

1.

Lecture 2 - Slide 1

Public Health / Community Service

■ 2.  
**The Science of Public Health:  
Epidemiology and Biostatistics**

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2.

Epidemiology and Biostatistics

Epidemiology and Biostatistics

■ **The Science of Public Health**

- **Epidemiology:** *What...Where...Who...When...?*
  - The basic science of public health
  - The study of the distribution and determinants of the frequency of diseases and conditions in specified populations during specified time periods
- **Biostatistics:** *How...?*
  - The basic science of public health
  - The study of measurement of biological or health data

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3.

Lecture 2 - Slide 5

The Science of Public Health

- Is there really any reason to know this stuff?
  - Literature Review
  - Clinical research
  - Scientific reporting
  - Community service
  - Sound smart
  - Assessment
  - Evaluation
  - Evidence-based practice
    - Office management
    - Clinical decision-making
    - Purchase of equipment, materials, devices, drugs
  - Risk assessment
  - Fun for the whole family

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4.

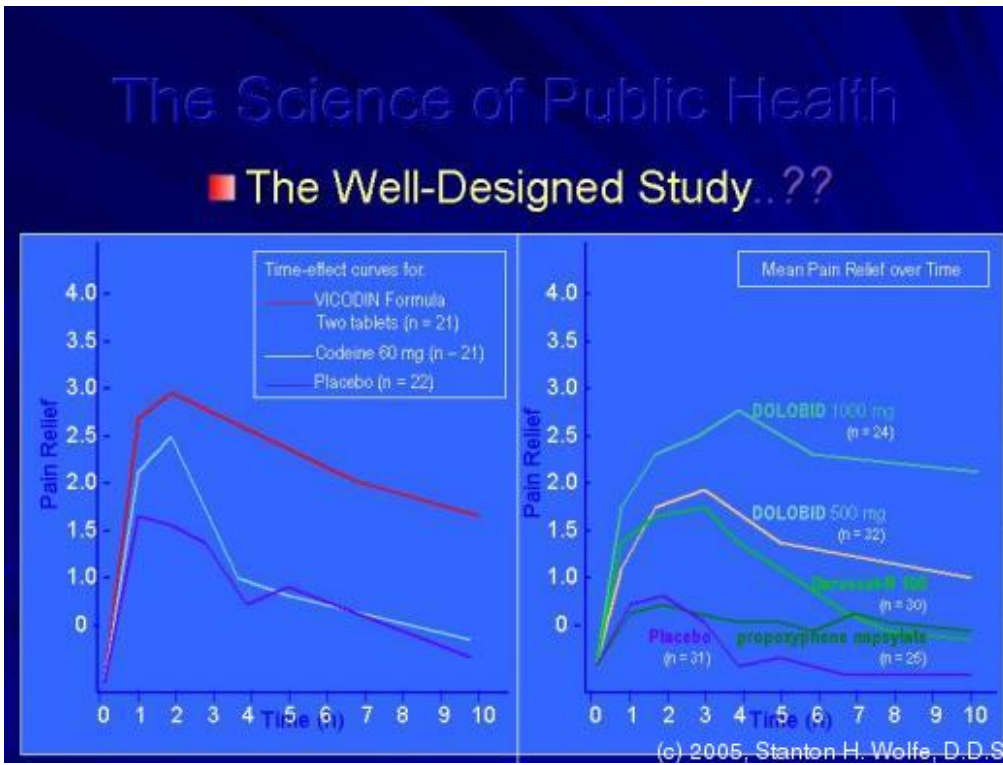
The Science of Public Health

The Science of Public Health

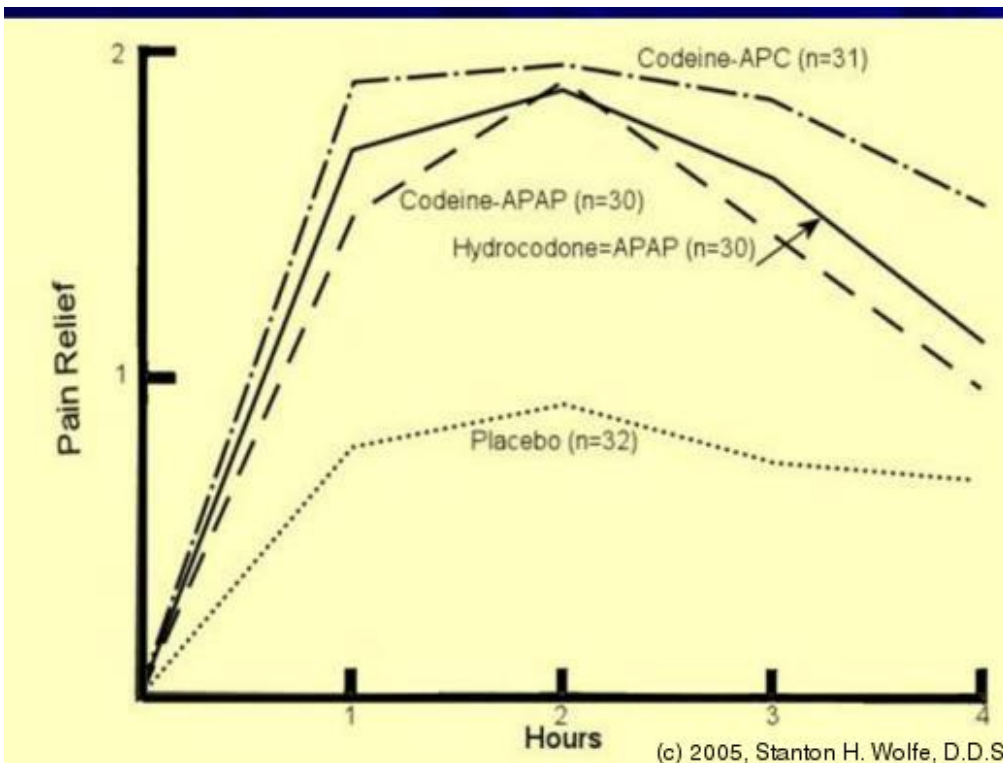
- The well-designed study
  - Double blind
  - Random sample
  - Control
  - Placebo
  - Standard reference
    - "Apples to apples"
    - Appropriateness
  - Minimize extraneous variables
  - Statistically significant

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5. The Science of Public Health



6. Lecture 2 - Slide 8



7. The Science of Public Health

## The Science of Public Health

- **Mean** - the arithmetic average of a set of values
- **Median** - the middle value(s) in the ordered set
- **Mode** - the value in a frequency distribution that occurs most often

Edentulous Patients Screened		
J	9	Ordered: 2
F	6	6
M	18	7
A	27	9
M	23	9
J	18	9
J	9	18
A	9	18
S	7	18
O	54	23
N	18	27
D	2	54

Total = 200

Mean =  $200/12 = 16.67 \approx 17$   
 Median =  $(9+18) / 2 = 13.50 \approx 14$   
 Mode = Bimodal = 9 and 18

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8. The Science of Public Health: Normal (Gaussian) Distribution...

## The Science of Public Health: Normal (Gaussian) Distribution

- **Mean = Median = Mode**

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9. Epidemiology and Biostatistics: Ratio, Proportion, Rate, Fre...

Epidemiology and Biostatistics:  
Ratio, Proportion, Rate, Frequency

- **Ratio** - the relationship between two measures expressed as  $a / b$
- **Proportion** - a type of ratio in which the numerator is included in the denominator, expressed as a percentage:  
$$(X / X+Y) \times 100$$

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10. Epidemiology and Biostatistics: Ratio, Proportion, Rate, Fre...

Epidemiology and Biostatistics:  
Ratio, Proportion, Rate, Frequency

- **Rate** - a time-specific proportion; the basic measure of disease occurrence; expresses the probability of risk of a disease in a defined population over a period of time
- **Frequency = Rate**  
Numerator / Denominator  
during a specified **time** period

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11. Epidemiology and Biostatistics: Incidence and Prevalence Ra...

Epidemiology and Biostatistics:  
Incidence and Prevalence Rates

■ Incidence Rates

- Direct **measure of risk** ( probability ) that healthy people will develop a disease or condition during a specified period of time
- Tells us the **rate** at which **new** disease occurs in a defined, previously disease-free group of people
- Basic tool to study **causality** ( etiology ) of disease

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12. Epidemiology and Biostatistics: Incidence and Prevalence Rat...

Epidemiology and Biostatistics:  
Incidence and Prevalence Rates

■ Incidence Rates ( IR )

# of **new** cases of a disease or condition

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Total # in population **at risk** for the disease or condition

over a period of **time**

Types of study: **Cohort, Prospective**

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13. Epidemiology and Biostatistics: Incidence and Prevalence Rat...

Epidemiology and Biostatistics:  
Incidence and Prevalence Rates

■ Prevalence Rates

- Measure the **disease burden**: the # of people in the total general population who **have the disease** at a given time.
- Tells us the **point prevalence**: the probability of people having a disease at a given point in time, or over a short period of time – the **period prevalence**.

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14. Epidemiology and Biostatistics: Incidence and Prevalence Rat...

Epidemiology and Biostatistics:  
Incidence and Prevalence Rates

■ Prevalence Rates

# of **existing cases** of a disease or condition

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# in the **total population**

At a **point** in time

Types of Studies: Cross-Sectional, Retrospective, Survey

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15. Epidemiology and Biostatistics: Incidence and Prevalence Rat...

Epidemiology and Biostatistics:  
Incidence and Prevalence Rates

- High or low prevalence is **not** a measure of risk or causality
  - Low Prevalence:
    - Low incidence?
    - High cure rate?
    - Short course of disease?
    - High virulence, rapidly fatal?
  - High Prevalence:
    - Increase survival rate?
    - Improved detection?

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16. Epidemiology and Biostatistics: Relative Risk, Odds Ratio, A...

Epidemiology and Biostatistics:  
Relative Risk, Odds Ratio, Attributable Risk

- Relative Risk = Risk Ratio ( **RR** )
  - Critical measure for determining **strength of association**, for assessing the causal ( etiological ) role of a risk factor for disease

IR of individuals disease positive, risk **positive**

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IR of individuals disease positive, risk **negative**

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17. Epidemiology and Biostatistics: Incidence and Prevalence Rat...

Epidemiology and Biostatistics:  
Incidence and Prevalence Rates

- Odds Ratio ( OR )
  - Calculated as the RR when IR is very low

Odds that risk **positive** are disease positive

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Odds that risk **negative** are disease positive

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18. Epidemiology and Biostatistics: Incidence and Prevalence Rat...

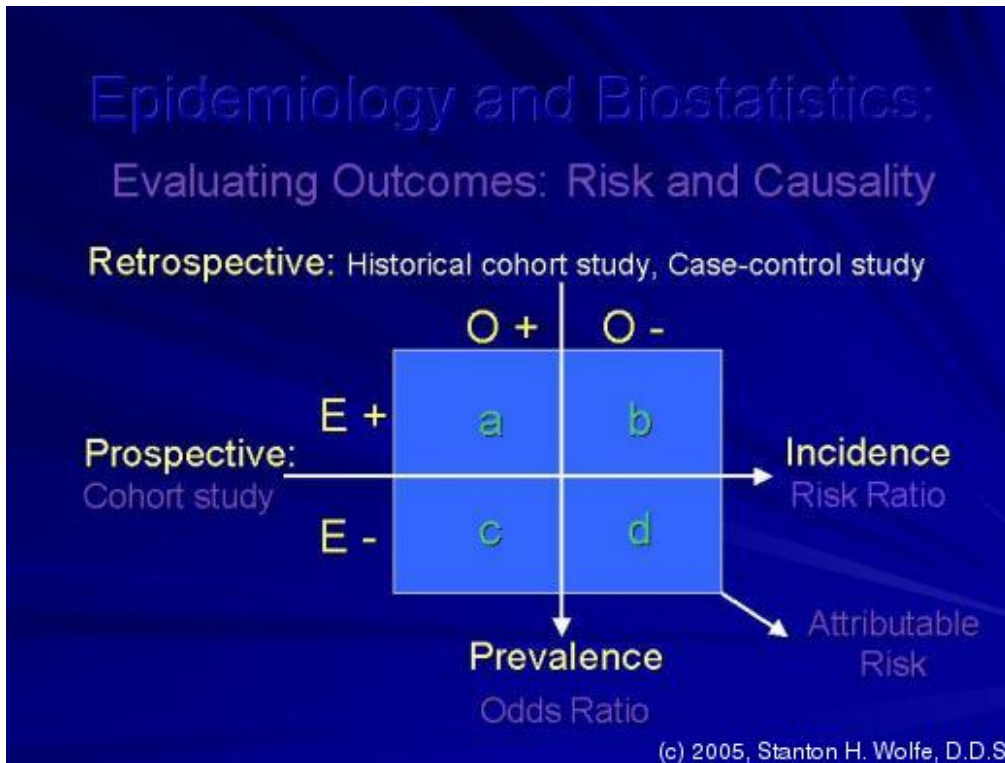
Epidemiology and Biostatistics:  
Incidence and Prevalence Rates

- Attributable Risk ( AR )
  - The risk of disease in individuals **exposed** to the risk factor, vs. those who are **not exposed**
  - Provides an estimate of the number of cases of disease that might be prevented if exposure to the risk factor is eliminated

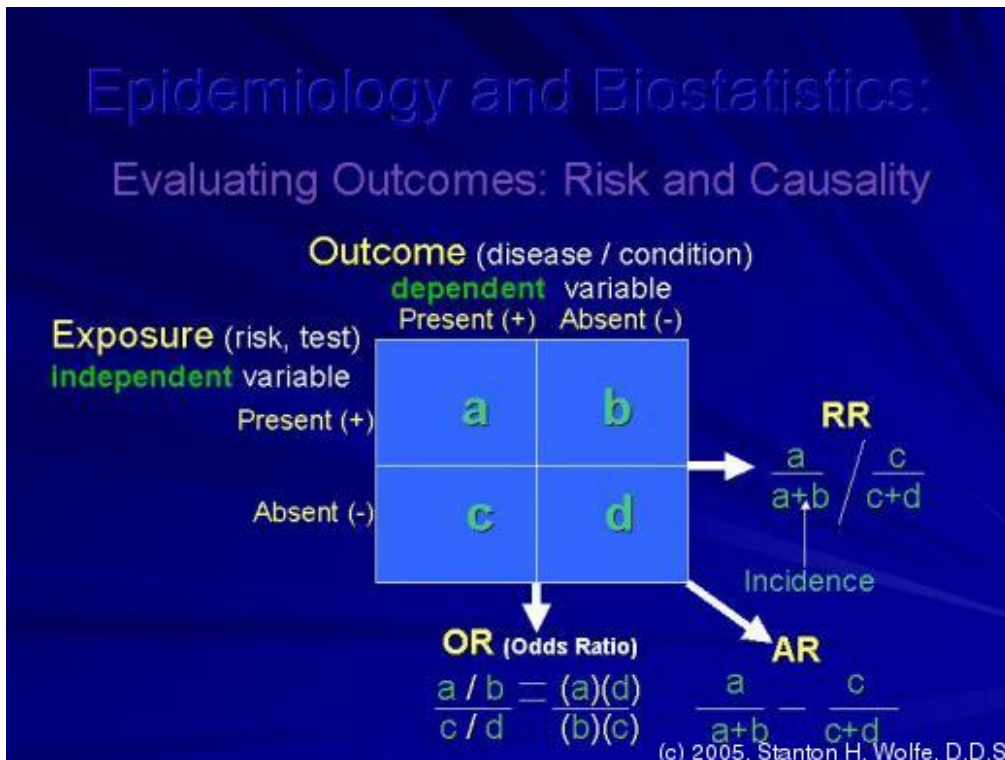
**AR** = Incidence rate of disease and risk factors **positive**  
**MINUS** Incidence rate of disease and risk factors **negative**

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19. Epidemiology and Biostatistics: Evaluating Outcomes: Risk a...



20. Epidemiology and Biostatistics: Evaluating Outcomes: Risk a...



21. Epidemiology and Biostatistics: Evaluating Outcomes: Associ...

Epidemiology and Biostatistics:  
Evaluating Outcomes: Association and Causality

- **Spurious** – from **chance** or **bias**
- **Indirect** – RF(A) appears to → Outcome (C)  
Actually, RF(A) associated w/ RF (B) → Outcome (C)
- **Causal** – RF(A) → Outcome (C) ...*IF*
  1. (A) precedes (C)
  2. Changes in (A) → changes in (C)
  3. (A) does NOT → (C) because of (B)

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22. Epidemiology and Biostatistics: Evaluating Outcomes: Associ...

Epidemiology and Biostatistics:  
Evaluating Outcomes: Association and Causality

- **Strength of association**
  - measured by RR
- **Dose-response association**
- **Consistency of association**
  - **correlating studies**: replication of findings by different methods, multiple testing
  - many lines of converging evidence

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23. Epidemiology and Biostatistics: Evaluating Outcomes: Associ...

Epidemiology and Biostatistics:  
Evaluating Outcomes: Association and Causality

- Temporal association
- Specificity of association
  - How tight does RF predict outcome
  - Ideally, 1:1
- Plausibility
  - Coherence with scientific knowledge

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24. Epidemiology and Biostatistics: Evaluating Outcomes: Associ...

Epidemiology and Biostatistics:  
Evaluating Outcomes: Association and Causality

- Impediments to etiologic investigation
  - No known etiologic agent
  - Multifactorial agents
  - Long latency
  - Indefinite onset
  - Different effects of factors on onset and progress of disease
  - Confounding and bias

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25. Epidemiology and Biostatistics: Describing the performance ...

Epidemiology and Biostatistics:  
Describing the performance of a test

■ Positive and negative test results

- True positive (TP)
- False positive (FP)
- True negative (TN)
- False negative (FN)

	+	-
+	TP	FP
-	FN	TN

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Epidemiology and Biostatistics:  
Describing the performance of a test

■ Sensitivity

- The probability that diseased individuals will have a positive test result
- =  $TPR = TP / TP + FN$  (all disease positive)

■ Specificity

- The probability that disease-free individual will have a negative test result
- =  $TNR = TN / TN + FP$  (all disease negative)

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27. Epidemiology and Biostatistics: Describing the performance ...

Epidemiology and Biostatistics:  
Describing the performance of a test

- Predictive value **positive**
  - The probability that individuals with a positive test have the disease
  - = **PVP** =  $TP / TP + FP$  (all with positive test)
- Predictive value **negative**
  - The probability that individuals with a negative test do not have the disease
  - = **PVN** =  $TN / TN + FN$  (all negative test)

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28. Epidemiology and Biostatistics: Describing the performance ...

Epidemiology and Biostatistics:  
Describing the performance of a test

- Reliability (Precision)
  - Test gives consistent results (standard spread of two frequency distributions), random error may not be accurate
  - Improved by **replication** and **standardization**
- Accuracy
  - Two frequency distributions true to positivity criteria, systemic error
  - Not improved by replication and standardization

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29. Epidemiology and Biostatistics: Evaluating Outcomes

