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# The Role of Information Systems to Support Improvisation during Emergencies

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## ABSTRACT

This paper discusses the use of information and communication technologies (ICTs) to support improvisation in hospital emergency response. Important characteristics of emergencies and improvisation are identified. Real-time decision support, communication and coordination, and training for improvisation have been identified as three key areas where ICTs can support the use of improvisation. This paper suggests that the documented plans, procedures, and policies to handle emergency situations in hospitals can complement the process of improvisation rather than forbidding or impeding it. Implications for research and practice are discussed.

## Keywords

Emergency, Improvisation, Information and Communication Technologies, Hospitals, Decision Support Systems.

## INTRODUCTION

Emergencies are unforeseen, unplanned, and unpredictable situations that threaten the property, health, and life of people. The ability to effectively handle an emergency situation can literally have life and death implications.

Health care plays a prominent role as an integral component of any community emergency response. The hospital's response to an emergency situation has very specific constraints. First, hospitals have to act within the bounds defined by the written procedures. Second, they have to work in coordination and cooperation with several external agencies. Third, often at times of emergencies, they are expected to provide services over and above their capacity. Despite the best efforts of health care professionals, the complex and unpredictable nature of emergencies make comprehensive, formal documented plans to address all emergencies impossible to achieve (Mendonca, Jefferson and Harrald, 2007). As a result, health care professionals must adapt the hospital's response to the specific, emergent context of the emergency.

One way to respond to the unplanned emerging needs of an emergency is through improvisation enabled by information and communication technologies (ICTs). Improvisation is a spontaneous and creative group activity accomplished under time constraints (Mendonca and Wallace, 2007). ICTs can play an important role in emergency response (Comfort, 1993; Harrison, Harrison and Smith, 2008). However, the use of ICTs in emergency response has been found to be not only positive, as in supporting communication and coordination (Ciborra, 1996; Harrison et al., 2008), but also negative, as in wasting time due to information overload (Hiltz and Turoff, 1985; Quarantelli, 1997) and with tools that are not user friendly (Mendonca, 2007).

On one hand, improvisation is characterized by spontaneity and creativity and often requires deviation from established use of resources (Adrot and Robey, 2008). On the other hand, hospitals are required to follow written procedures and policies in response to emergency situations. The two contradictory views make us wonder if and how improvisation can best be used in hospitals at times of emergencies.

The objective of this paper is to discuss the role of information and communication technologies (ICTs) to support improvisation in emergency response. We have chosen hospitals as the context for this study as they act as the center for treatment of the wounded, and as a safe haven from the event. As such, hospitals are almost always part of the emergency response, irrespective of the actual location of a disaster.

The remainder of the paper is structured as follows. Next, we take a look at characteristics of improvisation and why it could be valuable in responding to hospital emergencies. Then, we discuss the role ICTs can play in supporting improvisation in hospital emergency response. Finally, we share future research directions and concluding thoughts about this area research.

## **BACKGROUND**

### **Improvisation**

Improvisation is a term associated with jazz and describes a specific style of music in which musicians draw on their extensive knowledge of music and their experience to create spontaneous compositions. As the music is performed, each member of the group watches for signals from other members, listens to what is communicated in the music, and makes appropriate adjustments to complement the music (Mendonca and Wallace, 2007).

The concept of improvisation has been applied to the organizational context (Zack, 2000; Vera and Crossan, 2005; Ciborra, 1996). Incremental improvisation is used frequently in organizations to make adjustments to standard operating procedures, while radical improvisation is often associated with crisis situations (Vera and Crossan, 2005). This latter use of improvisation is consistent with the formation and implementation of an emergent (rather than deliberate) strategy and situated (rather than planned, slow, and incremental) change perspective proposed by Mintzberg and Waters (1985) and Orlikowski (1996). In general, improvisation is exemplified by several characteristics.

First, improvisation is a spontaneous, extemporaneous process. It is a process that requires creative thinking to respond and make decisions in real-time. It is the ability to create a unique solution to a problem based on knowledge, skills, and available resources within the constraint of time that differentiates improvisation from a planned response (McKnight and Bontis, 2002). The spontaneous nature is a little deceptive in that the process is spontaneous, but the decision to use improvisation may be considered in advance, as when organizations have formal or informal norms enabling people to depart from routines to create new variations (Vera and Crossan, 2005).

Second, improvisation is a creative process. Improvisation requires both novelty and resourcefulness (Webster, 1992). It demands an evaluation of all available information about a situation, a review of all available resources, and relies on existing knowledge and skills to formulate a unique solution.

Third, improvisation can be characterized by flexibility. When documented procedures cannot be used or are inadequate, response personnel make use of their past experience to devise new, innovative ways to provide flexible solutions to the situation at hand. By being flexible, organizations increase their ability to innovate when necessary (Pasmore, 1998). Thus flexibility is necessary to respond to the current contextual environment (Mendonca and Wallace, 2007).

Finally, improvisation is a coordinated response among individuals, and is therefore a group activity. As such improvisation requires collaboration, coordination and communication among the group members. Being a group activity, improvisation requires continuous flow of information among the members of the team (Mendonca and Fiedrich, 2006).

### **Improvisation and Emergencies**

Emergencies are generally characterized by chaos, complexity, uncertainty and ambiguity. Hospitals, as part of their accreditation process, are required to have written procedures and policies to cover all known types of emergencies. Due to the unpredictable nature of emergencies, however, formal plans cannot address all possible emergency scenarios. When planned for procedures cannot be used or are inadequate, response personnel in hospitals make use of their past experience to devise new innovative ways to provide flexible and spontaneous solutions to the situation at hand. In other words, they improvise. So, improvisation is one possible approach to improving the response to these unplanned scenarios (see for example Mendonca, 2007; Stewart, 2008; Reissman, 2006).

At first, the written policies and procedures hospital personnel are required to follow may seem to preclude the use of improvisation, yet improvisation can be employed to work within the formal policies and procedures for emergency response. Jazz musician Charles Mingus insists “you can’t improvise on nothing; you’ve gotta improvise on something” (Kernfeld, 1995, page 119). In the same way, organizational improvisation builds on the ideas, existing processes, and business strengths of an organization. In the case of hospital emergency response, the existing policies and procedures can be used as a “skeleton” or “blueprint” for improvisation rather than a force forbidding or impeding it. Improvisation can be used to provide flexibility to the policies and procedures and to fill the unavoidable gaps between policies and procedures and actual events as they occur (Suchman, 1987).

## **USE OF ICT FOR IMPROVISATION IN EMERGENCY RESPONSE**

This section describes how ICTs could support improvisation in emergency response in hospitals. Specifically we propose that the use of ICTs for decision support, communication and coordination, and training can support improvisation during a hospital emergency response.

### **ICT Support for Real-Time Decision-Making during Improvisation**

In response to emergency situations, several different courses of action have to be explored and evaluated from the point of view of risks and benefits, taking into consideration current information as well as the existing policies and procedures. Moreover during the implementation of a decision some events may arise which dictate full or partial change in the previously decided course of action. Human decision-making, however, deteriorates with complexity and stress (Nann, Ray and Kumara, 1989). Therefore an important ICT for supporting improvisation in hospital emergency response is decision support systems.

Decision Support Systems are interactive computer-based systems that aid users in judgment and choice activities. They are especially valuable in situations in which the amount of available information is prohibitive for the intuition of an unaided human decision maker and in which precision and optimality are of importance (Druzdzel and Flynn, 2002). The decision support systems can objectively assess the feasibility, effectiveness, and the risk associated with a particular decision. If a real time event occurs, the system can assess the effects of the event in order to determine the affected activities and preferences. Hospitals can make use of decision support technologies ranging from GIS (Geographical Information Systems) based DSS (Decision Support Systems) to effective and fast searching facilities from repositories of related plans, procedures and policies. For example, documents containing plans, procedures, and policies to handle hospital emergency situations along with the past records of disasters and actions taken can be stored in a knowledge base for decision support systems.

### **ICT Support for Communication and Coordination for Improvisation**

ICTs can also provide the foundation for the communication and coordination required for effective improvisation during a hospital emergency response. Given that improvisation is a group process, improvisation requires formation of a shared context among the team members (Daft and Weick, 1984). From an ICT perspective, the availability of peer to peer tools like document sharing, mobile phones, PDAs (Personal Data Assistants), and instant messaging facilities can provide continuous feedback on effectiveness and allow for adjustments to the course of action. Collaborative groupware technologies expand the reach and enhance the effectiveness of improvisation by allowing dispersed team members to continuously interact in a robust communication environment and access important knowledge in a timely manner (McKnight and Bontis, 2002).

Handheld PDAs can be used to record information at the disaster site on medical care and transfer these data by wireless connection to the emergency response center. Disaster LAN is a web-based solution for integrating and managing multiple functions of the State Emergency Operations Center. gIBIS (graphical Issue Based Information Systems) is a hypertext system designed to support the collaborative construction of networks by any number of cooperating team members spread across a local area network. These systems can help in maintaining a continuous exchange of information among the emergency response personnel and other experts.

### **ICT Support for Training for Improvisation**

Given the extemporaneous nature of improvisation, it seems counter-intuitive to train for improvisation. However, the process of improvisation is an experience-based behavior that improves with knowledge and experience (Barrett and Peplowski, 1998). Jazz musicians, for example, can practice the known structures and how to transition from them. Similarly, hospital personnel can benefit from practicing improvising in emergency response situations. Training for improvisation involves learning to recognize and respond to unplanned contingencies by using knowledge of documented responses to emergencies as a basis for improvisation (Mendonca and Fiedrich, 2006). Training in improvisation includes exercises aimed to develop process skills such as listening and communicating, developing context specific knowledge, and developing shared responsibility in teams (Crossan, 1998). Individuals can learn to be more spontaneous and creative (Amabile, 1988).

Knowledge databases that document successful or unsuccessful past emergency response activities and are experience-based can be used in training. Improvisation is often the result of the creative recombination of previously successful routines of knowledge and action (Weick, 1993). Reflecting on past emergency situations can be helpful in learning how to improvise during future emergencies. Drills and full scale exercises can also be conducted in real time using modern information technology (Litch, 2008). To provide effective and realistic training for improvisation, the consequences of improvised

actions can be simulated. Off-the-shelf training and simulation systems may be appropriate for some situations (Jain, McLean and Leong, 2003), and new technologies, such as virtual worlds, show promise for training on team cooperation and decision-making skills (Hansen, 2008).

## FUTURE DIRECTIONS

This study is purely based upon literature review, and is the first step towards the actual research. In the next step, we plan to collect qualitative data by conducting interviews with emergency response personnel and administrators in hospitals. We propose to ask them questions which may provide insight into the existing mechanism used in emergency response, and the extent to which improvisation and ICTs are made use of at times of emergencies. We would also like to know the extent existing hospital information systems incorporate ICTs that can support the use of improvisation in emergency response.

We have discussed how ICTs can support improvisation in emergency situations in the specific context of hospitals. As noted earlier, emergency response in hospitals is uniquely characterized by requirement of strict adherence to written policies and procedures, coordination and cooperation with several external agencies, and high expectations from people and the government. Future studies can examine the role of ICTs in providing support for improvisation in emergency situations in a more general way. Our study is also limited by our selective use of the ways in which ICTs can support improvisation in emergency response. Future research may reveal additional ways in which ICTs can support improvisation.

Future research should also examine the relative importance of different types of support that ICTs can provide for the use of improvisation in response to emergency situations. This is especially important in that hospitals have to allocate their limited resources to ICT infrastructure selection and construction in an optimal way for deriving maximum benefits. This may also help in the development of user friendly tools integrating the ICTs that are most relevant from the point of view of an effective emergency response.

## CONCLUSION

In view of the unpredictability, and hence lack of existing plans, associated with emergency situations, this paper argues for the use of ICT-enabled improvisation as a viable solution to the complex problem of emergency response in hospitals. It has been noted that modern information and communication technologies (ICTs) can provide support in a variety of ways, should hospital personnel decide to improvise while responding to emergency situations. Specifically, ICTs can support emergency response personnel adequately by providing real-time decision support and communication facilities for real-time feedback. ICTs can also help in providing training for emergency response personnel to help them acquire skills necessary for improvisation.

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