USAID
FROM THE AMERICAN PEOPLE

Food and Agriculture Organization of the United Nations

The Online R-FETPV 1st Module : Basic Epidemiology and Surveillance Data Analysis

5 April -28 May 2021

USAID FROM THE AMERICAN PEOPLE

Department of Livestock Development

Food and Agriculture Organization of the United Nations

R-FETPV Regional Field Epidemiology Training Program for Veterinarian

Basic descriptive and analytic statistics for disease outbreak event CLIP#5

Sith Premashthira

Analytical Epidemiology

- A study designed to investigate hypothesized causal relationships.
- Tries to determine why disease is occurring.
- Tests hypotheses.

Study design of an epidemiological research

- **Experimental:** Studies preventions and treatments for diseases; investigator actively manipulates which groups receive the agent under study.
- **Observational:** Studies causes, preventions, and treatments for diseases; investigator passively observes as nature takes its course.
  - **Cohort:** Typically examines multiple health effects of an exposure; subjects are defined according to their exposure levels and followed for disease occurrence.
  - **Case–control:** Typically examines multiple exposures in relation to a disease; subjects are defined as cases and controls, and exposure histories are compared.
  - **Cross-sectional:** Examines relationship between exposure and disease prevalence in a defined population at a single point in time.
- **Ecological:** Examines relationship between exposure and disease with population-level rather than individual-level data.

Source: ESSENTIALS OF EPIDEMIOLOGY IN PUBLIC HEALTH: http://publichealth.jbpub.com/aschengrau/Aschengrau06.pdf

Types of observational studies

- Cohort studies
  - Changes over time
  - Exposed and Not exposed
  - Smoking and cancer
- Case-control studies
  - Diseased and non-diseased animals
  - Positive and negative animals
  - Herd with lesions and herd without lesions
- Cross sectional studies
  - Prevalence or incidence at a time
  - National sero-surveillance for Foot and mouth disease

GENERAL REQUIREMENTS

In all study designs required that

1. each **unit of observation** (typically one animal, could also be an aggregate): **disease** and **exposure status** is recorded

2. disease and exposure status - if not directly observable – is established: reliable diagnostic tests (i.e. sensitivity and

specificity known and considered)

3. **diagnostic procedure**: standardized and not subject to changes

4. additional information: collected on traits with known

impact on disease and exposure status

(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)

Measure of association

	Diseased animals	Non-diseased animals
Exposed	a	b
Not exposed	c	d

- Incidence: The number of new cases that occur in a known population over a specified period of time

- Prevalence: The number of instances of diseases or related attributes (e.g., infection or presence of antibodies) in a known population, at a designated time, without distinction between old and new cases

(Source: Thrusfield M (2005) Veterinary Epidemiology 3rd Ed.)

Freie Universität Berlin

2x2 contingency table for cross-tabulation of disease and exposure state

	Diseased (D+)	Non-diseased (D-)	Total
Exposed (E+)	a	b	n_1
Unexposed (E-)	c	d	n_2
Total	m_1	m_2	n

Notation:

D+ = animals is diseased
D- = animal non-diseased
E+ = animal is exposed
E- = animal is unexposed

n_1 = total number of animals exposed to the risk factor
n_2 = total number of animals unexposed to the risk factor
m_1 = total number of diseased animals
m_2 = total number of non-diseased animals
n = total number of animals

a = number of diseased animals exposed to the risk factor
b = number of non-diseased animals exposed to the risk factor
c = number of diseased animals unexposed to the risk factor
d = number of non-diseased animals unexposed to the risk factor

(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)

Freie Universität Berlin

2x2 TABLE: PROBABILITY NOTATION

	Diseased (D+)	Non-diseased (D-)	Total
Exposed (E+)	a	b	n_1
Unexposed (E-)	c	d	n_2
Total	m_1	m_2	n

Proportion or rate of interest	Probability notation	Sample estimate
Exposed	Pr(E+)	(a + b)/n
Diseased	Pr(D+)	(a + c)/n
Diseased and exposed	Pr(E+ and D+)	a/n
Diseased in the exposed group	Pr(D+ | E+)	a/(a + b)
Diseased in the unexposed group	Pr(D+ | E-)	c/(c + d)
Exposed in the diseased group	Pr(E+ | D+)	a/(a + c)
Exposed in the non-diseased group	Pr(E+ | D-)	b/(b + d)

(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)

Freie Universität Berlin

"SAMPLING BY ROWS":

a/(a+c) is a valid estimator of Pr (E+ | D+)

b/(b+d) is a valid estimator of Pr (E+ | D-)

Pr (D+) and Pr (D-) cannot be estimated (directly) using this design

"SAMPLING BY COLUMNS":

a/(a+b) is a valid estimator of Pr (D+ | E+)

c/(c+d) is a valid estimator of Pr (D+ | E-)

Pr (E+) and Pr (E-) cannot be estimated (directly) using this design

"SAMPLING THE ENTIRE TABLE":

all sample estimates are valid estimators of the respective probabilities, but

we may end up with n_1 being a too small value if prevalence of exposure is low

we may end up with m_1 being a too small value if prevalence of disease is low

(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)

Freie Universität Berlin

CLASSIFICATION OF STUDY TYPES:

"sampling the entire table " = **cross-sectional** study

"sampling by rows" = **cohort** study

"sampling by columns" = **case - control** study

(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)

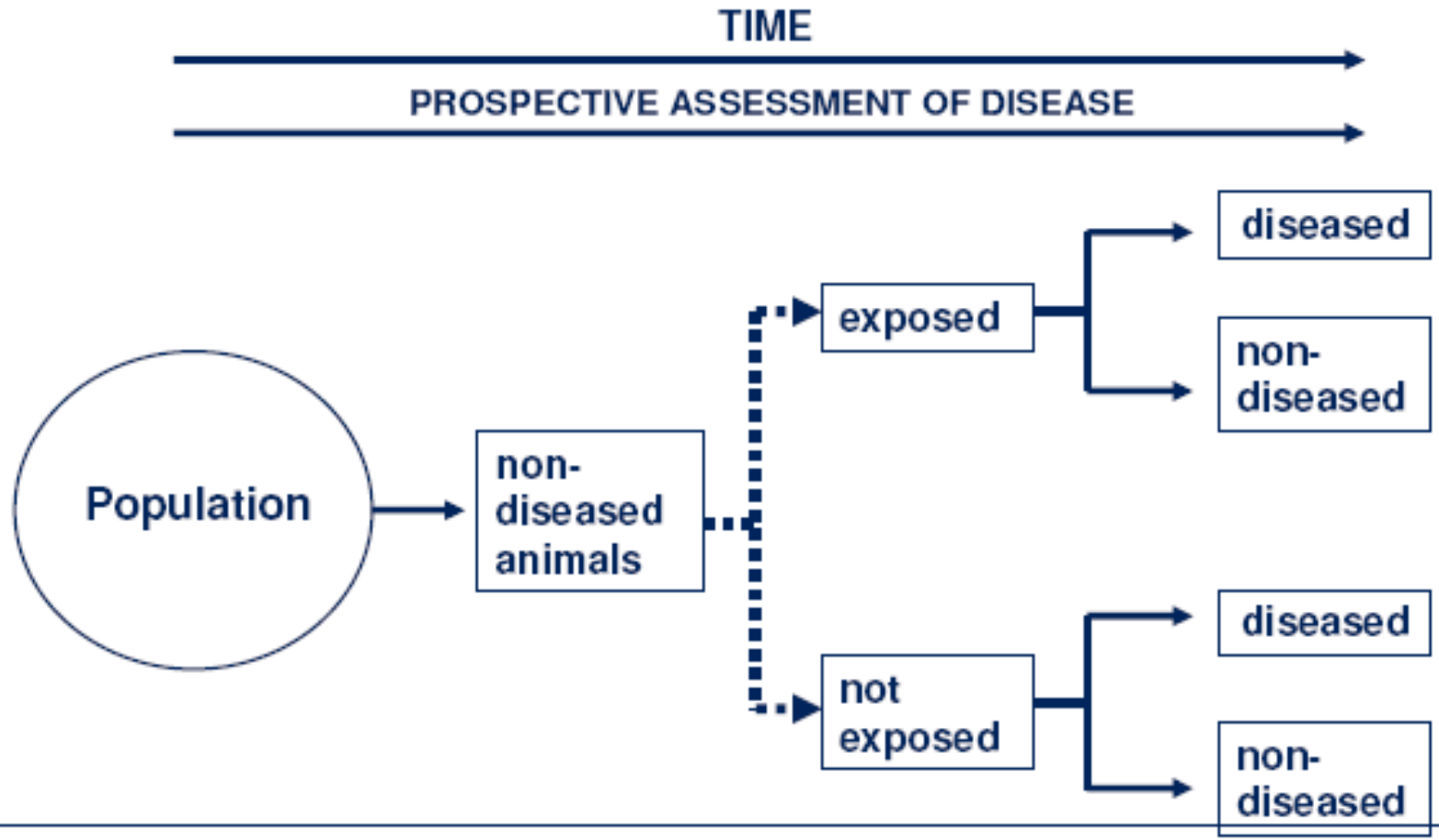
Freie Universität Berlin

CROSS-SECTION STUDY DESIGN

(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)

Freie Universität Berlin

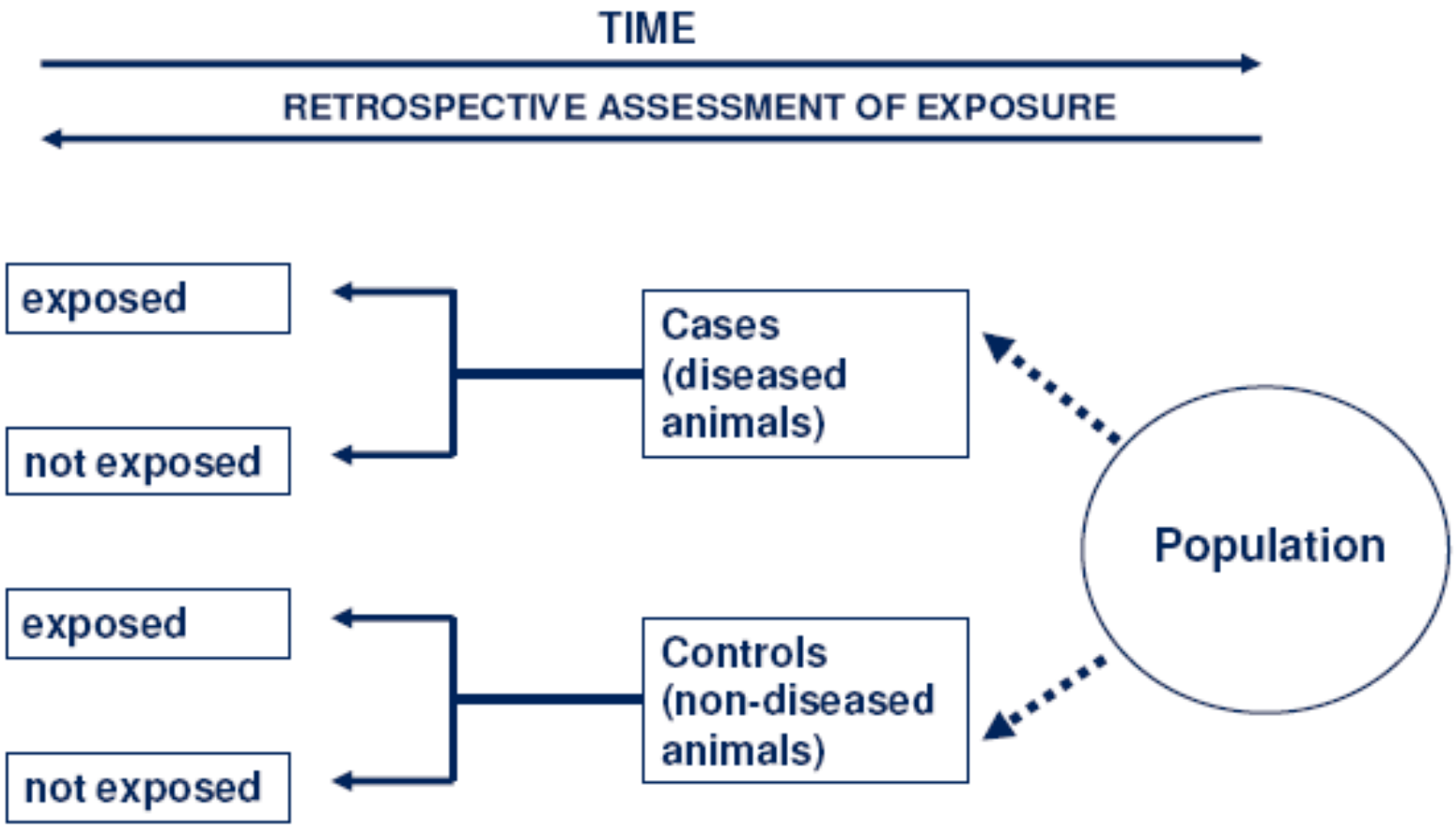
PROSPECTIVE (COHORT) STUDY DESIGN



(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)

Freie Universität Berlin

RETROSPECTIVE (CASE-CONTROL) STUDY DESIGN



(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)

Freie Universität Berlin

SUMMARY: MOST IMPORTANT FEATURES

	Cross-sectional study	Case-control study	Cohort study
Measure of disease frequency	Prevalence	Prevalence	Incidence
Direction of investigation	momentary/ Retrospective	Retrospective	Prospective
Samples (selections) involved	1 sample from the population	1 group of cases, 1 group of controls	1 cohort of exposed, 1 cohort of unexposed
Primary measure of association	Prevalence odds ratio	Odds ratio	Relative risk; attributable risk

(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)

Major ***advantages*** (**printed bold**) and **disadvantages**

	Cross-sectional study	Case-control study	Cohort study
Marginal conditions	**quick** **relatively cheap**	**quick** **relatively cheap**	time-consuming relatively costly
Applicability	permanent risk factors quite common dis.	**more general** **rare diseases**	**more general**
Data quality	**as good as diagnosis**	errors in historic data	**as good as diagnosis**
Sample sizes	large (low prevalences)	**relatively small**	large (dropout, low inc.)
Inferences/ estimatability	no causal evidence no incidence **prev. of exposure** **prev. of disease**	limited causal evidence no incidence **prev. of exposure** no prev. of disease	**causal evidence** **incidence** no prev. of exposure **prev. of disease**

(Freie Universitat, Berlin - http://www.arbo-zoo.net/_data/ArboConFlu_StudyDesign.pdf)