Chapter 10
Health Systems for Syndromic and Epidemiological Surveillance

Débora Helena Job
National Laboratory for Scientific Computing (LNCC), Brazil

Antônio Tadeu Azevedo Gomes
National Laboratory for Scientific Computing (LNCC), Brazil & National Institute of Science and Technology on Medicine Assisted by Scientific Computing (INCT-MACC), Brazil

Artur Ziviani
National Laboratory for Scientific Computing (LNCC), Brazil & National Institute of Science and Technology on Medicine Assisted by Scientific Computing (INCT-MACC), Brazil

ABSTRACT

Health surveillance practices date back to decades ago. Traditionally, such practices to gather health data have been manual; more recently, however, computerized health information systems have been applied to enhance and facilitate health information acquisition for surveillance. The so-called health surveillance systems put in practice the systematic acquisition of health data, which is stored and processed for expert analysis. This chapter makes a survey of health surveillance systems dedicated to syndromic and epidemiological surveillance, identifying the different design and technological strategies adopted in the development of such systems. The aims of such a survey are: (1) to provide practitioners with some information about the collective expertise of health information system architects in the design and implementation of syndromic and epidemiological surveillance systems; and (2) to pave the way for the establishment of software product lines dedicated to such systems.

INTRODUCTION

Surveillance practices date back to decades ago. They aim at monitoring outbreaks, emerging infectious diseases and the like, as well as their impacts on population health, according to national or international targets for disease control and eradication (WHO, 1999). Traditionally, such practices have been manual, using standardized diagnostic laboratory testing, and health notification reports (Forslund, et al., 2004). More recently, however, computerized Health Information Systems (HIS) have been also applied to enhance and facilitate

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health information acquisition for surveillance (Chen, Zeng, & Yan, 2010). The so-called *health surveillance systems* put in practice the systematic acquisition of health data, which are stored and processed for expert analysis. Such systems are usually composed of typical software artifacts such as graphical user interfaces and databases, but also employ somewhat sophisticated analysis techniques such as data (typically text) mining, ontologies, and mathematical disease spreading models. A particularly important aspect of such systems is the process of health information transmission, which relies on health protocol standards that aim at ensuring reliability, security, and interoperability on data acquisition.

For the sake of this chapter, we divide health surveillance systems into two groups: *epidemiological* and *syndromic* surveillance systems. Epidemiological surveillance systems collect and monitor data related to specific diseases and other health problems. Syndromic surveillance systems are wider in scope, relying on algorithms that are able to categorize health information in general and detect specific syndromes that, for example, might suggest the possibility of an underlying disease. The categorization into these two groups is blurry, though, and systems that implement both epidemiological and syndromic surveillance are more common than not. There are certainly other definitions and forms of classification related to health surveillance systems. One example is that of *sentinel surveillance systems*, in which a set of pre-arranged samples of reporting sources (e.g. hospitals)—usually distributed over a wide region—agree to report all cases of one or more notifiable health conditions. In this chapter, we try to collapse these alternative classifications into the ones of epidemiological and syndromic surveillance.

This chapter makes a survey of HISes dedicated to syndromic and epidemiological surveillance, identifying the different design and technological strategies adopted in the development of such systems. The aims of such a survey are: (1) to provide practitioners with some information about the collective expertise of HIS architects in the design and implementation of syndromic and epidemiological surveillance systems; and (2) to pave the way for the establishment of software product lines better aligned with the requirements imposed by such systems. The adopted methodology for structuring this survey comprises the definition of a set of criteria (data collection, data storage, data analysis, and data visualization) for comparative analysis of the discussed HISes as well as the presentation and comparison of such HISes in the light of the defined criteria.

The remainder of this chapter is organized as follows. Next section brings background information that provides the main definitions adopted along the chapter involving health surveillance systems. The considered criteria for comparative analysis of health surveillance systems are then introduced. There is then a section that reports a survey of epidemiological and syndromic surveillance systems. Another section compares the main characteristics of the surveyed systems. Finally, in the latest two sections we present the future trends and conclusions, respectively.

BACKGROUND

The last years have witnessed an increasing amount of work dedicated to the study and development of Health Information Systems (HISes) in general, and surveillance systems in particular. Thacker, Stroup, and Dicker (2003) define surveillance systems as HISes that allow the

"Ongoing, systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know" (p. 225).