Chapter 8
GIS, Grid Computing and RFID in Healthcare Information Supply Chain:
A Case for Infectious Disaster Management

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EXECUTIVE SUMMARY

Several healthcare disasters have occurred in the past decade, and their occurrence has become more frequent recently due to one natural catastrophe after another. The medical application requirement for such a disaster management system includes effective, reliable, and coordinated responses to disease and injury, accurate surveillance of area hospitals, and efficient management of clinical and research information. Based on the application requirements, this case study describes a grid-based system in a health information supply chain that monitors and detects national infectious events using geographical information system (GIS), radio-frequency identification (RFID), and grid computing technology. This system is fault-tolerant, highly secure, flexible, and extensible, thus making it capable of operation in case of a national catastrophe. It has a low cost of deployment and is designed for large-scale and quick responses. Owing to the grid-based nature of the network, no central server or data centre needs to be built. To reinforce the responsiveness of the national health information supply chain, this case study proposes a practical, tracking-based, spatially-aware, steady, and flexible architecture, based on GIS and RFID, for developing successful infectious disaster management plans to tackle technical issues. The architecture achieves a common understanding of spatial data and processes. Therefore, the system can efficiently and effectively share, compare, and federate—yet integrate—most local health information providers and results in more informed planning and better outcome.

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ORGANIZATION BACKGROUND

The outbreak of severe acute respiratory syndrome (SARS) in Southeast Asia in 2003 had a serious impact and proved disastrous for the entire society, healthcare practitioners, healthcare institutions and public works personnel worldwide (Esswein et al., 2004). In recent years, the numerous natural disasters have always entailed a massive prevalence of contagious diseases. For example, after a devastating earthquake in Haiti in 2010, there was reported an outbreak of a cholera-like disease that had killed hundreds of people. In order to better manage such disasters in the future, much attention was given to interoperability of a nationwide health information network (Chau & Yip, 2003). Inherent in the massive collection of data, there is expected to be trade-offs between quick response and accuracy that arises with mass surveillance systems. The application requirements for such a system include an effective and coordinated response to disease and injury, accurate surveillance of area hospitals, and efficient management of clinical and research information.

A nationwide health information network or supply chain can be extremely complex, since it needs to integrate geographically-distributed healthcare providers and other units with distinct functions and mutual dependencies. In this case study there has been discussed an enhanced health information network that dealt with natural disaster caused by mass epidemic outbreak.

Due to the dynamic nature of propagation of epidemics, many researches investigate, following various dynamic approaches, the causes and consequent behaviour patterns in the outbreak of infectious diseases (Forys, 2002; Scheffer et al., 2001). System dynamics modelling allows the integration of multiple political, environmental, social and structural variables into a single model. It also analyses the behaviour of all the variables in the system, allowing policies to be tested repeatedly (Forrester, 1961). The system dynamics modelling methodology has been applied to the health sector many a time and proven itself in resolving complex, systemic issues (Yousefi & Lauridsen, 1998; Flessa, 1999; Ritchie-Dunham & Galv´an, 1999; Lane, Monefeldt & Rosenhead, 2000).

This case study tries to reinforce the responsiveness of the national health information supply chain with a practical, tracking-based, spatially-aware, steady-to-use, and flexible architecture for developing successful infectious disaster management plan and implementing GIS and RFID to tackle technical issues. The proposed architecture will achieve a common understanding of spatial data and processes, which will enable this system to efficiently and effectively share, compare, and federate yet integrate most of the local health information providers and results for more informed planning and better outcomes.

SETTING THE STAGE

Early intervention is a key to stop a massive outbreak of diseases and new technologies can help in this. A mass epidemic outbreak caused by a natural disaster drew much attention recently. In response to such events, bodies related to biomedical, public health, defense, as also intelligence communities, are developing new approaches for real-time disease surveillance in an effort to augment existing public health surveillance systems. The term 'syndromic surveillance' refers to methods relying on detection of clinical case features that are discernible before confirmed diagnoses are made (Forslundet al., 2004). In particular, even before a laboratory confirms an infectious disease, sick people may show certain behavioural patterns, symptoms or signs, or there may be certain laboratory findings, that can be tracked through a variety of data sources. New information infrastructure and methods to support timely detection and monitoring, including the discipline of syndromic surveillance, are evolving rapidly (Homer et al., 2004; Hoard et al., 2005).

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