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Literature Review

Surveillance of Communicable Diseases in Era of Emerging Viral Zoonotic Infections: lessons from H1N1 and MERS-CoV

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The threat of communicable diseases is re-emerging both in developed and developing countries [1-3]. In the era of globalization the world around us is becoming progressively interconnected, complex and human health is increasingly perceived as the integrated outcome of its diverse determinants [4]. Changes in commercial and social practices, the environment, and travel will continually provide new opportunities for new viral pathogens to infect humans. Importantly, many of these viruses, including influenza, Hendra, Nipah and corona are of zoonotic importance [5].

Emerging zoonotic viral diseases outbreaks are increasing in number with at least 65% of recent major disease epidemics have zoonotic origins. The pandemic of Severe Acute Respiratory Syndrome (SARS) in 2003, the highly pathogenic avian influenza (HPAI) H5N1 in 2003 also [6], a novel 2009 influenza A/H1N1 pandemic and 2013 infections with influenza A (H7N9) with serious illness in China [7], and many other viruses are examples of such emerging viral zoonotic infectious diseases [8].

In 2012, a novel human Middle East Respiratory Syndrome - Corona Virus (MERS-CoV) has emerged in to cause fatal human infections. The virus has a zoonotic origin and recent studies confirmed that MERS-CoV infects dromedary camels and that this virus is genetically very similar to a MERS-CoV that is infecting humans [9,10]. Furthermore, there are five corona viruses that can infect people are: alpha corona viruses 229E and NL63 and beta corona viruses OC43, HKU1, and SARS-CoV [11]. The earliest known human infections with MERS-CoV occurred in Jordan in March, 2012 [12], after that Professor Ali Zaki conducted laboratory isolation and identification of the virus from a patient in Saudi Arabia some months later [12,13]. Globally, at 1st July 2014, 827 laboratory-confirmed cases of infection with MERS-CoV, including at least 287 related deaths have officially been reported to WHO [14]. MERS-CoV infections present with high case-fatality ratio (≈40%), multiple transmission routes are suspected, more among healthcare workers, with multiple disease foci are affecting Gulf Region, and cases have been exported to several other countries [12]. However, we still remain with many unanswered questions about the virus with lack serological studies, sequences from human cases, treatment or vaccines [12,15].

This escalating emerging disease problem illustrates the unpredictable nature of pathogens that require dynamic and evolving public health strategies for surveillance, disease management and mitigation [16]. This sharp rise of emerging diseases also tests our ability to respond appropriately [8]. Hence, the first step in controlling this growing emerging diseases problem is through prompt recognition and identification by effective and efficient surveillance system [1,17]. Reporting of communicable diseases allows public health officials to describe new diseases and the mode of transmission, so preventive measures can be developed and implemented [17]. Developing effective and efficient surveillance and response/control systems is important for national, the regional and global health security. Furthermore, functioning surveillance systems are necessary for the success of global health initiatives [1].

Public health surveillance is "the ongoing systematic collection, analysis, interpretation and dissemination of data regarding a health-related event" [1,18]. Data dissemination by public health surveillance systems can be used for immediate public health action, program planning and evaluation, and formulating research hypotheses. Successful communicable disease surveillance depends on effective bidirectional flow of information between the local level of health care and communicable disease control units at regional, national and global levels. The core activities of the surveillance system are detection, registration, confirmation, reporting and analysis and interpretation [19]. Surveillance systems attributes are evaluated on the basis of level of usefulness, sensitivity, data quality, positive predictive value, representativeness, simplicity, flexibility, acceptability and stability and timelines [1,17,20].

There are several types of surveillance, among them routine (passive) surveillance is there the regular reporting of disease by all institutions that see patients and are part of the reporting network [8,19,21]. Active surveillance, on the other hand, entails the active search by health authorities, for the occurrence of the disease or condition in a defined population. It involves visiting health facilities in outpatient clinics and hospital, talking to health-care providers and reviewing medical records and registers to identify suspected cases of disease under surveillance. Furthermore, sentinel reporting system is another type that used when we select reporting units, with a high probability of seeing cases of the disease in question, good laboratory facilities, having experienced well-qualified staff, for identifying and notifying of certain specific diseases or condition. In addition, syndromic (clinical) refers to the surveillance of health data about a clinical syndrome that has a significant impact on public health, and

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then used to drive decisions about health policy and health education [8,21,22]. Furthermore, syndromic surveillance can detect public health threats earlier than traditional types [8].

Laboratory surveillance is another type of surveillance that can be utilized where the starting point is the identification or isolation of a particular organism done in a laboratory (e.g. Corona [13] & Salmonellosis). Specimen collection, analysis and laboratory confirmation of the etiological cause of emerging zoonotic disease outbreaks are a vital part of any infectious disease surveillance system [8].

Furthermore, non-traditional methods of surveillance developed over the past 20 years. The 21st century has seen the rise of Internet-based participatory surveillance systems for infectious diseases. These systems capture voluntarily submitted symptom data from the general public and can aggregate and communicate that data in near real-time [23]. Electronic surveillance using web-based tools has proven to be of substantial value in reporting infectious disease outbreaks. Environmental surveillance can be done using the Geographic Information System "GIS" or location-based data [24]. GIS proves effectiveness in some diseases as Dengue fever in some countries of the world [25]. In addition, initiatives as "ProMED-mail, GPHIN, and Health Map, have demonstrated new ability and mechanisms for acquiring the surveillance data. Health Map , for example, is a new health surveillance system that scours web sources for real-time information on infectious disease outbreaks, was developed in an effort to address some of thorough [2,26]. A list of some electronic surveillance sites is presented in annex (I) [2]. In 2009 the U.S. Agency for International Development (USAID) began the Emerging Pandemic Threats (EPT) Program. It includes the PREDICT project to build global capacity for surveillance of novel infections that have pandemic potential (originating in wildlife and at the animal-human interface) and to develop a framework for risk assessment" [2,27].

Despite improvements in the past decade, public health surveillance capabilities remain limited and fragmented, with uneven global coverage. The failure of surveillance systems in developing countries is often due to limited available resources, lack of knowledgeable staff, disorganization, and poor infrastructure for finding and reporting cases [1,17]. So, there is an urgent need to address the deficiencies in resources, reporting and knowledge in order to correct them and improve the surveillance system. The development of continuing education, staff motivators and electronic database systems are among the strategies recommended in this regard [1]. All these facts are criteria for considering declaring a public health event of international concern and WHO international health regulations [10,28,29].

Recent initiatives provide hope of addressing the issue of emerging viral zoonotic diseases. New technological and conceptual advances could, for the first time, place capability for global surveillance within reach [27]. Such advances include the revised International Health Regulations (IHR 2005) and the use of new data sources and methods to improve global coverage, sensitivity and timeliness. These methods show promise for providing capabilities to extend and complement the existing infrastructure [30]. WHO is also working with affected countries and international partners to coordinate the global health response? This efforts include the provision of updated information on the situation, guidance to health authorities and technical health agencies, on interim surveillance recommendations, laboratory testing of cases, infection control and clinical management which is a regional collaboration aimed at facilitating implementation of the revised IHR and, more broadly, improving the detection and control of infectious disease outbreaks among neighboring countries in an area of continuous dispute [31].

Finally, trying to pinpoint a potential emerging outbreak and contain and control it before it spreads requires the constant surveillance of a continually growing number of disparate news sources and alert services [26]. All national disease surveillance systems need to comply with the requirements of the new IHR [20,26]. An effective global, integrated zoonotic disease surveillance and response system currently does not exist. National and international commitment to the purpose and goal of such a system are essential. As the system is built, continual assessment and evaluation of surveillance in human, animal, and linked surveillance systems will be needed regarding their comprehensiveness, quality, multi-sectoral collaborative aspects, and other aspects of the systems [8]. Improvements in Disease Surveillance and Response will result in better preparedness and more timely detection and response, which translated into reduced Case Fatality Rate (CFR). These gains can be achieved through a relatively high level of funding, technical support from CDC and WHO, and in service training in Integrated Disease Surveillance and Response (IDSR) core functions. Continued support is needed to maintain and expand the gains made through IDSR implementation [31].

Recommendations for improve surveillance of zoonotic viral emerging diseases [1,8,19,22,27,31,32]:

1. Training is a key component of building capacity for public health surveillance and response to emerging viral zoonotic diseases. Leaders require training for improving knowledge, skills, and experience to address the evolving nature of threats to public health. Enhancement of programs for training of trainers on epidemiological surveillance and preparedness for emerging diseases is urgently required.

2. Collaboration between leaders and health professionals in both public and private sectors across countries and regions of the world is required in all relevant sectors as health, agricultural, natural resource, education, and other sectors. Financial support and commitment will be critical to building an effective system that meets the purpose and goals of this system.

3. Developing evidence- based criteria to determine the magnitude and distribution of emerging zoonotic viral diseases.

4. Strengthening surveillance in human population who are at risk for zoonotic diseases is urgently required.

5. Developing and strengthening surveillance system in animal populations rather than waiting till discovered through outbreak.

6. Harmonizing and sharing surveillance information of both human populations and animal surveillance in an integrated system.

7. Improving surveillance, international collaboration, and data-sharing are crucial to refining our understanding of the transmission dynamics and epidemiology of this novel human virus and of the risk it poses.

8. Immediate notification of some specific diseases as MER-CoV, influenza virus subtypes and any event that is deemed to constitute a public health emergency should be an international concern.

9. Strengthening international surveillance system which should be able to address known and unknown diseases, including emerging zoonotic human diseases (as recommended by WHO).

10. Ensuring guidance for health care professionals regarding case definition, diagnosis and management for MERS-CoV infection, and establishing an active surveillance system for 'influenza-like' illnesses in hospitals are essential steps for surveillance.

11. Improving understanding of factors driving infectious disease emergence and new technological capabilities in modeling, diagnostics and pathogen identification, and communications, such as using the increasing global coverage of cell-phones for public health surveillance, can further enhance global surveillance.

12. Improving the ability of laboratory surveillance and enhancing molecular epidemiology.

13. Strengthening the electronic information stream for emergence of semi- and fully-automated surveillance systems for symptoms and for other indicators.

14. Pandemic preparedness and response measures are need to be established.

15. Engaging science-based Non-Governmental Organizations (NGOs) as important partners that provide wide geographic reach and field expertise needed. (Table 1)

Table 1: Sample Web-based data sources [2]

ProMED-mail, www.promedmail.org
Global Public Health Intelligence Network (GPHIN): www.phac-aspc.gc.ca/media/nr-rp/2004/2004_gphin-rmispbk-eng.php
HealthMap, www.healthmap.org
MediSys, http://medusa.jrc.it
EpiSPIDER, www.epispider.org
BioCaster, http://biocaster.nii.ac.jp
Wildlife Disease Information Node: http://wildlifedisease.nbii.gov
H5N1 Google Earth mashup: www.nature.com/avianflu/google-earth
Avian Influenza Daily Digest and blog, www.aidailydigest.blogspot.com
Google Flu Trends: www.google.org/flutrends

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