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Presenting The "Hesn" System As A Model For The Role Of Technology In Epidemiological Surveillance In Public Health

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ABSTRACT

Introduction: *Information and communication technologies (ICT) has the capacity to significantly enhance the efficiency and precision of crucial public health activities such as prediction, monitoring, identification of outbreaks, and response. This statement holds particularly true for recent advancements in digital technology. When assessing the pros and cons of utilizing digital technologies for public health tasks, it is crucial to consider the range and types of available digital technology, as well as contextual information about diseases and the regions in which they are employed.*

Aim of work: *To present the "HESN" system as a model for the role of technology in epidemiological surveillance in public health*

Methods: *Using the following search keywords, we performed a thorough search of the electronic literature in the MEDLINE database: HESN, System, Model, Role, Technology, Epidemiological, Surveillance, Public, Health. To find relevant literature, the search was limited to articles from 2016 to 2021. We looked through scholarly articles related to my topic by doing a search on Google Scholar. Certain inclusion criteria influenced the articles that were chosen.*

Results: *The study's analysis included papers that were published between 2015 and 2021. The research was divided up into several parts, each having a header for the discussion portion.*

Conclusion: *The use of digital technology in healthcare services in Saudi Arabia has facilitated communication between the general population and healthcare experts. The Saudi Arabian Ministry of Health has initiated a social media campaign[1] to endorse the Epidemiological Surveillance Program (HESN), a system that assists in averting disease outbreaks and enhancing public health results. The program oversees contagious diseases and outbreaks via the internet, establishes uniform health protocols, and minimizes inconsistencies in monitoring. HESN comprises modules such as Communicable Diseases and Epidemics Surveillance, Epidemic Outbreaks, Immunizations and Vaccinations, Material Inventory, Business Administration and Organizations, and Public Health Reporting HESN has been*

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found to facilitate the communication between healthcare experts in different institutions, in addition, it eased the reporting of contagious diseases to the relevant authorities.

Keywords: *HESN, System, Model, Role, Technology, Epidemiological, Surveillance, Public, Health.*

INTRODUCTION

Infectious illness outbreaks are characterized by their unpredictability and their potential to cause significant and enduring harm to both society and individual health (Schoch-Spana et al., 2017). For instance, the Ebola epidemic in West Africa during 2014-15 had negative effects on both the well-being of the people and the healthcare systems. The latter was due to variables including the deaths of healthcare workers and the diversion of limited resources from regular health services (Elston et al., 2017) The emergence of COVID-19, caused by SARS-CoV-2, in December 2019, has resulted in significant loss of life and worldwide economic consequences. The whole impact of this epidemic is not yet fully comprehended. COVID-19 has significant societal consequences for people and society because to the substantial strain it places on healthcare and social services, as well as the implementation of isolation and lockdown measures to reduce its transmission (Barua, 2020).

Predicting the time and features of future infectious disease epidemics, such as their route of transmission, incubation period, and case fatality rate, is challenging. Nevertheless, experts acknowledge that, despite these uncertainties, it is very likely that there will be future regional and global outbreaks of infectious illness that might have comparable and enduring consequences (Takes, 2020). The aforementioned instances emphasize the multitude of hazards and difficulties that infectious diseases still present at the regional, national, and global levels, underscoring the need for essential public health activities such as surveillance, monitoring, outbreak identification, response, and coordination. Furthermore, the many elements that impact the likelihood of infectious disease outbreaks, such as agriculture and land use, urbanization, commerce, travel, animal health, and population expansion, are continuously shifting and developing (Christaki, 2015).

Advancements in information and communication technologies (ICT), specifically in digital technologies, have the capacity to greatly enhance important aspects of public health, such as the speed, dependability, and scope of infectious disease monitoring, prevention, and control. Utilizing digital technology may enhance the capacity to identify and address emerging infectious illnesses via the implementation of automated and real-time mapping, generating novel data sources, and enabling the identification of pathogens. Additionally, this approach can lead to cost reduction (Hamilton and Hopkins, 2019). Digital technology may be used to mitigate the dangers associated with infectious disease prevention and control, such as the quick spread of false information on social media.

Nevertheless, there are still obstacles related to comprehending the potential use, advantages, and constraints of digital technology in the prevention, monitoring, and management of infectious illnesses. Novel technologies used during health crises are often not standardized within public health operations and are typically employed in an improvised manner. The possibilities of technology deployment vary in various geographical areas due to elements such as infrastructure, equipment, and qualified staff (Diallo et al., 2019). When evaluating the advantages and disadvantages of adopting digital technologies for public health purposes, it is important to take into account factors such as the variety and categories of digital technology,

as well as contextual factors like the specific illness and geographical location of implementation.

Aim of work:

To present the "HESN" system as a model for the role of technology in epidemiological surveillance in public health

METHODS

We performed a thorough search using particular keywords like HESN, System, Model, Role, Technology, Epidemiological, Surveillance, Public, Health on reputable scientific platforms like Pubmed and Google Scholar.

The goal was to include every relevant study articles. A set of criteria was used to choose the articles. After a thorough examination of the noteworthy titles and abstracts of every publication, we excluded case studies, duplicate papers, and publications without complete information. The research's reviews were published between 2015 and 2021.

RESULTS

The current investigation concentrated on the role of technology in epidemiological surveillance in public health between 2015 and 2021. As a result, the review was published under many headlines in the discussion area, including: Internet-based surveillance, Infectious diseases modeling, Electronic Health Surveillance in KSA and HESN as a model for technology in epidemiological surveillance.

DISCUSSION

1. Internet-based surveillance

1.1Event-based surveillance

Conventional passive monitoring depends on regular reporting of organized data about occurrences and illnesses, which is costly and delayed. Event-based surveillance has become a supplementary strategy due to improvements in computational science. These systems gather and evaluate unorganized data from several sources, including news stories, social media, and internet searches. The Global Public Health Intelligence Network (GPHIN) is a crucial event-based monitoring system that methodically monitors informal sources for atypical illness occurrences and outbreaks. The importance of GPHIN was emphasized during the SARS epidemic (McNabb et al., 2017).

Event-based approaches and syndromic surveillance are used to provide immediate and up-to-date data on local illness prevalence in nations without robust or non-existent national public health surveillance systems. Syndromic surveillance entails collecting and statistically examining pre-diagnostic data, such as major complaints and symptoms. This approach is particularly valuable in areas with low resources, when laboratory confirmation may be unavailable. Additional techniques of sentinel surveillance include tracking drug consumption and supply demand, which may provide early indications of possible epidemics (Kuehne et al., 2019).

The primary objective of public health monitoring systems is to promptly detect and alert authorities about developing health risks. The Global Outbreak Alert and Response Network (GOARN), which was created by the World Health Organization (WHO), utilizes data from the Global Public Health Intelligence Network (GPHIN) and pre-existing networks to identify

and address outbreaks. GOARN was established during the H1N1 pandemic to monitor disease activity, provide technical advise, and implement containment measures (Kundu et al., 2018).

1.2 Web-based tools for real-time surveillance

Public health surveillance systems aim to provide early warnings about emerging health threats. The Global Outbreak Alert and Response Network (GOARN), established in 2000 by WHO, uses data from GPHIN and existing networks to detect and verify outbreaks, issue real-time alerts, and respond quickly to global or national public health threats. During the H1N1 influenza pandemic, GOARN was activated to monitor disease activity, offer technical guidance, and implement screening strategies and containment measures (Choi et al., 2016).

2. Infectious diseases modeling

The field of computational science has facilitated the creation of techniques for simulating epidemics, which may be categorized into two main approaches: agent-based modeling and spatially organized metapopulation models. Agent-based models need meticulous data input for every person within the target population, while structural metapopulation models incorporate census data of geographic areas and patterns of inter-population movement to investigate disease dynamics and forecast the spread of epidemics (Citron et al., 2021).

The Global Epidemic and Mobility (GLEaM) model is a widely used metapopulation model that combines global demographic data, air travel, and short-range mobility data to simulate the global transmission of influenza-like infections. The GLEaM model partitions the globe into over 3300 subpopulations, creating a network with more than 16,800 mobility fluxes that depict the daily movement patterns between these subpopulations. The subpopulation and mobility network include disease dynamics, creating a framework that may simulate several epidemic scenarios in a computer model. This framework takes into consideration epidemic factors that may be originally unknown and allows for the simulation of the potential spread of a new infectious agent (Li et al., 2018).

Computational modeling is a valuable tool for studying how mobility patterns contribute to the spread of epidemics. It is used to analyze both historical and current epidemics, as well as to develop strategies for preventing future outbreaks. Long-distance air travel plays a crucial role in the transmission of epidemics worldwide, whereas short-distance commuting leads to the synchronization of adjoining subpopulations and the spreading of epidemics from regions with airports to nearby locations (Aguiar et al., 2021).

Proxy data has been used to define mobility networks, however the accuracy of predicting the time and pattern of epidemic invasion varies depending on the source of human mobility data. Understanding the precise mobility patterns in resource-poor contexts is essential for developing effective disease management efforts. These patterns may vary from those found in resource-rich nations, highlighting the need of identifying the unique mobility factors that drive disease transmission within a population (Changruenngam et al., 2020).

Restricting or regulating human movement is one of the first strategies used by national and international public health organizations to mitigate the transmission of contagious illnesses, particularly during pandemics or outbreaks caused by newly identified pathogens. Models have been used to examine the role and efficacy of travel limits in postponing or stopping a pandemic. These models have shown that international travel limitations may not be as successful as previously believed in preventing a pandemic (Kraemer et al., 2019).

Computational methods are essential for ensuring the dependability and precision of simulating infectious illnesses on a broad scale. FRED, an open-source program for epidemic modeling, is a versatile platform that utilizes synthetic populations based on census data to assess the effectiveness of intervention strategies in particular population groups during epidemic scenarios. The user can utilize and adapt parameters such as transmission characteristics, disease natural history, vaccine and treatment accessibility, immunological profile of the population, health-related behaviors, and responses to evaluate the efficacy of various control measures (Charu et al., 2017).

Epidemic modeling has been used to study diseases other than influenza-like illnesses, such as cholera or diseases transmitted by vectors. Gravity models were developed during the cholera outbreak in Haiti to replicate the spread of the illness and evaluate the possible impacts of control measures such as vaccine distribution and provision of clean drinking water. The One Health Initiative was initiated in 2009 with the aim of promoting collaborative educational and scientific endeavors focused on the creation of comprehensive surveillance systems, diagnostic tools, and preventative treatments (Cai et al., 2019).

Modeling techniques play a crucial role in pinpointing the specific regions where there is a higher probability of an emergent virus occurring at the interface between humans and animals. The PREDICT program, a component of the Emerging Pandemic Threats Program established by the US Agency for International Development, utilizes online monitoring and active collection of samples from wildlife hosts, along with predictive modeling, to detect pathogens that have the potential to spread between different species before they spread to humans (Kelly et al., 2016).

The predictive value of large-scale infectious diseases modeling is limited due to several factors. These include our incomplete understanding of human mobility patterns and their interactions at different scales, the delay in understanding the virulence and epidemic parameters of a new pathogen at the start of an outbreak, the failure to account for population and contact heterogeneities that can significantly impact disease transmission dynamics, and the decrease in accuracy when dealing with small populations (García-Carrasco et al., 2021).

Models must include the possibility that disease dynamics might vary as the epidemic spreads. Levy et al. conducted a study that examined how the variability of transmission networks and epidemic spread are connected. They used a versatile mathematical framework and found that primary infections are the main drivers of an epidemic when there is an increase in risky behavior. However, during the saturation phase of an epidemic, individuals who are infected but not yet showing symptoms play a larger role in spreading the disease (Levy et al., 2016).

3. Electronic Health Surveillance in KSA

The need for digital transformation in the healthcare sector has been apparent. The COVID-19 epidemic further emphasized the need for digitization. Amidst the epidemic, digitization facilitated several aspects like digital screening, contact tracing, dissemination of information, online appointment scheduling, remote medical consultations and follow-ups, surveillance, data gathering, scientific study, vaccine, and psychological assistance. Saudi Arabia has quickly implemented digital public health services to combat the spread of the COVID-19 epidemic during the pandemic. Three smartphone apps, including Tetamman, Tawakkalna, and Tabaud, were launched within the COVID-19 epidemic. Tetamman, released in March 2020 by the Ministry of Health (MOH), is an application that allows users to access their COVID-19 test results, learn about typical signs and symptoms of the virus, and get information on precautionary measures to be taken during the pandemic (Khan et al., 2021).

In May 2020, the Saudi Data and Artificial Intelligence Authority (SDAIA) released the Tawakkalna application, which offers a range of electronic health services. These services encompass various areas such as booking COVID-19 tests and vaccines, obtaining gathering permits during lockdowns, facilitating requests for Umrah and Hajj pilgrimages, providing updates on health condition and infection status (including unidentified, infected, exposed, institutional quarantine, home quarantine, non-immune, incomplete vaccination, no record of infection, exempted, and immune), assisting with ambulance requests, and generating electronic health passports. Furthermore, Tawakkalna offers other civil services, including the provision of digital government papers such as national driver's licenses and car registrations, as well as personal information such as name, age, blood type, and national address (Kahn et al., 2021).

4. HESN as a model for technology in epidemiological surveillance

Recently, nations across have begun acknowledging the crucial significance of efficient electronic health monitoring and reporting systems in the context of public health. Consequently, professionals, government officials, and other pertinent parties are increasingly recognizing the pressing need for the use of these systems (Mendu et al., 2019).

In the last twenty years, this global issue has mostly emerged due to the growing occurrence of newly appearing and recurring illnesses. Several of these diseases have the capacity to spread quickly across national boundaries, with notable instances being severe acute respiratory syndrome (SARS), Ebola virus disease (EVD), Middle East respiratory syndrome (MERS), Cholera, and Zika virus disease (El Bushra et al., 2019).

Furthermore, the traditional surveillance systems suffer from being outdated, fragmented, lacking standardization, and poorly integrated into epidemiologic functions. The limited resources and infrastructures in many countries have resulted in slow progress in enhancing novel electronic health surveillance systems, and the available literature remains inadequate. Nevertheless, these systems are expected to emerge as crucial and indispensable elements of public health in the foreseeable future (Al Mayahi et al., 2020).

The Health Electronic Surveillance Network (HESN) was implemented in the Kingdom of Saudi Arabia (KSA) to enhance its capacity to address current global health issues and to bolster national health security. It has accomplished this by assisting in the surveillance of illness patterns over prolonged durations, formulating theories, and promptly identifying clusters and outbreaks. Furthermore, HESN is anticipated to support the nation's public health services in countering biological terrorism, addressing health risks, and supporting other health initiatives such as vaccination and general health research (Humayun et al., 2021).

HESN depends on robust and prompt communication between frontline users at designated health institutions, specialized personnel at headquarters, health officials, and the central leadership at the Ministry of Health (MOH) in Riyadh, specifically under the Deputy Ministry for Public Health. HESN has been introduced in the KSA to oversee individual cases, outbreaks, vaccinations, and vaccine inventories as a preliminary measure. HESN incorporates a variety of valuable tools to aid health professionals in the surveillance, control, and documentation of public health concerns (Khan et al., 2021).

On a worldwide scale, HESN is always developing and staying inventive. Remarkably, only a small number of nations have not yet taken this important and beneficial action. Implementing a robust and prosperous electronic health system entails more than just including or enhancing a new technological feature. Instead, it requires going through a lengthy sequence of

preparation phases (Rattanaumpawan et al., 2018). This requires the presence of adequate and state-of-the-art infrastructure, a skilled workforce in the public health sector, the capacity to develop precise and targeted algorithms, and the ability to get and maintain sustainable resources and funding (Abat et al., 2016).

CONCLUSION

The use of digital technology in healthcare services in Saudi Arabia has facilitated communication between the general population and healthcare experts. Moreover, electronic health services functioned as a potent weapon in combating the transmission of the pandemic and contributed to the mitigation of COVID-19 cases and fatalities by facilitating and simplifying vaccination and testing procedures. The enhanced use and availability of these instruments have increased their versatility among the general population. Given the increasing importance of these tools in healthcare, it is necessary to do more assessment of their public acceptability and identify areas for development for each instrument.

The Ministry of Health (MOH) has initiated a promotional campaign on the Epidemiological Surveillance Program "HESN" using social media platforms. The initiative serves as a dependable repository of public health data in the Kingdom of Saudi Arabia, aiding decision-makers and public health practitioners in the prevention of disease outbreaks and epidemics, as well as enhancing public health outcomes.

The Ministry of Health (MOH) has emphasized that the significance of the Health Emergency Surveillance Network (HESN) rests in its ability to monitor and track infectious illnesses and epidemics online, in order to create efficient methods of control. Additionally, it aids in the monitoring of fundamental vaccines, standardizes health procedures, forms, and reports throughout the whole Kingdom, and reduces discrepancies in surveillance among various health departments and institutions. This will, therefore, provide health professionals and decision-makers with up-to-the-minute accurate information to deliver high-caliber health services.

Currently, HESN consists of many modules, such as Communicable Diseases and Epidemics Surveillance, Epidemics Outbreaks, Immunizations and Vaccinations, Material Inventory, Business Administration and Organizations, and Public Health Reporting.

It is worth mentioning that Saudi Arabia is the second country in the world to adopt such an advanced system. The electronic platform serves as a tool for public health programs and health sectors to enhance access to preventive information. It achieves this by improving the quality of surveillance programs and facilitating rapid intervention against communicable diseases and epidemics. Additionally, it promotes information integration among health sectors and establishes a unified network for collecting and archiving public health data.

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