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**Information Communication Technologies during Emergency: Field to Hospital  
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**Abstract:** Information is the most valuable commodity during emergencies which is needed by everyone for decision making. In a chaotic environment, information communication technology (ICT) supported by advanced smart devices have the capacity to enormously improve the emergency medical response to such mass-casualty incident disasters. Next-generation wireless Internet and geo-positioning have the greatest impact on improving communications, information management, and overall disaster response and emergency medical care. ICT is important to rescue victims on the site of accident or disaster and in hospitals which is used for triaging, testing and evaluation, handoffs, and admitting. ICT communication has three major challenges: sociological, technological, and organizational. The future communication in emergency will rely on wireless internet and geo-positioning technologies. Internet of Things and Machine to Machine communication are confirmed to be used in the future during state of uncertainty. The purpose of this essay is to review present and future differentials of ICT for emergency communication.

**Key Words:** Information Communication Technology, Electronic health record, internet, and emergency

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## **INTRODUCTION**

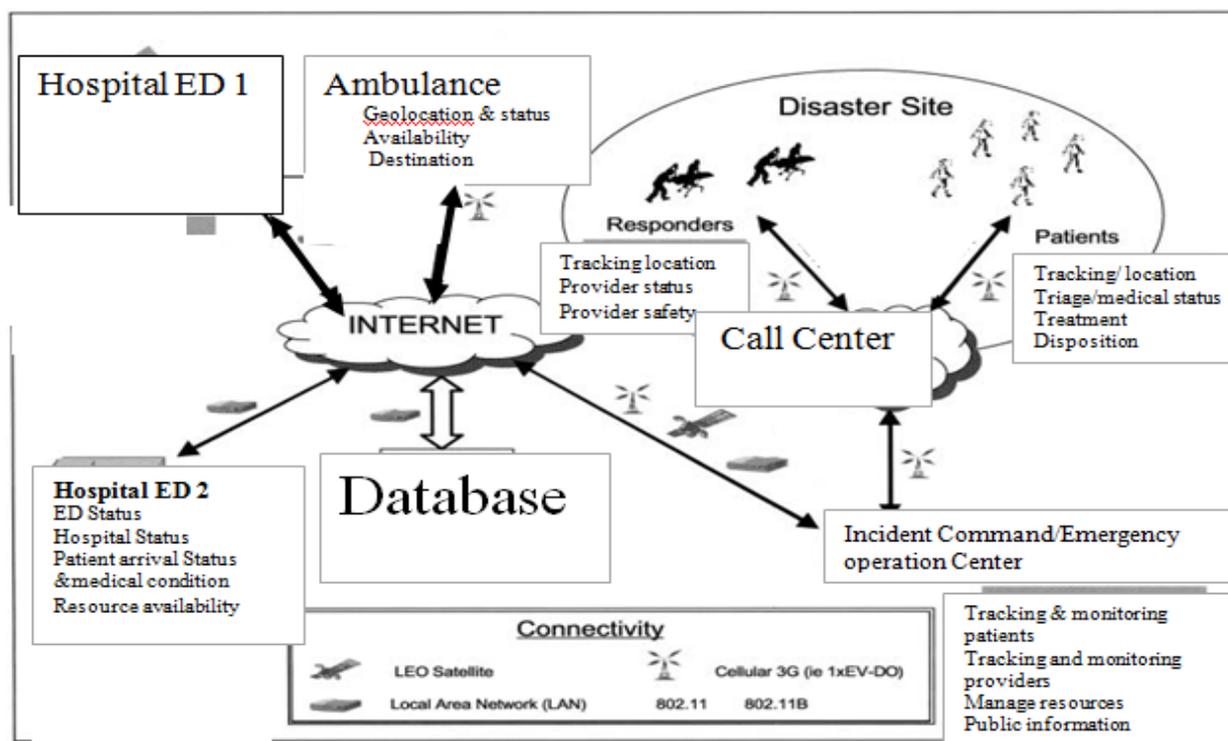
The definition of World Health Organization (WHO) for health signifies both health and disease are always in a constant state of change which requires an intermingled system of communication. (WHO,2006, Wright, Sparks, & O'Hair, 2013). Information obtained from effective communication is the most priceless input especially during emergencies for successful decision making. Effective communication uses different channels supported by a variety of tools or media (PAHO,2009). Although there are many alternative tools of health communication in the 21<sup>st</sup> century, technology assisted communication is the most prominent one. New technologies play its role in disseminating health information, facilitating relationships among people who share similar health conditions, and improve care provider-patient and intra-organization communication (Wright, Sparks, & O'Hair, 2013). Technologies used in the condition of uncertainty like internet, advanced computer system, and invention of smart devices have the potential to significantly improve the emergency medical response (Chan, Killeen, Griswold, Lenert,2004).

These days, searching victims and drafting rescuing strategies are easy because of the fast communication supported with geographic information system (GIS), and remote sensing technology. Using these technologies; rescuers can easily create maps of the disaster areas for rescue and aid operations, as well as to assess damage.

The purpose of this essay is to review present and future differentials of ICT for emergency communication. The landscape of ICT communication, technologies on use and with good hope for future use, and challenges of the field are discussed briefly. This essay will give an easy understanding for providers and designers. It can improve the understanding of care providers which intern helps them to improve their competency about ICT used in their working area. Designers, person or organization working on the infrastructures, can use it as a gateway for improving ways of ICT based communication since it shows what is happening now and tries to discuss the tested and predicted technologies in emergency for the upcoming decades. Moreover, the challenges and negative effects related to this way of communication are vastly crucial for planners to easily anticipate the common challenges related to it despite emergency conditions are not free from uncertainty.

## **ICT LANDSCAPE IN EMERGENCY CONDITIONS**

The landscape of ICT in emergency revolves around the places where the victims are affected and emergency medical service. Before victims arrive to a health care organization, emergency communications includes alerting and warnings; directives about exit from the site of disaster, monitor the movement of people living in and around the disaster, and other self protection from injury; and report about the condition of the victims, residents, opportunity to utilize accessible opportunities, and related matters that has influence on the reaction against the disaster and response and recovery from the disaster (Emergency Management Institute, 1999).



Source: Chan, Killeen, Griswold, Lenert, (2004)

Figure 1: Web of communication in emergency conditions

There are four communication processes in Emergency Department (ED) (Figure 1.) that are crucial in determining the direction and quality of care and chance of occurrences of unexpected outcomes. The four processes are triage, testing and evaluation, handoffs, admitting(Eisenber& et al, 2005).

There is an electronic triage tag which allows the health care provider to program the four colors used for triage of the patient based on their categories. The triaging software creates an opportunity for emergency care providers to manage multiple classifications of patients at a time (Malan, Fulford -Jones, Welsh, Moulton,2004). There are buttons with red, yellow, green, and blue color used for prioritization. Priority is given for red followed by the other colors as mentioned subsequently. Four light emitting diodes represent the triage colors and a patient can only be on one level at a time(Massey, Gao,Welsh,Sharp, Sarrafzadeh, 2006).

The other benefits of ICT based communication is electronic medical records which are important (with appropriate privacy considerations) to transfer patients' information from previous care setups to the next level of care which has an important implication for further follow up and patient care decision making.(Eisenber& et al., 2005). In other words, Computer-Assisted Handoff is a common practice after electronic recording system becomes common in emergency health recording in ED. Computerized handoff method is important for effective communication which intern reduces the occurrence of harm during surgical operations. The greatest benefit of electronic health records is that, by providing detailed information after handoff for further treatment, create a way of transferring an integrated patient assessments and other relevant information (Cheung& et al., 2010).These include functionality that can initiate users to communicate essential information and facilitate compliance of care and updating of patient history and information on the medical record. This process facilitates an interactive handoff between care providers.

### CURRENT ICTS: USE FOR EMERGENCY COMMUNICATION

Paper-based recording in the 21<sup>st</sup> century is becoming an obsolete way of health recording. The recently discovered technologies of Electronic Health Services (EHS) and Wireless Sensor Networks (WSN)are the most dependable technologies used for integration and exchange of information in emergency and disaster conditions. EHS are increasingly used by patients, employers, providers, doctors, policy makers, and other healthcare workers. EHS has a vital contribution for health care cost management and provides faster and more efficient work flow. However, it increases the concerns of confidentiality, safety and security, and consistency of healthcare data. These on the other hand will cause ineffective communication since the patient will fear health information disclosure and can cause life-threatening outcomes (Health IT.gov., 2015).

EHS focus on the consent exceptions during emergency when patients are unable to control their health data. To ensure the privacy of the patient, private-key storage, smart card usage, emergency responder, and break-glass are methods which can be used when a patient has an emergency situation(Yuksel, Kupcu, Ozkasap, 2016).

The electronic health recording can be wired or wireless. Wireless sensor networks are small, low-power, and low-cost devices that integrate restricted computation, sensing, and radio communication capabilities. Today, it is possible to obtain measurements of vital signs and other biochemical analysis like heart rate, oxygen saturation, end-tidal CO<sub>2</sub>, and serum chemistries, like blood glucose using easy and noninvasive sensors. MobiHealth, is the other alternative aimed at providing continuous monitoring of patients outside the healthcare setting by developing the concept of a 3G-enabled "Body-Area Network" (Malan, Fulford -Jones, Welsh, Moulton, 2004). Additionally, Code Blue, a wireless sensor network, is used for sensing, recording, and transmitting vital signs and geographical location data. Therefore, the communication among the stakeholders is virtually unlimited with location and number of victims (Massey, Gao, Welsh, Sharp, Sarrafzadeh, 2006)

When faced with a large number of casualties, the goal is to care for those patients who will be prioritized and benefited a lot from the emergency care. To accomplish this, EMTs can deploy a wireless, vital sign sensor which consumes low power to monitor severely injured patients. Using sensors, pre-hospital and hospital triage can be made interactive by continuously feeding patient information from a sensor network to a decision support system (Massey, Gao, Welsh, Sharp, Sarrafzadeh, 2006)

ICT has the potential to effectively support the cooperation and coordination between staff involved in the EMS workflow. In the United States, telemedical consultations between physicians in the health care setting and care providers in the field mostly accomplished via radio. By the use of ICT, the quality of primary care and intra-hospital procedures could be optimized respecting a faster and a more focused transfer of information (Katarzyna & et al., 2004).

Another innovative approach aims at the broad implementation of a telematic system in emergency medical services called as "teledoctor". To establish an effective telematic system or teledoctor service a high quality of ICT data with a proven reliability, security and safety of the patient and care provider, appropriate service fit for purpose for emergency response are important to be considered (Kyng, Nielsen, Kristensen, 2006). Care providers should have a standardized level of competency and readiness to comply with this new technology (Ziefle, Röcker, 2011).

## **FUTURE PERSPECTIVE**

The future emergency communication is expected to be dependent on "Internet of Things (IoT)" which is an innovative approach that connects us with a variety of things or objects (computing devices, objects, mechanical and digital machines, animals or people) that are provided with unique identifiers and the ability to transfer data automatically without human being intervention. The interaction can be between computers or computer to human or the other way round (Yang, Yang, Plotnick, 2013).

Data perception, network communication, business application, and integration service are the four layers of internet of things in emergency conditions. There is data perception layer that consists of various sensors as well as sensor gateways. This layer is responsible for monitoring the scene and collecting data for the general public, facilities that are responsible to rescue victims. Network communication layer is the line network of the emergency management platform. It is in charge of the transmission and integration of the concerning information. It facilitates the interaction between the satellite positioning systems, the computer telecommunication integration techniques (CTI), and the spatial information systems (GIS). Business application layer is responsible for providing the way for the exchange of data between the emergency managing system and end users. Integration service interface layer provides other layers of the emergency managing platform with an integrated telecommunication interface service. Generally, after emergencies occur, all the possible human resources and material resources should be deployed to deal with the urgent situation with the help of IoT (Yu, Wang, 2013).

The other noble technology which has a promising contribution for emergency communication is Machine to Machine (M2M). M2M communication system, the online social support system is given into two ways: the first way is from a social network formed among the patients. To get this support members should be registered in the M2M system of a hospital and the support is from those members. The second way is to provide information and facilitates the online connection among other groups which are prepared to provide social and psychological support to the patients (Liang, Barua, Lu R. Lin, Shen, 2012).

## **CHALLENGES**

Generally, there are three main categories of ICT based health communication challenges. These are technological related to the availability of facilities, sociological associated with societal make up, and organizational. The primary challenge which can occur in the three categories is lack of deployment of communication systems for first responders and disaster management workers (Manoj, Baker, 2007). On the other hand, the model we use to manage post extreme events may be improper since the consequence after disaster on the infrastructure is unpredictable, infrequent, and heterogeneous. The cause of emergency sometimes may destruct the ICT facility which can be the other cause of communication failure (Mendonça, Jefferson, Harrald, 2007).

With regard to the coordination between emergency department and emergency medical service teams, there are three major challenges including ineffectiveness of available technologies, lack of common understanding among emergency responders, and interruption in information flow. (Reddy, Paul, Abrahama, McNeese, Fritch, Yena, 2008)

Studies have revealed that the tools used during emergency have complex templates with detailed and numerous data components that requires a level of compliance. Detailed information requires much time to analyze which is not desired in emergency care settings. In addition, if tools or templates are adopted from other services or if not originally prepared for medical recording, their use could introduce redundancy of records. (Cheung& et al., 2010).

## CONCLUSION

In order to make a timely and right decision about emergency conditions, an up-to-dated ICT should be used to rescue the victims and minimize the level of harm. EHS requires wired and wireless technologies. This technology decreases the health care wage and increases the speed and quality of care. EHS increases the concern of autonomy of the patient and security and consistency of the health care data. The concept of IoT and M2M are tested in and found to be easier and important to use for emergency communication. The only thing that should be considered is making the wireless communication friendly. The primary challenge of ICT during emergency is lack of deployment of communication system for immediate responders regardless of the status of the infrastructure. Therefore, responsible parties and individuals should work as a system which can run spontaneously whenever emergency appears without further intervention. Generally, there should be well organized establishment of ICT for emergency management.

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