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## Syndromic surveillance: A necessary public health tool

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### ABSTRACT

Of late much has been said about emerging infectious diseases and the threat of bioterrorism. The focus has been on continuous public health surveillance for early detection of outbreaks and potential threats. Preparedness is the way forward and relevant institutions and organizations need to make the necessary investments early. Familiarity, good coordination, active participation and a change of mindset amongst personnel is crucial to make the system work. We also share a general approach to using electronic Emergency Department data for syndromic surveillance.

## 1. Introduction

In the highly interconnected and readily traversed global village of today, geographical and political boundaries offer trivial impediment to the spread of infections. With the rapidity of technological development and information gathering today, the way we handle medical cases and situations too has evolved. This must come hand in hand with a change in mindset amongst healthcare personnel. Relevant issues would include how we handle emerging infectious diseases such as Severe Acute Respiratory Syndrome (SARS), H1N1 and avian flu, recognise natural diseases outbreaks, identify intentional biological attacks and monitor disease trends. With recent outbreaks, it has been seen that even as they were progressing from day to day, new developments and discoveries in terms of etiology, management and treatment were being made. This calls for adaptability and the need to be alert and up to date.

The emergence and spread of microbial threats are driven by a complex set of factors: the convergence of which can lead to consequences of disease much greater than any single factor might suggest. The focus on naturally occurring threats must be maintained in the face of expanded efforts

to contain the potential for terrorism related ones<sup>[1-4]</sup>.

## 2. Syndromic surveillance

Surveillance is the cornerstone of public health security. Public health surveillance is a necessary step in the current management of emerging infectious diseases. It is also a means for controlling and managing diseases and its spread. The surveillance will include ongoing systematic collection and assessment of data which can be utilized in planning, implementation and evaluation of the disease and its spread. It will also help in the early detection of bioterrorism and pandemic events. Effective surveillance systems must help reduce the impact of an outbreak by enabling its quick detection and thus, more timely intervention. Identifying a potential or a real outbreak earlier than when using traditional/conventional methods can result in a reduction of mortality and morbidity and thus, the subsequent economic consequences<sup>[3-6]</sup>.

Syndromic surveillance, refers to the ongoing collection and analysis of statistical data on health trends (eg. symptoms reported by people) and may be the best type of public health surveillance to detect outbreaks both intentionally or naturally occurring. It utilizes health-related data that precede diagnoses and signal sufficient probability of a case or an outbreak to warrant further public health responses. Syndromic surveillance data systems do not rely on confirmatory laboratory tests of

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patients' samples. Data used can be primarily collected for other purposes as well eg. clinical management of patients. This will help look for significant increases in the frequency of a given syndrome against a baseline. Syndromic surveillance allows rapid detection of sudden outbreaks, including infections carried by unknown pathogens. This approach depends on the identification of specific 'symptoms' as signs of a possible outbreak, with no strict requirements for a specific diagnosis. It is also an emerging tool in epidemiology. In more recent years, this method has been used for early detection of possible bioterrorism<sup>[3-5]</sup>.

Syndromic surveillance is relatively quick, easy and inexpensive, but it requires commitment. By focusing on syndromes rather than confirmed diagnoses, syndromic surveillance aim to detect events earlier than traditional disease surveillance systems<sup>[3,7-10]</sup>. Emergency departments and acute care clinics are useful sources for collection of health data for surveillance. Other complementary data sources would include those from general practice and family medicine clinics<sup>[11-13]</sup>. Sentinel general practice surveillance and data from family practitioners' out of hours care provision also provide useful inputs.

Advanced technology in syndromic surveillance brings us closer to 'real time' detection and notification of outbreaks. Real-time data provides for a more responsive system with very early warnings of potential problems. The goal of syndromic surveillance is to detect disease outbreaks at least 2 d before traditional surveillance methods can. Traditional disease detection is based on acute illnesses and/or diagnoses of illnesses. Frontline healthcare providers can be trained to be familiar with collecting data for surveillance and to accurately identify syndromes. Manual extrapolation of data requires staff to set aside time from normal duties and extract the relevant information separately for each day. The introduction of electronic surveillance systems enable the system to produce reports, which makes it easier to track syndromes at regular intervals.

Each patient that seeks care can be categorized as either 'syndromic' or 'non-syndromic', based on presentation symptoms. This can be done at several points of contact such as at triage, consultation, investigation stage or during observation. For example, the syndrome, 'influenza-like illness' may have muscle aches, chills, fatigue and fever in the initial presentation. These, however, may represent symptoms for a variety of diseases, including mononucleosis and anthrax. Thus, one syndrome may represent several possible diseases. Threshold alerts should thus be set so as to be updated when there are causes for concern. Daily events can also be analyzed by total counts or averages can be calculated every week or for a specified period of time<sup>[3,10,13]</sup>.

Some common syndrome groups regularly tracked by surveillance systems include:

fever syndromes, respiratory tract syndromes, cutaneous syndromes, upper and lower gastrointestinal tract syndromes, asthma and neurological syndromes. Other factors to be taken into consideration when looking at the numbers and trend are seasonal variation, weather conditions and period of the year eg. holiday periods, school term.

Syndromic information is reported into the system as it is

entered into the patient's electronic medical records. This helps to avoid delays. Additional data input can be tailored as each individual system allows. For surveillance systems, as each report is entered, analysis by syndrome, facility, site and demography can be done. Syndrome frequencies are important to take note of, as the baseline, is often set and deviations will have their significance calculated. The progression or trends can be studied for a specified period such as during the period of the outbreak. The real time nature of the technology also allows for its use in prediction of the course and subsequent allowances for improved institution response time through informed staffing decisions<sup>[3,10,14]</sup>.

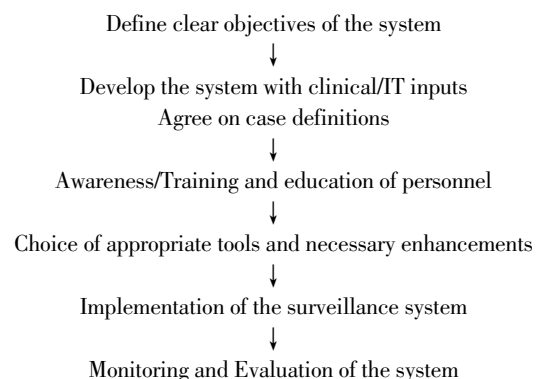
### 3. Using emergency department (ED) data for syndromic surveillance

The ED registers patients with routine data on demography and chief complaints. ED data are key components to syndromic surveillance systems. The registration can be programmed to trigger a message with the relevant information. This information is then securely sent to the collating office such as the state or regional office (Table 1). In Singapore, this is coordinated by the Ministry of Health.

The chief complaint can be classified into one of several common syndrome categories which the system has pre-defined. Subsequent to this, detection algorithms can be commanded to run every "x" hour, with email alerts activated as relevant. The data should preferably be formatted or configured, so that they can be transmitted by internet. The receiving staff, emergency preparedness coordinators, communicable diseases coordinators or epidemiologists can also then view charts, maps and registration data online. This type of electronic syndromic surveillance is easier and it does not require much changes or modifications to the ED registration and data gathering processes and thus is more likely to be achievable and also meet time guidelines. Prospective users of the system should be put through training and be familiar with the capabilities of the systems involved.

**Table 1**

General components and steps in a surveillance system.



There are also, however, some challenges to using ED data.

There are even to this day some EDs still using manual records. For those with electronic records, data, especially the chief complaints, are often entered in free text format instead of utilizing standardized terms. These can often be recorded with misspellings, abbreviations, acronyms and even local dialects. This will make it challenging to aggregate some of these into symptom clusters.

Another ED element that can sometimes be used is the final diagnosis. This is usually available in electronic format and is standardized using the International Classifications of Diseases (ICD). However, there may still be issues with coding variability, coding errors and the challenge of determining a definitive diagnosis after a very brief ED visit.

Other challenges include staffing and logistical issues, as well as timeliness of submissions. Coding delays and limited staffing resource are some of the reasons for this.

#### 4. Limitations

There are limitations to the current surveillance systems. These include inability to track the disease/syndromes fast enough and great reliance on the clinician to report these cases. With human reporting, there can be errors, reporting delays and low participation amongst some quarters. In many of these systems, it is important to have the age pattern defined clearly as this will be critical when there are age-related outbreaks and conditions which require tracking<sup>[12,14]</sup>.

Some syndromic surveillance systems include every encounter in the analysis, whilst others exclude individual repeat encounters within the same defined syndrome, occurring within a short period of time, with the rationale that these represent follow-up visits rather than new episodes.

An important challenge in the healthcare sectors in developing countries is to ensure quality and effectiveness of surveillance as well as the public health response. In an environment of decentralization, quality and timeliness can be a challenge to monitor and maintain

In a study by Jung et al which looked at encounters versus episodes, it was found that using all encounters may not only create too many signals but may also miss certain signals by masking the anomalies generated by actual episodes. It was also possible for the system to miss signals when using episodes<sup>[14]</sup>.

A "broad brush" approach of using non specific indicators may capture patients who do not specifically meet the core definitions. The size and timing of the prediction offered by syndromic surveillance may be limited. In the case of large outbreaks with hundreds affected simultaneously, no special detection methods may be required. However, in cases where there are very few individuals affected (such as anthrax), even the best syndromic surveillance system might not be sensitive enough in detecting it. A high index of clinical suspicion becomes very important in these cases. Surveillance systems are subjected to false positive detection as well. This means detecting an event which is not present. False claims, such as this, can cost the institution or the country, a lot of money. Resources are also required to

respond to these phantom events. If these happen often enough, they can desensitize personnel to the real events. Thus, institutions must set what constitutes an acceptable false positive rate.

The collection of more information and better analyses may help to reduce false positive rates but, this must be balanced with the sacrifice of timeliness and reduction in sensitivity. When comparing a fast spreading agent (ie spread within 3 d) with a slower spreading one (spread over 9 d), the latter often requires more sophisticated statistical methods. The performance of surveillance systems can be improved by monitoring a less common syndrome, pooling data across institutions, analyzing similar indicators and studying geographic patterns<sup>[13,14]</sup>.

As most surveillance systems are electronic, issues such as systems downtime and back-up also need to be addressed adequately.

#### 5. Improving domestic/National surveillance

WHO and World Bank cites health or syndromic surveillance as an essential component of the public health system. It helps to target intervention and document effects on population<sup>[15,16]</sup>. Countries will usually have national and local level programmes. For the latter, there is decentralization, but this requires alignment and training so as to ensure compatibility, quality assurance and adequacy of data with the national system. The surveillance data can then be used to make evidence based decisions. An observed gap in promoting effective surveillance often lies between the production and generation of data and the ability to convert them into usable information which will help initiate appropriate public health action. Attention is often needed to create and strengthen the local capacity<sup>[13]</sup>.

To do effective nationwide surveillance, parties involved (healthcare providers, public health authorities, environmental agencies etc) must have an open line of communications and good working relationships. If the different institutions doing surveillance use compatible tracking systems, this can improve the timeliness and inspection of the data collected. Regular trials and dialogues amongst the institutions too become an integral part of testing out the systems. There have also been suggestions to include veterinary healthcare providers in this surveillance as there are indeed emerging diseases affecting both human and animals. Nations today should support more research on the innovative system of surveillance that can capitalize on state-of-the-art Information Technology (IT)<sup>[6,8]</sup>.

In the local context of Singapore, data collated is submitted and assessed by the Ministry of Health (MOH). All doctors are then updated and given relevant alerts through an SMS (short messaging system) or email notifications, which also contains necessary instructions. For example throughout the year, under surveillance of febrile syndromes, a look out is also made for Hand, Foot and Mouth Disease outbreak. This frequently affects childcare centres and schools, which spreads in the community rapidly. Community and public education and awareness is enhanced and reiterated during these periods as reminders and the media also helps with

publicity, to enhance the population's information of the matter/outbreak as needed.

## 6. Global infectious diseases surveillance and global response

Global surveillance, especially to newly recognized infectious diseases, is crucial in responding to microbial threats before outbreaks develop into regional or international pandemics. The effort will have to be multi-national and requires global coordination, advice and resources from participating nations. Direct prevention and control efforts can also be shared. Organisations such as Communicable Diseases Centre (CDC) and World Health Organisation (WHO) have collaborations with various agencies and private organizations and foundations to facilitate the work in this area<sup>[8,16]</sup>.

Investments by these organizations may take the form of financial, technical assistance, operational research, enhanced surveillance and efforts to share best practices and knowledge in public health across national boundaries. Research on syndromic surveillance systems must continue to assess factors such as capacity to transmit existing data electronically to standardize complaints or other coded data and explore the usefulness of geographical coding. Usually CDC would provide the leadership in these evaluations<sup>[3,15,16]</sup>. International cooperation is crucial in controlling infectious diseases. Globalisation has indeed created challenges for infectious diseases policies. These can arise from global microbial load and traffic, inadequate surveillance capacities or poor national level coordination. Unilateral efforts may not be effective when the source of the problem is beyond national jurisdiction. Developing and third world nations may need assistance in improving domestic public health. These countries must come up with their plans and also cooperate to reduce importation and exportation internationally. WHO also requires all members states to report public health emergencies of international concern to help strengthen global surveillance. There are also WHO – developed criteria to help identify whether an outbreak constitutes such an emergency<sup>[3,16]</sup>.

## 7. Conclusion

Syndromic surveillance systems are undergoing continuing advancement and development to meet higher demands and expectations in public health policies. Novel techniques too are becoming more commonly utilized, such as the internet-based search queries, which are providing a new perspective to the established systems.

Surveillance systems must eventually be well integrated into the broader public health system. When the system does set off the alarm bells, a systematic process of investigating these alarms and responding effectively must be in place. Moving forward, one very important consideration is the need for increasing involvement of physicians/clinicians, which some of the existing surveillance systems tend to downplay.

Owners of the systems must be able to scrutinize the strengths and weaknesses of their systems. Stakeholders validation too can help fine tune and modify the system to better achieve the intended objectives.

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