Al-Farabi Kazakh National University

Introduction to Epidemiology

lecture

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History of Cholera

https://www.youtube.com/watch?v=jG1VNSCsP5Q

Definitions

Health: A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO,1948)

Disease: A physiological or psychological dysfunction

Illness: A subjective state of not being well

Sickness: A state of social dysfunction

https://www.youtube.com/watch?v=htUswNThzO4

Definitions…

Public health

The science & art of

Preventing disease,

prolonging life,

promoting health & efficiency

through organized *community effort* (Winslow, 1920)

Definitions…

Epidemiology

It is the *study* of *frequency*, *distribution*, and *determinants* of *diseases* and *other health-related* conditions in a human *population*

and

the *application* of this study to the prevention of disease and promotion of health

Components of the definition

1.Study: Systematic collection, analysis and interpretation of data

Epidemiology involves collection, analysis and interpretation of health related data

Epidemiology is a science

Components…

2. ***Frequency***: the number of times an event occurs

Epidemiology studies the number of times a disease occurs

It answers the question ***How many***?

Epidemiology is a quantitative science

Components…

3. ***Distribution***: Distribution of an event by person, place and time

Epidemiology studies distribution of diseases

It answers the question ***who, where and when?***

Epidemiology describes health events

Components…

4. ***Determinants***: Factors the presence/absence of which affect the occurrence and level of an event

Epidemiology studies what determines health events

It answers the question how and why?

Epidemiology analyzes health events

DETERMINANTS (source)

HOST FACTORS	SOCIO-ECONOMIC FACTORS	ENVIRON-MENTAL FACTORS	LIFE STYLE FACTORS	OTHER FACTORS
- Genes - Gender - Age	- Poverty - Employment - Isolation	- Air quality - Water quality - Occupational environment - Home environment - Social environment	- Nutrition - Physical activity - Tobacco - Alcohol - Drugs - Sexual activity	-Education -- Health care system - Transport. - Recreation

Components…

5. ***Diseases & other health related events***

Epidemiology is not only the study of diseases

The focus of Epidemiology are not only patients

It studies all health related conditions

Epidemiology is a broader science

Components…

6. ***Human population***

Epidemiology diagnoses and treats communities/populations

Clinical medicine diagnoses and treats patients

Epidemiology is a basic science of public health

Components…

7. *Application*

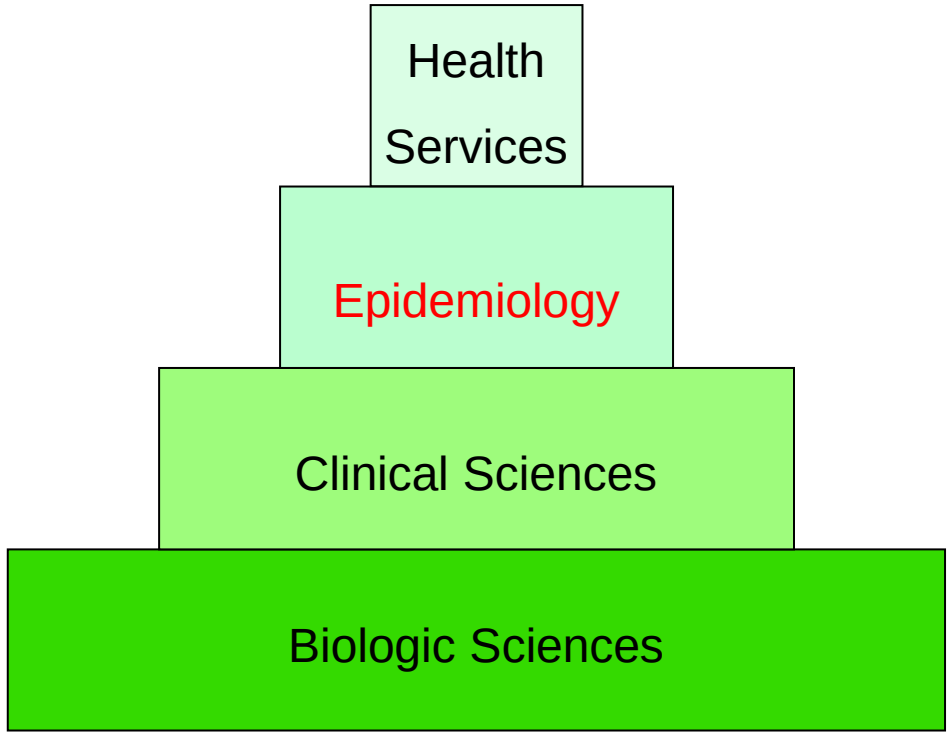
Epidemiological studies have direct and practical applications for prevention of diseases & promotion of health

Epidemiology is a science and practice

Epidemiology is an applied science

HEALTH SCIENCES

RESEARCH FIELD	PRIMARY FOCUS
Health Services	Health care systems
Epidemiology	Populations
Clinical Sciences	Individual patients
Biologic Sciences	Human & animal models, cells & transmitters, molecules, genes, drugs development



Source: Fletcher R.W., Fletcher S.W.: Clinical Epidemiology. The essentials .Lippincott Williams & Wilkins 2005

EPIDEMIOLOGY versus CLINICAL MEDICINE

PRINCIPAL TASKS

CLINICAL MEDICINE	EPIDEMIOLOGY
Diagnosis	Epidemiological study
Treatment	Prevention, health promotion
Prognosis	Risk assessment

History of Epidemiology

Seven land marks in the history of Epidemiology

1. ***Hippocrates*** (460BC): Environment & human behaviors affects health
2. ***John Graunt*** (1662): Quantified births, deaths and diseases
3. ***Lind*** (1747): Scurvy could be treated with fresh fruit

History…

4. ***William Farr*** (1839): Established application of vital statistics for the evaluation of health problems
5. ***John Snow*** (1854): tested a hypothesis on the origin of epidemic of cholera
6. ***Alexander Louis*** (1872): Systematized application of numerical thinking (quantitative reasoning)

History…

7. ***Bradford Hill*** (1937): Suggested criteria for establishing causation

Epidemiological thought emerged in 460 BC

Epidemiology flourished as a discipline in 1940s

Scope of Epidemiology

Originally, Epidemiology was concerned with investigation & management of ***epidemics*** of communicable diseases

Lately, Epidemiology was extended to endemic communicable diseases and non-communicable infectious ***diseases***

Recently, Epidemiology can be applied to ***all*** diseases and other health related events

Purpose/use of Epidemiology

The ultimate purpose of Epidemiology is prevention of diseases and promotion of health

How?

1. Elucidation of natural history of diseases
2. Description of health status of population
3. Establishing determinants of diseases
4. Evaluation of intervention effectiveness

Types of Epidemiology

Two major categories of Epidemiology

1.Descriptive Epidemiology

Defines ***frequency*** and ***distribution*** of diseases and other health related events

Answers the four major questions: ***how many, who, where, and when?***

Types…

2. *Analytic Epidemiology*

Analyses ***determinants*** of health problems

Answers two other major questions: ***how***? and ***why***?

Generally, Epidemiology answers six major questions: *how many, who, where, when, how and why?*

Basic Epidemiological assumptions

1. Human diseases doesn't occur at ***random*** or by chance

2. Human diseases have ***causal*** and ***preventive*** factors

Basic features of Epidemiology

1. Studies are conducted on human population
2. It examines patterns of events in people
3. Can establish cause-effect relationship without the knowledge of biological mechanism
4. It covers a wide range of conditions
5. It is an advancing science

Core Epidemiologic Functions

- public health surveillance
- field investigation
- analytic studies
- Evaluation
- Linkages
- policy development,

Public health surveillance

- Public health surveillance is the ongoing, systematic collection, analysis, interpretation, and dissemination of health data to help guide public health decision making and action
- Surveillance is equivalent to monitoring the pulse of the community.
- The purpose of public health surveillance, which is sometimes called “information for action,” is to portray the ongoing patterns of disease occurrence and disease potential so that investigation, control, and prevention measures can be applied efficiently and effectively.

Gathering information and establishing surveillance

- Case series

  - interview cases, doctors

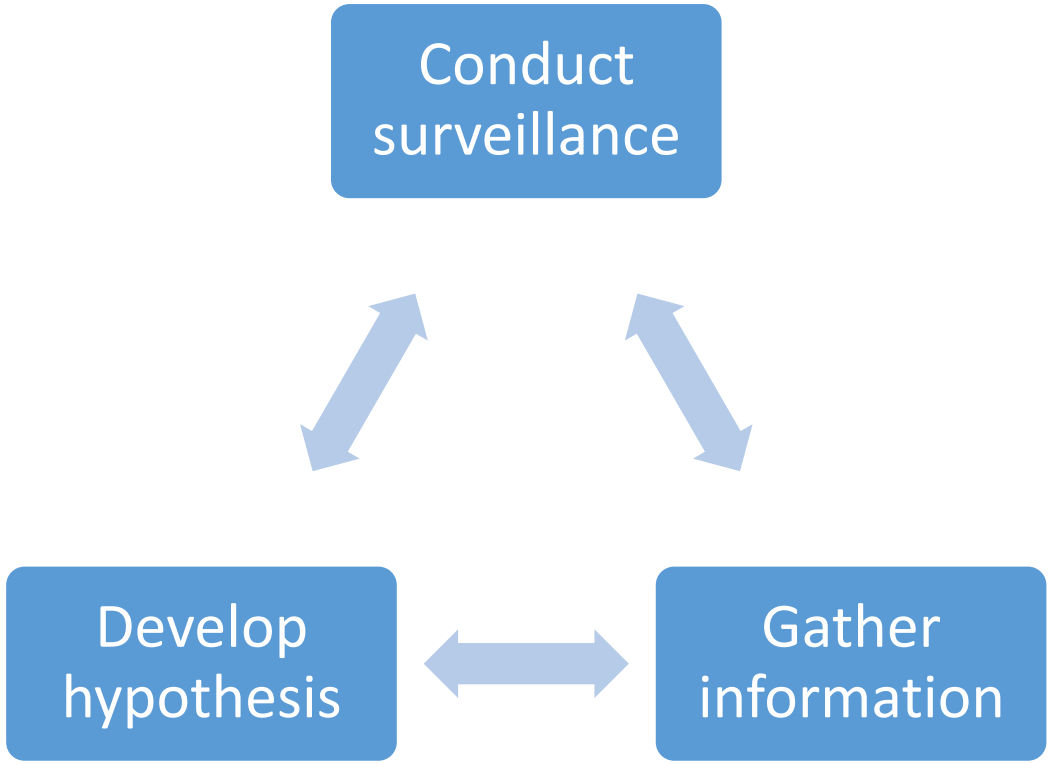
  - review medical records

  - laboratory diagnostic testing

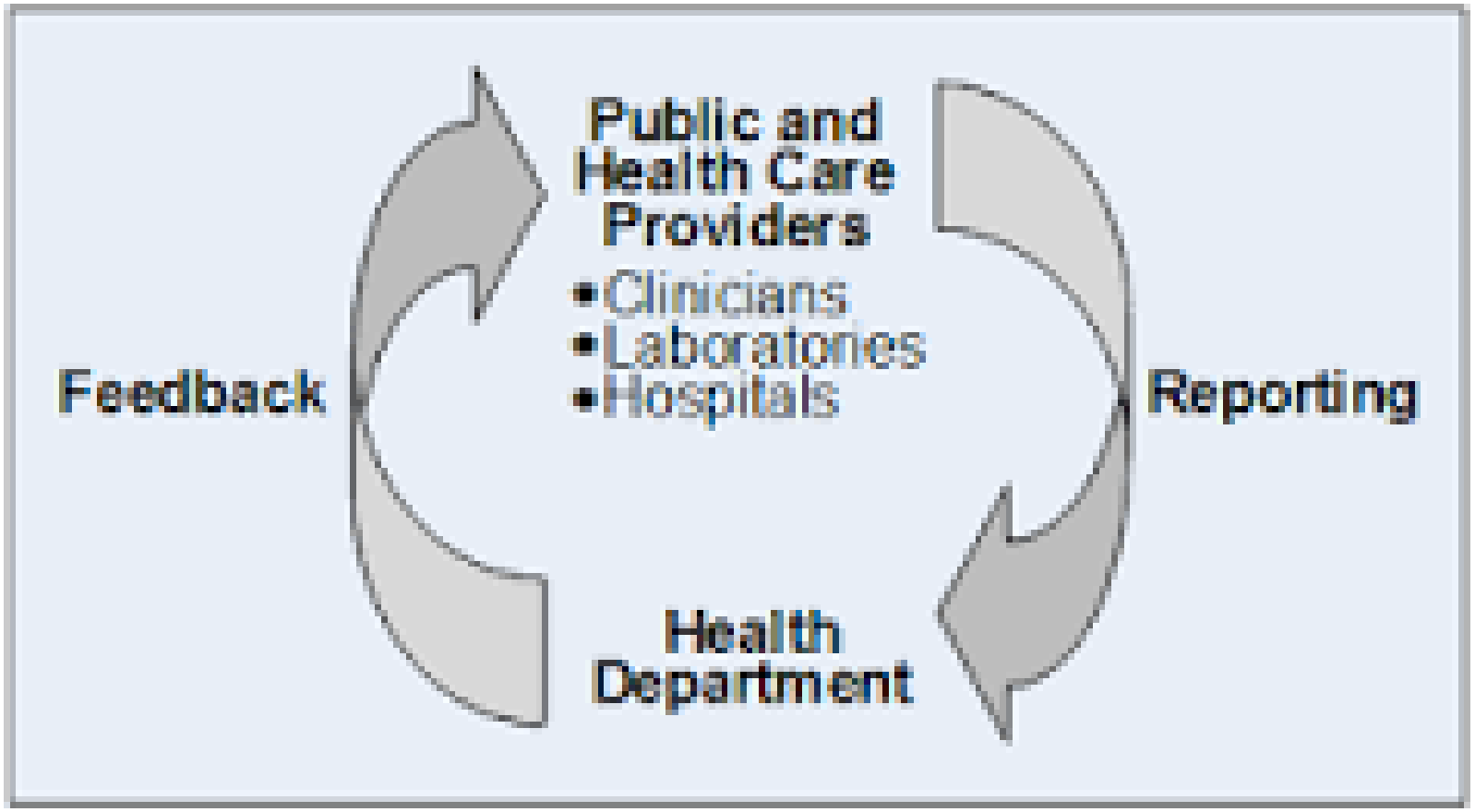
- Surveillance

  - local doctors

  - occupational physician at the plant



Surveillance Cycle



Field investigation

- The investigation is as a phone call to a field investigation requiring to characterize the extent of an epidemic and to identify its cause.
- The objectives of investigations are to learn about the natural history, clinical spectrum, descriptive epidemiology, and risk factors of the disease.
- For example, Early investigations of the epidemic of SARS in 2003 were needed to establish a case definition based on the clinical presentation, and to characterize the populations at risk by time, place, and person. As more was learned about the epidemiology of the disease and communicability of the virus, appropriate recommendations regarding isolation and quarantine were issued
- Surveillance and Field investigation is usually sufficient to identify causes, modes of transmission, and appropriate control and prevention measures.

Analytical studies

- Studies that use of a valid comparison group, and include design, conduct, analysis, interpretation, and communication of findings.

• Design - determining the appropriate research strategy and study design, writing justifications and protocols, calculating sample sizes, deciding on criteria for subject selection (e.g., developing case definitions), choosing an appropriate comparison group, and designing questionnaires.

• Conduct involves securing appropriate clearances and approvals, adhering to appropriate ethical principles, abstracting records, tracking down and interviewing subjects, collecting and handling specimens, and managing the data.

• Analysis begins with describing the characteristics of the subjects; to calculation of rates, creation of comparative tables (e.g., two-by-two tables), and computation of measures of association (e.g., risk ratios or odds ratios), tests of significance (e.g., chi-square test), confidence intervals, and the like.

• Interpretation involves putting the study findings into perspective, identifying the key take-home messages, and making sound recommendations.

Evaluation

Evaluation is the process of determining, as systematically and objectively as possible, the relevance, effectiveness, efficiency, and impact of activities with respect to established goals.

- Effectiveness refers to the ability of a program to produce the intended or expected results in the field; effectiveness differs from efficacy, which is the ability to produce results under ideal conditions.
- Efficiency refers to the ability of the program to produce.

Epidemiologists, who are accustomed to using systematic and quantitative approaches, have come to play an important role in evaluation of public health services and other activities.

Linkages

- Investigation means work in a multidisciplinary team: epidemiologists, laboratorians, sanitarians, infection control personnel, nurses or other clinical staff, and, computer information specialists.
- Due to outbreaks cross geographical and jurisdictional lines, so co-investigators may be from local, state, or federal levels of government, academic institutions, clinical facilities, or the private sector.
- To promote current and future collaboration, the epidemiologists need to maintain relationships with staff of other agencies and institutions.
- Mechanisms for sustaining such linkages include official memoranda of understanding, sharing of published or on-line information for public health audiences and outside partners, and informal networking that takes place at professional meetings.

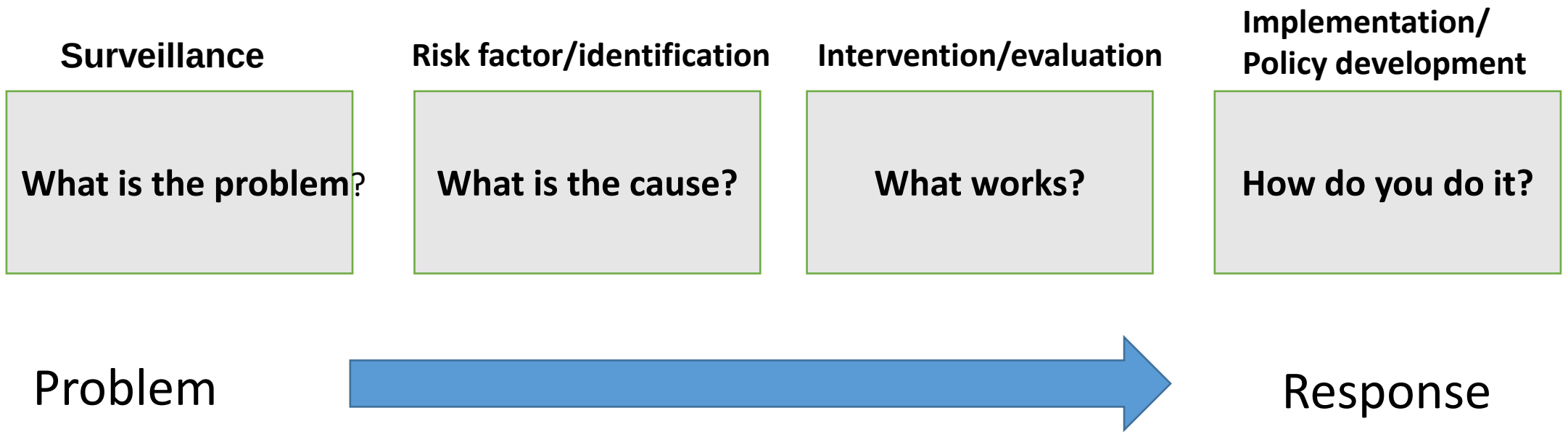
Policy development

- The definition of epidemiology ends with the following phrase: “...and the application of this study to the control of health problems.”
- While some academically minded epidemiologists have stated that epidemiologists should stick to research and not get involved in policy development or even make recommendations, public health epidemiologists do not have this luxury.
- Indeed, epidemiologists who understand a problem and the population in which it occurs are often in a uniquely qualified position to recommend appropriate interventions.
- As a result, epidemiologists working in public health regularly provide input, testimony, and recommendations regarding disease control strategies, reportable disease regulations, and health-care policy.

Core Epidemiologic Functions

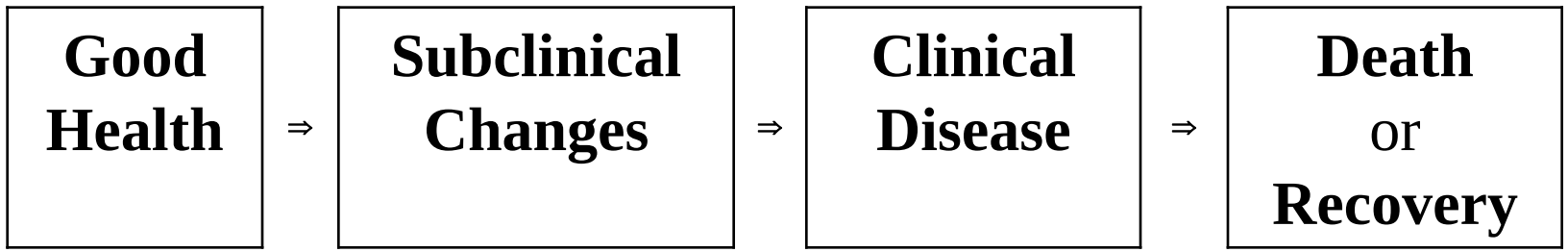
- Public Health Surveillance
- Field investigation
- Analytical Studies

- Evaluation
- Linkages
- Policy development



EPI CONTRIBUTION TO MEDICAL RESEARCH

I – INVESTIGATION INTO NATURAL HISTORY OF DISEASES

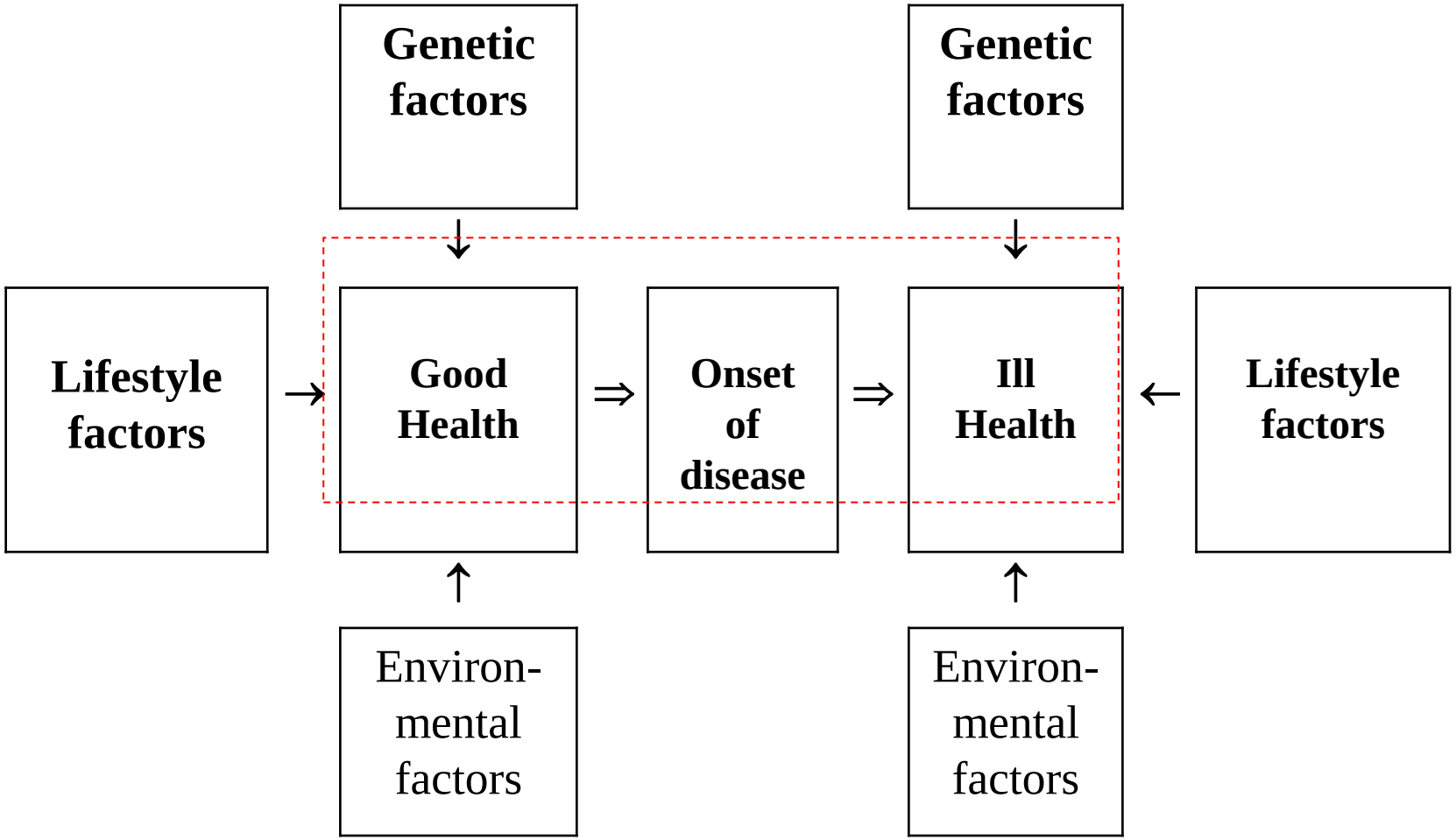


EPI CONTRIBUTION TO MEDICAL RESEARCH

II – DESCRIPTION OF HEALTH STATUS OF POPULATION

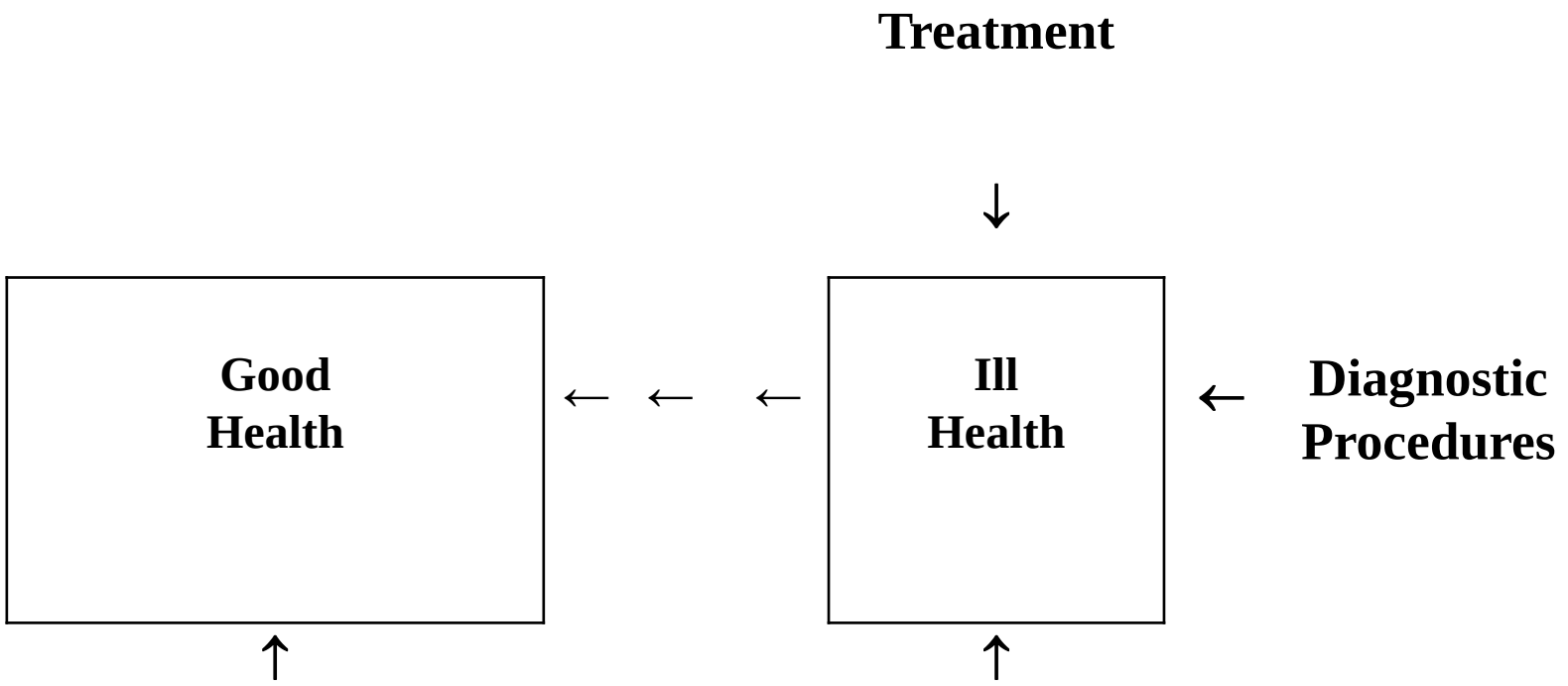
EPI CONTRIBUTION TO MEDICAL RESEARCH

III – EXPLORATION OF CAUSATION

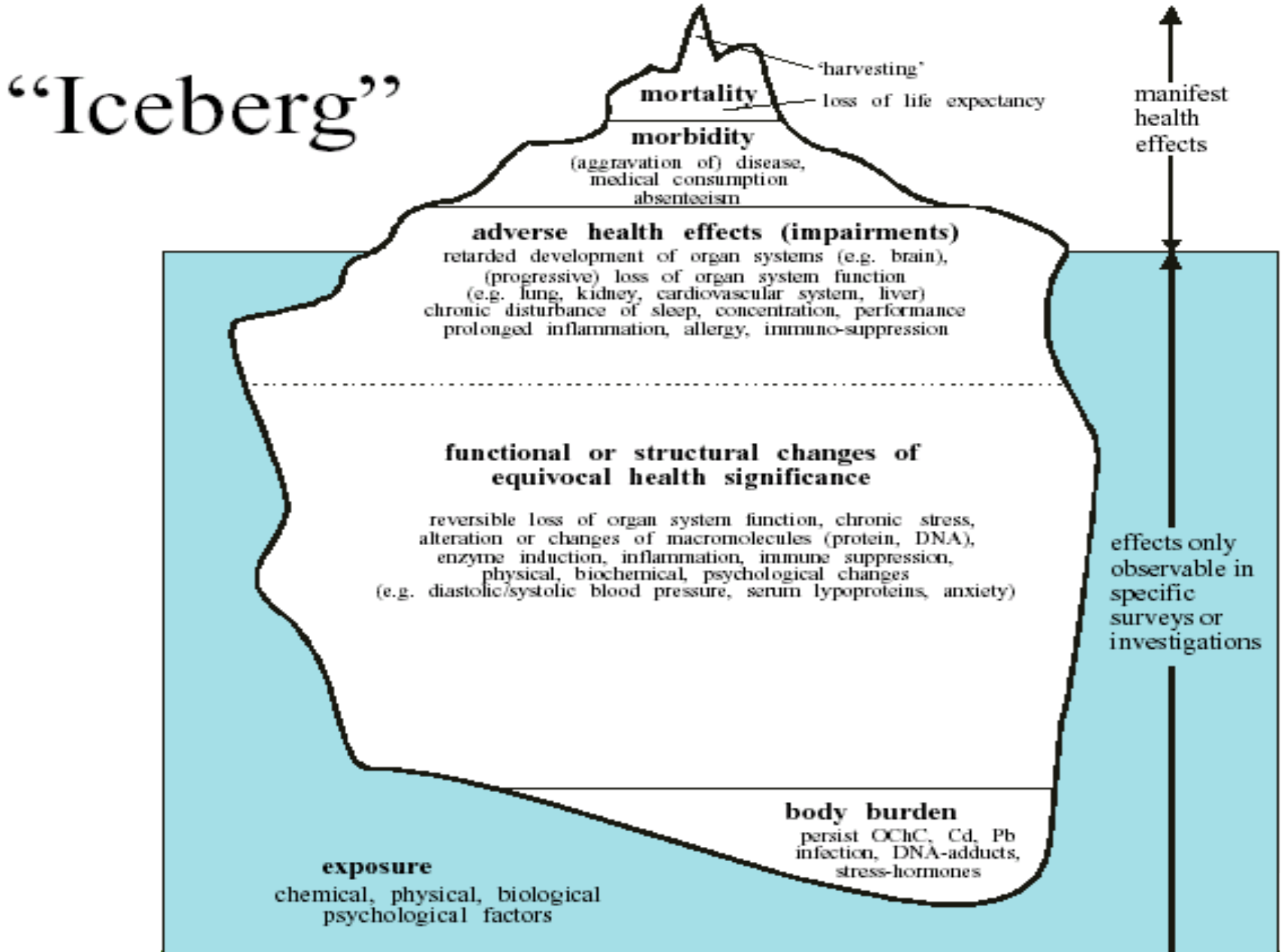


EPI CONTRIBUTION TO MEDICAL RESEARCH

IV – EVALUATION OF INTERVENTION



HEALTH-RELATED PHENOMENA



From Observational Data to Preventive Action

- Edward Jenner 1768 heard

  "I cannot take the smallpox for I have already had cowpox."

  – A dairy maid

- John Snow

  - " Cholera was transmitted through contaminated water"

  - The intake of water companies in London was in a very polluted part of Thames river

The objectives of Epidemiology

1.To identify the etiology or the cause of a disease and the risk factors-that is, factors that increase a person's risk for a disease.

2. To determine the extent of disease found in the community.

3. To study the natural history and prognosis of disease.

4.To evaluate both existing and new preventive and therapeutic measures and modes of health care delivery.

5. To provide the foundation for developing public policy and making regulatory decisions relating to environmental problems.

Epidemiology and prevention

- Identifying subgroups in the population whoa re at high risk.
  - Proper direction of preventive efforts
  - Identify modifiable and non-modifiable factors or characteristics
- Prevention
  - Primary
  - Secondary
- Approach
  - Population based
  - High-risk

The Epidemiologic Approach

- Association between exposure to a factor and development of a disease
  - Is the association statistically significant?
  - Can it be explained by bias?
- Is the relationship causal?
  - Is the association consistent with other data?
  - Are the criteria for causality met?

Example

- Flouride and dental caries

Conclusion

- Epidemiology is an invaluable tool for providing the rational basis on which effective prevention programmes can be planned and implemented and for conducting clinical investigations that contribute to the control of disease and to the amelioration of the human suffering associated with it

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