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Abstract

Accurate surveillance and timely control of the potential outbreak of infectious diseases is an integral component for organizing big sport events such as Olympics. It relates to the health and safety of all of the event participants, the stability of the society and the credibility of the event organizing committee and the country in which the event is held. The current advancement of information and communication technology (ICT) provides a great opportunity for fast aggregation of huge amount of relevant data, accurate analysis and assessment to identify potential epidemics, fast reporting, accurate control measures, timely identification and utilization of resources and supplies for infectious disease management. However, technology in itself is inadequate for achieving the above objectives. An evidence-based, emergency responsive management strategy, coordinated public health surveillance team from the local community, government and central government level that are able to mobilize the international resources in emergent situations are critical for the successful surveillance and control of any potential outbreak of infectious diseases. This paper will discuss the functions of the communicable disease surveillance and control network. The building blocks of the network and the strategies to facilitate its implementation are addressed.

Keywords

Recommended, Communicable, Disease, Surveillance, Control, Network, Secure, Healthy, Happy, Olympic, Game

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A Recommended Communicable Disease Surveillance and Control Network to Secure a Healthy and Happy Olympic Game

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Abstract

Accurate surveillance and timely control of the potential outbreak of infectious diseases is an integral component for organizing big sport events such as Olympics. It relates to the health and safety of all of the event participants, the stability of the society and the credibility of the event organizing committee and the country in which the event is hold. The current advancement of information and communication technology (ICT) provides a great opportunity for fast aggregation of huge amount of relevant data, accurate analysis and assessment to identify potential epidemics, fast reporting, accurate control measures, timely identification and utilization of resources and supplies for infectious disease management. However, technology in itself is inadequate for achieving the above objectives. An evidence-based, emergency responsive management strategy, coordinated public health surveillance team from the local community, government and central government level that are able to mobilize the international resources in emergent situations are critical for the successful surveillance and control of any potential outbreak of infectious diseases. This paper will discuss the functions of the communicable disease surveillance and control network. The building blocks of the network and the strategies to facilitate its implementation are addressed.

Index Terms—Communicable disease surveillance and control, information and communication technology, building blocks, strategies, resource utilization

1. Introduction

It is well recognized that an increase of the number of cases of a disease may result from a sudden increase of population density in a small region at a given time interval [1]. The wide spread of severe acute respiratory syndrome (SARS) epidemic throughout Asia and certain other regions of the world in 2003 warns us the severity of a potential danger of the outbreak of infectious diseases in big sport events such as Olympics when abnormally high population densities will suddenly emerge. How to prepare health services and disease control mechanisms to effectively respond to such human disaster is an integral component for the nation with the opportunity to organizing the most important sport event in the world - Olympics. "Health surveillance is the ongoing, systematic use of routinely collected health data to guide public health action in a timely fashion" [2]. The development of strategies, protocols and infrastructure for infectious disease surveillance and control for 2008 Beijing Olympic Game has to be strategically planned and implemented to ensure that effective surveillance and control mechanism will be in place when the event starts.

The manual, systematic surveillance system for infectious disease control has been well developed and implemented in each country to track and forecast the occurrence of health events. This is achieved through collecting and analyzing data, interpreting and organizing the information into a product that could be disseminated to those who need to know [2]. The history of outbreak of SARS epidemic in 2003 highlights the important enabling role information and communication technology (ICT) could play in communicable disease surveillance and control [3]. This paper will start with discussing the current practice for communicable disease surveillance and control. It then discusses what surveillance and control functions could be more effectively handled by a proposed communicable disease surveillance and control network and the building blocks for such network. Afterwards the strategies and protocols for securing the successful implementation of a coordinated surveillance action are proposed. Finally it

describes the importance of collaborating with international research and surveillance agencies such as capacity of a country to respond to potential public health emergencies in Olympics.

2. The Current Practice for Infectious Disease Surveillance and Control

World Health Organization (WHO) has developed a well-designed protocol for infectious disease surveillance and control, which has been widely adopted by countries across the world. The protocol includes the following five critical steps [1]:

- **Rapid assessment** to identify the main disease threats, including potential epidemic diseases, and define the health status of the population.
- **Prevention:** prevent communicable disease through maintaining a healthy physical environment (including essential clinical and laboratory services) and good general living conditions such as adequate water, food and sanitation facilities.
- **Surveillance:** establishing an early warning mechanism to ensure the early reporting of cases, continuous monitoring disease trends and prompt detection and response to outbreaks;
- **Outbreak control** to rapidly detect and control outbreaks through adequate preparedness (i.e. outbreak response team, standard treatment protocols and staff training) and rapid response (i.e. confirmation, investigation and implementation of control measures); and
- **Disease management** to diagnose and treat cases promptly with trained staff using effective treatment and standard protocols at all health facilities.

Lessons learned from SARS epidemic surveillance and control suggests that ICT can lead to improved performance on every step of infectious disease surveillance and control. We will elaborate on what surveillance and control actions can be bettered handled by information systems in the following section.

3. What are the Ideal Functionalities of the Communicable Disease Surveillance and Control Network

as World Health Organization, education and public health work force capacity building for strengthening

The role of information technology for improved infectious disease surveillance and control is realized through hardware and software that enables data entering into electronic databases, data aggregation and warehousing, statistical data analysis to detect trends, easy information retrieval and sharing across heterogeneous network and providing interactive, responsive reporting mechanism. To realize the above role, the following functions have to be developed:

- The establishment of an epidemiology database or data warehouse that gathers real-time data from various pathology labs, hospital admission records, particularly cases recorded in the emergency departments of hospitals in the event holding city.
- Information stored in the database includes baseline data about symptoms and causes of communicable diseases; the period of time between infection and the onset of infectiousness; the timeline for patients remain infectious; how many further infections will each patient produce; how many people will get infected during the epidemic; spatial and stochastic processes, seasonality and different modes of transmission; radio and microscopic images and genomic sequencing [3].
- A geographically integrated database of environment, mortality and morbidity, health services and infrastructure, food, nutritional status, settlements, water sources, transport routes, health data and resource needs as these data are essential for assisting accurate, rapid assessment of priority health interventions and high risk groups [1].
- Record and track locations and amount of essential treatment supplies such as vaccines, gloves, masks, thermometer units, aircraft quarantine kits and other supplies in various warehouses located in different locations. Information recorded includes items and quantities, suppliers available in the database and can be delivered within hours [1]. The above information is important for ensuring that adequate supply team can be mobilized in case of emergency outbreaks.
- Contact tracing: The identification of people potentially exposed to a case of communicable disease is essential for preventing spread of the disease. This requires focusing control efforts on people who are at high risk of communicable diseases, identifying people early in the course of

their illness and implementing control measures before they can spread the virus to others. RFID technology, GIS and GPS system play an important role in this context.

- Dynamic mathematical models that predict epidemics trends and facilitate rapid assessment of cases across historic data stored in the central database. This will facilitate rapid assessment to identify abnormal illness and death caused by both unknown and known pathogens that have the potential for large-scale epidemics, particularly infectious disease outbreak.
- Modules to cover the resources, skills and treatment protocols required to respond to the outbreak of each identified infectious disease in WHO database.
- A list of competent laboratories to contact for confirmation of cases.
- Establishment of laboratory networks to achieve effective laboratory based surveillance.
- Hospital surveillance systems with a combination of clinical and epidemiological features, specific guidelines, including database templates and other tools to provide clues for accurately diagnosing communicable diseases.
- Tools for detection and notification to facilitate a public health official in one area who is aware of local cases to rapidly share the information with other public health workers. This will allow the public health community to identify outbreaks or case clusters and respond timely.
- The establishment of an epidemiology network across the city where the event is held, if possible, across the province or even the whole country. The network should be linked to quarantine case report from the Custom. It should gather preliminary media reports of public health significance 24 hours a day, 7 days a week. Notifications about public health events that may have serious public health consequences should be immediately forwarded to users.
- Timely information on the number of new cases, the likely source of exposure for cases, the number of cases not previously identified as contacts and the number of contacts with high-risk exposures to known cases.
- Decision support functionality to facilitate the transfer of results of clinical studies into knowledge regarding what proportion of infections progress to patient disease. This includes
 - alert functions to remind clinicians of symptoms of communicable disease

- reports to the global network of over 100 laboratories and countries or national disease control centers.

- Control measures that consider spatial variation in transmission, with assistance of Geographic Information Systems and GPS location system to monitor spatial and stochastic processes.
- Linking hospitalization rate to the system for accurate knowledge of transmission progress and the proportion of cases occurring in quarantined contacts.

4. The Building Blocks for the Proposed Communicable Disease Surveillance and Control Network

To ensure the proposed network will deliver its promise of timely detection of infectious diseases from individual and population level, accurately prediction outbreak of and effectively support the control and management of epidemic emergencies in big sport event, a number of key “building blocks” have to be developed to underpin the system development. These include governance structure, standards, terminologies and data sets, health identifiers and privacy control for consumer health records, etc. The authors will elaborate on each of the issues below:

- Governance structure: clear identification of roles and responsibilities of various levels of healthcare organizations, public health agencies and government has to be conducted to ensure that public health surveillance and intervention will be carried out in a coordinated, systematic manner.
- Surveillance standards have to be established to ensure that a common terminology and approach is used by health care workers in different health care settings. The minimum data set should be established for various specific conditions. A nationally uniform case definition should be developed. Reference standard and guidelines should be established for confirmation of infection of various communicable diseases.
- Identification standards such as unique patient identifier and unique health service provider have to be developed to ensure that the infected patient will be accurately identified and traced. The history of patient encounter in different hospitals will be followed. This will also facilitate the accurate identification of outbreak area and severity level.
- Supply chain procurement standards to standardize the procurement process.

- Technical integration standards such as HL7 should be implemented to ensure that different healthcare information systems in different healthcare organizations can interoperate with each other to transfer data as required in a secure manner.
- Effective privacy control for personal health information to secure the effective protection of consumers' privacy and confidentiality and gain consumer's confidence with our network.

The above proposed communicable disease surveillance and control network is an effective mechanism for reducing the social and economic impact of any potential infectious disease outbreak in Olympics and maintaining reputation of the country. Although the cost for the establishment of such network is substantial, its successful implementation will significantly contribute to the improvement of healthcare IT infrastructure and capacity of the event holding city, even the country. It will also accelerate the adoption of healthcare IT in various health care settings. However, technology is only the enabler. It is people who make things happen. To move the agenda forward, the central and local government may consider implementing the following strategies:

5. The Strategies to Facilitate the Implementation of the Proposed Communicable Disease Surveillance and Control Network

The strategies to facilitate the development and implementation of the proposed network are as follows:

- The establishment of a national infrastructure for co-ordination of national communicable disease surveillance and the planning and prioritization for action.
- The establishment of national guidelines related to infectious disease detection, investigation and response. This should be used as the basis for developing policies and procedures for infection prevention and control in health care facilities across the city, even country.
- Increasing government coordination, promotion and support on the causes, control and consequences of communicable diseases. Evaluating the sensitivity and specificity of current diagnostic tests and developing second generation tests.
- Protocols and training programs be developed for the management of communicable disease outbreaks of national significance [4].
- Guidelines for routine practices and additional precautions should be broadly disseminated to health care workers through brochures, posters, video education and meetings.
- Funding project that aims at strengthening public health measures to bring communicable diseases under control.
- Funding research project that contributes to understanding the coherent picture of life cycle, control mechanism of communicable diseases.
- Strengthening hospital surveillance systems through providing specific guidelines on hospital surveillance, including database templates and other tools to assist hospitals.
- Functions to identify chance event, provide guidelines for case management and tracking, including individual and multiple cases. Project that uses RFID technology for detecting and tracking the suspicious disease carriers and monitoring the change of symptoms should be supported.
- Funding mathematical modeling studies that incorporate 'super-spreading events', environment conducive to transmission, the cycle of infection and the mechanism of transmission.
- Funding genome sequencing to identify viral strains that have an inherently greater epidemic potential.
- Strategies to protect against spread in the community including following travel history of patients; identifying close contacts/travel companions; home isolation and following-up to ensure that no more spread be made in the community.
- Establishing response teams to respond to disease/health threat emergencies, which are deployable in an outbreak. The team should be coordinated by the central Ministry of Health and work with city public health officials according to pre-arranged protocols.
- Outbreak preparedness, investigation and response: shared protocols and guidelines should be established for rapid and efficient response. Clear definition of roles and responsibilities, general principles and operating procedures should be agreed upon by the central and city government, and event organization committee.
- Reporting network should be established that communicates risks of infectious disease threats rapidly to public health partners, government officials and international bodies.

- The establishment of emergency response mechanism. In serious outbreaks, the mechanism should be activated to assist in tracking, responding to and reporting internationally on outbreak events, including the provision of resources such as supplies or people as needed and as requested.

6. Mobilizing National and International Resources through Education, National and International Collaboration

Communicable disease surveillance and control requires co-ordination and co-operation among health care, public health and other emergency response entities at all levels of government [2]. It is essential for the success of the control effort that education and training program be implemented to teach health care and public health workers about the clinical and epidemiological aspects of communicable diseases, appropriate use and interpretation of laboratory tests, and best practices for effective use of infection control strategies.

Governments of many countries see communicable disease surveillance and control as their duty as the spread of diseases has no boundaries. WHO provides ready technical advice and supplies for this effort and coordinates international investigations/responses. Global Outbreak Alert and Response Network (GOARN), a pooled resource for alert and response operations drawing on 110 technical institutions by WHO, can provide useful support.

It is essential for the establishment of extensive national and international networking mechanisms to facilitate access to a pool of expertise in communicable diseases, linkage and liaison. Please see Table 1 for a list of center of excellence in communicable disease surveillance and control.

Table 1. A list of international centers of excellence in disease surveillance and control.

The Center for Disease Control (CDC) in USA: CDC has a strong laboratory and epidemiological data base. It is the leading agency responsible for communicable disease surveillance, control and prevention.

The Laboratory Center for Disease Control (LCDC) in Canada: the national laboratory for the provision of reference services to the provinces and territories since the 1940s.

The Public Health Laboratory Service (PHLS) for England and Wales: a nationally based integrated network of laboratories and associated epidemiological expertise. It provides diagnosis and

surveillance for the prevention and control of communicable diseases.

Communicable Diseases Network Australia-New Zealand: A forum for information exchange on communicable disease activity in Australia, New Zealand and internationally. Oversees the coordination of national communicable diseases surveillance and communicable diseases outbreak control.

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