UNODA Project on “Strengthening National, Sub-Regional and International Capacities to Prepare for and Respond to Deliberate Use of BWs”

Seminar
“The importance of Disease Surveillance and Alert Mechanisms: Lessons for the BWC”

Geneva Centre for Security Policy, 20 November 2018

The evolution of infectious disease surveillance

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Surveillance is the ongoing systematic collection, analysis, and interpretation of outcome specific data for use in planning, implementing and evaluating public health policies and practices.

Early warning of potential threats to public health

Program monitoring functions which may be disease specific or multi-disease in nature.

Infectious disease surveillance framework: better data for better action 2014-2019
Components of surveillance and response systems

- the priority diseases targeted for surveillance
- the structure of the system
- core functions of the system
- support functions of the system
- quality of the system
Indicator based surveillance

Logical framework approach

- **Input indicators** are the resources needed to implement the system.

- **Process indicators** are used to monitor and track implementation of the planned activities.

- **Output indicators** are measures of the immediate results of the activities.

- **Outcome indicators** are measures of the quality of the surveillance system and the extent to which the surveillance objectives are achieved.

- **Impact indicators** are measures of the extent to which the overall objectives of the system are being achieved.

Indicator selection

- Simplicity
- Sensitivity
- Time-series data
- Policy relevance
Introduction of unstructured event-based sources

- Shift from indicator based surveillance to unstructured event-based reports
- Sources may include: Internet news, airline forums, real-time data
HealthMap: Ebola

“HealthMap is notorious for announcing the first public notification regarding Ebola in March of 2014, 5 months before the WHO declared Ebola as an PHEIC. The HealthMap tool exemplifies how real-time digital intelligence has the potential to improve early detection, granting a timely response to public health emergencies”.

1664, Plague, Bills of Mortality (UK)

- Bills of Mortality are weekly mortality statistics in London, designed to monitor burials from 1532.
- From 1629, the cause of death was included, and from the early 18th century, the age at death.
1815, Smallpox, JC Moore (UK)

- Smallpox was a highly virulent, contagious disease.
- Vaccination was discovered by Edward Jenner in 1796 and was made compulsory in England and Wales in 1853.
- Vaccination led to the eradication of smallpox in 1980.
1838, Vital Records and Public Health surveillance (UK)

- William Farr: medical statistician in the General Register Office for England and Wales
- Set up a system for routinely recording causes of death
- Instrumental in the creation of ICD (international classification of diseases)
• John Snow was convinced that something other than the air might be responsible for the cholera transmission.
• Through mapping the cases during an outbreak in 1854, he found that everyone has a single connection in common: they have all retrieved water from the local Broad Street pump.
• Snow tested his theory by removing the pump’s handle, effectively stopping the outbreak.
• He was the first to use maps and records to track the spread of a disease back to its source.
International Classification of Diseases

120+ years of ICD History

1893  1909  1929  1948  1975  1990  2017

1. ICD-1: International List of Causes of Death
2. ICD-2: International List of Causes of Sickness and Death
3. ICD-4: Categories based on etiology
5. ICD-9: Narrative descriptions of Mental & Behavioral disorders
6. ICD-10: Mental, Psychoneurotic and Personality Disorders
7. ICD-11: Future version
1918, Pneumonia and Influenza, US Cities Mortality Reporting System

- US «sentinel cities» from where pneumonia and influenza mortality is reported to the CDC on near real-time (Atlanta)
- Allows for defining epidemic threshold
- Allows for calculation of excess mortality
- Became the gold standard for influenza surveillance
1984, French Sentinel System

• The first fully computerized surveillance system operational at a national level (France)
• Open access to real time morbidity reports from a network of sentinel general practitioners
• Operated by researchers at Inserm (Paris)
• With maps and forecasting tools (mathematical modelling)
1998, Remote sensing data tracking Vector-Borne Diseases

- NDVI (vegetation coverage anomalies) when wetter than usual for three consecutive months in the Horn of Africa are associated with outbreaks of Rift Valley Fever
2008, Search queries
Google Flu Trends

• Artificial Intelligence took over traditional CDC influenza surveillance
• Used Google search terms as time series data source
• Seemed to performed better: earlier and as accurate
• Up to 2013...
2014, Twitter

- Artificial Intelligence looking for challenging traditional Influenza surveillance
- Used tweets as time series data source
- Promising use of Big Data collected for non health purpose
- Participatory disease monitoring
- Augmented anthropology to help understanding transmission networks
MOOCs and participatory research
In refugee camps (e.g. Kakuma, Kenya)

- > 70 applicants
- 15 selected participants on line and on site

(R. Ruiz de Castañeda et I. Bolon, 2018)
MOOCs for and with refugees

From Geneva
• On-line mentoring by 15 Master students at UNIGE, using WhatsApp

From Kakuma
• Work on site and on-line
• Participatory research projects
Source: InZone-UNIGE’s MOOC Global Health at the Human-Animal-Ecosystem Interface
IHR 3.0 Simulator
Combining data science with life science and social science may fundamentally change the way predictions are made.
Augmented surveillance and detection of new outbreaks

Providing medical algorithms integrated in smartphone applications offers the opportunity to rapidly detect and report an increase in fever cases using a syndromic and etiological approach.
Augmented surveillance and detection of new outbreaks

Along with these field data, **other data from diverse sources** including remote sensing data from satellites, virus identification and environmental can augment available information.
Augmented surveillance and detection of new outbreaks

This data can be used to inform epidemiological models, GIS or to forecast new outbreaks and detect transmission networks through Artificial Intelligence.
Augmented surveillance and detection of new outbreaks

Early detection of outbreaks **guides intervention** efforts increasing capacity in relevant local clinical services and improving outcomes.