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Animal Health Matters.
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Introduction to Epidemiological Surveillance

Marco De Nardi

Outline

- Objectives
- The scope of epidemiology
- Definitions and concepts related to surveillance
- Characteristics of surveillance system
- Surveillance objectives
- Surveillance types
- Application on dairy farm
- Surveillance vs Inspection

- The scope of epidemiology

Contributions of Epidemiology

Contributions	Examples
Establish **causes** of disease	Discovery that a bacteria was the cause of anthrax
Discover **new** pathogens	Listeria
Discover **routes** of infection	Cholera linked to contaminated water sources
Detect patterns and unusual occurrences of diseases within a population	Milkmaids (through exposure to cowpox) were not becoming infected with smallpox

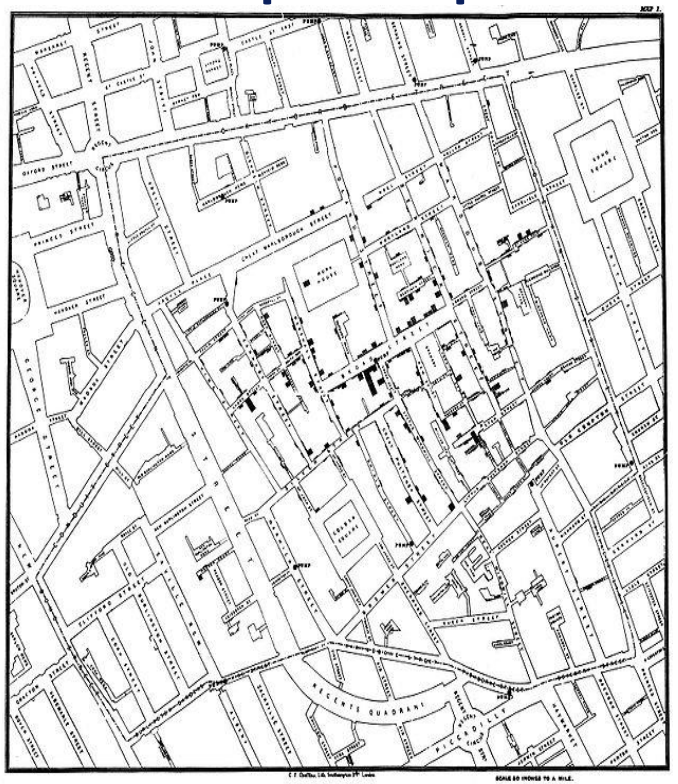
How did it all begin?...

London Cholera Outbreaks

Mid-1840s

- Soho and Golden Square districts, London, 500 deaths from cholera in 10 days
- John Snow plotted dates and mortality rates
- Assessed flow of water from wells and pumps
- Found that virtually all deaths took place within a short distance of the Broad Street water pump
- Outbreak ended quickly after pump handle was removed

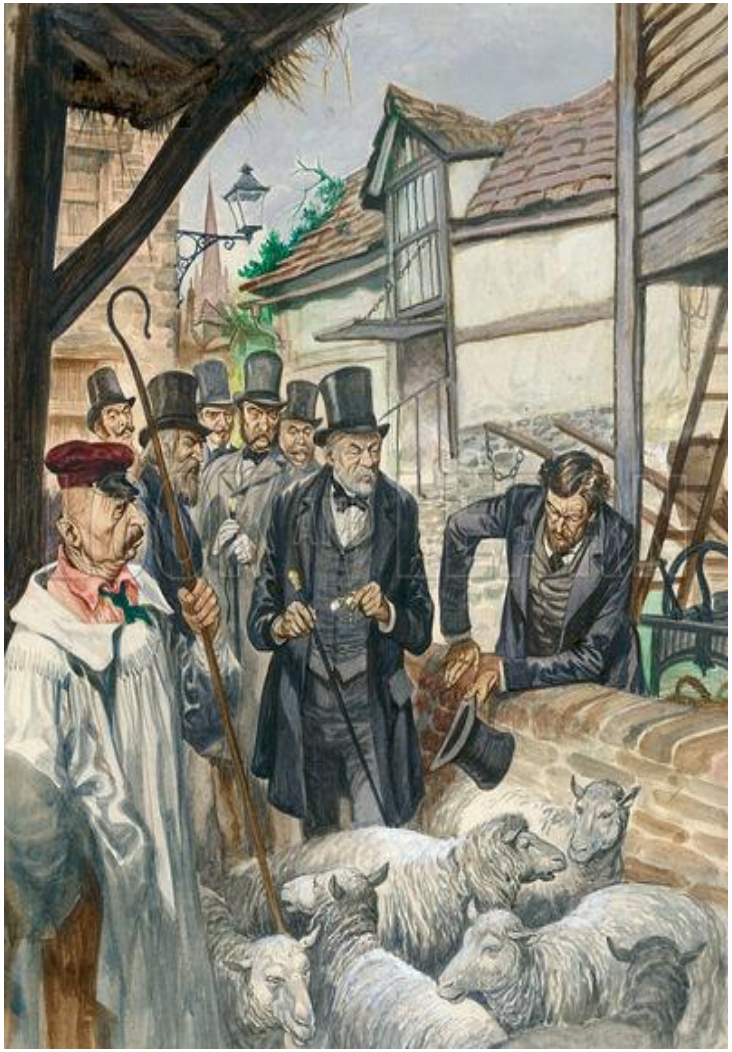
Snow's Spot Map



Snow's work serves as a foundation for descriptive and analytic epidemiologic approaches. He is often referred to as the *Father of Epidemiology*

Louis Pasteur (1822-1895)

- In 1870s, anthrax was a major epidemic that affected farm animals and had severe economic impacts on farmers
- Louis Pasteur believed that a bacteria was the cause of anthrax, however was unclear about the exact association
- **Pasteur demonstrated that microorganisms cause disease > "Cause-effect association" exists between microbes and disease**
- Pasteur went on to develop a vaccine against anthrax that was tested in sheep



Epidemiology Definition

Epi = upon

Demos = population

Logos = study of

The study of how disease is distributed in populations and the factors that influence or determine this distribution.

Epidemiology, Third Edition, Leon Gordis

Key Word: Distribution

Distribution refers to the **frequency** and **pattern** of health and events in a population

Frequency -the number of events, and relationship to the size of population

Pattern – Occurrence of events by time, place, and person

Ex. *Time* patterns – annual, seasonal – *Temporal analysis*

Ex. *Place* patterns – rural, urban, - *Spatial analysis*

Key Words: Determinant & Health Related Events

Determinant (exposure)	Health Related Event (outcome)
Any physical, biological, social, cultural or behavioral factor that influences health	• Disease • Death • Injury • Disability • Decrease in animal production

Determinants (risk factors) ➔ Health related event (outcome)

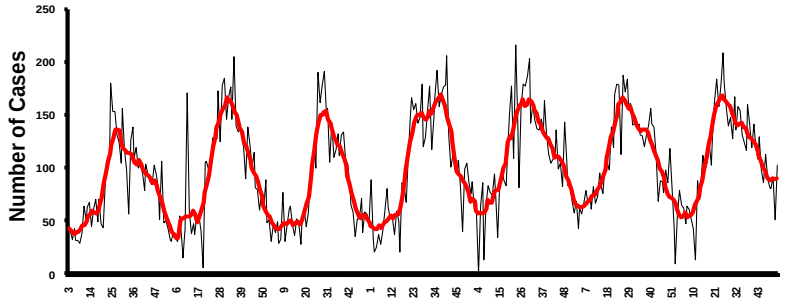
Objectives of Epidemiology

- Identify the **etiology** or cause of disease
- Determine the **magnitude** of disease (impact) and **trends** over time and space
- Determine the **mode of transmission**
- Identify **risk factors** or **protective variables**
- Determine the role of the **environment**
- Identify potential **interventions/control measures**
- Evaluate the **impact** of prevention/control measures

- Definitions and concepts

Definition and concepts

- **Monitoring**



- **Disease Monitoring** describes the ongoing (or repeated) efforts directed at assessing the health and disease status of a given population (e.g. animals or humans).

- **Disease Surveillance** (in contrast to disease monitoring) is characterized by a perspective for actions: disease control, disease eradication, further investigation.

Definition of Epid. Surveillance

- "Ongoing systematic and continuous **collection, analysis and interpretation of health data** (often designed to detect the appearance of specific diseases),

↓

allowing epidemiologists to **follow in time and space** the health status and some **risk factors** associated with diseases for a given population,

↓

for use in the planning, implementation and evaluation of disease **control measures**"

(*Toma et al., 1999*)

Definition of Epid. Surveillance

- Co-existing factors:

- **Descriptive epidemiology**: provide reliable picture of the epidemiological situation (frequency of disease, risk factors, temporal and spatial characteristics),

- **Long term system**: permanent, continuous recording system,

- **Communication**: dissemination of information,

- **Perspectives for actions**: further studies, control measures, eradications.

- General characteristics of a surveillance system

General characteristics of a (public health or veterinary or one health) Surveillance System

- **Systematic:** organized, not haphazard
- **Ongoing**: continuous recording system (not just a one time survey)
- **Analytical:** data is not only collected, but it should also be reviewed and analyzed.
- **Disseminated:** analysis is disseminated
- **Perspectives for actions:** linked to public health/veterinary practices to implement programs and policies to improve practices

Differences between longitudinal surveys and epidemiological surveillance (Adjusted from: Toma *et al.*, 1998)

Parameters	Longitudinal Survey	Epidemiological Surveillance
Duration	Limited	Long term
Quantity of data collected at each time point	Can be considerable	Small
Type of epidemiology	Descriptive or Analytical	Descriptive or Analytical

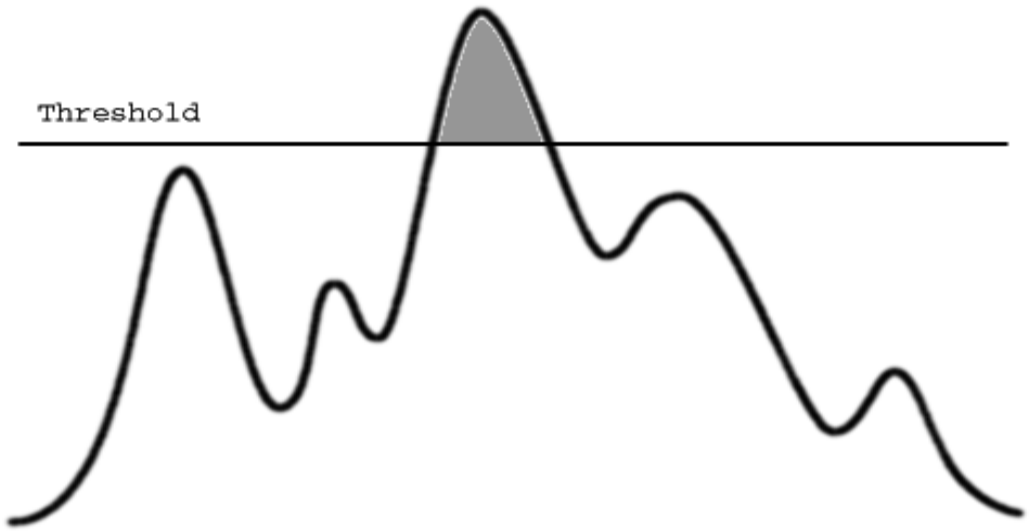
Monitoring vs Surveillance

- Disease Surveillance sytems requires 3 components:

1. A defined disease **monitoring** system
2. A defined **thresold** for disease level (predefined critical level at which action will be taken)
3. A predefined **directed actions** (interventions)

- So surveillance is a specific case of monitoring in which control or eradication measures are implemented whenever **certain threshold levels** related to the infection or disease status have been exceeded

- But what’s a thresold?
- How can we calculate it?



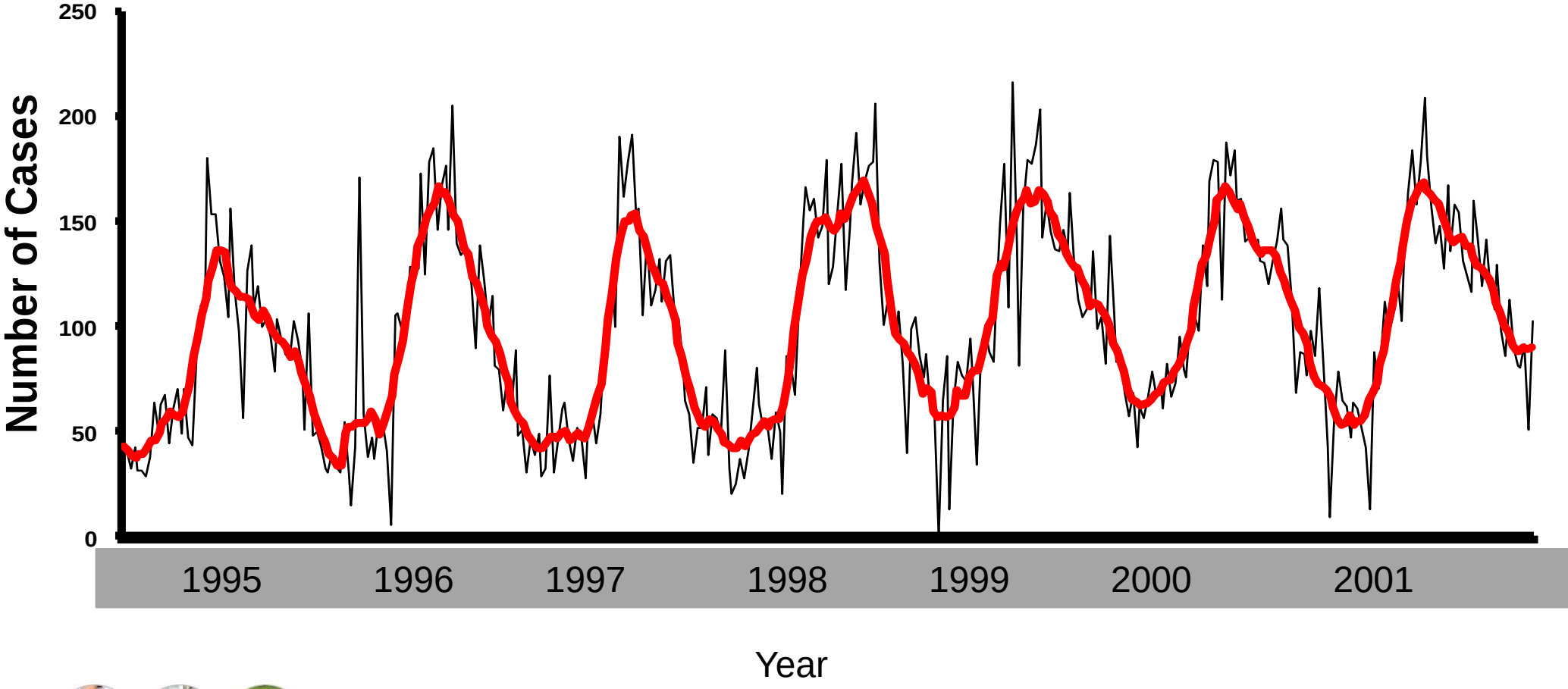
Definitions and concepts: Threshold

- A **marker** that alerts public or veterinary health officials to take action

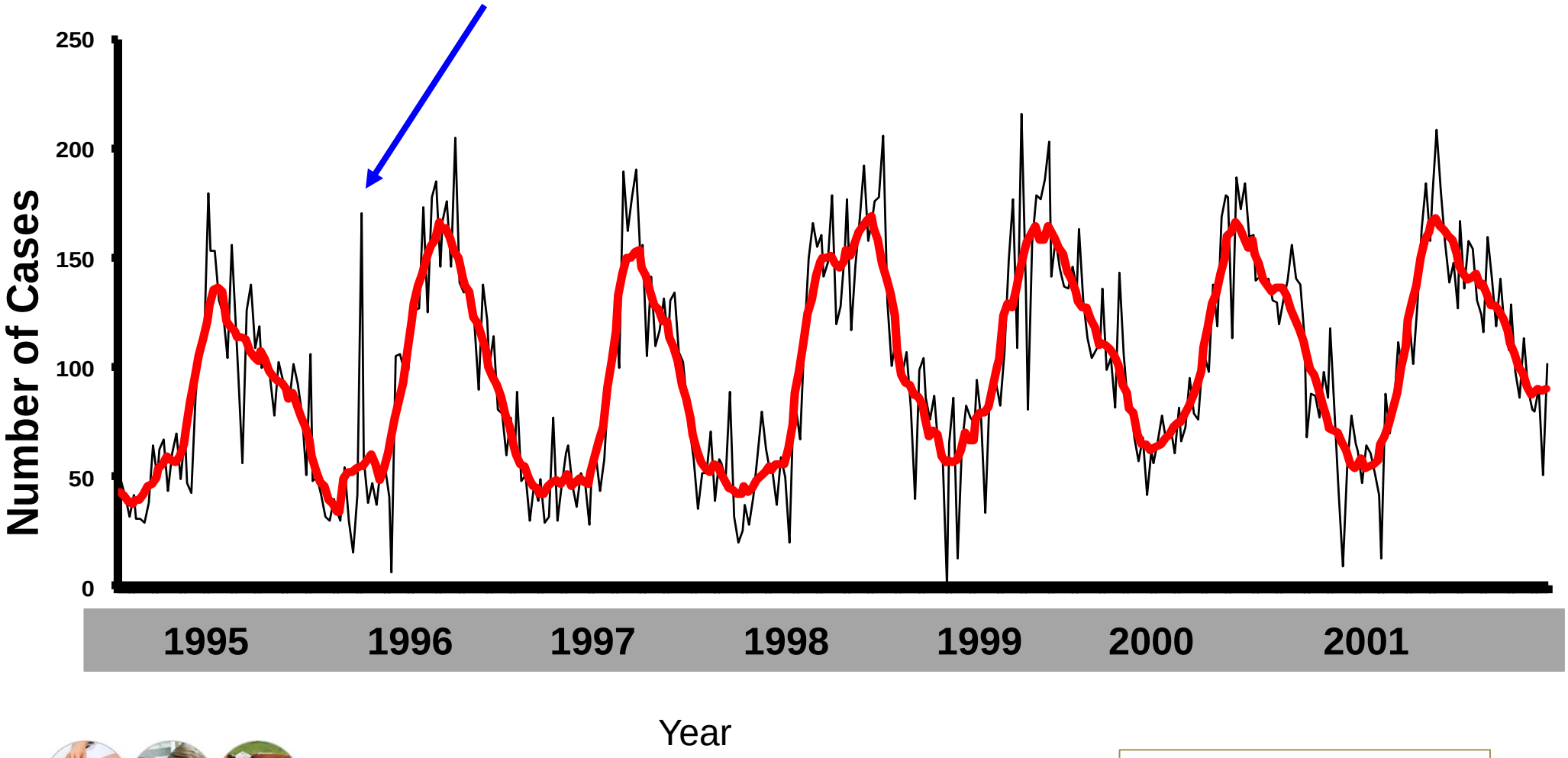
- Use **past data** to decide if a current event is abnormal

- **Help identify possible outbreaks** with surveillance data

Reported diarrhea cases by week, East Amman, Jordan 1995-2000



Do you see an unusual situation? a possible outbreak?



Calculating Expected Cases

- Can be useful to calculate **expected number of cases** for comparison
- "**Baseline**" for what you would expect the number of cases to be
- Often calculated using historical data
  - e.g. the **mean number of cases** for a past period
- Not a threshold in itself, but helps to gain an understanding of what is normal vs. abnormal

Calculating Expected Cases

Diarrhea cases by year and week, Aqaba, Jordan 1997-2001

Year

Week	1997	1998	1999	2000	2001	2002
1	69	36	37	71	59	
2	63	87	72	44	67	
3	10	84	48	39	37	
4	42	97	82	37	48	
5	88	50	80	23	65	?

Calculating Expected Cases

Diarrhea cases by year and week, Aqaba, Jordan 1997-2001

Year

Week	1997	1998	1999	2000	2001	2002
1	69	36	37	71	59	54.4
2	63	87	72	44	67	66.6
3	10	84	48	39	37	43.6
4	42	97	82	37	48	61.2
5	88	50	80	23	65	(61.2)

88 + 50 + 80 + 23 + 65 = 306

306/5 = **61.2 expected cases**

- Objectives of surveillance

Objectives of Surveillance

- Objectives should contribute to improve **epidemiological knowledge** of the situation,
- Objectives need to be **defined in details** before surveillance comes into operation,
- Depending on the objectives, **appropriate surveillance mechanism** (voluntary notification, mandatory notification, sentinel surveillance, structured surveys, outbreak investigation, census) and **type** (active, passive, targeted, sentinel, serological, mixed) will be chosen,
- Often several objectives can become **intertwined**, but it is essential to separate and circumscribe them

Specific objectives of Surveillance

1) Allows rapid detection of **diseases outbreaks**,

2) Support early identification of **diseases problems** (endemic and non-endemic),

3) Provide an **early warning system** able to identify new and emerging diseases,

4) Assess the **health status** of a defined population (estimating level of occurrence/trends among diseases),

5) Confirm **absence** of a specific disease.

Final aims of Surveillance

1. Enable **prompt response** to disease outbreaks,

2. Definition of **priorities** for disease control and prevention (efficient allocation of resources!),

3. **Evaluation** of disease control programmes effectiveness,

4. Provision of information to plan and conduct **research** (development of research hypothesis),

5. Support the planning, development and implementation of **policies** for animal and public health (hierarchy of importance of different diseases),

Surveillance types

Animal health surveillance

- Surveillance may be based on many different data sources and can be classified in a number of ways, including:

- i) the means by which **data** are collected (active versus passive surveillance);
- ii) the **disease focus** (pathogen-specific versus general surveillance); and
- iii) the way in which **units for observation** are selected (structured surveys versus non-random data sources).

(Chapter 1.4. - Animal health surveillance, 2010 © OIE - Terrestrial Animal Health Code)

Types of animal health surveillance

Description available at: http://www.fp7-risksur.eu/sites/default/files/partner_logos/icahs-workshop-2011_surveillance_tewrminology_report_V1.2.pdf

- General surveillance
- Early warning surveillance (epidemiological watch, epidemiovigilance)
- Indicator-based surveillance
- Hazard-specific surveillance
- Syndromic surveillance
- Event-based (media-based, digital) surveillance
- Risk-based surveillance
- Sentinel surveillance
- Participatory surveillance
- **Active** (proactive) surveillance
- **Passive** (reactive) surveillance
- **Enhanced passive** surveillance

Types of animal health surveillance

The distinction between **Passive** and **Active** surveillance is probably among the more important futures in animal health surveillance because the objectives/scopes/expectations are different.

- **Active (proactive) surveillance**: **Investigator-**initiated **collection of animal health related data** using a defined **protocol** to perform actions that are scheduled in advance. Decisions about whether information is collected, and what information should be collected from which animals is made by the **investigator**.

- **Passive (reactive) surveillance: Observer-**initiated **provision of animal health related data** (e.g. voluntary notification of suspect disease) or the use of **existing data** for surveillance. Decisions about whether information is provided, and what information is provided from which animals is made by the data **provider.**

- **Enhanced passive surveillance**: **Observer-**initiated **provision of animal health related data** with active investigator involvement e.g. by actively encouraging producers to report certain types of disease or by active follow up of suspect disease reports.

Active or Passive Surv.?

Passive

Monitor animal populations to detect:

- the undefined
- the unexpected

Active

Seek answer to a specific question about:

- a defined disease or condition
- using agreed mechanism for detection

Both of them are necessary components of National Surveillance Systems

Passive Surveillance

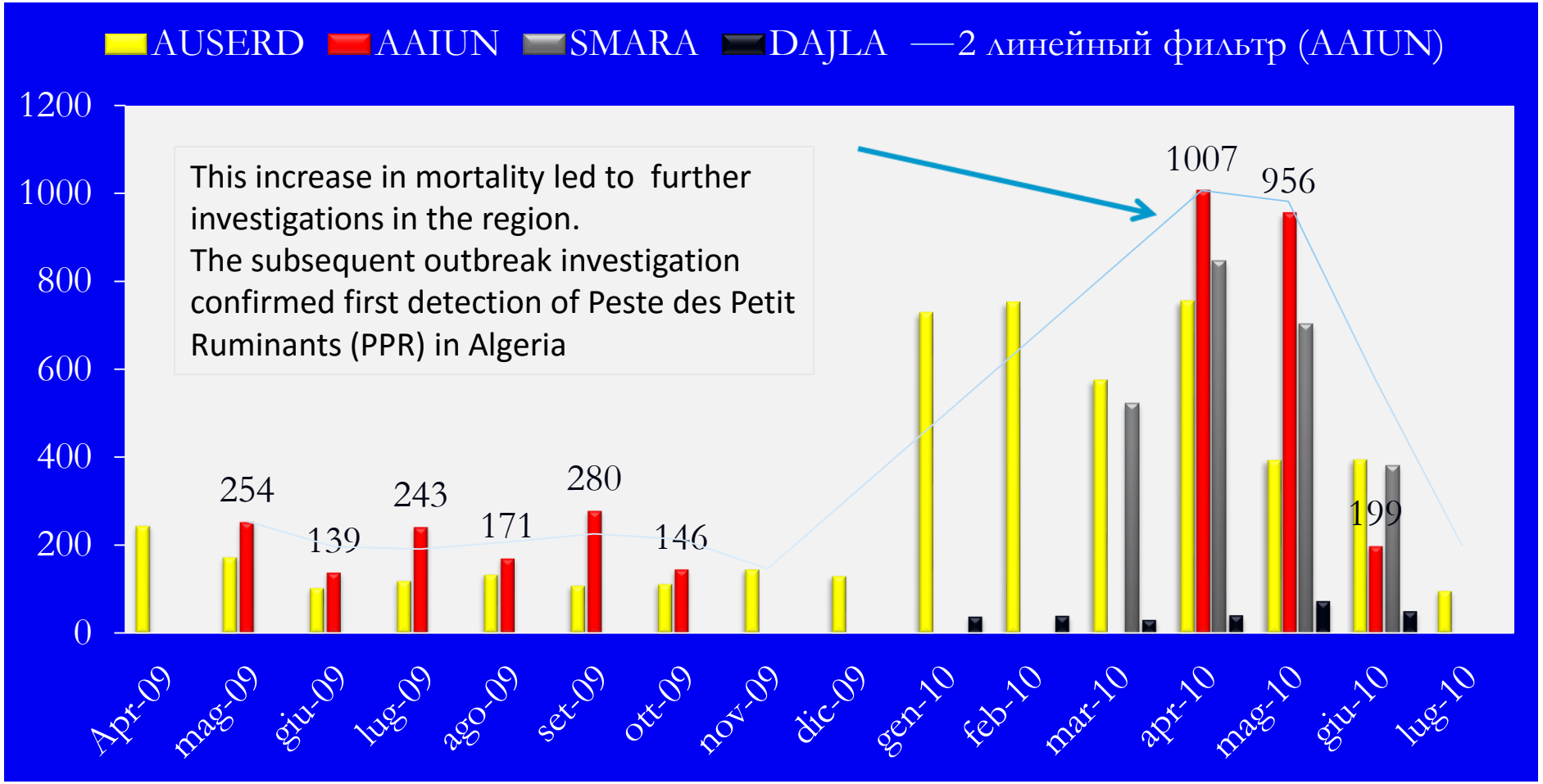
- **Continuous watch** over the endemic (and non endemic) disease profile so that the **unexpected** and **unpredicted** can be detected (early warning system),

- Any surveillance activity based on the **spontaneous or compulsory notification** of cases or suspected cases of a disease under surveillance,

- It is **impossible to know in advance** the amount, type and localization of data that will be collected,

- Possible to define a **threshold level** which will trigger in-depth investigation or to evidentiate an unseasonally excessive number of samples submitted for lab diagnosis

Livestock Mortality data- Saharawi territories (South Algeria)



Transboundary and Emerging Diseases

Transboundary and Emerging Diseases

ORIGINAL ARTICLE

First Evidence of Peste des Petits Ruminants (PPR) Virus Circulation in Algeria (Sahrawi Territories): Outbreak Investigation and Virus Lineage Identification

M. De Nardi[1], S. M. Lamin Saleh[2], C. Batten[3], C. Oura[3], A. Di Nardo[3] and D. Rossi[4]

[1] Istituto Zooprofilattico Sperimentale delle Venezie, Legnaro (PD), Italy
[2] Sahrawi Veterinary Services, Ministry of Public Health, Sahrawi Arab Democratic Republic, Rabouni, Algeria
[3] Institute for Animal Health, Pirbright, UK
[4] Faculty of Veterinary Medicine, University of Bologna, Bologna, Italy

Reccomended actions:

- A contingency plan based on enhanced surveillance and preventive vaccination of small ruminants was therefore promoted to control the disease and to prevent the occurrence of new outbreaks.

Passive Surveillance

- **Data streams (voluntary or statutory):**

1. Notifications from **farmers** and **practicing vets**,
2. Herd information from **pastoralists**,
3. Information from members of the **public**,
4. Notifications from **diagnostic laboratories**,
5. Notifications from **slaughterhouses** (meat insp.),
6. Reports of veterinary inspections at **markets,**
7. Identification of **illegal imports** of animals and animal products,
8. Information resulting from the collation of **worldwide surveillance**

Passive Surveillance

- **Strenghts:**
- Able to detect **unexpected and unpredicted diseases** (!!!),
- **Limited cost** per case detected,

- **Weaknesses:**
- Potential under-reporting (**poor sensitivity**),
- Cannot prove that a specific disease is NOT present (**poor specificity**),
- Cannot determine **disease level** and **geographical patterns**,
- Cannot dimostrate **disease status** to trading partners (i.e. freedom from disease),
- Cannot determine the **importance** in terms of costs, p. health,
- Cannot set priorities, plan, implement and monitor national **disease controls programs**

Active Surveillance

- Any surveillance methods based on a **search for data** through actions scheduled in advance,

- It is possible to **know in advance** the amount, type and localization of the data which will be collected,

- **Options:**

- **Risk-based sampling**: population can be categorized according to the risk of being affected by the outcome (high-risk, low-risk),
- **Population based**: no regards to risk grouping

Active surveillance objectives

- Estimation of **prevalence** of outcomes like clinical disease, infection, sero-positive animals (**prevalence survey-cross sectional surveys**),
- Assessment of **disease presence** or **absence** (**outbreak investigation, flock-herd diagnosis, disease freedom certification**),
- Estimation of **incidence**
- Frequency of **risk factors** and its potential association with survey' outcome (risk estimates: RR, OR)
- Detect **difference** in prevalence or incidence between groups.

Active surveillance

- **<u>Variety of methods:</u>**

1. Exhaustive surveillance/Census
2. Surveillance on representative samples
3. Risk Based/Targeted surveillance
4. Sentinel
5. Combination of methods:

- Application to dairy sector

openaccess Journal
VETERINAIRA
2013 | Volume 1 | Issue 1 | pages 18-20

Short Communication

A population based active disease surveillance of mastitis in cattle

Ghulam Murtaza Arshad[a], Muhammad Ali Shah[b], Khawar Ali Shahzad[c], Azhar Maqbool[a], Athar Ali Khan[a*]

[a]University of Veterinary and Animal Sciences, Lahore, Pakistan
[c]Department of Pathobiology, Arid Agriculture University, Rawalpindi, Pakistan
[c]University of Lahore, 54000, Lahore, Pakistan

Objective: to determine the incidence of clinical and subclinical mastitis under field conditions.

Results: cattle **incidence** of **clinical mastitis** at the five farms was 12.5, 17.64, 16.84, 19.44 and 19.88%, respectively. The fore and hind quarters were the regions with 34.34 and 60.78% infection rate of mastitis, respectively.

The maximum infection rate of mastitis was observed during and after sixth lactation.

Due to mastitis, the **total economic losses** were estimated at Rs. 1, 94,920.00 in all the five clusters, whereas at a farmer level it was Rs.8, 405.00 per annum.

Guidelines for coordinated human and animal brucellosis surveillance

FAO ANIMAL PRODUCTION AND HEALTH PAPER 156

ELSEVIER

Preventive Veterinary Medicine 48 (2001) 73–83

PREVENTIVE VETERINARY MEDICINE

www.elsevier.nl/locate/prevetmed

Incidence of clinical mastitis in Danish dairy cattle and screening for non-reporting in a passively collected national surveillance system

Paul C. Bartlett[a,*], Jens F. Agger[b], Hans Houe[c], Lartey G. Lawson[b]

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[b]Department of Animal Science and Animal Health, Division of Etholog
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[c]Research Centre for the Management of Animal Production

Received 21 September 1999; accepted 1 No

J. Dairy Sci. 96:307–317
http://dx.doi.org/10.3168/jds.2012-5906

A survey of management practices that influence production and welfare of dairy cattle on family farms in southern Brazil

J. H. C. Costa, M. J. Hötzel,[1] C. Longo, and L. F. Balcão
Laboratório de Etologia Aplicada e Bem-Estar Animal (LETA), Departamento de Zootecnia e Desenvolvimento Rural, Universidade Federal de Santa Catarina, Rod. Admar Gonzaga, 1346 Itacorubi, 88034-001, Florianópolis, SC, Brazil

Surveillance vs Inspection

Def. inspection:

- an inspection is, most generally, an organized **examination** or formal **evaluation** exercise.
- In government, an inspection is the act of a monitoring authority administering an official **review of various criteria** (such as documents, facilities, records, and any other assets)
- Inspections are used for the purpose of determining if a **body is complying with regulations**.
- The inspector examines the criteria and talks with involved individuals. A report and evaluation follows such visits.

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- "Ongoing systematic and continuous **collection, analysis and interpretation of health data** (often designed to detect the appearance of specific diseases),

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allowing epidemiologists to **follow in time and space** the health status and some **risk factors** associated with diseases for a given population,

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for use in the planning, implementation and evaluation of disease **control measures**"

(*Toma et al., 1999*)

- Is there any difference?

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Thanks