

Global Public Health Monitoring Systems

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Abstract

Public health monitoring is an important cog in the wheel for public health care systems around the world. The data generated from such surveillance is used by governments the world over for the purpose of planning and strategizing policies in the field of public health. It involves keeping tabs on communicable, infectious, vector-borne diseases incidences within their boundaries. This paper aims to review some of the research studies which have been carried out on the public health monitoring systems worldwide. For this paper, specific search terms, such as “public health systems”, “public health monitoring”, and “public health surveillance”, were used in Google Scholar search engine and the results were shortlisted according to the year of publication. From the review of the studies available on the subject, it was clear that across the world, governments were engaged in collecting public health data using public health surveillance methods. These systems can prove to be beneficial for countries which are engaged in revamping their healthcare systems, as they can provide successful examples of public health surveillance and monitoring.

Keywords: Public Health, Monitoring, Systems, Review

Introduction

In order for governments around the world to plan and strategize public health efficiently, they require data which allows them to do the same. For this purpose, governments need public health surveillance systems in place.

Public health surveillance systems are different around the world, but they generate data along the same lines which are required by the governments for the purpose of public health policies. Poorer nations with weak public health infrastructure use help from donor countries and communities.

Methodology

In this paper, we will review some of the research studies which have been carried out on the subject of global public health monitoring systems. Towards this end, specific search terms like “public health monitoring system”, “public health surveillance + global”, and “public health + monitoring” were used in Google Scholar search engine. The results of these searches were shortlisted as per the year of publication. For the purpose of this study, only studies published after 2000 were used, in order to examine public health monitoring systems worldwide.

Results and Discussion

Types of Surveillance Systems

In her study, Anderson (n.d.) talks about the various surveillance systems used in a country’s public health monitoring system. Anderson has used examples from the U.S. public health monitoring system. Hence, the following sub-sections also give us an idea of the U.S. public health monitoring system.

In the United States, the National Center for Health Statistics makes vital statistics available. Alongside, the Centers for Disease Control and Prevention (CDC) operates an online system called the CDC WONDER which contains data on births, deaths, as well as many diseases.

Disease Reporting (Morbidity Data)

In case of certain diseases, it is required by law that incidences are reported to public health authorities. Internationally, disease reporting for diseases such as smallpox, wild-type poliomyelitis, severe acute respiratory syndrome (SARS), and human influenza caused by new subtypes, is required by the World Health Organization, through the International Health Regulations (IHR). Under IHR, countries are also required to report any public health emergency of international concern.

In the United States, state laws mandate disease reporting as the list of reportable diseases varies by state. States report nationally notifiable diseases to the CDC voluntarily. The list of notifiable diseases is updated regularly by the Council of State and Territorial Epidemiologists and the CDC (Anderson, n.d.).

Surveys

Another type of surveillance system is the survey. Surveys carried out on a routine basis are helpful for monitoring chronic diseases.

In the U.S., an example of a national survey is the Youth Risk Behavior Survey (YRBS) which asks high school students about health-related behaviors such as substance use, sexual behavior, physical activity, and nutrition. YRBS results are helpful in monitoring trends in health behaviors. These are also used to plan public health programs, and evaluate public health policies at national and state levels. CDC carries out other national surveys such as the Behavioral Risk Factor Surveillance System (BRFSS), the National Health Interview Survey (NHIS), the Pregnancy Risk Assessment Monitoring System (PRAMS), and the National Health and Nutrition Examination Survey (NHANES) (Anderson, n.d.).

Sentinel Surveillance

An alternative to population-based surveillance or surveys, sentinel surveillance involves collecting data from a sample of reporting sites (also known as sentinel sites). Sentinel providers can also be used to gather more specific information (Anderson, n.d.).

In the U.S., one of the most common sentinel surveillance systems used is for influenza. Selected health care providers, on a weekly basis, report the number of cases of influenza-like illnesses to their state health department. This allows states to monitor disease trends using a relatively small amount of information. In British Columbia, Canada, a sentinel provider was used in a study of vaccine effectiveness during the 2005-2006 influenza season (Anderson, n.d.).

Zoonotic Disease Surveillance

In public health, surveillance gets extended to diseases in animals. not necessarily limited to humans. Surveillance of zoonotic diseases (diseases found in animals that can be transmitted to humans) often involves a system for detecting infected animals (Anderson, n.d.).

In 2001, Florida conducted surveillance for West Nile Virus (WNV) using a variety of strategies, most involving animals. The state health department provided a website and a telephone hotline for the public to report dead birds, some of which were collected and tested for WNV.

Mosquitoes were collected and tested for WNV in 10 counties. Blood was collected from 3-12 sentinel chickens in each of 212 flocks up to 4 times per month and tested for antibodies to WNV. Veterinarians were asked to test horses with neurologic symptoms consistent with WNV. Health care providers were reminded of reporting and diagnostic criteria for possible human cases of WNV. Together, these surveillance systems allowed public health authorities to determine the intensity of WNV by geographic area. Detection of WNV led to public health control measures, such as advising the public to protect against mosquito bites and intensifying mosquito abatement efforts (Anderson, n.d.).

Adverse Events Surveillance

A type of surveillance system focusing on patient safety is the Adverse Events Reporting System (AERS), operated by the Food and Drug Administration (FDA). The aim here is to gain information about the ill effects experienced by people who have received approved drugs and other therapeutic agents. Health care providers, including doctors, pharmacists and nurses, along with the general public can give voluntary reports to the AERS. Even product manufacturers can directly get informed by the public or the health care provider at times, in which case, the manufacturer needs to report the event to AERS. The FDA uses AERS to identify possible safety concerns associated with approved products (Anderson, n.d.).

Like AERS, the Vaccine Adverse Events Reporting System (VAERS), operated by the CDC with the FDA, is also focused on patient safety. VAERS focuses on the negative effects experienced by people who have received licensed vaccines. In 2003, VAERS was used as part of a surveillance program for smallpox vaccines given to health care and public health professionals in preparation for a possible bioterrorist attack. More than 100 adverse events were reported after smallpox vaccination, including 16 suspect and 5 probable cases of myocarditis or pericarditis. Based on these and related concerns, the Advisory Committee on Immunization Practices eventually recommended ending smallpox vaccination after health care and public health response teams had been vaccinated (Anderson, n.d.).

Syndromic Surveillance

This is a new surveillance method which uses clinical information about disease signs and symptoms, before a diagnosis is made. Syndromic surveillance systems frequently use electronic data from hospital emergency rooms (Anderson, n.d.).

For example, New York City operates a syndromic surveillance system using emergency department chief complaint data from approximately 44 hospitals. The data are monitored electronically for signals indicating the beginning of a disease outbreak.

In 2002, the system detected a higher than usual number of diarrheal and vomiting symptoms. Based on this information, the health department notified hospital emergency departments of a possible outbreak and collected stool specimens, several of which tested positive for norovirus. Thus, the syndromic surveillance system provided the health department with early notification of the outbreak (Anderson, n.d.).

However, a similar outbreak later that year was not detected by the system. The failure to detect this outbreak was attributed to incorrect coding of the chief complaint by emergency departments (Anderson, n.d.).

Registries

Registries are a type of surveillance system used for particular conditions, such as cancer and birth defects, often established at the state level to collect information about the people diagnosed with the particular condition (Anderson, n.d.).

For example, cancer registries collect information about the type of cancer, anatomic location, stage of disease at diagnosis, treatment, and outcomes. This kind of information can be used to improve prevention programs. Based on registry data, a state might discover that women in rural areas are diagnosed with breast cancer later than women in urban areas. In this situation, the state might choose to promote mammography screening in rural areas using a mobile van.

Laboratory

Another source of surveillance data is public health laboratories, which routinely conduct tests for viruses, bacteria, and other pathogens. Laboratory serotyping provides information about cases that are likely to be linked to a common source. For this reason, serotypes are useful for detecting local, state, or national outbreaks (Anderson, n.d.).

In the US, public health laboratories participate in the National Salmonella Surveillance System through electronic reporting of Salmonella isolates. In 2006, more than 40,000 isolates from the US were reported through this system (Anderson, n.d.).

Another laboratory system that plays an important role in surveillance is PulseNet, developed by the CDC and the Association of Public Health Laboratories to monitor outbreaks of foodborne illnesses. PulseNet enables public health laboratories across the U.S. to compare pulsed-field gel electrophoresis (PFGE) patterns of bacteria isolated from ill persons and determine whether they are similar. This allows scientists to determine whether an outbreak is occurring, even at geographically distant locations, and can decrease the time required to identify outbreaks of foodborne illness and their causes (Anderson, n.d.).

Public Health Monitoring Across the World

According to Calain (2007), donors (both countries and community) assume that to support resource-poor country in developing their country's public health surveillance infrastructure, targeted funding of global, regional or cross-border surveillance programs is an efficient way. This also encourages countries to share outbreak intelligence, and ultimately to ensure compliance with the revised (2005) International Health Regulation (IHRs). At country level, a number of factors contradict this view. Global or regional surveillance initiatives, including syndromic surveillance and rumour surveillance projects, have been conceived in neglect of fragile health systems, from which they extract scarce human resources (Calain, 2007).

In his study, Calain (2007) says that when donor-driven, poorly coordinated and redundant surveillance systems are nurtured, it only adds to further fragmentation of the health priorities set up by developing nations as they ignore the overwhelming deficits in governance as well as health care capacity. In their current categorical format, global surveillance strategies tend to be advantageous to the most developed nations through the provision of early warning information or scientific data (Calain, 2007).

In his study, Calain (2007) says that if lower income countries are to benefit, the focus of resources needs to be on strengthening the health system first. This would be an efficient way to proper detection and response to outbreaks at national or sub-national level. As documented in

several pilot initiatives at sub-national level (India, South Africa, Tuvalu and Cambodia), the empowerment of frontline health workers and communities is a key element for an efficient surveillance system (Calain, 2007).

European Union

In their study, Bogaert & Van Oyen (2017), the current EU health information and data infrastructure system is fragmented and sectorial with issues of timeliness and usefulness. Despite discussions regarding the benefit of sound data and health information being the basis of evidence-based policy-making and research, there is no single, integrated and sustainable EU-wide public health monitoring system (Bogaert, & Van Oyen, 2017). The authors say that EU still has large information gaps when it comes to a quality health information system on diseases such as non-communicable diseases, even though it has been documented that chronic diseases are the main cause of death and poor quality of life in Europe.

According to Bogaert, & Van Oyen (2017), the discussions around development of an integrated EU health information system started in 1994 when eight different programs were established as an initial strategy for putting in place actions on public health at a European level, for the first time. These included programs on communicable diseases, cancer, rare diseases, injury prevention and drug prevention. Efforts on subsequent health programs led to the evolution of the current EU health surveys, European Community Health Indicators (ECHI), the communicable disease infrastructure in the EU, regulations at the Community level and many other successful projects. The integration of collected data from these projects provides useful inputs for research and national and European decision makers. It helps in pooling scarce resources and in reducing the burden of health reporting on both the member states as well as at the level of the EU. However, these projects have also demonstrated that there are significant gaps that need to be overcome such as diversity of health services and health information structures in Europe; fragmentation of databases and registries; health information inequality, and lack of sustainability of health information activities (Bogaert, & Van Oyen, 2017).

Sweden

Sweden has one national law concerning health care and also has a well-developed primary health care system (Albin, Hjelm, & Zhang, 2010). According to a study on Sweden's health registries, the country has 90 national registries tracking data on diverse health issues (Webster, 2014). Sweden has made it their national priority to expand these registries and due to that, the funding for registries has expanded five times, from USD 11 million to USD 50 million per year. According to the 2010 government report, *A Review of the National Registers: A Gold Mine in Health Care*, an investment of USD 70 million annually in disease registries, data analysis resources and information technology infrastructure, could allow Sweden to reduce its annual growth in health care spending from an estimated 4.1% to 4.7% and save an estimated USD 7.8 billion over ten years. Webster's paper found that Sweden was focusing on registry-based research by looking at risk factors and chronic diseases. The country is also cognizant of the fact that public health needs must be closely integrated with clinical research strategy (Webster, 2014).

Hong Kong

Hong Kong has a sentinel surveillance system (SSS) to monitor hand, foot and mouth disease (HFMD) trends. In their study on the effectiveness of this system in Hong Kong, Edmond,

Wong, & Chuang (2011) say that the SSS was both simple and flexible with high-quality data which correlated well with the laboratory surveillance data. The system facilitated the early detection of community epidemics and helped identify seasonal trends as well as high-risk groups (Edmond, Wong, & Chuang, 2011). The authors conclude that Hong Kong's SSS is effective for monitoring HFMD trends in the country, and is useful for initiating preventive measures.

China

In China, the Chinese Center for Disease Control and Prevention (China CDC) is in charge of public health surveillance. In 2004, China initiated the Infectious Diseases and Public Health Emergencies Reporting System which keeps tabs on the spread of infectious diseases in the country (Chinese Center for Disease Control and Prevention). The National Center for Public Health Surveillance and Information Service (NCPHSIS) is responsible for acting as the public health information resource management. It is responsible for China CDC's internal information construction and management, and also for the construction, application, management, services and sharing of both public health information resources and big data. NCPHSIS provides technical support for the planning, construction and operations of national disease control and prevention information systems. In addition to coordination with affiliated institutions (such as the National Institute for Communicable Disease Control and Prevention, National Institute for Viral Disease Control and Prevention, National Institute for Parasitic Diseases, National Center for AIDS/STD Control and Prevention, National Immunization Program, the Division of Infectious Diseases, National Institute of Environmental Health, National Institute for Occupational Health and Poison Control, and the National Institute for Radiological Protection etc.) directly, it instructs Chinese CDCs at all levels in information construction. In his study, Liu (n.d.) says that China needs to reorganize its public health system by strengthening both the vertical and horizontal connections between its various public health organizations. The author states that China's recent policy of establishing a matching-fund financed rural health insurance system could be an exciting opportunity to improve people's access to health care.

Colombia

The public health monitoring system in Colombia is called SIVIGILA or the National Public Health Monitoring System (Sistema Nacional de Vigilancia en Salud Pública). Since 2000, Colombia's National Health Institute has been responsible for generating reports on national epidemiological monitoring on the basis of information sources including the passive monitoring of weekly notification of events of interest to public health (using SIVIGILA) (National UNGASS Report, Republic of Colombia).

Saudi Arabia

According to Memish, Zumla, Alhakeem, Assiri, et al. (2014), Saudi Arabia has extensive experience of providing health care at mass gatherings due to decades of managing millions of pilgrims at the Hajj. According to Memish, McNabb, Mahoney, Alrabiah, et al. (2009), Hajj is the yearly pilgrimage by Muslims to Saudi Arabia, which is one of the largest, most culturally and geographically diverse mass gatherings in the world.

Recently, Saudi Arabia established the Global Center for Mass Gathering Medicine, which is the Saudi government's partnership with the WHO Collaborating Centre for Mass Gatherings

Medicine, Gulf Co-operation Council states, UK universities, and public health institutions globally (Mehmish et al., 2014).

Saudi Arabia can draw lessons from success stories of public health monitoring systems worldwide.

Conclusion

In this paper, we reviewed research studies which have explored public health monitoring systems worldwide. It is clear from the review that governments worldwide have been giving priority to their public health monitoring systems. They differ on the basis of the level of organization, structures, hierarchies etc., but countries across the world are actively involved in gathering data for purposes of public health.

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