Chapter 3
Predicting Medical Resources Required to be Dispatched After Earthquake and Flood, Using Historical Data and Machine Learning Techniques: The COncORDE Emergency Medical Service Use Case

Homer Papadopoulos
National Center for Scientific Research Demokritos, Greece

Antonis Korakis
National Center for Scientific Research Demokritos, Greece

ABSTRACT

This article presents a method to predict the medical resources required to be dispatched after large-scale disasters to satisfy the demand. The historical data of past incidents (earthquakes, floods) regarding the number of victims requested emergency medical services and hospitalisation, simulation tools, web services and machine learning techniques have been combined. The authors adopted a twofold approach: a) use of web services and simulation tools to predict the potential number of victims and b) use of historical data and self-trained algorithms to "learn" from these data and provide relative predictions. Comparing actual and predicted victims needed hospitalisation showed that the proposed models can predict the medical resources required to be dispatched with acceptable errors. The results are promoting the use of electronic platforms able to coordinate an emergency medical response

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since these platforms can collect big heterogeneous datasets necessary to optimise the performance of the suggested algorithms.

1. INTRODUCTION

Demand prediction and forecasting after natural disasters are especially critical in emergency health management (Ardalan et al., 2009). According to WHO (World Health Organization, 2007), large-scale disaster situations causing mass casualty incidents are characterised among the others by:

- Large numbers of patients, which require the mobilisation of increased hospital personnel and equipment;
- Large numbers of the same type of injury (e.g. skin damage in fire or breathing problems in a gas leakage) that may require equally large amounts of the same type of medical supplies and specialists;
- Injuries that require immediate and simultaneous highly specialised intervention;
- Ambulances availability to deliver several patients;
- Stress and panic situations and, very often, inaccurate estimates of the number of injured people who need treatment.

Preparing essential parts of the healthcare system such as hospitals to prevent, respond, and rapidly recover from these threats is critical for protecting and securing the entire health infrastructure. Incidents such as the 2009 H1N1 influenza pandemic (Shrestha et al., 2010), the Fukushima tsunami (Bachev, 2014) and the hurricane Sandy (Kryvasheyeu et al., 2015) highlighted the importance of preparedness for hospitals against potential threats and their consequences in the community. We should also note that these threats, are added to the considerable multiple challenges faced by trauma centres operating in hospitals and healthcare systems on a daily basis. However, during the emergency response process, in reality, it is difficult to obtain an accurate estimation and prediction of commodities demand after natural disasters because traditional statistic methods such as time-series forecasting methods seem to be ineffective (Zhao and Cao, 2015).

Recent years, aiming at this problem, new technological advancements (Web 2.0 services, broadband communications, and the ability to process, and analyse big heterogeneous data-streams) have been applied to get an insight into the fast-changing situation and help drive an effective disaster response. More specifically Haiti earthquake motivated ICT usage driven crisis since big data collected during the crisis (Meier, 2014) helped to find information about the affected population.