Evaluating Surveillance Systems – Let’s Get Critical, Critical!

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Session Overview

- Introduction and learning objectives
- Definition and purposes of surveillance
- Monitoring vs. evaluation – purpose and process
- Framework for conducting a surveillance evaluation
- Surveillance system attributes – what they are and how to select the most appropriate for your evaluation
- Interpreting results and making recommendations
- Wrap-up and workshop evaluation
Learning Objectives

By the end of this session, participants should be able to:

**Describe** the purpose and importance of evaluating a surveillance system

**Outline** the key components involved in the process for evaluating a surveillance system

**List** and define the key attributes of surveillance systems

**Apply** the key attributes and knowledge of the surveillance cycle to evaluate a surveillance system

**Translate** surveillance evaluation principles to their routine work
What is Public Health Surveillance?

Public health surveillance is the ongoing, systematic collection, analysis, interpretation and dissemination of health-related event data to help guide public health action and policy development.
Purposes of Public Health Surveillance

- Guide immediate action for cases of public health importance
- Measure disease burden, including changes in related factors, identification of high-risk populations, and identification of new or emerging health concerns
- Monitor trends, including detection of outbreaks
- Guide the planning, implementation and evaluation of disease prevention and control programs
- Evaluate public policy
Purposes of Public Health Surveillance (2)

- Detect changes in health practices and the effects of these changes
- Prioritize the allocation of health resources
- Describe the clinical course of a disease
- Provide a basis for epidemiologic research, including identification of research needs and facilitation of planning
- Assess the safety of drugs, devices, diagnostics and procedures and overall quality of health care
Surveillance Cycle

Response

Data Collection

Interpretation

Analysis
Surveillance Cycle

- Dissemination: reports, alerts, publications
- Action: investigation, policy, research

Response

- Case definitions
- Sampling frame
- Collection tools
- Data transfer

Data Collection

- Person, place, time
- Counts/rates
- Time series

Analysis

- Trends/comparisons
- Hypotheses
- Aberration detection

Interpretation
FIGURE 1. Simplified flow chart for a generic surveillance system

An infectious, chronic, or zoonotic disease; injury; adverse exposure; risk factor or protective behavior; or other surveilled event associated with public health action

Identification by whom and how

Reporting process
- Data entry and editing possible
- Assurance of confidentiality

Data management
- Collection
- Entry
- Editing
- Storage
- Analysis
- Report generation
- Report dissemination
- Assurance of confidentiality

Occurrence of health-related event

Case confirmation

Audiences

Reporting sources
- Physicians
- Health-care providers
- Veterinarians
- Survey respondents
- Laboratories
- Hospitals
- Health-care organizations
- Schools
- Vital records
- Other

Feedback and dissemination of information for public health action

Data recipients

Primary level
(e.g., county health department)

Secondary level
(e.g., state health department)

Tertiary level
(e.g., Federal agency)
Evaluation Cycle

- Monitoring and evaluation
- Gaps between needs and capacities
- Implementation
- Planning for improvements
Surveillance Monitoring

- **Routine** collection and analysis of indicators to measure how well the system is achieving its objectives

- Informal and ongoing – can be done anytime

- Necessary to understand where the data comes from and for evaluating the quality of information used to guide evidence-based program decisions

- May lead to a formal evaluation
Surveillance Evaluation

- **Periodic** assessment of the relevance, effectiveness, and impact of the surveillance system

- Formal and structured – use a systematic approach

- Done periodically – often after a system has been operating for some time, or when questions arise about the integrity and value of the surveillance system

- Usually undertaken by persons involved directly or indirectly in the management of the surveillance system
Purpose of Surveillance Evaluation

Public health surveillance systems should be evaluated periodically in order to:

- Assess their performance and determine how well the system operates to meet its stated purpose and objectives
- Ensure data collected are adequately and effectively guiding their intended public health actions
- Develop recommendations for improving quality, efficiency, and usefulness, including the optimization of resources
- Ensure that problems of public health importance are being monitored efficiently and effectively
Surveillance Evaluation Framework (CDC)

A. Engage stakeholders
B. Describe surveillance system
C. Focus the evaluation design
D. Gather evidence regarding performance of surveillance system
E. Justify and state conclusions, make recommendations
F. Ensure use of evaluation findings and share lessons learned

http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5013a1.htm
A. Engage Stakeholders

**Stakeholders** = persons and organizations that contribute to the collection, analysis and interpretation of surveillance data and/or use the data to inform and guide public health action.

Should be consulted and engaged early in the evaluation process to provide input to ensure that the evaluation:

<table>
<thead>
<tr>
<th>Addresses appropriate questions</th>
<th>Assesses pertinent attributes</th>
<th>Produces acceptable and useful findings</th>
</tr>
</thead>
</table>
B. Describe Surveillance System

Describe the public health surveillance system to be evaluated with respect to:

- Public health importance of health-related event under surveillance
- Purpose and operation of the system
- Resources used to operate the system
Parameters for measuring importance of a health-related event - and thus the surveillance system with which it is monitored include:

- Indices of frequency (e.g., cases/deaths, incidence, prevalence)
- Indices of severity (e.g., hospitalization rate, case-fatality ratio)
- Clinical course in absence of interventions
- Disparities or inequities associated with health-related event
- Costs associated with health-related event
- Preventability
- Public interest
B2: Purpose and Operation

- List purpose and objectives of the system
- Describe planned uses of the data from the system
- Describe health-related event under surveillance, including the case definition(s)
- Describe components of surveillance system (e.g., population, time period, data sources, what/how data are collected, policies and procedures re: data management and privacy etc.)
- Describe where in the organization the system resides and the level of integration with other systems, if appropriate
- Draw a flow chart of the system
B3: Resources Used

Include only those resources directly required to operate a public health surveillance system (e.g., direct costs) such as:

- Funding source(s) – if applicable
- Personnel requirements
  - Person-time required for collection, analysis, interpretation and dissemination of data
- Other resources
  - Training, supplies, equipment (i.e., computer hardware/software), internet access, mail/phone/fax, laboratory support
C. Focus Evaluation Design

- Determine the specific purpose of the evaluation
- Identify stakeholders who will receive the findings and recommendations of the evaluation (i.e., intended users)
- Consider what will be done with the information generated from the evaluation (i.e., intended uses)
- Specify questions that will be answered by the evaluation
- Determine standards for assessing the system’s performance
D. Gather Evidence

• Indicate the level of usefulness of the surveillance system by:
  - Describing the actions taken as a result of analysis and interpretation of the data collected by the system
  - Characterizing the entities that have used the data to make decisions and take action
  - Listing other anticipated uses of the data

• Describe the key system attributes
Key Surveillance System Attributes

- Simplicity
- Flexibility
- Data Quality
- Acceptability
- Sensitivity
- Predictive value positive
- Representativeness
- Timeliness
- Stability

Key attributes
Table Activity: Defining the Key Attribute of a Surveillance System

• Within your tables read the one-page summary of the attribute assigned to you.
• Discuss what this attribute means and how you can summarize it to the other participants in one or two sentences. Try and come up with an example of how this attribute is used in surveillance.

Instructions

Time

• Ten minutes for table discussion and then discuss as a group. Ensure you identify a speaker for your table.
Key Attributes of a Surveillance System

There are 9 key attributes:

**QUANTITATIVE:**
- Data quality
- Timeliness
- Representativeness
- Sensitivity
- Positive predictive value

**QUALITATIVE:**
- Simplicity
- Flexibility
- Acceptability
- Stability
Data Quality

• Reflects the completeness and validity of the data recorded in the surveillance system
• Completeness of records
  ➢ Blanks – missing or unknown
• Errors when computing data
• Influenced by:
  ➢ Simplicity of surveillance form
  ➢ Clarity of electronic surveillance forms
  ➢ Training
  ➢ Validation
Timeliness

- Reflects the delay/speed between surveillance steps: recorded in the surveillance system
  - Onset
  - Diagnosis
  - Report
  - Data entry
  - Analysis
  - Interpretation
  - Intervention

Time
Representativeness

- Representative = accurately describing the occurrence of a health event with respect to its distribution in the population by place and time

- Related to:
  - Data quality
  - Bias of data collection
  - Completeness of reporting
Sensitivity

• At the level of case reporting, sensitivity refers to the proportion of cases of a disease (or other health-related event) detected by the surveillance system.

• Sensitivity can also refer to the ability to detect outbreaks, including the ability to monitor changes in the number of cases over time.

• Requires (in principle):
  - To validate the information collected and
  - To collect information outside of the system to determine the frequency of the condition in the community.
Predictive Value Positive (PVP)

- The proportion of reported cases that actually have the health-related event under surveillance
- Depends on:
  - Sensitivity and specificity
  - Prevalence of condition in the population
- Consequences of a low PVP:
  - Frequent false-positive result
  - Inappropriate follow-up of non-cases
  - Incorrect identification of outbreaks (artefacts)
  - Wastage of resources
  - Inappropriate public concern (credibility)
Simplicity

• Refers to both its structure and ease of operation
• Structure
  ➢ Information needed
  ➢ Number and type of sources
  ➢ Number of information users
• Ease of operation
  ➢ Data transmission and system maintenance
  ➢ Data analysis
  ➢ Information dissemination
• Surveillance systems should be as simple as possible while still meeting their objectives
Flexibility

- Ability of system to accommodate changes with little additional time, persons or allocated funds
  - New event to follow-up
  - New case definition
  - New data about an event
  - New sources of information
Acceptability

- Knowledge
  - Case definition, notification procedures
- Notification conditions
  - Sufficient stock of notification forms/electronic access
  - Simplicity
- Motivation
  - Understanding the importance
  - Risk perception
  - Existence of regular feedback
Stability

Refers to public health surveillance system’s:

• Reliability: the ability to collect, manage, and provide data properly without failure
• Availability: the ability to be operational when it is needed
Choosing what Attributes to Evaluate

- Select attributes that are most relevant to the main objectives of your surveillance system
  - e.g., if goal is to detect outbreaks – need a system that is timely, representative, and has high sensitivity/PPV
- Quantitative attributes are easy to assess, however, additional information may be needed to calculate (e.g., sensitivity)
- Qualitative attributes are more subjective and require input from key stakeholders, but they tell you a lot more about how the system is actually working and its perceived usefulness
Looking at different surveillance systems from different public health perspectives. By doing this, does it change surveillance attributes to be evaluated?
Measles Reporting Process

Identification by whom and how

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Audiences

Feedback and dissemination of information for public health action
Measles Surveillance Objectives:  
Local Level

- All cases of measles are investigated immediately in order to confirm the diagnosis, identify the source of infection, identify other cases and protect susceptible contacts in the community.

- Investigate the case to determine source of infection, including inquiring about travel history or exposure to persons who have recently travelled and documenting location of travel. Immunization status of all cases should be determined; including total number of doses of measles-containing vaccine received and dates of receipt. Collect appropriate data as per the Ontario Regulation 569 under the HPPA.

- Management of contacts within 24 hours of reporting a suspect case of measles, all contacts should be identified and classified as susceptible or non-susceptible.
Looking at the different attributes, which one would be the **most important** to include in your surveillance evaluation?

A. Simplicity
B. Flexibility
C. Data Quality
D. Acceptability
E. Sensitivity
F. Predictive value positive
G. Representativeness
H. Timeliness
I. Stability
Looking at the different attributes, which one would be the second most important to include in your surveillance evaluation?

A. Simplicity
B. Flexibility
C. Data Quality
D. Acceptability
E. Sensitivity
F. Predictive value positive
G. Representativeness
H. Timeliness
I. Stability
Measles Surveillance Objectives: Federal Level

The surveillance system was created in 1998 in order to enhance existing national surveillance for measles following its elimination in Canada. The purpose is to conduct timely, ongoing, national monitoring of the circulation of measles and rubella virus in Canada.

It involves weekly reporting by all provinces and territories, including zero-reporting, to the Public Health Agency of Canada (PHAC) and subsequent weekly reporting by PHAC to the Pan American Health Organization (PAHO).

Travel history and exposure details are important data variables in the case report form.

Probabilistic matching on province/territory, date of birth (or age), and gender is conducted to link the laboratory and epidemiological data.
Key Points:

- In Canada, during week 33, no new cases of measles were reported for 2015.
- A total of 195 cases of measles, and 0 cases of rubella have been reported in Canada for 2015.

Epidemiological Summary:

Figure 1: Number of cases of measles (n=195) and rubella (n=0), by week of rash onset, as reported to the Canadian Measles/ Rubella Surveillance System (CMRSS) and Measles and Rubella Surveillance system (MARS), for the period ending August 22, 2015.
Looking at the different attributes, which one would be the most important to include in your surveillance evaluation?

A. Simplicity
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Mass Gathering Surveillance

Situation

Jurisdiction Y will be hosting a two week festival of music, fashion, cars and celebrities, the biggest festival ever, expecting to host hundreds of thousands of visitors.

The King of Jurisdiction Y put together a mass gathering surveillance strategy that encompassed a number of different data sources and was difficult to implement and use because of its complexity.

After the festival, the King evaluated their mass gathering surveillance strategy and realized the data completeness and timeliness were poor because public health officials and clinicians couldn’t use it.
Looking at the list of attributes, which one do you think should have been considered while developing the mass gathering surveillance plan?

A. Simplicity  
B. Flexibility  
C. Data Quality  
D. Acceptability  
E. Sensitivity  
F. Predictive value positive  
G. Representativeness  
H. Timeliness  
I. Stability
### SARS Reporting Requirements

<table>
<thead>
<tr>
<th>To local Board of Health</th>
<th>To the Ministry of Health and Long-Term Care (the ministry) or Public Health Ontario (PHO), as specified by the ministry</th>
<th>To the World Health Organization (WHO)</th>
</tr>
</thead>
</table>
| • Individuals who have or may have SARS shall be reported **immediately by phone** to the medical officer of health by persons required to do so under the *Health Protection and Promotion Act*, R.S.O. 1990 (HPPA). | • Cases shall be reported using the integrated Public Health Information System (iPHIS), or any other method specified by the ministry **within one business day of receipt of initial notification** as per iPHIS Bulletin Number 17: Timely Entry of Cases and Outbreaks.  
• For cases associated with an institution, the board of health must phone PHO, as specified by the ministry, within 24 hours. | • Under the International Health Regulations (IHR), member countries must **report cases of SARS within 24 hours** of notification. |
Given Canada has a legal obligation under the International Health Regulations to report cases of SARS within 24 hours to the World Health Organization, what attribute do you think is important to ensure is evaluated on a continuous basis?

A. Simplicity
B. Flexibility
C. Data Quality
D. Acceptability
E. Sensitivity
F. Predictive value positive
G. Representativeness
H. Timeliness
I. Stability
Malaria

To local Board of Health

• Individuals who have or may have malaria shall be reported as soon as possible to the medical officer of health by persons required to do so under the Health Protection and Promotion Act, R.S.O. 1990 (HPPA).

To the Ministry of Health and Long-Term Care (the ministry) or Public Health Ontario (PHO), as specified by the ministry

• Report only case classifications specified in the case definition.
• Cases shall be reported using the integrated Public Health Information System (iPHIS), or any other method specified by the ministry within five (5) business days of receipt of initial notification as per iPHIS Bulletin Number 17: Timely Entry of Cases.
• Treatment is under the direction of the attending health care provider.
• Provide education about the illness and how to prevent the spread.
• As per this Disease-Specific Chapter, notify the Canadian Blood Services (CBS) and Trillium Gift-of-Life of any positive human malaria disease results with blood/organ donation histories.
• Management of contacts or outbreaks is not applicable.
Looking at the different attributes, which one would be the most important to include in your surveillance evaluation?

- A. Simplicity
- B. Flexibility
- C. Data Quality
- D. Acceptability
- E. Sensitivity
- F. Predictive value positive
- G. Representativeness
- H. Timeliness
- I. Stability
E. Conclusions and Recommendations

• Derive conclusions from the gathered evidence regarding the performance of the public health surveillance system
• State whether the surveillance system is addressing an important public health problem and is meeting its objectives
• Make recommendations for improvements/modifications that are SMART:
  - Specific
  - Measurable
  - Achievable
  - Realistic
  - Time scaled
F. Ensure Use & Share Lessons Learned

- Ensure that the findings from a public health surveillance system evaluation are used and disseminated appropriately.
- Strategies for communicating the findings from the evaluation and recommendations should be tailored to relevant audiences, including those who provided data used for the evaluation.
- Follow-up may be necessary to remind intended users of their planned uses and to prevent lessons learned from becoming lost or ignored.
Summary

• Public health surveillance is the cornerstone of public health practice

• All public health surveillance systems should be periodically evaluated

• Strengthening one system attribute could adversely affect another attribute of a higher priority

• No perfect system exists – trade-offs must always be made
References


Questions?

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