of research, studies the socio-technical advancements in disaster management. The purpose of this review is to summarise the involvement of mobile applications (apps) in crisis informatics literature and to scope needs and opportunities for further research on citizen's use of mobile apps during disasters.

This review uses a scoping process to identify and analyse 49 crisis informatics articles that focus on mobile apps in disaster situations. The study investigates the various mobile apps that engage with the crowd during disaster situations. Findings show that apps used in disasters can be general-purpose apps or built-for-disaster-purpose apps. This review further focuses on the built-for-disaster-purpose apps and shows the various interactions these apps foster with the public and the apps' value-added contributions throughout the disaster life cycle.

Communication during disasters between the public and authorities has become more dispersed. To fully augment disaster resilience through technology it is important that future research should engage in user-centred studies to gain more insights from the citizens' on using mobile apps. This study highlights three areas of need for future research: engagement of apps prior disaster response stage, public behaviour and motivation towards the use of apps, and usability of mobile apps.

### 1. Introduction

Communication is a crucial component in managing disasters, as communication can aggravate or alleviate the impact of disaster situations [30,74]. In disaster scenarios, numerous people and agencies become linked, creating complex information demands in constrained supply capacities, thus generating large and unique problems [5]. How members of society interact during disaster situations has significantly changed because of technological advancements and new media evolution [4]. With the ubiquitous presence of social media and mobile devices in our networked world, the influence of Information and Communications Technology (ICT) on social phenomena cannot be ignored [52].

Crisis informatics, as termed by Hagar [31], is "broadly defined as the interconnectedness of people, organisations, information and technology during crises. Informatics often relates to the development

of new uses for information technology and focuses on how people transform technology and how technology transforms people." Two important movements in communications have given rise to crisis informatics: (1) the shift from a top-down approach to bottom-up interaction, and (2) the growth of socio-mobile capacities [47]. The increasing interconnectedness of our society challenges the traditional one-way dissemination of disaster communications [4,70]. The rising trend of social media has created a communications world that has become "more complex rather than linear" (Andersen [4], p. 128).

In line with the growth of social media usage for disaster communications, mobile inventions and applications have also expanded. It is through these mobile technologies that users have unparalleled access to information [29,30]. This paper seeks to contribute to current research by reviewing the role of mobile applications (apps) in the crisis informatics literature and by framing opportunities for further research on citizen's use of mobile apps during disasters.

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This literature review followed the scoping review process by Arksey and O'Malley's [8]. The review process started with a broad question: 'Are mobile applications represented in crisis informatics literature?' Through the scoping process, the following questions were raised: What purpose do mobile apps serve in disaster situations? What interactions do mobile apps foster? What are the roles of the public when using these apps? In which stage of the disaster management cycle do the apps contribute? Findings from the 49 articles included in this review provided insights into the above questions. Furthermore, this review highlights three areas for future research: engagement with apps before the disaster response stage; public behaviour and motivation in the use of apps; and usability of mobile apps.

This paper is structured as follows. First, the paper contextualises the review by providing a background to the study, briefly discussing (1) the change in the communication landscape and (2) crisis informatics as a field of study. The paper then presents the methodology. The findings from the literature follow. Then the discussion section examines the findings in context to current and future research trends for mobile apps in crisis informatics. The paper concludes with a summary of recommendations for future research.

## 2. Background of the study

### 2.1. Communication during disasters

Most practices in disaster communication, whether stemming from crisis communication or risk communication traditions, have centred on an authority-centric 'push' culture where messages come from authorities and are principally distributed through mass media to the public [36,74]. Traditionally, communication is understood "as a planned activity conducted through the use of established strategies, regulations, and standardised plans" (Olsson [55], p. 115). A top-down approach is one in which the focus is on the transmission [55].

In this traditional 'push' culture, the authorities act as the focal point where they treat communication as an intentional activity [4,55]. Authorities can be the government or official organisations that have a mandate over the management of disaster situations; they can be international, national, regional or local in scale [25]. People assume authorities are ready to take responsibility, to maintain order and to safeguard society from the effects of disasters [19,25]. Traditional mass media during disaster communication uses one-to-many transmission [4]. The public has often relied on news media (i.e. radio and television) as their main source of detailed information on disaster situations; however, for alerting to reach the widest audience possible, news media alone is not sufficient [25]. In strategic alerting, as good practice, multiple channels are needed to promote reinforcement and redundancy [25].

However, the one-way disaster communication paradigm has been challenged by the changing media landscape. Through the years, different media channels allow people to communicate with each other in various ways during crises (see Table 1). Reuter et al. [73] pointed out that social technologies are already integrated into our societal infrastructure. Social-software assisted cooperation has aided in crisis management in four categories [73]. The categories are (1) crisis

**Table 1**  
Communication paradigms.

Interactions	Description	Examples
One-to-one	Individuals communicate with each other	Telephone call, SMS messaging
One-to-many	A single source distributes information broadly	TV broadcast, radio broadcast
Many-to-many	Participants can publish and receive broadly with one-another	Social media platforms: Facebook, Twitter

communication – quickly communicating with citizens for individual needs, (2) self-help communities – cooperation through emergent groups, (3) integration of citizen-generated content – integration of information from various social software sources and (4) inter-organisational crisis management – cooperation among professional organisation communities. These various types of social-software assisted cooperation, along with emerging technologies such as mobile phones and location-based media, have the potential to enhance crisis management [73].

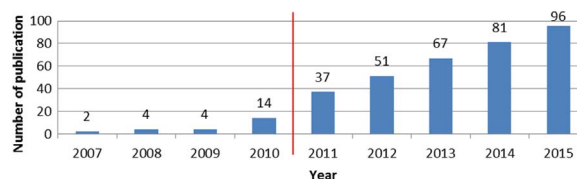
Communication during disasters is moving towards the crowd [9]. 'Movement towards the crowd' means that members of the public no longer act simply as passive recipients of information; but rather, the crowd can self-organise, communicate as a network, and provide on-going assistance amongst each other during disaster events [59]. This movement is a great opportunity to improve independent community resilience. However, multiple complexities arise with this many-to-many interaction from the crowd. For example, too much information can cause strain on the collective or authority-based capacity to manage the disaster [49]. Despite the increased complications, the presence of social media technologies may be advantageous during disaster events because such technologies also have many beneficial attributes such as greater capacity and interactivity [36].

### 2.2. Crisis informatics

Crisis informatics, as a growing research field of interest, seeks to understand online behaviour in social computing during disaster events [58]. The 2010 Haitian earthquake acted as the tipping point for demonstrating the value of ICT and new media in crisis communications [24,90]. Crisis informatics looks into the socio-technical aspects of disaster management with a particular focus on the interaction between the people and organisations involved [37]. The study of crisis informatics aims to contribute to scientific knowledge and society by updating theories, developing informed policies, and innovating technologies to better improve disaster resilience [62,65].

Even before the 2010 Haitian earthquake, some studies already noted the changing media landscape. As early as the 2005 Hurricane Katrina, researchers observed the emergence of online forums following the disaster [59]. Further interest in crisis informatics emerged as social media platforms, such as Facebook, gained in popularity. For example, after the 2007 Virginia Tech Shooting, many of those affected sought social media information during and after the mass shooting event [89]. Early academic publications on crisis informatics also emerged from the 2007 Southern California Wildfires [85], the 2009 Red River Valley Flood [60], and the 2009 H1N1 pandemic [13,61].

However, crisis informatics gained more traction as the Haitian 2010 Earthquake amassed a vast scale of spontaneous digital volunteerism [46]. Partly because of the Haitian diaspora, volunteers across the world came together with technology skills through social media to collaboratively work on crisis maps to aid relief efforts. For the first time, the United States of America government agencies used social media extensively to gain and coordinate knowledge for disaster management [90]. The wide-scale acceptance of new media technologies by the public, as well as by the authorities, legitimised crisis informatics as an area of research. Since 2010, an increased volume of academic research has explored crisis informatics. For example (See Fig. 1), the initial search for relevant crisis informatics articles for this review



**Fig. 1.** Increase in crisis informatics publications post 2010.

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