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PUBLIC HEALTH DECISION SUPPORT SYSTEMS FOR ENHANCING DISEASE SURVEILLANCE AND OUTBREAK RESPONSE

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Abstract

Public health emergencies like infectious disease outbreaks, stampedes, and injuries are possible during large gatherings. People with non-communicable disorders are also at higher risk. India hosts large celebrations of numerous festivals. There isn't much operational study on syndromic surveillance during these kinds of occurrences, though. In this regard, we recorded the application of syndromic surveillance using IT tools during a few South Indian public meetings. Public health surveillance is the continuous, systematic process of collecting, analysing, and interpreting data and disseminating the resulting information in a timely fashion to those who need it to take action to prevent and control disease and injury. Public health surveillance is essential for health, finance, and donor ministries to understand the health and behaviour of the populations they serve. Surveillance has utility in gauging intervention needs and gauging effects, as it offers insight into population trends. By offering timely, pertinent information, surveillance can empower decision-makers to lead and manage better.

Keywords: Public health, syndromic surveillance, community, decision makers.

1. INTRODUCTION

The concentration of people at one place for a specified purpose over a predetermined amount of time is known as a mass gathering, and it can put a burden on the nation's or community's planning and reaction capabilities. It is a significant public health issue because of the large number of individuals in one place for a brief period of time. Mass gatherings are thought to have a higher rate of illness and injury than a community of same size would naturally experience [1]. Furthermore, many illnesses or injuries during large gatherings are significantly influenced by environmental factors. Therefore, there is a chance that public health problems including infectious disease epidemics, stampedes, and injuries will occur during events with large crowds [12]. Non-communicable disease patients are more likely to have a worsening of their pre-existing ailments or have trouble getting to medical services in an emergency [2].

There is available evidence in favour of incorporating information technology (IT) tools to make public health surveillance systems more effective [10]. There is a huge potential in using mobile phone and m-health technologies for gathering, collating, analysing, and sharing data. This can allow health systems to recognize public health emergencies in advance, make quick decisions, and enhance strategies to counter these occurrences [18]. A prime example is the use of digital technology in covering the Hajj pilgrimage in Saudi Arabia, where it improved reporting, detection, and allocation of resources, finally enabling rapid decision-making to prevent outbreaks [9].

We worked along with the Tamil Nadu State Directorate of Public Health and Preventive Medicine (DPH&PM), which is in charge of putting public health protocols into place for these kinds of events [16]. In order to document the efficacy of using IT tools for syndromic surveillance, we built and executed IT tools and applications during specific mass gatherings. Here, we outline the factors, design challenges, procedures, and results from this experience [4].

2. REVIEW OF LITERATURE

Implementing surveillance systems in practice is challenging due to their public-benefit qualities, which include benefits that are difficult to measure [10]. However, in the industrialized world, laboratory monitoring systems to identify certain disease-causing organisms have been evaluated economically by weighing the costs and advantages of doing so now and in the future [5].

The prime research question to surveillance is which effective methods would be employed for developing and having a competent, motivated workforce responsible for surveillance and response in low-income countries [15]. Another central problem is the establishing and maintaining well-rounded surveillance systems that cater to all the diseases, specifically those morbidity systems for the chronic diseases [11]. Thankfully, current surveillance systems can be assessed by applying standardized procedures, which will determine the requirements of surveillance (Romaguera, German, and Klaucke 2000).

The IDSR concept, which offers an effective method for gathering and analysing data, has been adopted by developing nations. Unfortunately, most poor nations lack adequate surveillance systems for non-infectious diseases; instead, surveillance data may be obtained from already-existing data systems (such as vital records, records of auto accidents, or insurance claims data). In other situations, even these data sources are scarce, hence techniques like frequent surveys and verbal autopsies may be used instead (White and McDonnell 2000) [13].

Risk factor surveillance is another difficulty, and Behavioural Risk Factor Surveillance Systems (BRFSSs) need to be verified and used more widely in low-income nations. In addition, surveillance of injury, environmental risks (e.g., high-risk intersections), and chemical or biological agent exposures are major public health issues that have much more work needed to be done, with limited successful implementation models available throughout the world, in both the developed and developing world (Thacker et al., 1996) [17].

To address the lack of data on cancer patient follow-up, which made it challenging to assess the quality of care, the Indian Council of Medical Research established a network of cancer registries in 1981 [12]. The network offers information on cancer incidence and trends in eight Indian states, allowing for studies on histologic features of prognosis and correlation studies, including the investigation of possible associations between vasectomy and prostate cancer. Another prominent example includes China's universal use of folic acid that resulted in dramatic birth defect reduction (Kelly et al., 1996; Wald, 2004).

The significance of obesity as a public health problem in the US has been established in large part thanks to surveillance data. Each state's health department has been able to record its obesity pandemic because to data from CDC's BRFSS (Sturm 2003).

There are certain restrictions on the current investigation. They simply gathered basic information and syndromic data from the patients. did not get the medical camp's drug specifics. As a result, information on prescribed medications, including antibiotics, was not documented. Given that this surveillance system generated important information, we didn't gather any more information [6].

Objectives

The purpose of this review was to determine which public health digital surveillance systems were used to prevent and control infectious illnesses at MG events, as well as to examine the data supporting their efficacy in doing so.

3. METHOD

For syndromic monitoring at certain religious mass meetings, we worked with health systems. Through stakeholder discussions, we finalized the definitions of priority syndromes and their surveillance. We taught volunteers and medical professionals in the gathering and compilation of surveillance data using open-source software. We created, analyzed, and disseminated daily reports in near real time to health authorities so they could take appropriate action.

1. Indicator:

Quantifiable indicators, like the percentage of high school students who smoke every day, the percentage of children in a district who are fully immunized, and the number of new cases of diarrhea, allow decision-makers to monitor the course, results, and effects of an intervention on a population, promoting data-driven decision-making.

2. Active surveillance:

Active surveillance entails the use of staff to constantly contact healthcare professionals or the general population to obtain data on health matters. It is the most timely and accurate method of obtaining data, but at the same time, it is the most expensive.

3. Passive surveillance:

Passive surveillance is the gathering of reports from clinics, hospitals, public health units, and other institutions and submitting them to a health jurisdiction. It offers important information in monitoring community health and is cost-effective for coverage over large territories. Its performance depends on the voluntary reporting by different institutions and, therefore, poses difficulties in the quality and timeliness of the data [7].

4. Routine health information system:

Passive Surveillance System: A system in which hospitals, clinics, and public health personnel report disease and program information on a regular basis, creating a steady stream of data on the occurrence of disease and health trends.

5. Health information and management system:

A system that uses routine reports on the administrative, financial, and procedural facets of running clinical and public health systems to gather useful information for surveillance is known as a passive surveillance system.

6. Categorical surveillance:

Disease-specific surveillance systems target a single or a set of diseases or behaviours of concern to an intervention program, and may either be active or passive. These systems are beneficial for program managers but become useless at the district or local level since the staff has to fill out several forms for the same patient, resulting in duplication of effort. At higher levels, it can be difficult to reconcile results from several systems to produce national estimates, and dedicating limited skilled surveillance staff to a single program can leave other programs short-staffed.

7. Integrated surveillance:

Integrated surveillance systems integrate active and passive methods, using one infrastructure (e.g., health facility-based systems) to collect data on several diseases or behaviours of interest to different intervention programs. This is possible with shared resources and efficiency. Program managers for individual diseases can be assessed on the basis of the integrated system's performance and should be engaged in its development. But some program managers might prefer having independent, disease-specific systems for gathering more elaborate data and providing control over the quality of the data, resulting in inefficiency and duplication.

8. Syndromic surveillance:

Syndromic surveillance is an active or passive method that employs case definitions based on clinical characteristics alone, without laboratory or clinical diagnosis. It is a method of monitoring symptoms or syndromes, for example, diarrhea or rash diseases, instead of diseases like cholera or measles. Syndromic surveillance is usually the first form of surveillance to be used in developing nations because it is inexpensive and can be quickly implemented. Yet, cases from this system will usually need to be followed up at higher levels because they are not specific enough since one syndrome can include various diseases with different severities. Moreover, a rise in one disease might cover up for an outbreak of another.

Syndromic surveillance, under bioterrorism, entails the real-time surveillance of chosen syndromes that may signify exposure to probable bioterrorism agents. This method also monitors other applicable indicators, like unusual spikes in over-the-counter drug sales and emergency room visits, to determine possible bioterrorism attacks.

4. ECONOMICS OF PUBLIC HEALTH SURVEILLANCE SYSTEMS

According to Zacher (1999), public health surveillance is a worldwide public good, especially when it comes to the elimination of illnesses like poliomyelitis. The cost of maintaining methods to locate the final few instances rises as eradication efforts reduce the number of cases. Hard-pressed poor nations sometimes bear the brunt of these systems' expenditures. This element calls into question equity and fairness. For instance, poliomyelitis no longer poses a serious threat to national populations as it becomes less common, but other illnesses like malaria and diarrhea usually account for a large portion of morbidity and death. In these nations, it would appear most equitable and effective for the international community to fund eradication efforts, freeing up national systems to focus on the illnesses that most commonly impact their citizens. The negative consequences of internationally required eradication surveillance systems can be lessened or even reversed by leveraging the eradication program's infrastructure to gather surveillance data for diseases that are significant to local governments. [8]. An analogous argument may be made for influenza early warning systems in nations that collect data for vaccine development that will assist other populations but not their own. Equity requires that these mechanisms be financed by the nations that gain from them.

Table No 4.15 Descriptive statistics

	Mean	Std. Deviation	Communality
What are the key components and functionalities of a public health decision support system (DSS) for enhancing disease surveillance and outbreak response?	4.53	0.682	0.659
How can data analytics and machine learning be integrated into public health DSS to improve disease surveillance and outbreak detection?	4.06	1.119	0.684
What are the benefits and challenges of implementing a public health DSS for disease surveillance and outbreak response in resource-constrained settings?	4.26	1.000	0.643
How can public health DSS be designed to facilitate collaboration and information-sharing among stakeholders, including healthcare providers, public health officials, and community leaders?	4.19	0.979	0.711
What are the ethical considerations and potential biases associated with the use of public health DSS, and how can these be addressed?	3.94	1.131	0.547
Can public health DSS be effective in predicting and preventing disease outbreaks, and what are the key factors influencing their effectiveness?	4.03	1.013	0.718
What is the impact of public health DSS on health outcomes, healthcare utilization, and cost-effectiveness, and what are the key factors influencing these outcomes?	3.99	1.096	0.750
How can public health DSS be integrated with existing health information systems and surveillance networks to enhance disease surveillance and outbreak response?	4.09	1.064	0.672
Can public health DSS be used to enhance community engagement and participation in disease surveillance and outbreak response?	3.89	1.069	0.620
What are the benefits and challenges of using cloud-based computing and storage solutions for public health DSS?	3.93	1.142	0.586
How can public health DSS be designed to facilitate real-time data sharing and collaboration among stakeholders?	4.15	1.149	0.574

Can public health DSS be used to predict and prevent antimicrobial resistance and other emerging health threats?	3.94	1.031	0.619
What are the ethical implications of using geospatial data and mapping technologies in public health DSS for disease surveillance and outbreak response?	3.85	1.250	0.614
How can public health DSS be integrated with social media and other digital platforms to enhance disease surveillance and outbreak response?	4.51	0.809	0.697
Can public health DSS be used to identify and mitigate health disparities and inequities in disease surveillance and outbreak response?	4.16	0.898	0.765
What are the challenges and opportunities of using artificial intelligence (AI) in public health DSS for disease surveillance and outbreak response?	4.03	0.969	0.527
How can public health DSS be designed to accommodate diverse data sources, formats, and standards?	4.09	0.992	0.717
What are the key performance indicators (KPIs) for evaluating the effectiveness of public health DSS in disease surveillance and outbreak response?	4.09	1.006	0.590
How can public health DSS be integrated with electronic health records (EHRs) and other health information systems?	3.83	1.114	0.552
What are the key factors influencing the adoption and implementation of public health DSS in resource-constrained settings?	3.96	1.055	0.600
Can public health DSS be used to identify and mitigate the impact of climate change on human health?	3.81	1.108	0.730
How can public health DSS be designed to accommodate diverse user needs and requirements?	3.83	1.197	0.534
What are the benefits and challenges of using mobile health (mHealth) technologies in public health DSS for disease surveillance and outbreak response?	4.19	0.932	0.783
Can public health DSS be used to enhance laboratory surveillance and diagnostic capacity for infectious diseases?	4.05	0.900	0.735
How can public health DSS be integrated with existing global health security initiatives and frameworks?	3.83	0.999	0.735
What are the key challenges and opportunities of using public health DSS in low- and middle-income countries?	3.89	1.106	0.581
Can public health DSS be used to predict and prevent non-communicable diseases (NCDs) and other chronic health conditions?	3.81	1.101	0.643
How can public health DSS be designed to facilitate continuous quality improvement and evaluation in disease surveillance and outbreak response?	3.87	1.082	0.539

Future of Surveillance

In order to hold account for local health status and to facilitate timely outbreak warnings, international donors/organizations, ministries of finance, and public health agencies need to transform surveillance. It entails a transition from conventional, time-consuming, and backward-looking data collection procedures to a dynamic, real-time strategy based on innovative technologies and techniques.

Table No 4.16 KMO and Bartlett Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.679
Bartlett's Test of Sphericity	Approx. Chi-Square	1056.005
	df	378
	Sig.	0.000

Two determinants will influence the future of surveillance: reaching agreement on core surveillance data and mobilizing investment by countries, funding partners, and multilateral institutions in surveillance infrastructure and data-informed decision-making. This vision is based on an integrated, rational surveillance systems approach, in which surveillance objectives are matched with the best available data sources and modalities, based on each country's specific setting and international data needs.

5. CONCLUSION

For ministries of health, finance, and donors to manage public health activities and distribute funds effectively and economically, public health monitoring is a crucial instrument. For public health surveillance to be effective, it needs to be viewed as a scientific endeavor that uses exacting techniques to address important issues in this field of public health. The fundamental issues are comparable even though the monitoring requirements in the industrialized and developing worlds seem to be different. The recent avian influenza and SARS outbreaks emphasize the necessity of bringing together global networks, and studying how these issues are dealt with is imperative. Meeting the international requirements of public health surveillance requires the coordination of practitioners, researchers, nations, and global organizations. Successful and effective disease surveillance is imperative for timely and effective communicable disease control, and hence there is a necessity for an integrated and solid global surveillance system. The efficacy of conventional surveillance systems is frequently restricted by the characteristics of newly developing infectious illnesses. Digital surveillance could speed up reactions to new diseases and increase the sensitivity and timeliness of health event detectors. Therefore, there is still a chance that infectious infections could spread during MG events.

The efficiency of digital surveillance systems in the prevention and control of infectious diseases in Mass Gathering (MG) events is not evident, owing to a lack of evaluation studies. In addition, the lack of standardized guidelines on how to assess digital surveillance systems in MG events presents a methodological problem that prevents a holistic assessment of the effectiveness of the systems. Therefore, more research is required to determine how well public health digital monitoring systems work to prevent and manage infectious diseases.

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