

# **Disease Surveillance: a Public Health Informatics Approach**

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Book Review - DOI: 10.3395/reciis.v2i1.167en

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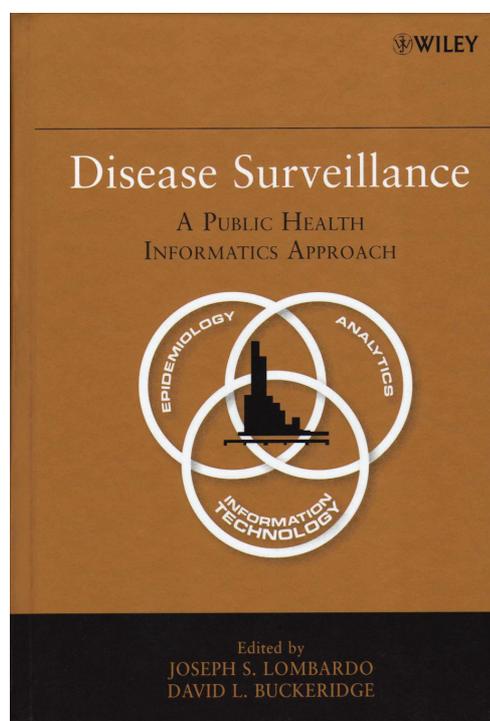
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The collection embraces different essential topics for the implantation of an integrated and automated disease surveillance system on national level, dynamic and able to offer rapid responses within the scope of data management. The discussed concepts are clearly illustrated on the basis of some applications developed for specific problems, describing their *modus operandi* and the necessary steps for ensuring a good functioning of systems of this nature in the future.

The book begins with a text emphasizing the need for systems of this kind in our days, in which the means of communication reduce distances and abolish frontiers, in which we are concerned with the possibility of an extensive and quick dissemination of emerging and reemerging diseases like the avian flu and SARS (Severe acute respiratory syndrome), and in which potential terrorist groups can avail themselves of biological weapons for threatening communities all over the planet; in short, situations capable of contributing to the emergence and rapid dissemination of an epidemic or natural catastrophe, which need to be faced with due urgency and appropriate means and resources.

The collection also discusses some problems with regard to the implementation of a surveillance system and how these problems can be dealt with and solved, although restricting the greater part of the initial examples to a developed country, the United States who



*John Wiley & Sons, 2007*

ISBN: 978-047006812-0

possess, to a much greater extent than any other country, the necessary means, resources and qualified personnel. However, the proposed methodological ideas do not seem to be of difficult application in other contexts and the indicated resources are not particularly expensive or complex. Besides, in the second part the book presents and discusses integrated disease surveillance systems of rapid response established in different developed and developing countries.

The points presented in the book are originated in different fields of study but are adequately integrated and interconnected and essential for the development of the subject and for the implementation of the systems. The systems are described in an organized, clear, simple and illustrative manner, facilitating the comprehension of the text.

The initial part of the text (introduction) emphasizes the importance of disease surveillance in our days, shows how the transformations in this sphere are linked to the technological progress, and traces a brief history of the dynamic connection between technologies and their concrete application in information systems. The formulated concepts are exemplified on the basis of epidemics of great relevance and magnitude occurred in the XX century as for example the Spanish flu (influenza) pandemic in the first decades of the past century. Together with the emergence of problems of this magnitude appear the first disease surveillance techniques used for the detection and control of epidemics, mainly based on observation and registration of quickly disseminating and highly mortal diseases.

Sadly ironic is the fact that infectious diseases of the past, today under absolute medical control like anthrax, have been recovered from their repositories in labs and used as biological weapons, today constituting a dangerous arsenal threatening human lives. On the other hand this threat has mobilized important resources for its prevention, immediately aborting the propagation of the disease in case of an attack with biological weapons.

In the following sections the text is divided into two parts, the first one consisting of sections 2, 3 and 5, presenting the elements related to the design of a disease surveillance system and the priorities to be taken into consideration with regard to its implementation. This part approaches elements and methodologies coming from all areas involved in the subject, such as the health indicators of the populations potentially associated with the emergence of an epidemic, data registration and storage, the techniques and different resources used in information science, the standardizing of procedures and norms, formulation and application of pertinent legislation, statistics and geoprocessing.

Section 2 presents elements considered of basic importance for the construction of population health indicators such as: data related to the sale of over-the-counter medicaments (nonprescription drugs), calls to emergency services type 911 (in the USA), appointments with private practitioners, care delivery in medical centers, outpatient clinics and emergency services, laboratory

tests and absenteeism from school etc. The exhaustive description of consistent data regarding these elements requires capacity building and collaboration of different health professionals. Devices must be implemented for a consistent and systematic data collection, storage and retrieval. The organization of these information systems is illustrated by means of data flow diagrams and examples of application in different places. This section also includes population health indicators related to diseases affecting the health of humans and animals like cattle (aphthous fever, for example) as well as environmental conditions, as long as these are composing the basket of population health indicators.

Section 3 describes in detail the collection, flow, storage and accessibility of the data. The section begins with an introduction about the Internet and web-based databases and shows how these data should be collected and stored in an automated manner. It is important to emphasize the importance given to standardizing these data so that they can be shared on international level, and the need for a legislation allowing for obtaining these data in a quick and integrated way while preserving the privacy of individuals and collectivities. The system designed for the collection of data from different origins includes drugstores, private physicians, emergency services, schools etc., whose data are introduced into a digital storage center utilizing different means, mainly the Internet. The data to be in fact incorporated must be selected judiciously, contemplating only those considered useful for the purpose of the system. This will avoid overloading the system and favors the uniformity and storage of the data. The section ends demonstrating how to transmit data through the Internet by means of safe standard procedures.

Section 4 describes procedures used for analyzing data automatically stored for health survey purposes, in order to detect as quickly as possible any abnormality capable of resulting in a threat to the health of the population. These algorithms are also used for minimizing/avoiding false alarms. The characteristics these algorithms should have and the algorithms most frequently used are described. The first group of procedures presented consists of statistical procedures aimed at analysis and monitoring of time series with generation of control graphs and of probable scenarios for future occurrences. Then, the space-time variables are described which, besides serving for monitoring and alerting purposes, help identifying the geographic localization of epidemics by means of geoprocessing. Examples for this type of analyses are the methods used in the analysis of clusters.

Section 5 discusses the junction of information systems with the monitoring demands, aimed at implementation of an automated system. The section describes how to implant an information system and how to utilize the procedures and tools for presenting the information to the system administrators. The system administrators will concentrate and integrate the information from different origins, store the data in a hierarchical and inter-related way, conduct a quick analysis (some-

times in real time) and serve as a warning signal for the possible appearance of some epidemic. These disease alerts can be georeferenced, in other words, generate alerts with a real geographic reference. Finally the text presents examples of communications between users of surveillance systems from different jurisdictions with the purpose to encourage cooperative work. There are still some considerations about the safety of the system, indicating safety systems similar to those used by the great corporations for protecting information. Finally, three possible architectures of surveillance systems, their characteristics and orientations are presented. Another important item is the nature of the database, its design and the software to be selected besides the recommendations about the nature of the hardware, where the data will be stored and the respective software for the administration of the database.

The use of the Internet is emphasized, mentioning the web servers, different applications, geographic information systems (GIS) and disease surveillance software. The disease survey applications can be visualized, normally utilizing a GIS. Protocols for communication of the users of the system are presented, followed by a list of essential topics for the implantation of a safety system for the surveillance system.

The second part of the book, composed by sections 6, 7, 8 and 9, presents specific applications of integrated disease surveillance systems on national level, capable of offering quick responses and whose characteristics are organization, use of technology and qualified personnel. It must be pointed out that, although showing the applications in use in developed countries like Canada, a country possessing an automated, sophisticated and highly integrated system, or the United Kingdom, where the monitoring system was integrated with the telephone system, the developing countries were not forgotten. Disease surveillance systems of countries with fewer resources are shown, like those implemented in some countries in the Southeast of Asia and in Peru with support of the respective armies.

Section 6 addresses epidemiologists and other professionals working with disease surveillance and describes the necessary requisites for monitoring the health of the populations and their operational aspects. It discusses some North-American surveillance systems, especially the Centers for Disease Control and Prevention – CDC, a well-succeeded North-American surveillance initiative on national level.

Section 7 describes the Canadian initiatives for implementing an automated disease surveillance sys-

tem and discusses the good use of the new tools and technologies for the development of this surveillance system focused on real time epidemic alert. The Canadian system involves subsystems for specific diseases and real time surveillance of epidemics and outbreaks using easily visualized procedures. The section also presents some optimistic conclusions with respect to advanced systems based on new communication and information technologies.

Section 8 provides a detailed description of the automated disease surveillance system of the United Kingdom and how this country integrated the national population health survey system via telephone – the telehealth- with the dissemination of a possible alert.

Section 9 presents a detailed description of disease surveillance systems implanted in countries with few resources with support of North-American military research labs, in some cases facing difficulties to access certain regions and problems with access to the Internet. Different case studies are presented and discussed. The first case study describes a disease surveillance system implanted in the Asian southeast for monitoring epidemics like the avian flu. A software was installed in hospitals and urban areas, used for organizing and registering disease data. These data are frequently transmitted via e-mail to the collection centers, where these data are analyzed for detecting any possible epidemic. The second case study presents the disease surveillance system implanted in Peru.

The third part of the book including the sections 10, 11 and 12, addresses the future of disease surveillance systems and the evaluation of their performance. This part also refers to the importance of preparing and training human resources for ensuring the future functioning of these systems and defends wide use of information technology and continuous updating.

Section 10 presents some statistical and mathematical techniques for evaluating a surveillance system, approaches the detection of an outbreak and the response protocols and evaluates the response time and precision of the system.

Section 11 addresses the question of human resources for operating this kind of system in its different phases and recommends a higher degree of informatization of the systems as well as capacitation in informatics of the personnel involved in disease surveillance. Finally, it evaluates the structure for the training of this kind of personnel and states the lack of professionals in the field of evaluation of surveillance systems. 