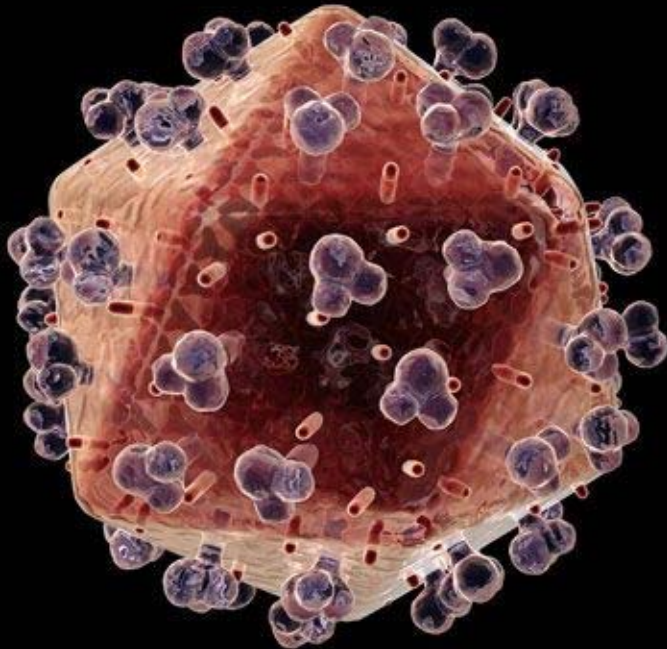




Epidemiology for Community Agencies

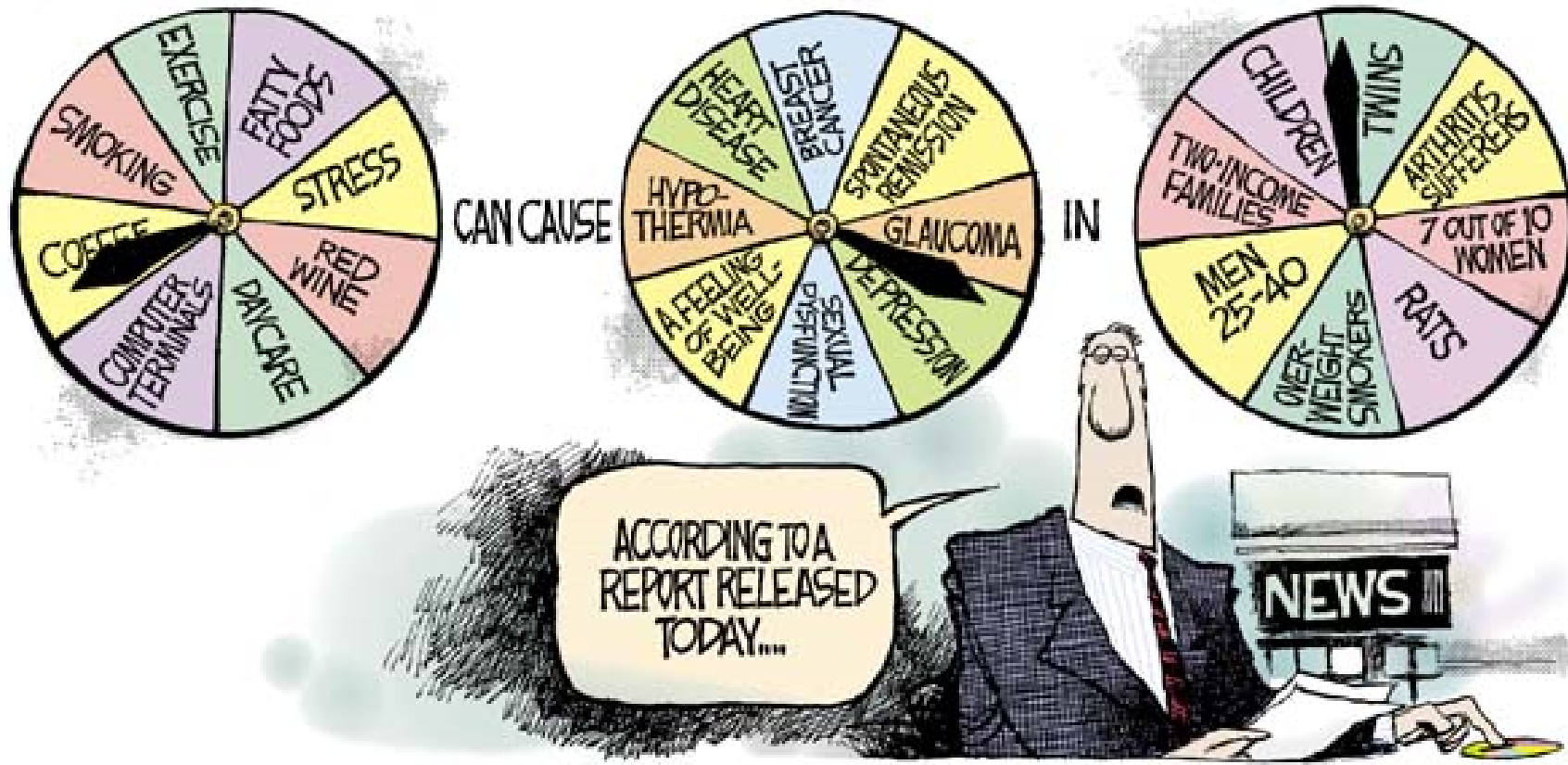


Warren Michelow

Today's Random Medical News

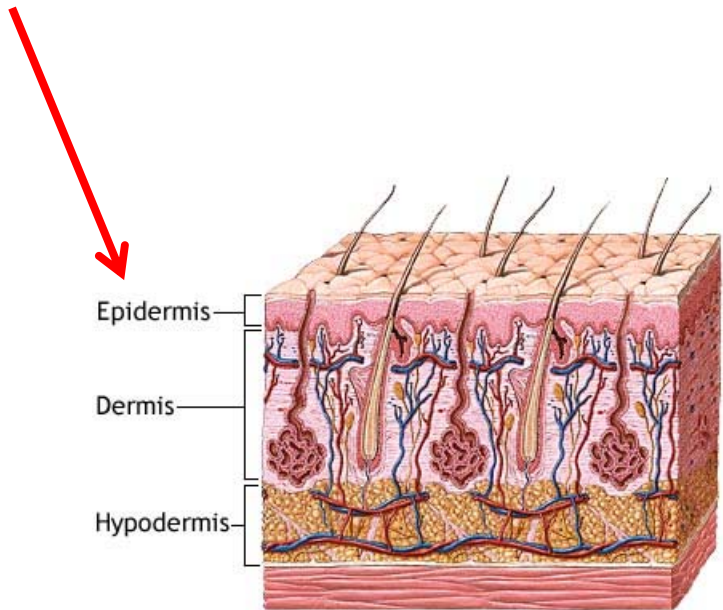
from the New England
Journal of
Panic-Inducing
Gobbledygook

JIM BORGMAN
CINCINNATI INQUIRER © 1997



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What is “epidemiology”?



ADAM.

© A.D.A.M. Medical Encyclopedia

- Nothing to do with SKIN !!
- That’s DERMA-tology and the **epidermis** is the outermost layer of skin

What is “epidemiology”?



© milkintheclock.com News Network

- The study of patterns of health and illness and associated determinants at the **population level**
- From Greek for
epi = upon
demos = people/district
logos = study

Why does epidemiology matter?

- Cornerstone of public health and evidence-based medicine
- Describes who is affected by a health condition...

How many of what kind of people get this disease?
- Identifies factors that cause a disease to spread...

Why did these people get this disease at this time?



Purpose of epidemiology

- Determine the extent of disease in a population
What is the prevalence of Hepatitis C among injection drug users in Vancouver's Downtown Eastside?
- Assess risk of exposure on developing disease
What is the risk from smoking cigarettes on the likelihood of developing lung cancer?
- Identify the cause of new syndromes
What was the cause of the unusually high incidence of Kaposi's sarcoma among homosexual men in San Francisco in the early 1980s?
- Study the natural history and prognosis of disease
In the absence of antiretroviral therapy, how long do people survive after a diagnosis of HIV infection?

Purpose of epidemiology

- Determine whether treatment “x” is effective
Is the over-the-counter remedy Cold-FX an effective treatment against the common cold?
- Identify practical disease prevention strategies and determining whether they are effective
What is the effect of municipal smoking bylaws on the prevalence of smoking and incidence of lung cancer?
- Identify health service use needs and trends
What is the prevalence and incidence of HIV/AIDS in British Columbia and what proportion of infected individuals will require antiretroviral therapy by 2015?
- Provide a foundation for healthy public policy

Why listen (instead of nap)?!

- Evidence, evidence, evidence!
- Basic understanding of epidemiological concepts
 - For understanding what we're dealing with
 - For funding and grant applications
 - For program design
 - For advocacy



Presentation overview

- (Brief!) history of epidemiology
- Key concepts
- Causation
- Types of study designs
- Research vs surveillance
- Finding and using epidemiological information
- Questions

Learning objectives

Have a better sense of...

- Nature and value of epidemiological evidence
- Familiarity with key terms
- Understand types of study designs
- Richer sense of HIV epidemiology
- Better able to find and use scientific evidence

History of epidemiology

- Hippocrates (460-370 BCE)
 - Occurrence of disease related to environment, diet, habits
- Galen (2nd C)
 - Miasma or “bad air”
- Ibn Khatima & Ibn al-Khatib (14th C) in Andalusia
 - Infectious diseases caused by minute bodies
- Veronese doctor Girolamo Fracastoro (1546)
 - Disease particles are alive -> “spores”



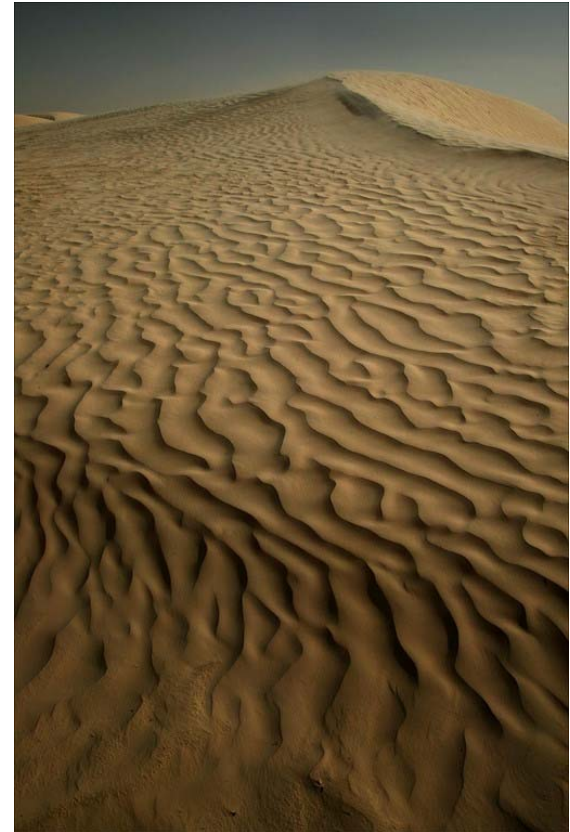
History of epidemiology

- John Graunt (17th C)
 - Life tables of deaths and disease trends
 - Statistical evidence for theories on diseases
- Dr. John Snow (19th C)
 - Source of cholera epidemic in London
 - Founded science of epidemiology
- Many others since then...
 - Study designs & statistical techniques



Key concepts

- Morbidity & mortality
- Epidemic, endemic, pandemic
- Population
- Determinant & outcome
- Prevalence & incidence
- Comparison measures
- Key statistical concepts



© Declan McCullagh, 2005

Morbidity & Mortality

- Morbidity
 - = “sickness”
 - = burden of disease
- Mortality
 - = death
 - = death from the disease of interest
 - “All-cause” mortality = any kind of death



Epidemic

- “epi” = Greek for *upon* or *from outside*
hence *epidemic* = disease from outside the population, or which is unusual for it
- The HIV epidemic was first discovered among gay men and Haitians and still affects only specific vulnerable groups in North America



Endemic

- “en” = Greek for *in* or *inside*

hence *endemic* = disease that is inside the population and maintained near a steady state

- In many southern African countries HIV has become endemic: in Swaziland 25.9% of adults are living with HIV, which is also the leading cause of death

Pandemic

- “pan” = Greek for *around* or *all over*

hence *pandemic* = (new) disease that is geographically widespread

- In 2009 a new variant of the H1N1 influenza caused flu epidemics all over the world, hence it was a new pandemic that some feared might be as deadly as the 1918 Spanish flu

Population

- Group of people with a common characteristic
- Permanent population
 - Defined by an event
 - e.g. HIV+ women over 40
- Dynamic population
 - Defined by a state
 - Membership transient
 - e.g. MSM in Vancouver



Determinant

- Also called “exposure” or “risk factor”
- Characteristic that influences whether or not disease occurs
 - e.g. body mass index
 - CD4 cell count, viral load
 - Age, gender, sex, SES
- Does not imply a causal relationship (but causality might be of interest)



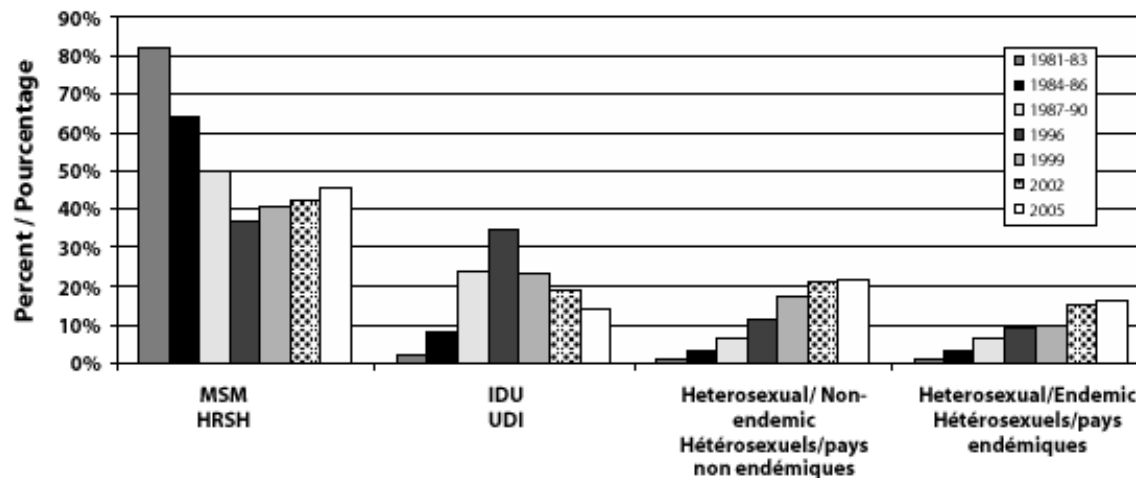


Outcome

- The “result” or “event” of interest
- Various types:
 - Death (the ultimate event)
 - State: VL < 40 = “undetectable”
 - Time: to AIDS diagnosis
 - Count: number of angina attacks
- Usually described in detail in a paper

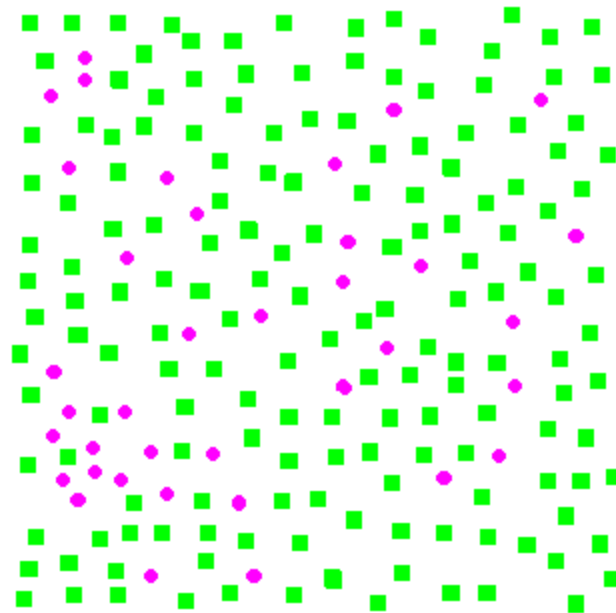
Measures of Occurrence

- Prevalence
- Incidence

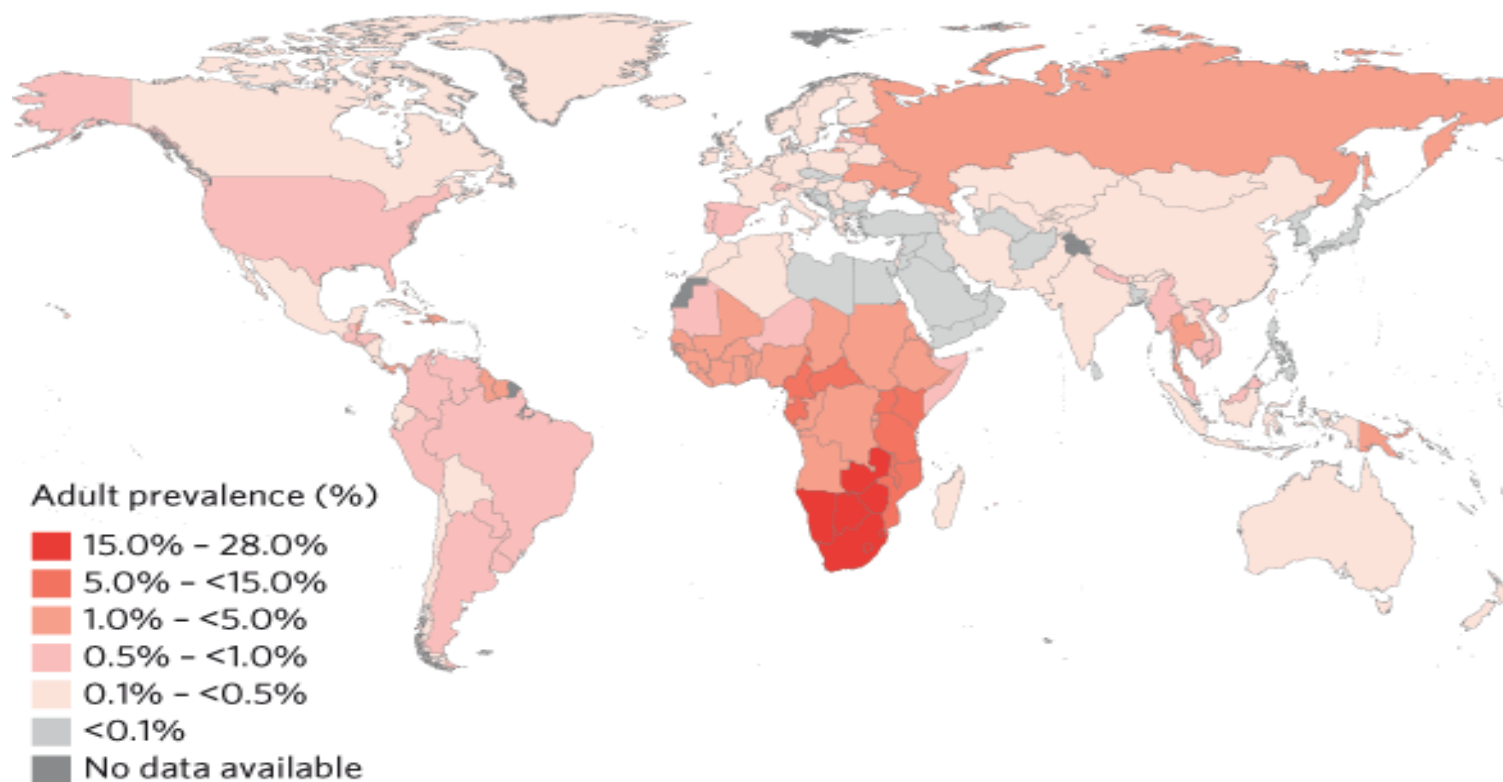


Prevalence

- Number of cases of a disease or condition in a specific population at a given time
- “Snapshot” measure
- Proportion or %
- E.g., Aboriginals make up about 7.5% of all prevalent HIV infections in Canada



Prevalence example



UNAIDS, Global AIDS Report, 2008



Prevalence is used to

- Quantify the proportion of people with a disease
 - How many MSM in BC are infected with HIV?
- Estimate probability that an individual in the population will have disease at a point in time
 - How likely is an IDU to have Hepatitis C?
- Project health care and other policy needs or issues

Let's estimate a prevalence!

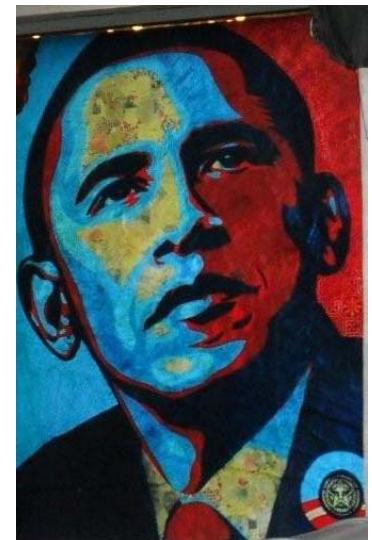
- Left-handedness has been identified as a potentially deadly condition!
- What is the prevalence of left-handedness among the people in this room?



© The Simpsons

Left-handed-itis (*the “good” news*)

- Though constituting $< 10\%$ of the general US population, four of the last six past US presidents (67%) have been left-handed:
 - ☒ Gerald Ford
 - ☒ Ronald Reagan
 - ☒ George H.W. Bush
 - ☒ Bill Clinton
- President Barack Obama is also left-handed, as was his opponent in 2008, John McCain



Source: http://en.wikipedia.org/wiki/Left_handed

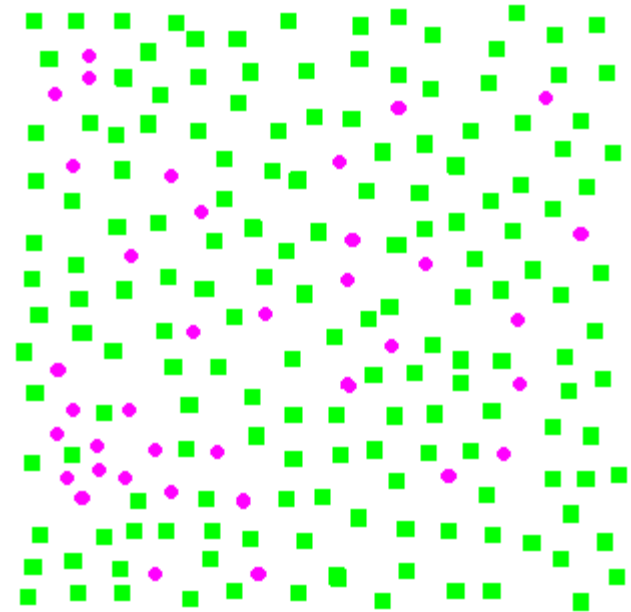
Incidence

- Number of **new** cases of disease that develop in a population at risk during a specified time period

- Rate

- E.g., incidence of HIV

among young women aged 20-29 in South Africa was 5.6% per year vs 0.9% for males





Incidence – Key concepts

- **New** disease events
For diseases that can happen more than once, usually count the first time disease occurs
- Population at risk
can't have disease already but should be at risk of getting it in the future
- Time must pass for a person to move from state of health to having disease



Incidence is used to

- Measure how quickly people are getting a disease
 - How many new cases of HIV are diagnosed annually among heterosexuals in BC?
- Estimate probability or risk that a person will develop disease during a specified time period
- Incidence rate, cumulative incidence, incidence density

Let's estimate an incidence rate

- What is the incidence rate of people yawning during this presentation?

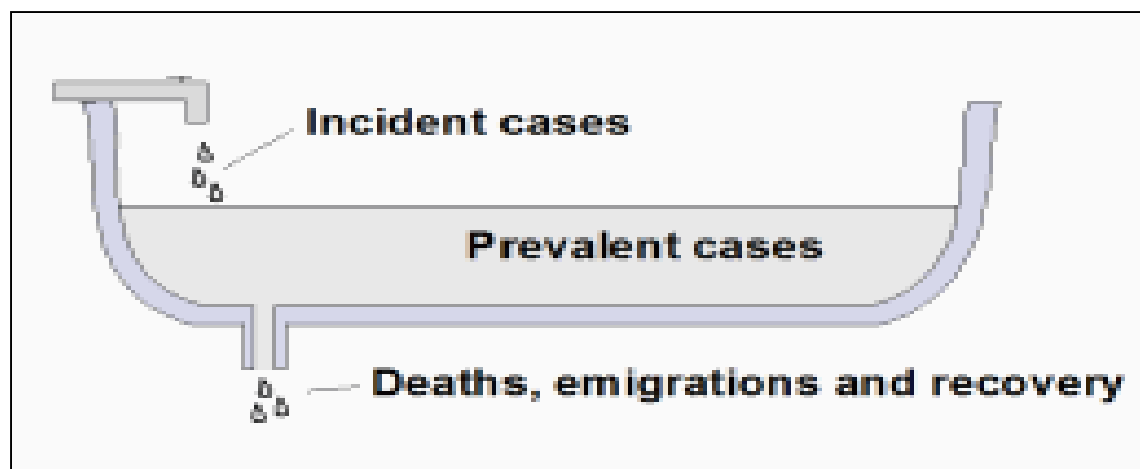


(number of *first* yawns)

(person minutes of presentation)

Prevalence and incidence together

- “Bathtub” model (simple case)
 - Tub = population
 - Water = cases





Measures of Comparison

- Effect measures commonly reported in studies
- Ratios
 - Incidence rate ratio
 - Relative risk
 - Odds ratio
- Ratio = $\frac{\text{numerator}}{\text{denominator}}$



Incidence rate ratio

- Comparison of risk between two groups
- Ratio of incidence rate in one group compared with the incidence rate in another group
- Using the previous example of annual HIV incidence among 20-29 year olds in South Africa,
$$\text{IRR} = 5.6 (\% \text{ in women}) / 0.9 (\% \text{ in men}) = 6.2$$

i.e., among South Africans aged 20-29 years, women are infected at 6.2 times the rate of men

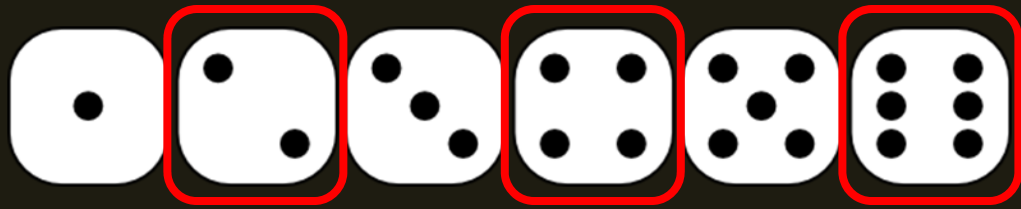
Relative risk

- Used in cohort studies & controlled trials
- Describes the increase (or decrease) in risk for an “exposed” group vs an “unexposed” group
- Example: For lung cancer among passive smokers
RR=1.15
i.e., non-smokers who lived with a smoker were 1.15 times more at risk--or 15% more likely--to get lung cancer than those who didn't live with a smoker

Odds ratio

- Used in case control studies
- Describes the strength of association (or non-independence) of two binary variables
- One of the commonest effect measures
- Has excellent statistical properties (symmetry)
- Can be estimated when other ratios cannot

Odds



- With betting, odds are:
chance of winning vs chance of not winning
- **Chance** of rolling an even number?
 $(2,4,6)$ from $(1,2,3,4,5,6) = 3/6 = 0.5$
- **Odds** of rolling an even number?
 $(2,4,6)$ vs $(1,3,5) = 3:3 = 3/3 = 1$

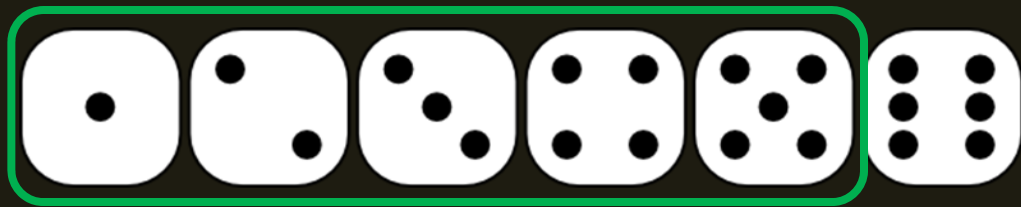
Odds



- Odds of rolling a 6?

$$(6) \text{ vs } (1,2,3,4,5) = 1:5 = 1/5 = 0.2$$

Odds



- Odds of rolling a 6?

$$(6) \text{ vs } (1,2,3,4,5) = 1:5 = 1/5 = 0.2$$

- Odds of not rolling a 6?

$$(1,2,3,4,5) \text{ vs } (6) = 5:1 = 5/1 = 5$$

- Odds are symmetrical

$$1 \div 5 = 0.2 \quad \text{and} \quad 1 \div 0.2 = 5$$

- Thus it doesn't matter how you define it !

Odds



- Chance of rolling a 6?
 $(6) \text{ from } (1,2,3,4,5,6) = 1/6 = 0.167$
- Chance of not rolling a 6?
 $(1,2,3,4,5) \text{ from } (1,2,3,4,5,6) = 5/6 = 0.833$
- Chance (or risk) is NOT symmetrical
 $1 \div 0.833 = 1.2$ and $1 \div 0.167 = 5.99$
- Thus it matters how you define the “risk” you’re measuring – this is not so good



Odds example

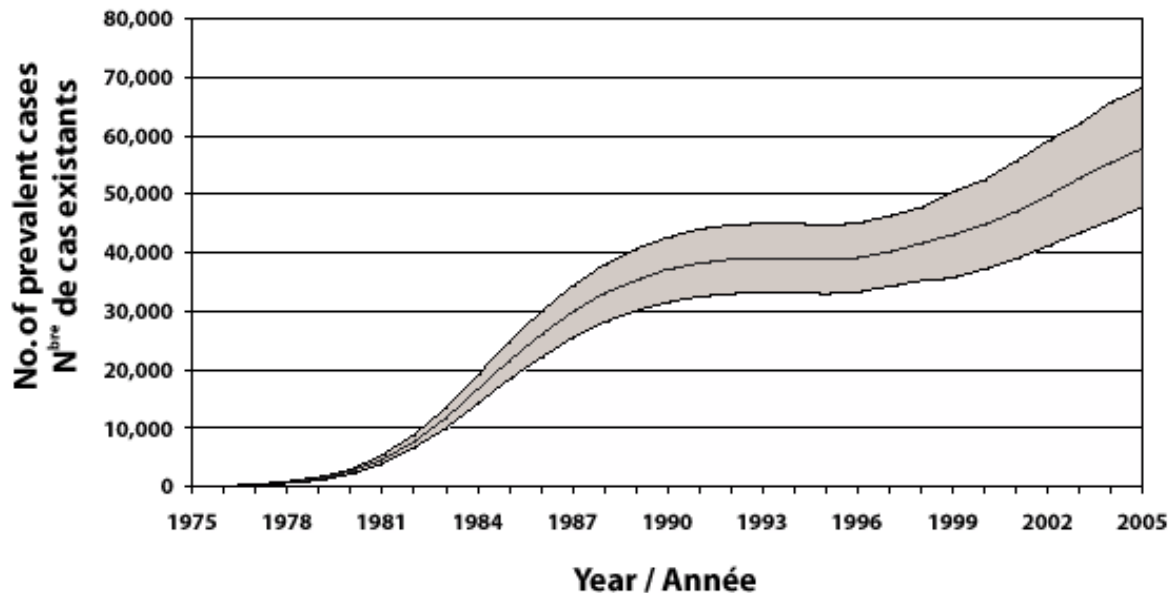
- Sex with Older Partners is Associated with Primary HIV Infection among Men who have Sex with Men in North Carolina
Hurt et al. JAIDS. 2010; 54(2):185-190.
- After adjusting for race, sex while intoxicated, and having a serodiscordant/serostatus unknown partner, a participant had twice the odds of primary HIV infection if his sex partner was 5 years his senior (**odds ratio 2.0**, 95% confidence interval: 1.2 to 3.3)

Statistically significant

- A statistical term that means the result of the study is unlikely to have occurred by chance
- Statistically significant \neq clinically significant
- Very large sample sizes often produce statistically significant results, but the results may make no difference to clinical practice

Confidence interval

- Range around a numerical estimate obtained from a sample
- Range is likely to contain the “real” population value with a certain probability—usually 95%



November 2007
HIV/AIDS Epi Update.
PHAC

Any questions so far?



Causation – What is a “cause”?

- Merriam-Webster Dictionary:
Something that brings about a result especially a person or thing that is the agent of bringing something about.
- Mervyn Susser (famous epidemiologist):
Something that makes a difference.
- Problem: How do we know when something makes a difference?

Causation

- Association is not equal to causation
- Consider the following:
If the rooster crows at the break of dawn then
the rooster caused the sun to rise





Characteristics of a cause

- Must precede the effect
(proximate vs. distant)
- Host or environmental factors;
e.g., personal characteristics, conditions,
actions of individuals, events,
natural, social or economic phenomena
- Positive (presence of a causative exposure) or
negative (lack of a preventive exposure)

Social determinants of health

Fig. 1. Social determinants of health



Source: Dahlgren G, Whitehead M. Tackling inequalities in health: what can we learn from what has been tried? Background paper for "The King's Fund International Seminar on Tackling Health Inequalities". Ditchely Park, Oxford: King's Fund; Reproduced with permission of the authors.

WHO 05.111

Types of Studies



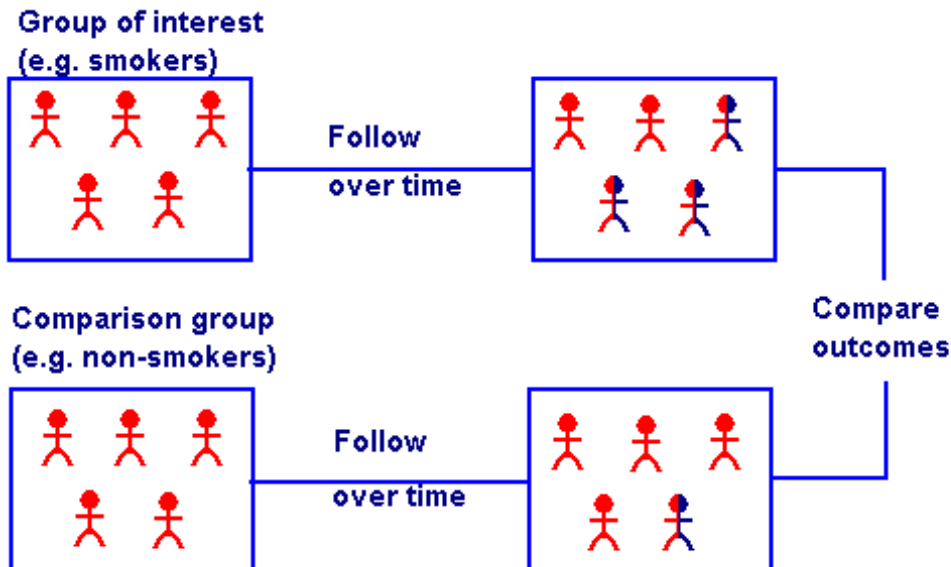
- Cross-sectional
- Cohort
- Case Control
- Clinical Trial

Cross-sectional

- Pro: Simplest, often inexpensive
- Con: Cannot establish causality
- Survey, census, ManCount
- Sample people once at one point in time

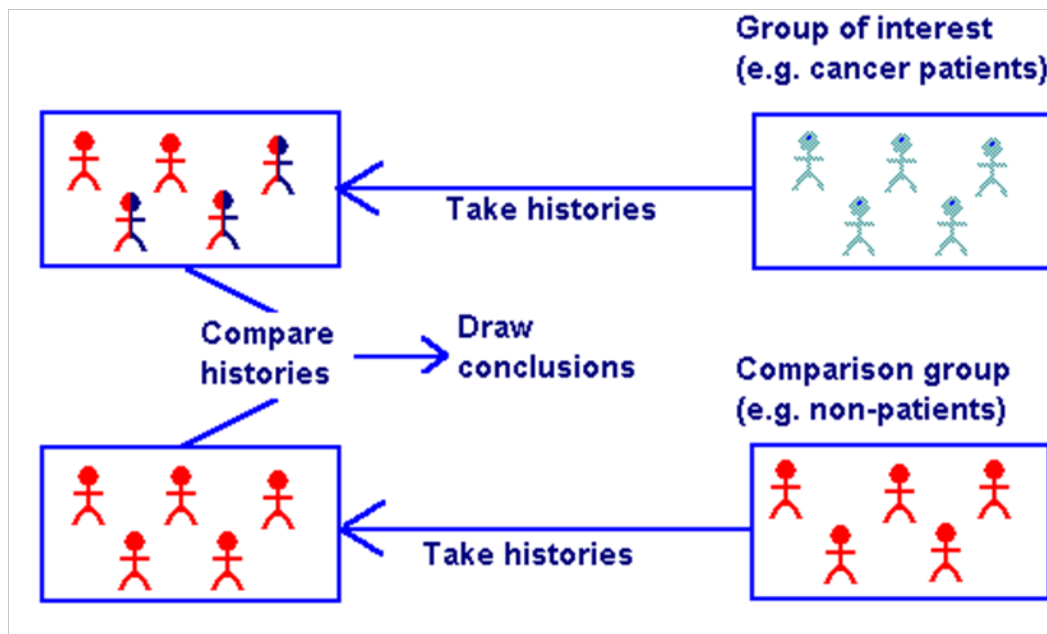
Cohort Studies

- Pro: Can study many outcomes and exposures
- Con: Sometimes big, expensive and long
- VIDUS, Vanguard, ARYS, Framingham



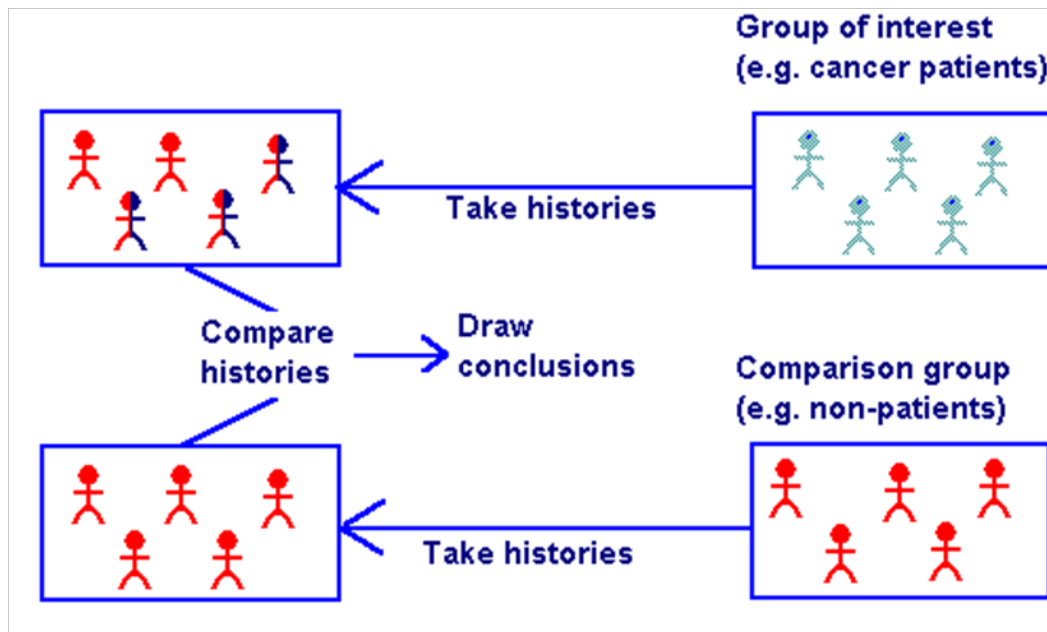
Randomised Controlled Studies

- Pro: Standard method of testing therapies, highest standard of evidence
- Con: Study conditions may be unrealistic



Case Control Studies

- Pro: Focused, cheaper, simpler analysis
- Con: Can only look at one outcome



Research is...

- Search for knowledge
- **Systematic** investigation to establish facts
- *Scientific* research is a specific kind of research that uses the scientific method





Scientific research

- Generally follows these steps:
 - Formation of the question
 - Hypothesis
 - Conceptual & operational definitions
 - Gather data
 - Analyse data
 - Test hypothesis and revise
 - Conclusion
 - Repeat

Surveillance

- The ongoing systematic collection, analysis and interpretation of health data...
- ...essential to the planning, implementation, and evaluation of public health practice...
- ... as well as the timely dissemination of these data to those who need to know
- **Surveillance is data for action!**



Sources of epidemiological info

- Scientific literature
 - Journals
- “Grey” literature
 - Conference abstracts
 - Websites
 - Reports



Journal articles

- Most journals are not free but may be available through a university library
- Free:
 - PubMed
<http://www.ncbi.nlm.nih.gov/pubmed>
 - PubMed Central
<http://www.ncbi.nlm.nih.gov/pmc/>
 - PubMed Central Canada
<http://pubmedcentralcanada.ca/>
 - World Wide Science.Org
<http://worldwidescience.org/>

Grey literature

- Public Health Agency of Canada
<http://www.phac-aspc.gc.ca/>
- BC Centre for Disease Control
<http://www.bccdc.ca/>
- US Centers for Disease Control and Prevention
<http://www.cdc.gov/>
- BC Centre for Excellence in HIV/AIDS
<http://cfenet.ubc.ca/>
- BC Ministry of Healthy Living and Sport
<http://www.hls.gov.bc.ca/publications/>
- Ontario Ministry of Health and Long-Term Care
<http://www.health.gov.on.ca/>

Questions



Thank You

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Warren
Michelow

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“And it was so typically brilliant of you
to have invited an epidemiologist.”