Chapter 75
A Clinical Decision Support System:
Ontology-Driven Approach for Effective Emergency Management

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ABSTRACT

Inadequate response and bad decisions taken by mobile physicians may lead to bad consequences threatening rescued people lives. Moreover, there are growing information that overload physicians when facing urgent cases. In order to facilitate the on road decision making for the mobile physicians, we propose a clinical decision support system based on an ontology driven approach for effective emergency management that allows finding out as quickly as possible the needed medical resources and reserves the most suitable health care institutions according to the patient state. Specifically, this work permits to localize rapidly the closets health care institution to the emergency scene, to find out the needed medical resources to deal with the patient first diagnosis, to match the localized health care institutions that contain the necessary medical resources to fulfil the patient determined needs, and to rank medical institutions, according to urgent case requirements, in order to allow the mobile physician to perform the adequate choice of one of them.

INTRODUCTION

Healthcare is experiencing an exponential growth in the scientific understanding of diagnostic, diseases and care pathways. As a consequence, the future outlook of healthcare knowledge management can significantly impact patient care and health outcomes. The goal of healthcare knowledge management is to provide effective, optimal and timely health care knowledge to physicians and especially to patients whenever and wherever they need it, to support them in making effective patient care decisions.

DOI: 10.4018/978-1-4666-9845-1.ch075

With the shortage of physicians in particular and more generally of medical staff, there is, in developed and in developing countries, a lack of medical coverage in large geographic areas (Lin et al., 2013). Over the last decade, worldwide, many thousands of people die every year due to inappropriate emergency management, inadequate responses and poor decisions made by rescue teams, etc. Regardless of the type of emergency, they are all characterized by unexpectedness and confusion (Ayeni & Misra, 2014).

The need to enhance emergency management is becoming imperative. In fact, a good health rescue system is primarily based on good emergency management (Zvikhachevskaya et al., 2009). Therefore, physicians in general and mobile ones in particular have to react promptly and efficiently to save human lives and help people with serious or life-threatening conditions especially if they are called to treat them far from medical institutions. Taking effective and swift actions to reach the patient and/or the health institution in time may help to reduce serious problems, and consequently improve the chances of patient treatment and/or survival that are of primary concern of the physician.

The lives and health of millions of people are affected, daily, by emergencies actions. Therefore providing tools which assist mobile physicians in managing emergencies during critical and/ or urgent situations cases is essential. Indeed, hardware and software tools used to improve performance of emergency tasks are of particular interest for their ability to address the growing information overload that clinicians face. Well used information, obviously, assists them to react promptly and efficiently when facing urgent situations.

Hence, in light of these facts and in order to facilitate on-road decision-making for the mobile physician, we propose an Ontology-based medical assistance system, that allows finding out as quickly as possible the required medical resources and alerts the most suitable health care institutions according to the patient's condition.

Ontology is defined by a set of concepts with a conforming subsumption hierarchy (Ehrig & Staab, 2004). With it, we aim to provide common, unambiguous semantics and a vocabulary for the use cases we are dealing with. Specifically, this work answers the following three research questions:

1. How to rapidly localize the health care institution closest to the emergency scene?
2. How to determine the required medical resources to deal with the patient's condition?
3. Does the local health care institution have the necessary medical resources to fulfill the patient needs?

In emergency calls where response time is critical, mobile physicians are especially qualified to deal with huge quantities of clinical data and make quick and efficient decisions in order to save human lives. In fact, the patient's health state may change to be critical and require immediate medical intervention.

In a traditional emergency system, a senior physician is in charge of providing appropriate responses to emergency calls through an emergency hotline. He evaluates the medical emergency and decides whether or not it requires a rescue team to transport the patient to the closest medical care institution. While the traditional system can identify suitable medical institutions, it cannot predict the availability of the needed medical resources such as equipment and specialized staff. In fact, the medical condition of the patient and the medical institution are continually changing.

Many countries suffer from the problem of shortage of medical care. In fact, some of their regions lack expert physicians and/or well-equipped health care institutions, while others are saturated. The question that arises is whether the patient should be transferred to the closest hospital that may not have