Food and Agriculture Organization of the United Nations

FAO/China Intensive Training Course on Tilapia Lake Virus (TiLV)

Sun Yat Sen University, Guangzhou, China

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Session 4

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Epidemiology and surveillance

Aquatic epidemiology – an introduction

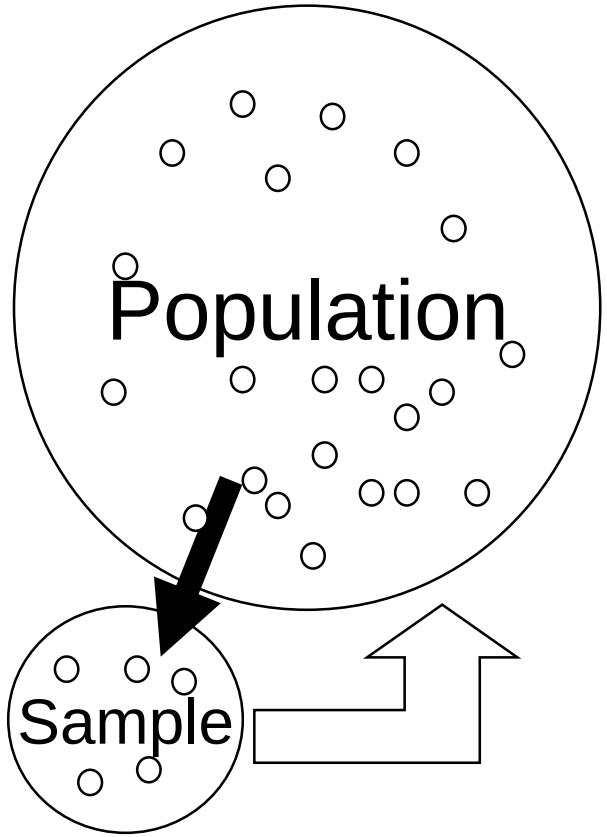
Learning objectives

- Gain knowledge on:
  - Some key elements of aquatic animal epidemiology
  - The contribution of this field in the design and implementation of national and/or regional surveillance programs

What is aquatic animal epidemiology?

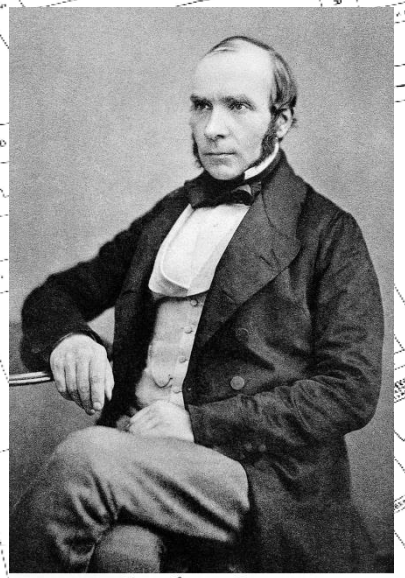
- Structured approach to (amongst other things):
  - Describe health/disease/welfare in fish population(s)
    - Current status
    - Changes over time
    - Difference between groups
  - Describe production in fish population(s)
  - Analyze which and how internal/external factors influence these outcomes
  - Analyze how/where to intervene in a cost-efficient way

What is aquatic animal epidemiology?



Make inferences to the population
based on observations from a sample of the population

London 1854



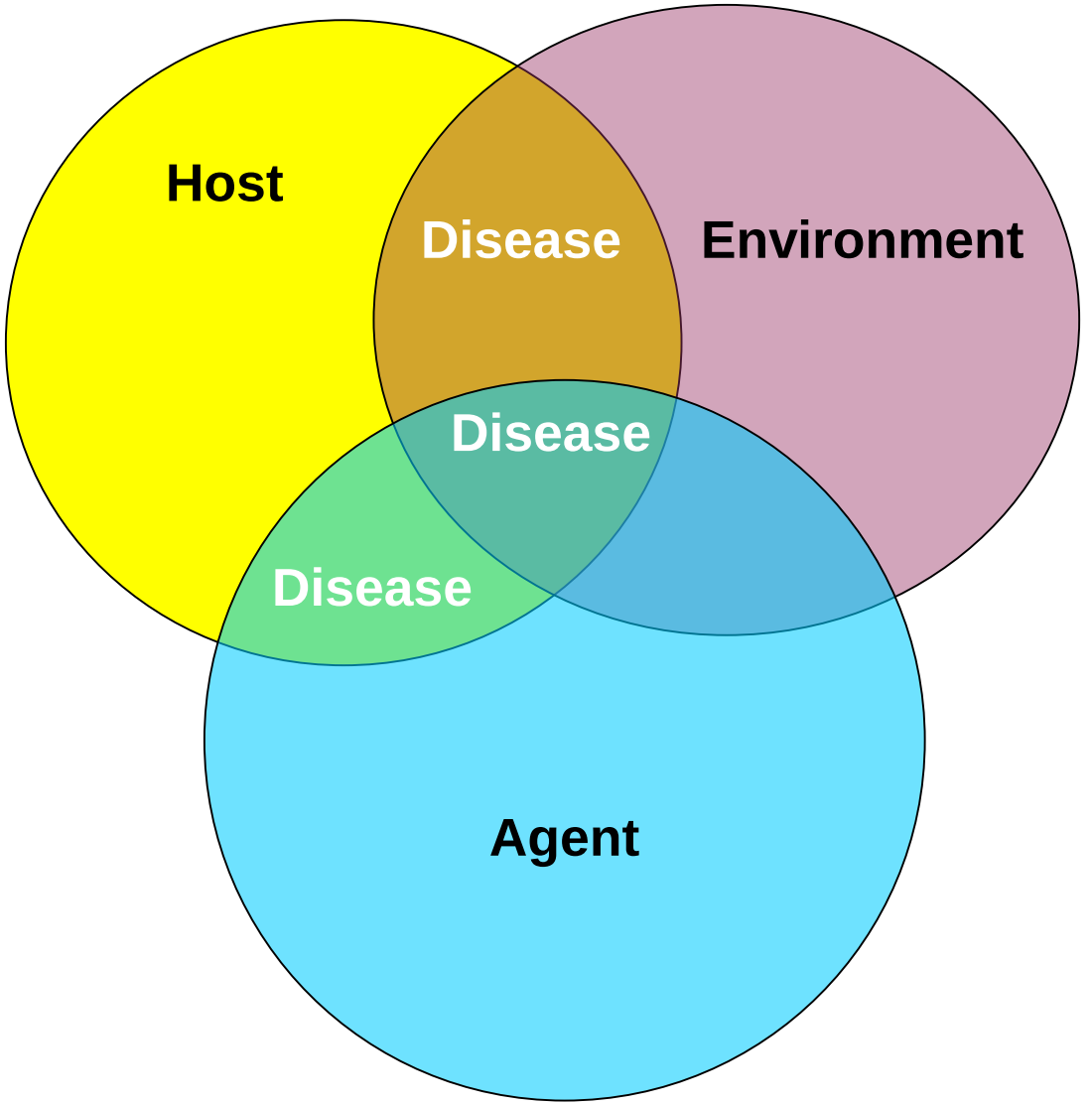
John Snow

Removed the handle from the water pump in Broad(wick) street. Controlled the epidemic WITHOUT knowledge of actual pathogen (defined in 1905)

Common requests to epidemiologists

- Describe infections/diseases, their distribution and dynamics
- Design appropriate studies for the study objective
  - E.g. risk factors
- Calculate sample sizes
- Analyse data for diagnostic test validation
- Design surveillance programs
- Evaluate effects of intervention
- Assess cost-effectiveness of potential interventions
- Provide advice based on available epidemiological information

Multifactorial causality theory

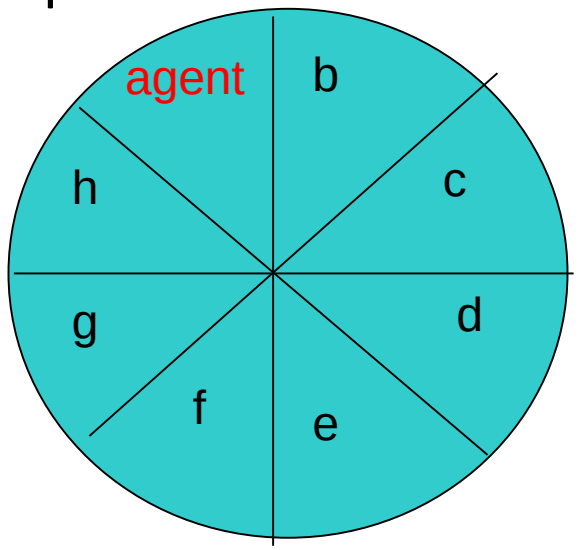


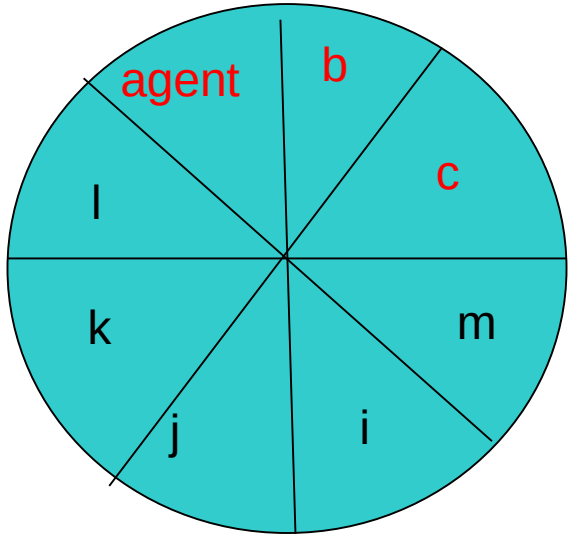
Causality

- Factors that influence the probability for change (measurable event)
- The cause of a health problem are those factors that need to be there in order to increase the probability of a disease to occur
- Causality is not the same as an association

Multifactorial causality theory (2)

- Necessary cause - required for the disease to occur
- Sufficient causes - component causes, all present = disease occur
  - Effect at the same time or consecutively
  - Dose-response

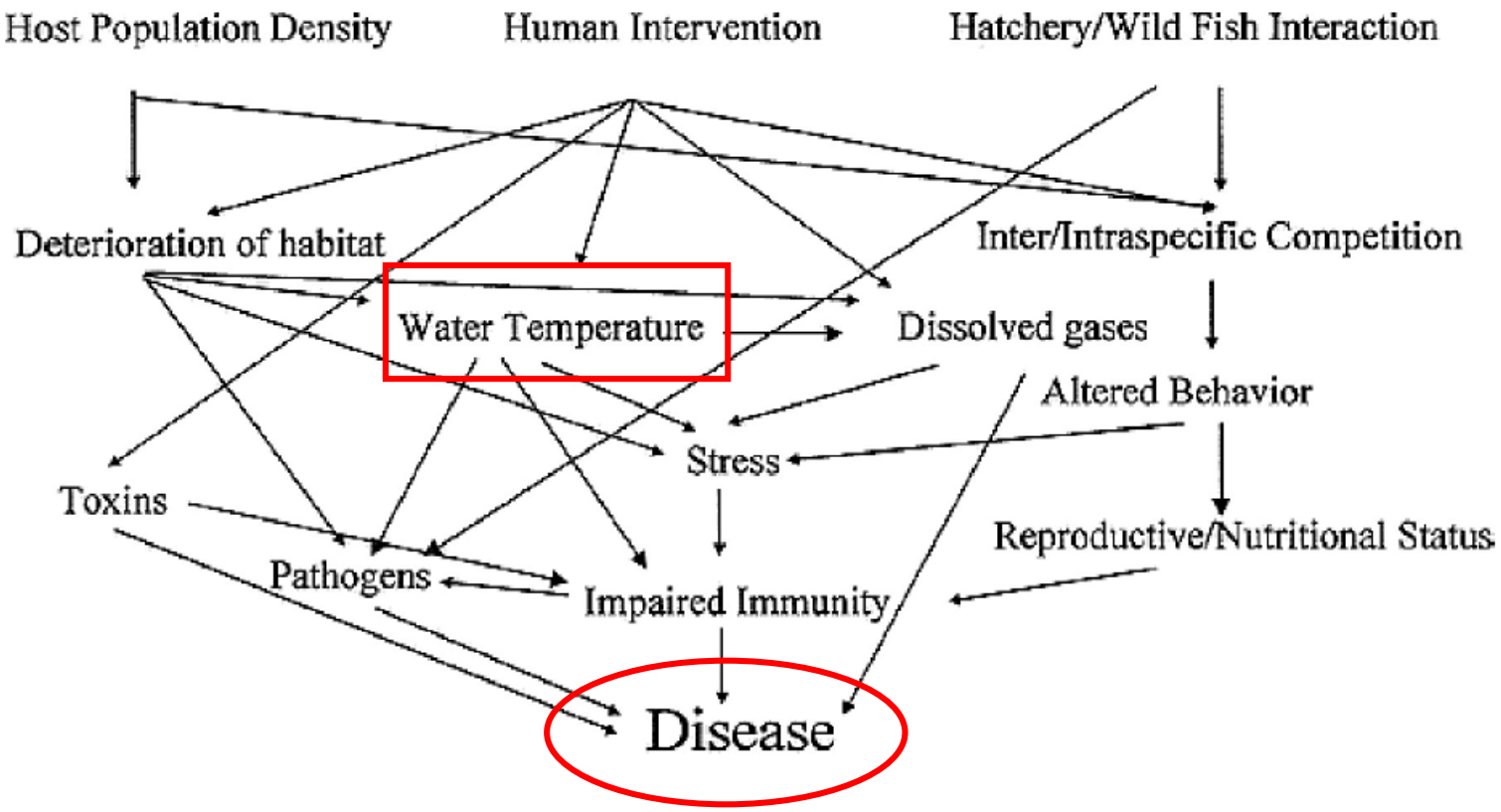




Some assumptions related to causality

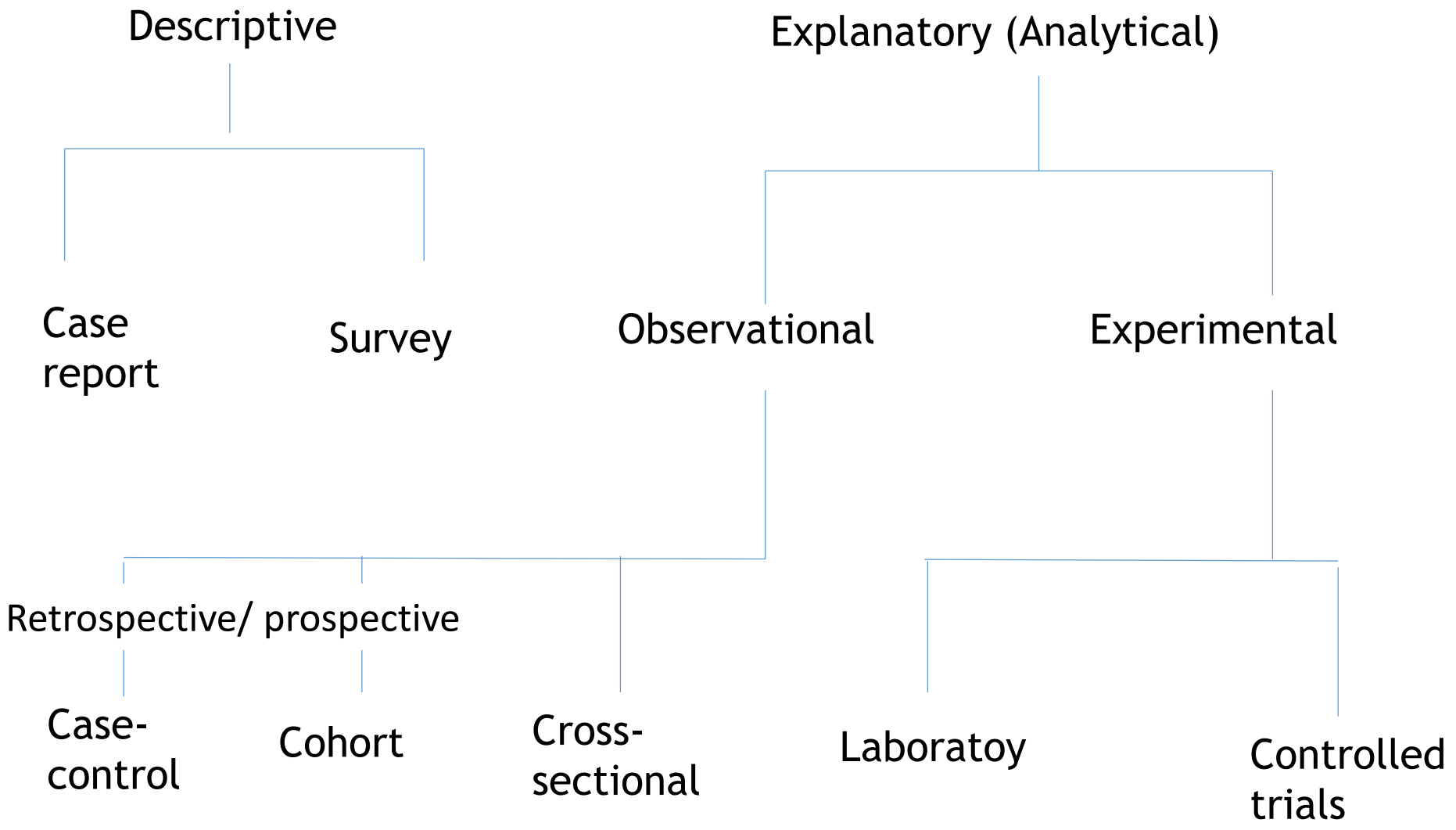
- Cause before effect
- Dose-response effect
- Plausible
- Consistency
- Experimental trials
  - Causation at the biological (individual) level or at the population (group) level

Causal webs



R.P. Hedrick, 1998. Relationships of the host, pathogen and environment: Implications for diseases of cultured and wild fish populations. Journal of Aquatic Animal Health 10:107-111.

Study types (based on I. Dohoo et al)



Descriptive studies

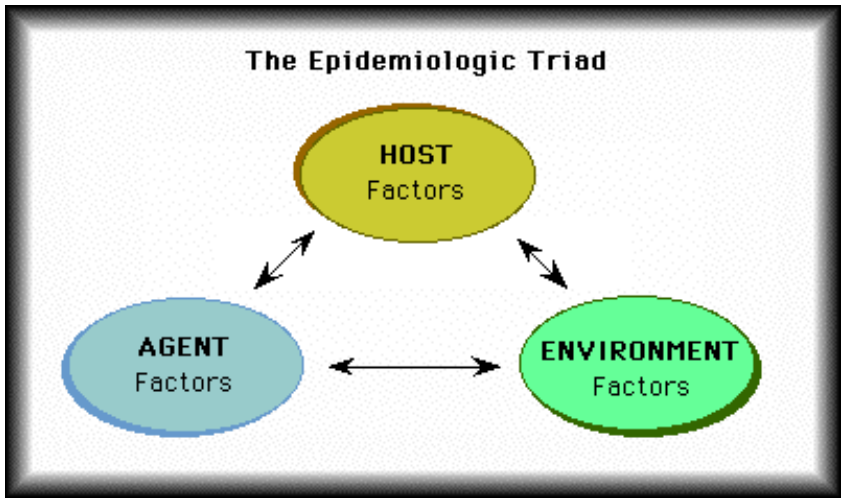
- Describe the characteristics of the condition in time and/or space
- Doesn’t always answer a research question
- No group comparison
- Forms the basis of hypothesis building
- Often limited resources needed compared to analytical studies

Analytical studies

- Involve analysis of the characteristics in question
- Hypothesis testing (test an association)
- Comparison of exposure/non-exposure (dose) for cases/non-cases
- Sometimes used to collect evidence for possible causation

Epidemiological investigation

- Diagnostics
- Agent identification
- Agent characterization
- Host-agent response studies



- Industry data
- Individual company data
- Individual site data
- Disease data
- Treatment data
- Screening data
- Economic data

Challenges

- Case definition
- Sampling
  - How to sample the fish you want to sample?
  - How to get a representative (not too biased) sample?
- Observations
  - How to observe the population?
    - Limited access to individuals
- Data quality
  - Mortality
  - Feed consumption
  - Environmental data
    - How to measure (interacting) environmental exposure?

Infectious disease pattern
What do we know about TiLV?

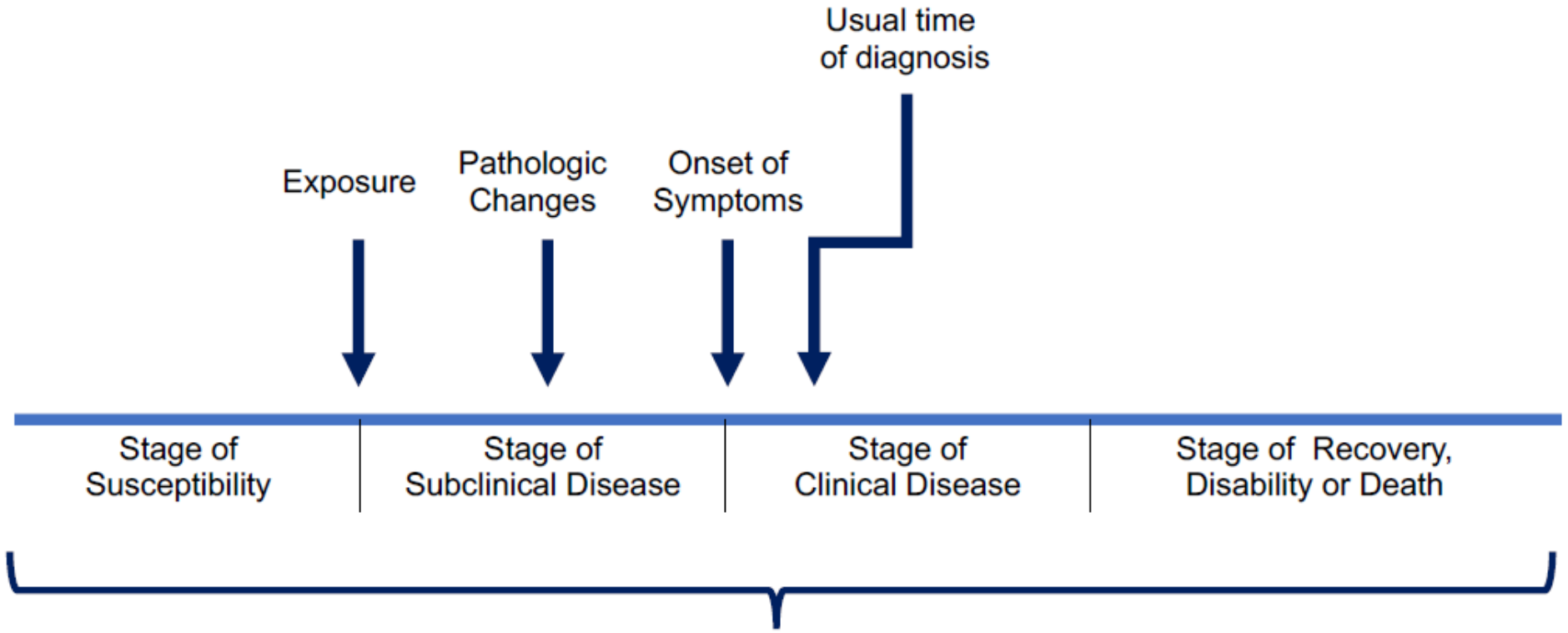


Illustration:
F. Mardones

Disease frequency

- Counts
- Proportion
  - Prevalence

$$= \frac{\text{Number infected fish (farms) at a given time}}{\text{Total number of fish (farms) in the population at the same time}}$$

  - Incidence rate

    = the number of new cases over a given time period (e.g. 1 year)

Measures of association

- Expressed as
  - odds ratio
  - risk ratio (risk difference)
- Relative measures
  - Excess risk in exposed group relative to unexposed
  - Expressed from 0 to infinity (<1/ **1**/ >1)
  - Useful method for identifying risk factors

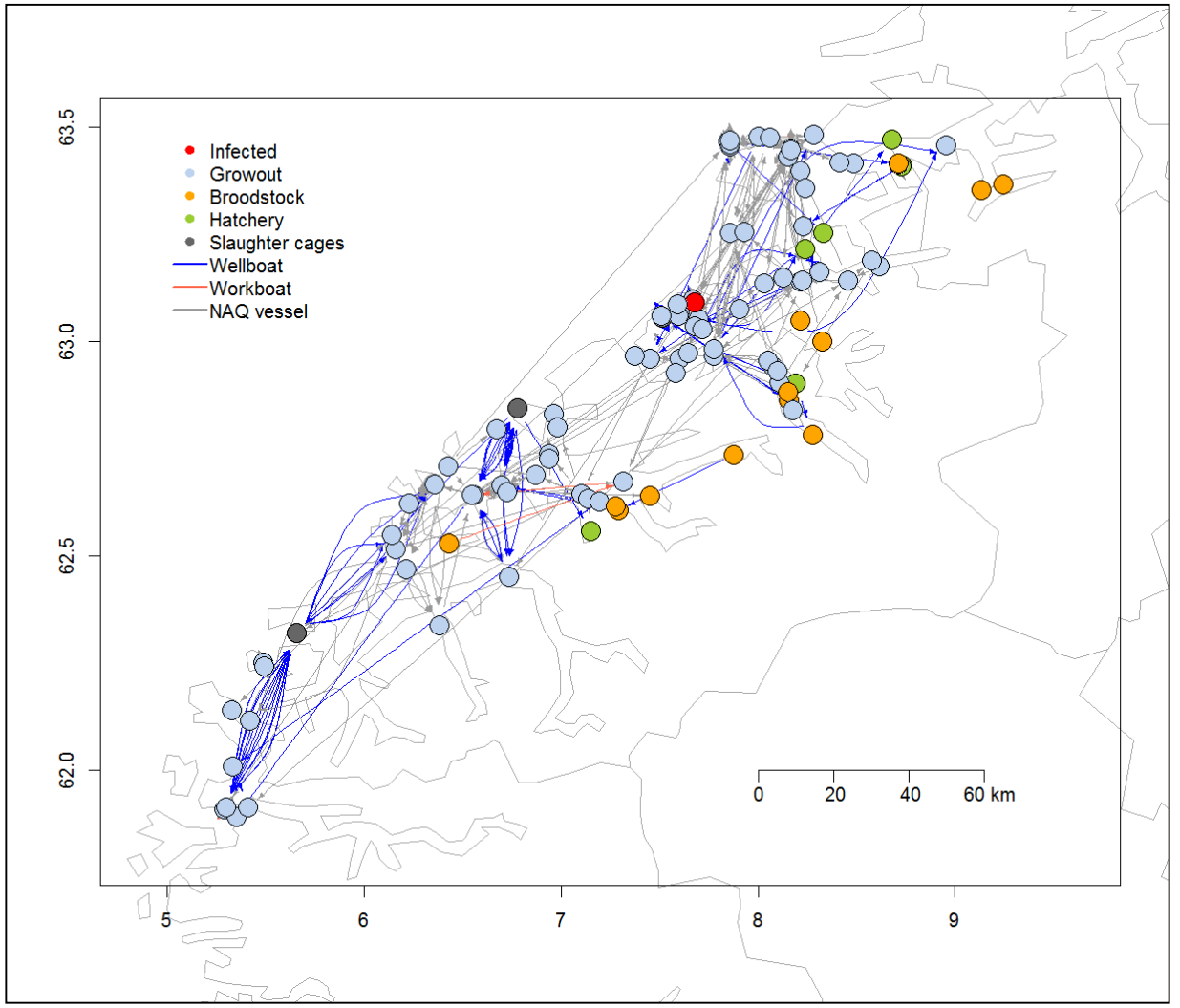
Odds ratios (OR)

- E.g. odds for TiLV in a farm that used feed X
- Odds for cases
  - = $\frac{\text{number of TiLV+ve farms using feed X}}{\text{number of TiLV +ve farms not using feed X}}$
- Odds for controls
  - = $\frac{\text{number of TiLV-ve farms using feed X}}{\text{number of TiLV -ve farms not using feed X}}$
- Odds ratio (OR) = $\frac{\text{Odds for cases}}{\text{Odds for controls}}$

Relative risk (RR)

- E.g. is farming Chitralada strain of a risk factor for the farm being TiLV +ve?
  - $\text{Risk}_{\text{Chitralada}} = \frac{\text{number of TiLV +ve farms with Chitralada}}{\text{total number of farms with Chitralada}}$
  - $\text{Risk}_{\text{GIFT}} = \frac{\text{number of TiLV +ve farms with GIFT}}{\text{total number of farms with GIFT}}$
  - $\text{RR} = \frac{\text{Risk}_{\text{Chitralada}}}{\text{Risk}_{\text{GIFT}}}$

Modern method example: network analysis



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