

Strengthening IPC for Effective Epidemic Preparedness

FOCAL PERSONS IPC TRAINING

Topic: Principles of Epidemiology



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Principles of Epidemiology

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Objectives

- To be able to define epidemiology
- To understand the scope of epidemiology
- To describe the aims of Epidemiological approach
- To understand the evolution of epidemiology
- To be able to state the uses of epidemiology



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Outline

- Introduction
- Definition of epidemiology
- Aims of epidemiology
- Evolution of the science of epidemiology
- Uses of epidemiology



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Introduction

- Basic science underpinning public health practice
- Comparatively new discipline
- Population-based medicine



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Epidemiology

From Greek word

- Epid: on or upon
- Demos: people
- Logy: study of

Initially concerned with study of epidemics



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Definition

- Epidemiology is the study of the **occurrence** and **distribution** of **disease, health-related states or events** in **specified populations**, and the **application** of this knowledge to **control** the health problems.

(Last J.M. 1988. A Dictionary of Epidemiology, 2nd ed.)

- The study of the distributions and determinants of disease frequency in human populations (MacMahon and Pugh, 1970)



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Concepts

A look at the key words will help illuminate the meaning:

Study—Epidemiology is the basic science of public health. It's a highly quantitative scientific discipline based on principles of statistics and research methodologies.

- Study includes surveillance, observation, hypothesis testing, analytic research, outbreak investigations and experiments etc.



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Distribution

Distribution—Epidemiologists study the distribution of frequencies and patterns of health events within groups in a population.

- To do this, they use descriptive epidemiology, which characterizes health events in terms of time, place, and person.



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Determinants

- Determinants**—the search for **causes or factors** that are associated with increased risk or probability of disease.
- This type of epidemiology, where we move from questions of "who," "what," "where," and "when" and start trying to answer "how" and "why," is referred to as analytical epidemiology.



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Health related states

Health-related states—Although infectious diseases were clearly the focus of much of the early epidemiological work, this is no longer true.

- Epidemiology is applied to the whole spectrum of health-related events, which includes:
 - Chronic disease,
 - Communicable & non-communicable dx,
 - Environmental problems,
 - Behavioural problems,
 - Accidents and injuries in addition to infectious disease.



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Health related states..2

Diseases

- Infectious disease epidemiology
- Cancer epidemiology
- Cardiovascular disease epidemiology
- Neuro-epidemiology
- Renal epidemiology
- Intestinal epidemiology
- Respiratory Epidemiology
- Oral/Dental epidemiology
- Psychiatric/Mental Health Epidemiology



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Health related states..3

Other states or events

- Obesity
- Infertility
- Violence
- Rape
- Injuries
- Torture



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Populations

Populations—One of the most important distinguishing characteristics of epidemiology is that it deals with groups of people rather than with individual patients.

- Specified population, could be of:
 - Humans
 - Animals
 - Organism
 - Specific profession etc.
- Exposures (source and action that cause and illness), number of persons affected, number at risk, number exposed and potential for disease spread in a given population of interest to epidemiologist not single patient.



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Control

- **Control**—Epidemiological data steers public health decision making and aids in developing and evaluating interventions to control and prevent health problems.
- This is the primary function of applied, or field, epidemiology.
- Study of impact of actions to deter or treat a disease – *experimental epidemiology*



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Aims of Epidemiology

- Understand the causation of disease
- Explain local disease patterns
- Describe and elucidate the natural history of disease and the effect of treatments
- Inform disease control and prevention programmes, public health planning and evaluation



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Epochs in the evolution of Epidemiology

- Period of observation - relating disease to the environment: Hypocrates
- Period of counting numbers: John Graunt
- Period of natural experiments: William Farr, John Snow, Doll and Hill, Framingham Heart study in Massachusetts
- Period of experimental studies: Edward Jenner, John Lind



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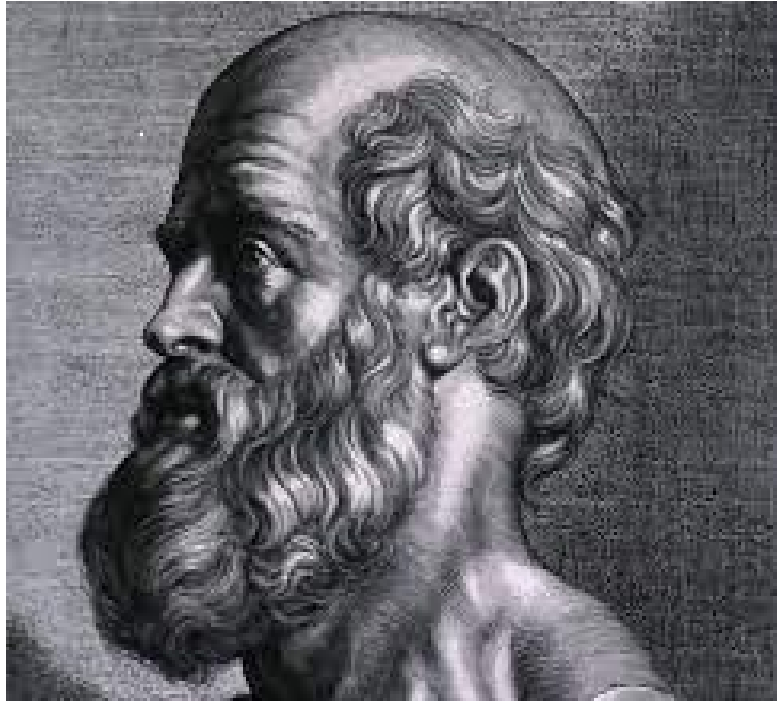
Historical Background

- **Hippocrates** – '*On Airs, Waters, and Places*', gave birth to the idea that disease might be associated with the physical environment, and this was a movement from supernatural explanation of origin disease to a rational basis of disease causation.
- **Lind James**: Observed the effect of **time, place, weather and diet** on spread of disease. He experimented with mariners using limes. Lind performed one of his most important experiments on curing **scurvy** in 1747.
- Many people knew that far more sailors on British warships died from scurvy than from battle.



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Hippocrates



James Lind



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History ..2

- **Edward Jenner** :an English physician who is credited with successfully introducing the practice of vaccinating against **smallpox**.
- In 1796 he inoculated James Phipps, an 8-year-old son of a local farmer. Phipps was exposed to fluid from the pustules of a woman with cowpox.
- The boy contracted cowpox, and several weeks later Jenner exposed him to smallpox.
- Fortunately, the boy didn't contract smallpox and Jenner's theory was proved correct.
- He named his therapeutic discovery vaccination after the Latin word "vacca" for cow, and vaccinia for cowpox



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Edward Jenner



History ...3

- **Semmelweis Ignaz**, was the one who associated “childbed fever”(puerperal fever) with lack of handwashing among doctors and medical students. He instituted hand washing and is today known as the **father of handwashing**.
- **Typhoid Mary**: Mary Mallon was a healthy carrier of typhoid who worked as a cook and was responsible for spreading the dx to many families. She was eventually quarantined where she died.
- **Bernardino Ramazzini**: An Italian physician, regarded as the Father of occupational Medicine. He was a pioneer in the fields of epidemiology, trade diseases, and industrial hygiene.



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- He systematically identified health hazards in more than forty occupations, including mining, midwifery, pharmacy, painting, printing and gilding.
- By recognizing the relationship between certain metals and the artisans who used them, Ramazzini effectively launched the science of industrial medicine.
- **John Graunt**-founder of demography, he used analysis of the mortality in London to present one of the **first life tables** and reported **time trends** for many diseases, new and old.
- He provided **statistical evidence** for many theories on disease and refuted many widespread ideas on them.



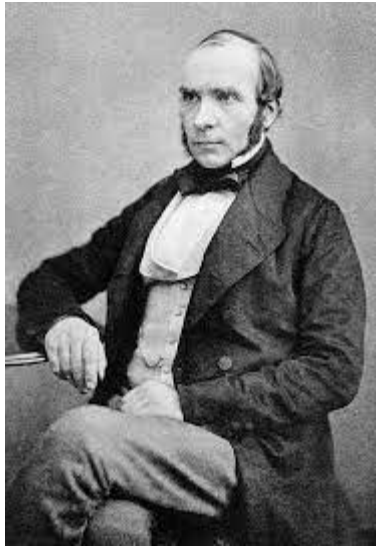
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Natural experiment.... John Snow

- Father of field epidemiology
- Classical elucidation of reasoning from descriptive studies to intervention studies
- 1854: Cholera in Golden Square London
 - Started by finding out where each person lived and worked. Developed spot map
 - Believed water was source of infection, marked location of water pumps. Cases clustered round particular water pump
 - Hypothesis, that water from that pump was source of infection
 - Collected information on source of water to households and cholera deaths
 - Computed rates of mortality by water source. Death rates from districts served by Vauxhall and Southwark were 5.5 times higher than those served by Lambeth
 - He got authorities to stop water supply from that tap and epidemic aborted.



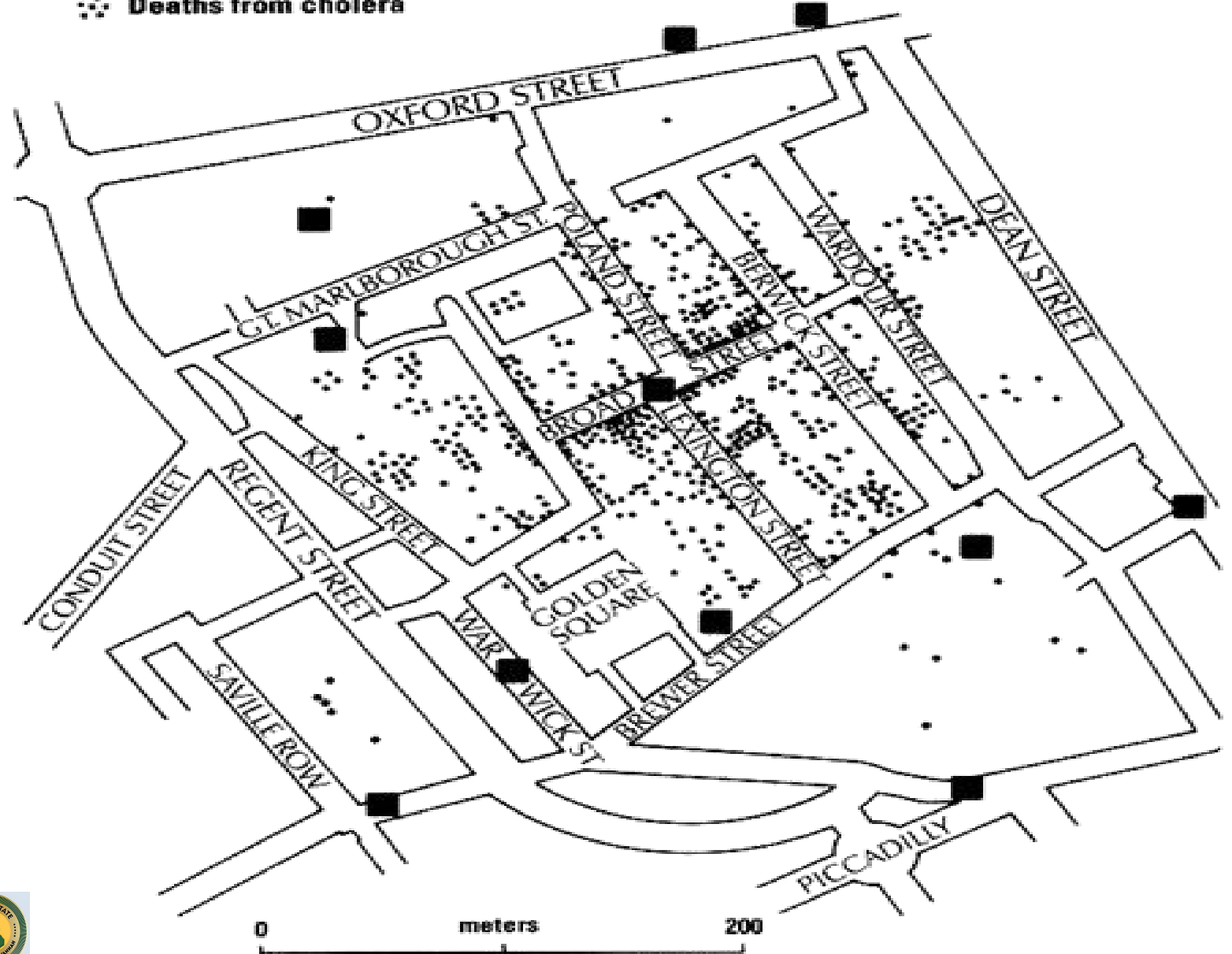


John Snow

Cholera Outbreak 1854

**Examined cholera
according to water
source**

■ Pump sites
●●●●● Deaths from cholera



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John Snow

John Snow

1854

Cholera outbreak in Soho

Examined cholera according to water supply

Water Supply	Mortality from Cholera per 100,000
Southwark and Vauxhall	844
Both companies (mixed)	60
Lambeth	16
House in mixed area supplied by Southwark and Vauxhall	652
House in mixed areas supplied by Lambeth	37



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Uses of Epidemiology

- To describe the pattern of disease in human populations
 - What is the burden of disease in a community?
 - What are the actual and potential health problems in a community?
 - How does the distribution of the disease differ from one community to another, in different individuals and over time?
 - Who are the people at risk?
 - How do the distribution of health problems relate to distribution of health services?
 - Information used for rational planning of health services and programmes



Uses of Epidemiology..2

- To determine the aetiology and risk factors that increase the risk of development of a disease
 - How is disease transmitted from one person to another?
 - Which exposures or behaviours increase risks of ill health?
- Information useful for developing preventive interventions to reduce morbidity and mortality



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Uses of Epidemiology..3

- To study the natural history of a disease
 - What is the spectrum of the disease?
 - What are the different modes of presentation of the disease?
- The information allows for making a prognosis and for deciding news ways of intervention either through treatment or prevention of complications.



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Uses of Epidemiology..4

- To evaluate the impact of health interventions, either preventive or therapeutic measures or modes of health care delivery
 - For example:
 - Does measles immunization protect against measles?
 - Does screening for prostate specific antigens (PSA) improve survival from prostate cancer?
 - Does managed care and other patient management modalities improve the quality of life? Etc.



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Other uses of Epidemiology

- To provide a foundation for making public health policy and making regulatory decisions relating to environmental problems
- For classification of diseases
- For informing peoples choices relating to lifestyle and behaviour



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Matching the Questions to the Study Design

- What types of questions are there?
- What types of study are there?



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What does the epidemiologist want to know?

- Case definition (what)
- Person (who)
- Place (where)
- Time (when)
- Causes (how and why)



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What sorts of questions are there?

- Descriptive
 - What or how much?
- Analytic
 - What is the cause?
- Risk
 - How much harm can this exposure cause me?
- Prognosis
 - How long have I got?
- Effectiveness
 - What is the best treatment?
- Value for money
 - What provides the best outcome for the least cost?
- Acceptability
 - What type of treatment options are preferred by the community?

What type of studies are there?

- Descriptive
 - Ecological
 - Cross-sectional
 - Survey
 - Prevalence study
- Analytic
 - Case-control
 - Cohort
- Intervention Studies
 - Clinical trials
 - Field trials
 - Community trials



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Exercise: determine study design

- Which are the groups at highest risk of tuberculosis?
- Why are there different rates of HIV/AIDS in different countries?
- Are Dalkon shield tampons responsible for Toxic Shock Syndrome?
- Why was there a sudden rise in young women with vaginal cancer?
- What are the health consequences of exposure to aluminium sulphate in the water supply?
- Does use of condoms protect against HIV infection?



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Thank you!!

- Questions?
- Comments?



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