

12th lecture:

Surveillance

Closely related to Monitoring

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Objectives: To

- Define surveillance for infectious diseases (nowadays it is also done for chronic diseases)
- Know the objectives and uses of surveillance system
- Recognize the elements of surveillance system
- Be able to assist in establishing a surveillance system



What is surveillance?

- The process that is used to collect, manage, analyze, interpret, and report this information for action is called surveillance.

Surveillance is an ongoing (continues) system. All factories (hospitals, MOH, etc.) can use this system. Example: There are lots of infections by drug resistance organisms in a hospital or In some wards there are two medical units; one of them has a very high infection rate as compared to the other and you would like to discuss these and report them to take an action, so you collect the data for drug resistance organisms: number of drug resistance organisms in all ward and units, they may involve laboratory investigations for monthly data collection. Then they analyze, interpret and report this information for an action to be taken (so it is a network for many things).

- e.g. surveillance for neonatal mortality in Neonatal Intensive Care Unit e.g. Babies who are very small for birth (less than 2500g), normal weight of a baby is 3 kg and unusualsepsis....change in antibiotic use Supposing there are many deaths from sepsis and subclinical resistance to antibiotics, you may change the antibiotics "the policy of changing antibiotics", so it has an action and policy related to it.

Examples

- **For diseases:**
 - **Communicable diseases:** influenza, HIV/AIDS, sexually-transmitted infections
In India for example: HIV is common, so they would like to keep a record for how many people are getting HIV, where is it happening and who's getting it so they can take action there to control HIV (This is a service element).
 - **For disease outbreaks:** e.g. food poisoning, cholera
When collecting data continuously e.g. in wards, ICU, etc. > You'll be able to detect outbreaks.
 - **Non-communicable diseases:** lead poisoning, cancer, hypertension, diabetes
You can know which cancer is common in which city and if prognoses has improved or not based on surveillance
 - **Risk factors:** tobacco use, physical exercise
- **For emergencies:** bioterrorism, chemical, radiation, natural disasters
Surveillance here is an ongoing collection of data, monitoring, interpretation and taking action by the use of cameras for documentation (These are all measures for protection).
- **For hospitals:** e.g. nosocomial infections.
- **In the industry:** for occupational disorders, injuries, disability pensions (income)
- **In the military:** for diseases of the recruits
Military people who went to Iraq must be having environmental problems

Surveillance

- Continuous collection, collation and analyses of data with or without subsequent action
- Clusters of disease in time and space

- Sudden changes in incidence ~ epidemics
If new cases are occurring more → you can detect epidemics
- Sensitivity: detect an epidemic situation
Sensitivity of surveillance system is that it can detect an epidemic situation
E.g. If the person who's collecting the data about new infection cases in the ICU is not doing it properly the sensitivity will go down (If surveillance system cannot detect new cases → it can't detect epidemic situations).
- Specificity ~ correctness of data
- Sentinel surveillance systems; *collection of samples from selected / sampled clinics e.g. influenza vaccine development each year e.g. influenza vaccine. How does it come up? There is sentinel surveillance through out USA (they take throat swab for people with URTI, check the strains that are causing influenza each year) and that's why influenza vaccine comes somewhere between sep – oct so every year new vaccine comes out against these strains.*

Sentinel: to watch over as a guard

Describing Surveillance

- Surveillance systems are networks of people and activities to keep this process
- Functions at local to international levels.
- Populations under surveillance are defined by the information needs of prevention or control programs.
- New public health problems e.g. new infectious strains / diseases; rapid implementation of surveillance is effective in early response.
- Over time, it is used to identify changes in the nature or extent of health problems and the effectiveness of public health interventions.
- Surveillance systems are generally called on to provide descriptive information regarding when and where health problems are occurring and who is affected—the basic epidemiologic parameters of time, place, and person.

Objectives of Surveillance

- Descriptive epidemiology of health problems e.g. measles vaccine doses
Descriptive epidemiology is person, place and time
E.g. For the measles vaccine, surveillance in USA came to know that some adolescence were getting measles because the immunity was waning off, so they instituted that all children should be vaccinated again.
- Detection of outbreaks / lab based / else
- Program planning /intervention /evaluation
- Links to services
- Links to research
- Links to Education and Policy
- Monitoring incidence and prevalence

Steps in Surveillance Analysis

You have to take care of:

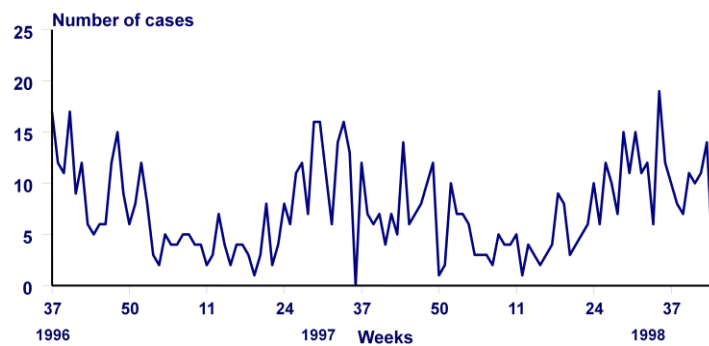
- Data quality
- Descriptive analysis
 - Time
 - Place
 - Persons
- Generate hypothesis
- Test hypothesis

That means you can do a research as well

Descriptive Analysis of Time

- Graphical analysis
- Requires aggregation on appropriate time unit
 - Date of onset
 - Date of notification
- To describe trend, seasonality, and residuals
- Use of rates when denominator changes over time

Descriptive Analysis of Time Graphical analysis



The same data represented as a simple line chart provides a much better insight on the characteristics of the trend and the seasonality.

In a way, this kind of charts are quite similar with the temperature chart that clinicians use. No clinician would use 3D chart to monitor the temperature of his patients. In a similar way, no epidemiologist should use 3D bars to monitor the “temperature” of his community.

Burden of diseases (burden is somehow prevalence)

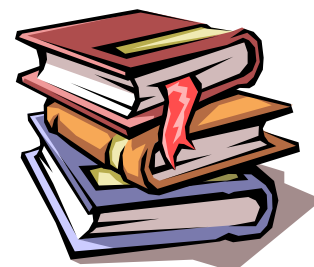
- Reporting only confirmed cases may not reflect true status resulting in ineffective control (mild cases may not be reported which would affect the results)
- Only severe cases are reported
- Under reporting may lead to high case fatality rates; resource utilization affected
- Approaches to Surveillance
 - Active versus passive If you are collecting the data “active”, if you use any data that are already been collected “passive”
- If there is a deadly disease → you have to do active surveillance
- The routine surveillance have both types depends on how much money you have.
- Supposing MOH is doing surveillance on measles, chicken pox, tetanus, diphtheria.
 - Because they are giving free vaccines, so they want to make sure that the diseases have been controlled. So if they asked KKUH to send a weekly report about these diseases → “passive” or If MOH sent someone every week to collect the data from KKUH → “active”
- Notifiable diseases there are some diseases that must be reported by law (e.g. Polio and meningitis)
- Laboratory based
- Registries
- Surveys
- Information systems
- Record linkage
- Combination of surveillance methods
- Volunteers E.g. rumors about measles vaccination being associated with gullain barre syndrome “neurological disorder”, there is a very rare complications of measles vaccine which is encephalopathy, so you can have neurologists volunteers to send information about gullain barre syndrome.

Elements of Surveillance system Important points of surveillance

- Case definition : (possible, probable, confirmed)
- Population under surveillance (hospitals, prisons, schools, factories, national, international)
You have to define who will be under surveillance
- Cycle of surveillance (recognizing health event, notifying it, information transfer, networks, action) As you collect, interpret, report, inform, take action.
- Confidentiality (e.g. HIV+ve children in schools)
- Ethics (when research is involved)
- Laws (as a service component governed by law in USA; e.g. disease notification)

Case Definition

- Standard set of criteria (for diagnosing)
- Clinical and lab
- Allows for comparison
- Sensitive vs. Specific



- Refer to standard definitions stated by WHO and CDC

Sensitive “how good it picks the disease ” vs. Specific “how good it exclude the non-diseased person”

Case Definition Gradient

Low Specificity

High Specificity

Suspected

Probable

Confirmed

- if there is an outbreak or surveillance you have to think where is your definition line
- you may not have all the facilities and laboratories to conform it

Example of Case Definition (Imp.)

- Smallpox
 - Clinical Description:
- An illness with acute onset of fever $>101^{\circ}\text{F}$ followed by a rash characterized by vesicles or firm pustules in the same stage of development without other apparent cause.
 - Laboratory Criteria for Confirmation:
- Isolation of smallpox (variola) virus from a clinical specimen, or
- Polymerase chain reaction (PCR) identification of variola DNA in a clinical specimen, or
- Negative stain electron microscopy (EM) identification of variola virus in a clinical specimen (Level D laboratory or approved Level C laboratory)
- If you don't have the facilities of laboratory → **Probable Case of Smallpox**; A case that meets the clinical case definition that is not laboratory confirmed but has an epidemiological link to another confirmed or probable case.
- **Confirmed Case of Smallpox**; A case of smallpox that is laboratory confirmed.

Working Case Definition

- Smallpox Outbreak
 - Anyone who meets original case definition
 - Anyone with fever ($>101^{\circ}\text{F}$) or rash who was in a confirmed exposed area during the Bioterrorism (BT) event or came in contact with a confirmed or probable case should be considered a case. *(until confirmed; if not confirmed; will be under observation and could be classified as “case”; and others as “confirmed cases”)*

Disease notification

- Physicians
- Laboratories
- Hospitals

- Countries to CDC , WHO

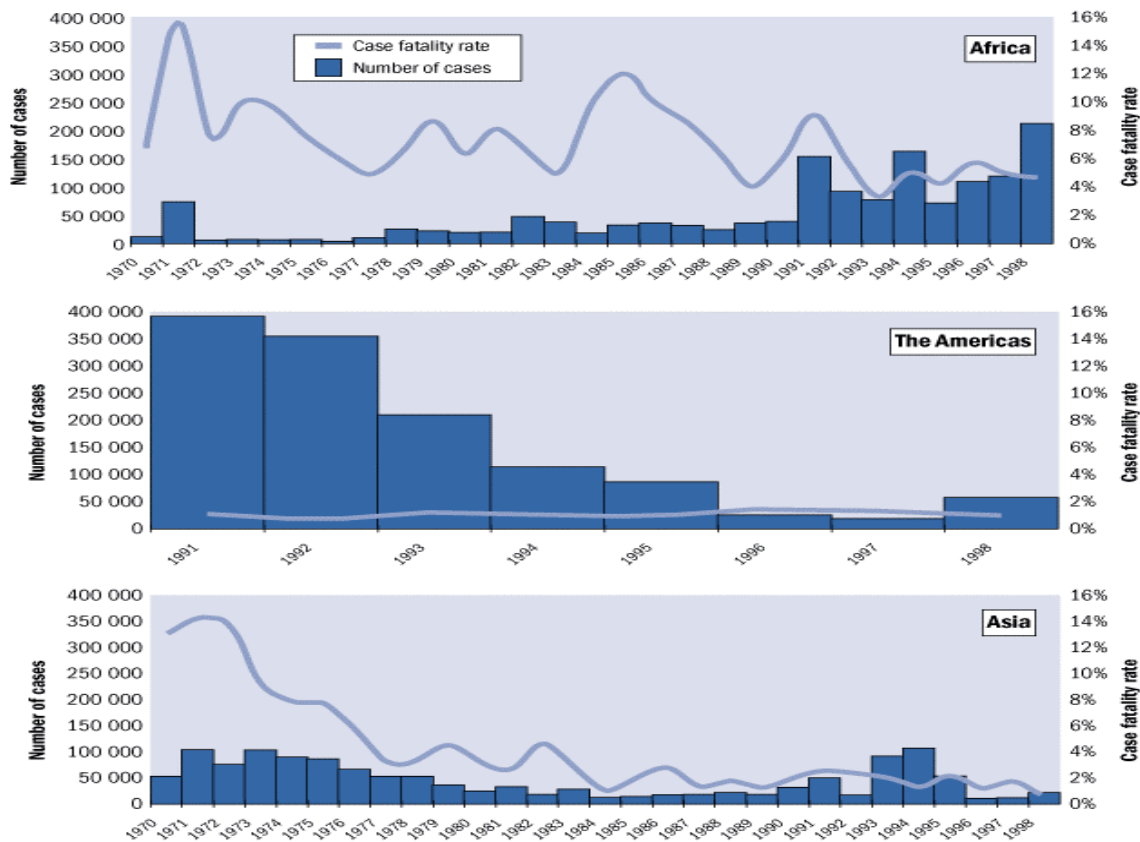


Fig. 2 Cholera reported cases and case fatality rates, per Continent

Disease notification

- Instituted for rapid application of prevention measure
- List of diseases vary by country
- Notification goes by mail /fax
- Information on form includes dx, date of onset, age, sex, and place of residence; may contain Sx, Rx given, and precautions [When you notify you have to provide all these information](#)

Validity of notification data Validity is truthfulness of the data “how good the data is” e.g.; many patient may not seek care so you have to go and find the cases.

- Seeking of medical care is not constant
- Distance to the nearest hospital
- Cost and distance to travel
- Media reports will increase the # of people reporting to the hospital e.g. dengue fever [e.g. new test for a disease](#)

- Public awareness will increase the incidence

Data Quality Issues

- Missing values e.g. age is missing or gender.
- Attraction to round figures such as in is doing a study about low birth weight → there is a tendency to cluster data around 2.5 and 3 kg rather than writing down 2.4 kg or 2.9 kg “clustering of cases”
- Data entry errors
- Bias related to lack of representativity
 - Cases more severe
 - Urban > rural
 - Source not represented (private sector, GPs)

The first step in analyzing surveillance data focuses on data quality. This is different from the evaluation process which gives you an in-depth knowledge of data collection process and potential limitation of the data. Frequency distributions of each variable is looked at, in order to identify missing values, digit attraction, logical errors such as neonatal tetanus affecting adults, and biases related to a lack of representativity of the data:

- Cases in the surveillance system may be more severe than cases in the community because of a reporting bias
- Cases from urban settings may be more represented than cases from rural area with a poor coverage of health facilities
- Certain sources of notification may not be represented, such as general practitioners, of health care providers from the private sector.

A quick look at the data may help you to identify these limitations that you will need to take into account when summarizing your findings.

Timeliness of disease notification

1. Health event occurs
2. Identified by health care system
3. Reported to local health authority
4. Verification/investigation by PHS (public health service)
5. Health event reported to other systems
6. Analyses of health data
7. Dissemination of surveillance finding
8. Actions based on surveillance findings

Early warning system

- Major threats to the population; 0-4 & 5 or more years of age, have been identified.
- Severe malnutrition, injuries, acute watery diarrhoea, bloody diarrhoea, acute flaccid paralysis, acute respiratory infections, neonatal tetanus, malaria, suspected measles, suspected meningitis, acute jaundice syndrome and acute FUO
- A threshold for each is defined; unusual pattern or occurrence will trigger investigations and responses.

Surveillance data summary (what's the importance of the summary)

- Monitors long term trends e.g. graphs.
- To make comparisons
- Analyze costs and benefits of preventive measures
It is blamed that it is very expensive to do, so you can do a cost benefit analysis to show that you can prevent many diseases by using this money rather than if you let people die.
- Demands on quality of data
- To promote the best use of public health resources, all public health surveillance systems should be evaluated periodically
You need to evaluate a system whether it is actually the system is sensitive, detecting diseases and outbreaks, how good is it working, has it reduced mortality, has it reduced disease or not. If it is not doing anything, then just data are being collected

•References

- Teutsch SM, Churchill RE. Principles and practice of public health surveillance. Oxford: Oxford university press, 2000
- Modern Epidemiology 2008; 3rd Edition Kenneth J Rothman. Chapter 22 Surveillance