Welcome to the Training

Please Stand By

Arizona Advisory Council on Indian Health Care

Epidemiology Training Part II

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Introduction

- This follow-up training provides a brief introduction to the statistical side of the field of epidemiology. Using these foundations, we can apply them to the goals of epidemiology as they relate to their statistical background. This will be illustrated through the basic calculations and a brief overview of how/when they are used.

Learning Objectives

- Define epidemiology
- Describe basic terminology and concepts of epidemiology
- Identify types of data sources
- Identify basic methods of data collection and interpretation
- Identify applications of epidemiology
- Develop familiarness with basic statistical concepts as it pertains to epidemiology

Goals of Epidemiology

- To identify cause of disease
- Discover the agent, host, and environmental factors that affect health
- To study the progression of the disease
- To evaluate preventive and therapeutic measures for a disease or condition
- Determine the relative importance of causes of illness, disability, and death
- Identify those segments of the population that have the greatest risk from specific causes of ill health
- Evaluate the effectiveness of health programs and services in improving population health

Applications

Disease Surveillance

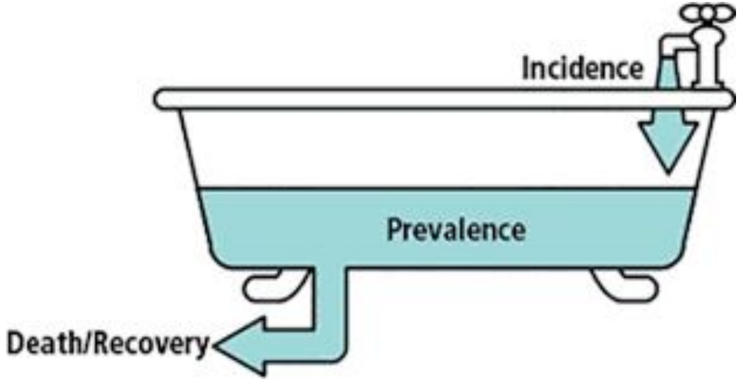
- Frequency of which disease occurs
- Definition of disease
- Items of the disease and population
- Environmental, occupational, infectious diseases.

Incidence

- All new and incoming cases.

Prevalence

- How many total cases exist over time or over a population.



Knowledge Check

On Day 1 of a technology conference in San Diego, 15 presenters who were setting up for their sessions in Annex X became ill with flu-like symptoms. During the course of the conference, 20 participants who attended sessions in Annex X also became ill with the same symptoms.

To begin calculating the rate of this outbreak, investigators should first determine

A. the size of the conference population.

✓ B. the number of cases of illness.

C. the number of days the conference was held.

D. the location of the conference.

Seatbelts, well-water, wearing helmets and other applications

An Introduction to Calculations Contingency Table: The Classic 2x2

	Outcome Yes	Outcome No	Total
Exposed	A	B	A+B
Unexposed	C	D	C+D
Total	A+C	B+D	Total

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Analytical Applications (Risk Ratio)

Risk Ratio:

- How many more (or less) times likely an exposed person develops an outcome relative to an unexposed person.
- The relative risk (RR), also sometimes known as the risk ratio, compares the risk of exposed and unexposed subjects, while the odds ratio (OR) compares odds.
- Works well in cohort studies (over time case and controls).
- RR > 1 = Increased risk of outcome
- RR = 1 = No risk of outcome
- RR < 1 = Reduced risk of outcome
- RR=(a/(a+b))/

$$RR = \frac{(A/(A+B))}{(C/(C+D))}$$

	Outcome Yes	Outcome No	Total
Exposed	A	B	A+B
Unexposed	C	D	C+D
Total	A+C	B+D	Total

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Analytical Applications (Odds Ratio)

Odds Ratio:

- Odds Ratio: the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure.
- How many more times likely the odds of finding an exposure in someone with disease compared to finding the exposure in someone without the disease.
- Works well in cross-sectional studies (points measured at single time, cannot create inference for future events).
- OR > 1 = increased frequency of exposure among cases
- OR = 1 = No change in frequency of exposure
- OR < 1 = Decreased frequency of exposure
- **OR= AD/BC**

	Outcome Yes	Outcome No	Total
Exposed	A	B	A+B
Unexposed	C	D	C+D
Total	A+C	B+D	Total

$$Odds\ of\ Exposure\ in\ Cases = \frac{Number\ of\ Cases\ with\ Exposure}{Number\ of\ Cases\ without\ Exposure} = \frac{a}{c}$$

$$Odds\ of\ Exposure\ in\ Controls = \frac{Number\ of\ Controls\ with\ Exposure}{Number\ of\ Controls\ without\ Exposure} = \frac{b}{d}$$

$$Odds\ Ratio = \frac{Odds\ of\ Exposure\ in\ Cases}{Odds\ of\ Exposure\ in\ Controls} = \frac{a/c}{b/d} = \frac{a*d}{b*c}$$

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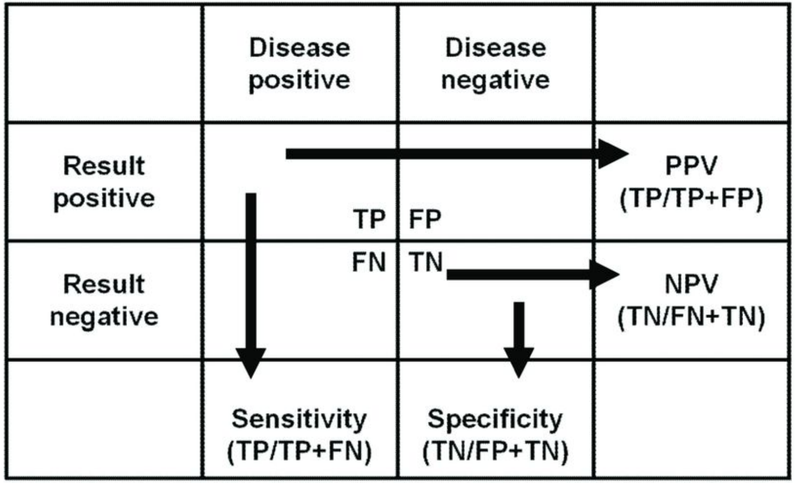
Testing

Sensitivity is the percentage of true positives (e.g. 90% sensitivity = 90% of people who have the target disease will test positive).

Specificity is the percentage of true negatives (e.g. 90% specificity = 90% of people who do not have the target disease will test negative).

The **positive predictive value** is the **probability** that following a **positive test result**, that individual will **truly have** that **specific disease**.

The **negative predictive value** is the **probability** that following a **negative test result**, that individual will **truly not have that specific disease**.



Significance

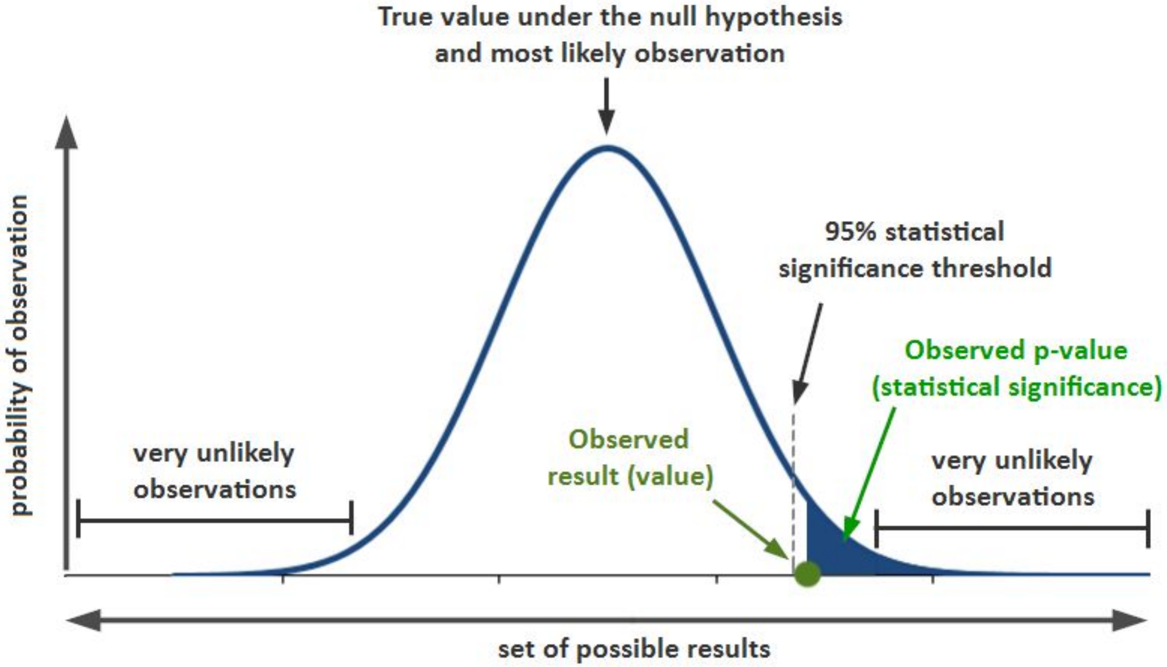
- **P-Value and Significance**

- The ***p*-value**, or probability value, tells you how likely it is that your data could have occurred under the null hypothesis. It does this by calculating the likelihood of your **test statistic**, which is the number calculated by a statistical test using your data.

- The *p*-value tells you how often you would expect to see a test statistic as extreme or more extreme than the one calculated by your statistical test if the null hypothesis of that test was true. The *p*-value gets smaller as the test statistic calculated from your data gets further away from the range of test statistics predicted by the null hypothesis.

- The *p*-value will never reach zero, because there's always a possibility, even if extremely unlikely, that the patterns in your data occurred by chance.

Probability & Statistical Significance Explained



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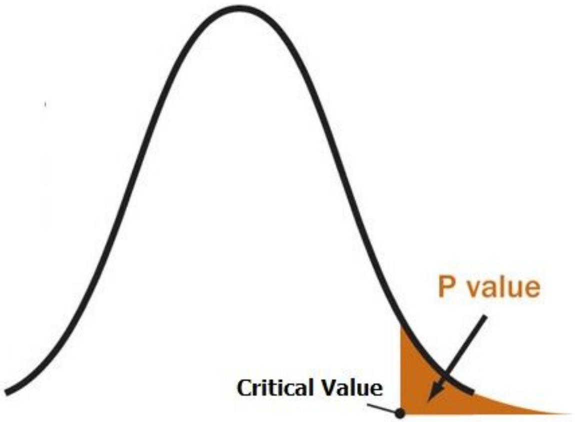
P-Value Example

Example Table:

- Odds Ratio: the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure.

- Table: Odds of the outcome of ALL RESPIRATORY FAILURE with exposures of interest (codes containing J96)

Variable (Exposure)	Odds Ratio	P-Value
Homeless	0.879	0.365
Nicotine	1.13	0.383
Exposure to Second-Hand Smoke	2.663	0.013
COVID Induced Pneumonia	5.06	0.000 > p
Other Viral Pneumonia	16.171	0.000 > p



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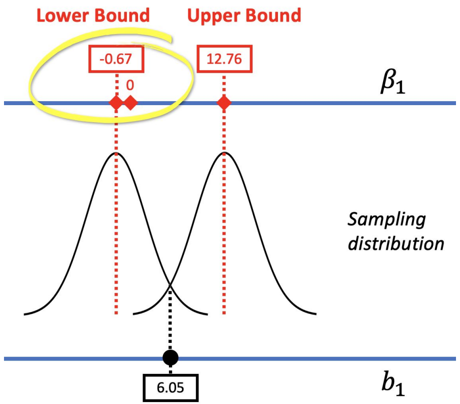
Confidence Intervals

TABLE 3.

Univariate and multivariate logistic regression models of the association between opioid dependence and significant covariates.

	Unadjusted Model*		Adjusted Model†	
Characteristic	unOR	95% CI	adOR	95% CI
‡				
Nicotine Dependence in Last Month	11.55	6.59, 20.24	6.37	3.53, 11.47
Heroin Dependence or Abuse in Last Year	150.79	59.20, 384.06	14.30	2.01, 101.66
Received Opioid Medication/Assisted Treatment in Last Year	394.24	131.07, 1185.83	57.88	11.69, 286.56



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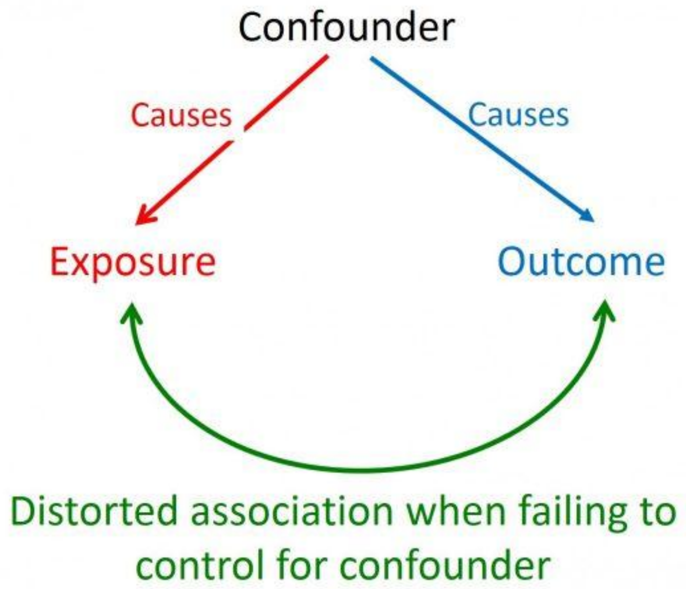
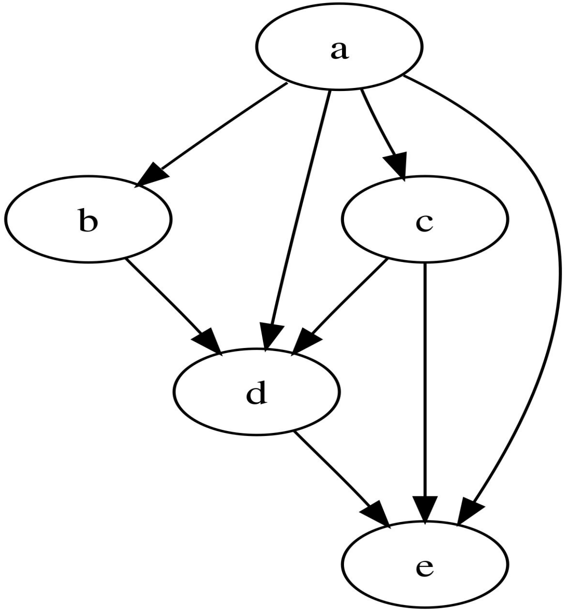
Confounding

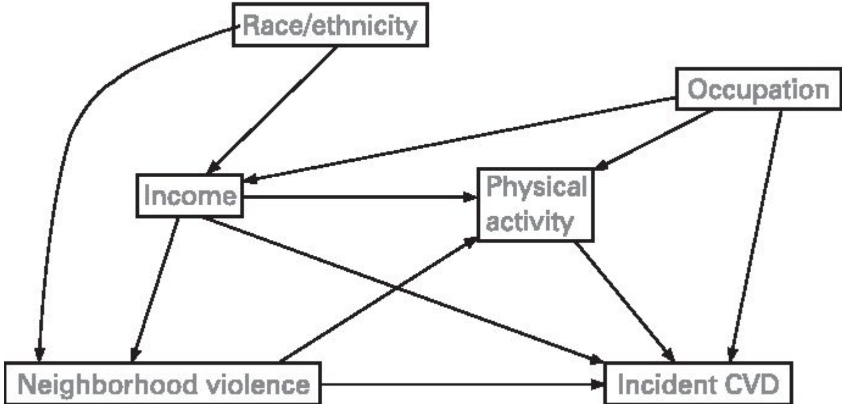
Confounding variables (a.k.a. confounders or confounding factors) are a type of extraneous variable that are related to a study's independent and dependent variables. A variable must meet two conditions to be a confounder:

- It must be correlated with the independent variable. This may be a causal relationship, but it does not have to be.
- It must be causally related to the dependent variable.



Directed Acyclic Graphs (DAGs)





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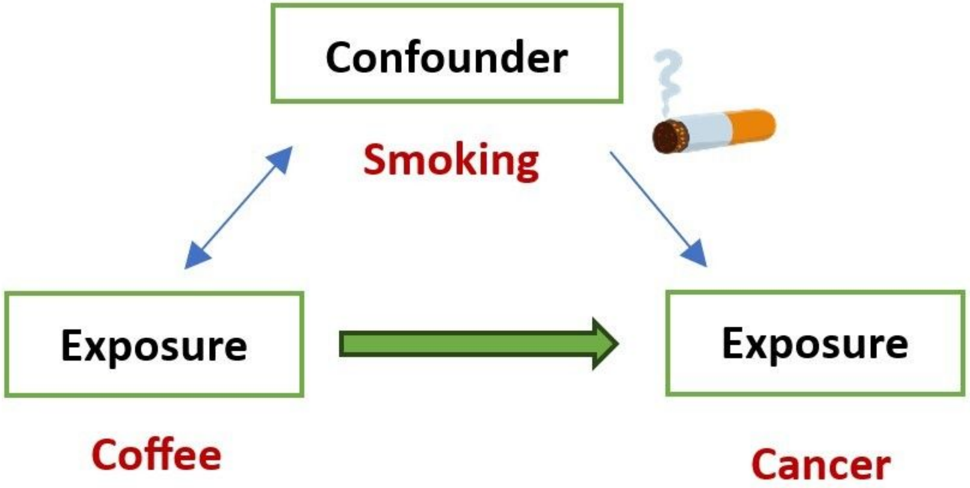
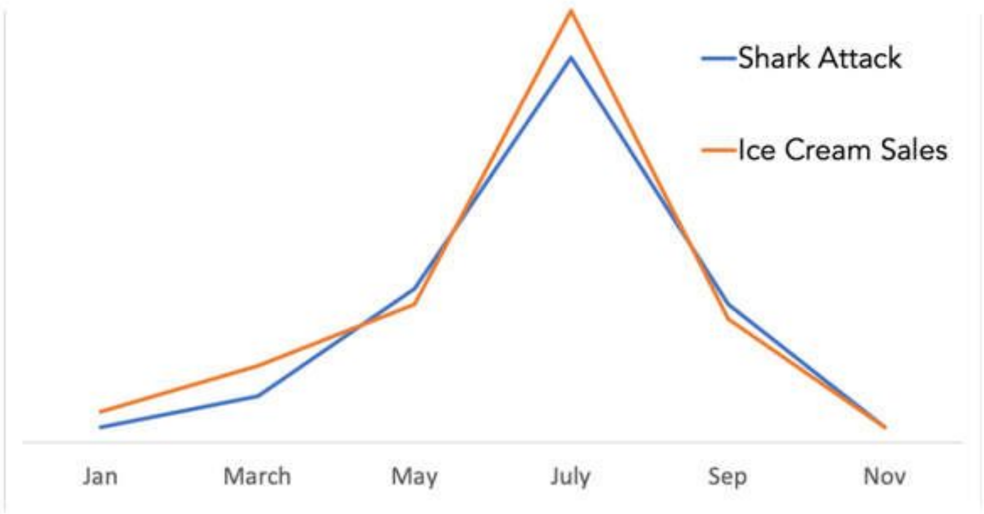
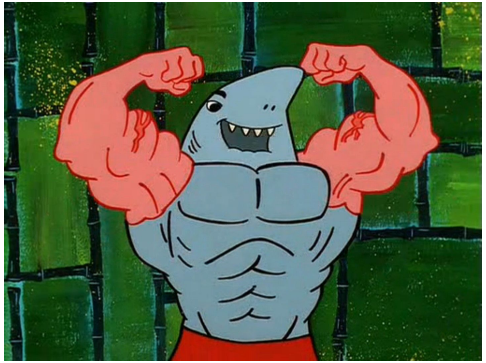
Examples of Confounders



Correlation vs Causation

Correlation tests for a relationship between two variables. However, seeing two variables moving together does not necessarily mean we know whether one variable causes the other to occur. This is why we commonly say “correlation does not imply causation.”





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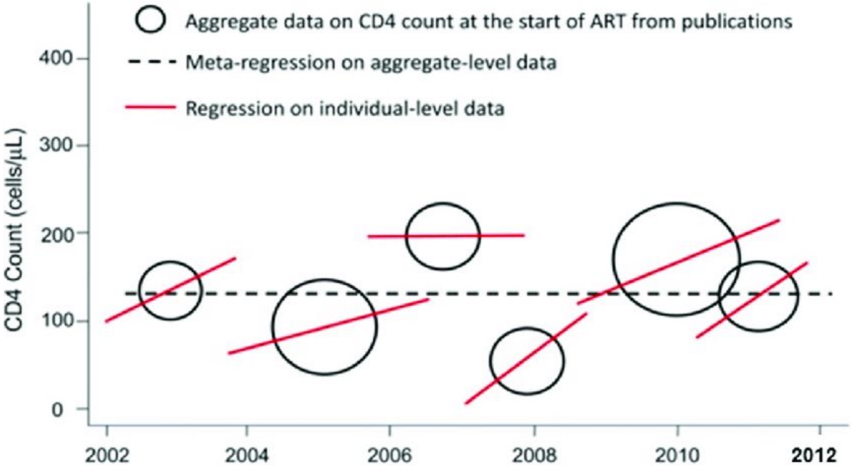
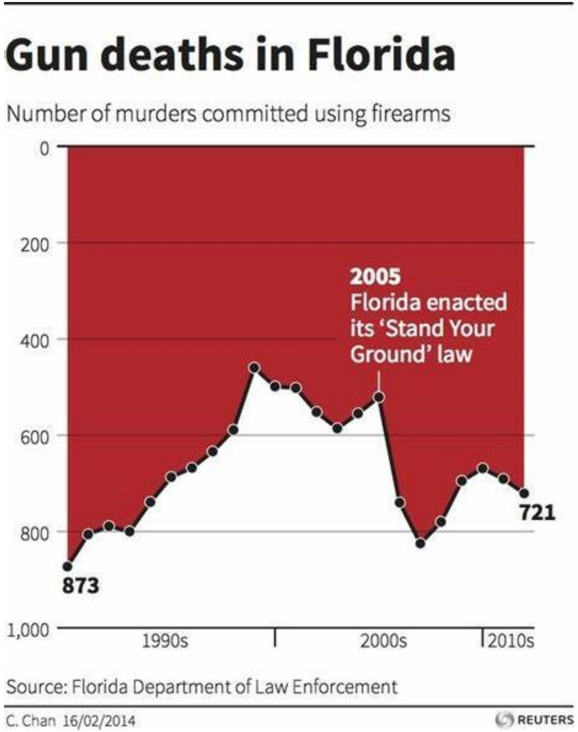
Ecological Fallacy

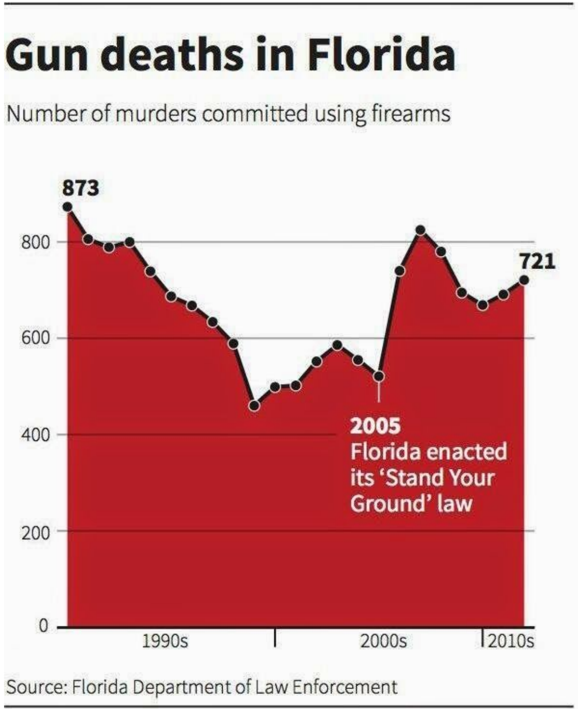
- Definition:

  Ecological fallacy, also called ecological inference fallacy, in epidemiology, **failure in reasoning that arises when an inference is made about an individual based on aggregate data for a group**.



Disclaimers on Research





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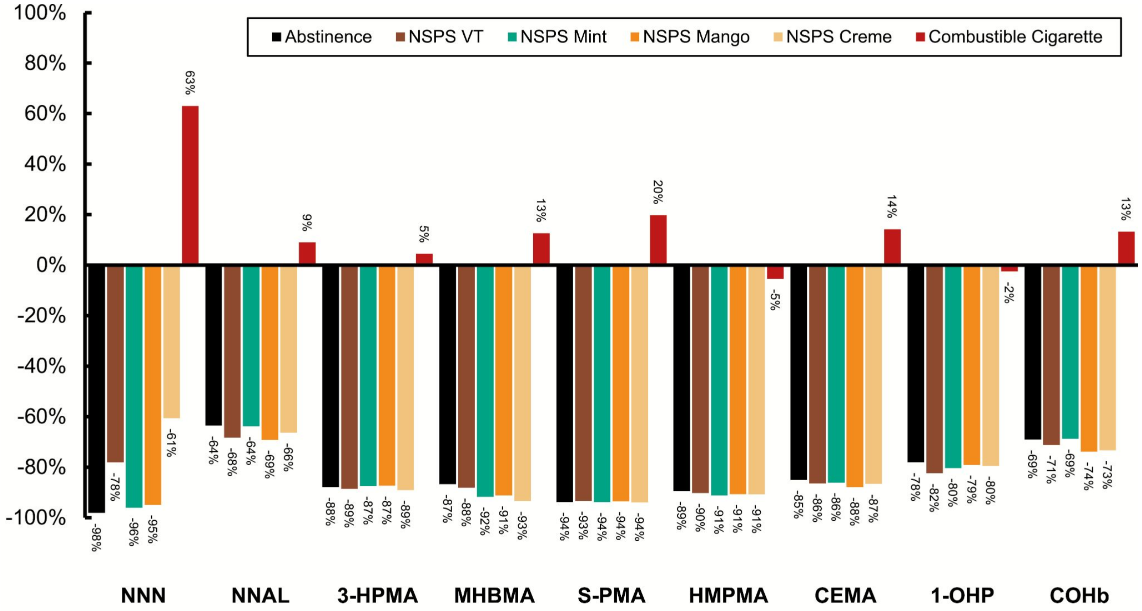
Disclaimers on Research



Data are presented as percent change (%, Day 5 vs. Baseline = (Day 5 – Baseline) / Baseline x 100)
VT = Virginia Tobacco

Juul labs study on biomarkers (vaping and cigarette use)

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Transparency, Accountability within Data Work

- Research transparency is a key concept and underpinning principle of open research, promoting values of openness and transparency in the scientific process. It is an ethical approach to research which improves research integrity and enhances the informational value and impact of research.
- Research transparency encompasses a range of open practices including registering studies, sharing study data, and publicly reporting research findings. Researchers are encouraged to adopt transparent and responsible practices to improve research integrity and the trustworthiness of scientific findings.
  - University of Manchester

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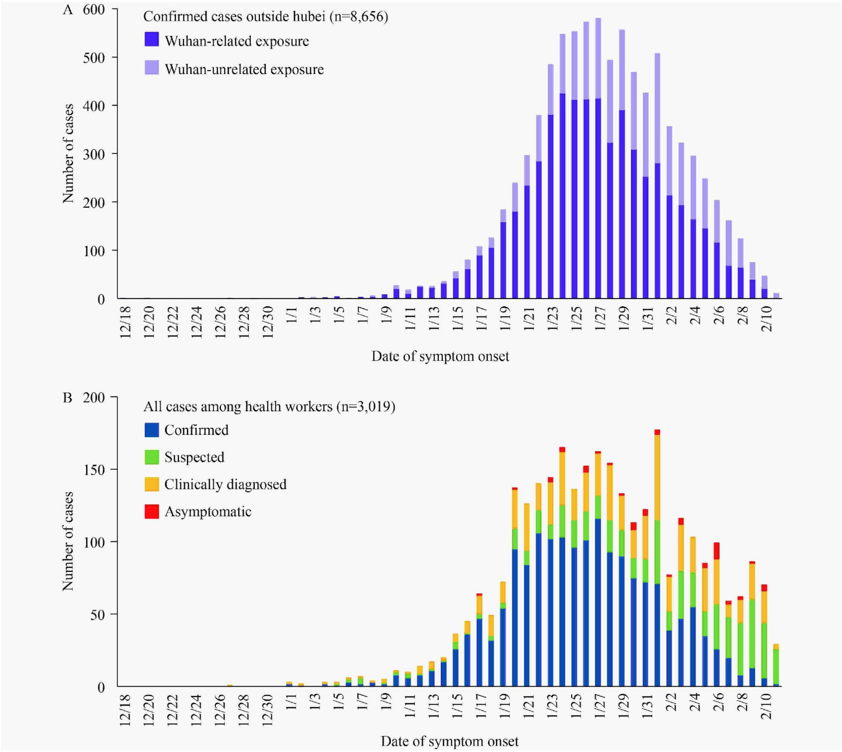
COVID Applications

Vital Surveillances: The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020



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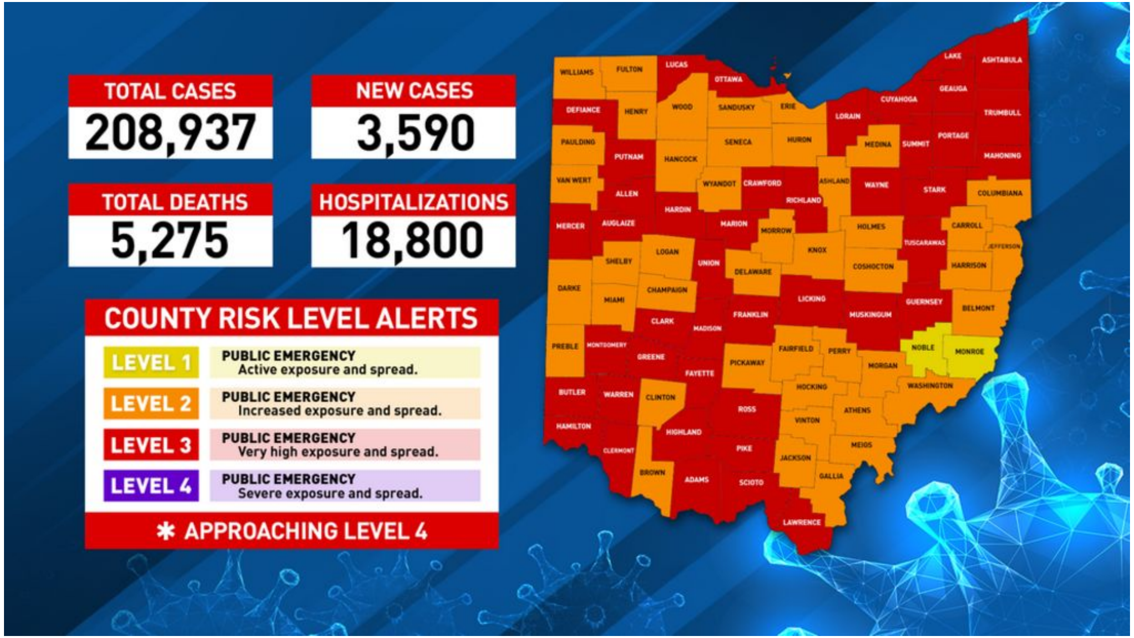
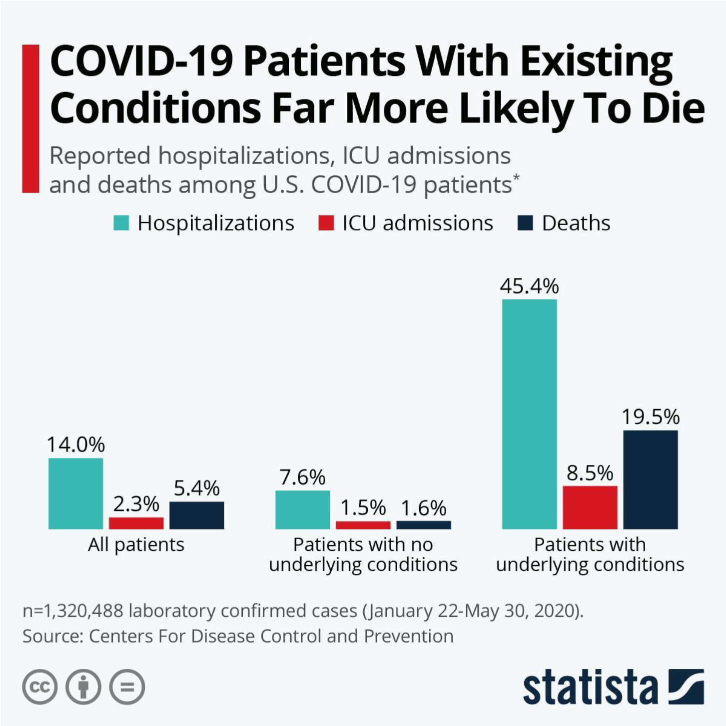
Tracking



TOTAL CASES
208,937
NEW CASES
3,590
TOTAL DEATHS
5,275
HOSPITALIZATIONS
18,800
COUNTY RISK LEVEL ALERTS
LEVEL 1
PUBLIC EMERGENCY
Active exposure and spread.
LEVEL 2
PUBLIC EMERGENCY
Increased exposure and spread.
LEVEL 3
PUBLIC EMERGENCY
Very high exposure and spread.
LEVEL 4
PUBLIC EMERGENCY
Severe exposure and spread.
✱ APPROACHING LEVEL 4

Finding Associations



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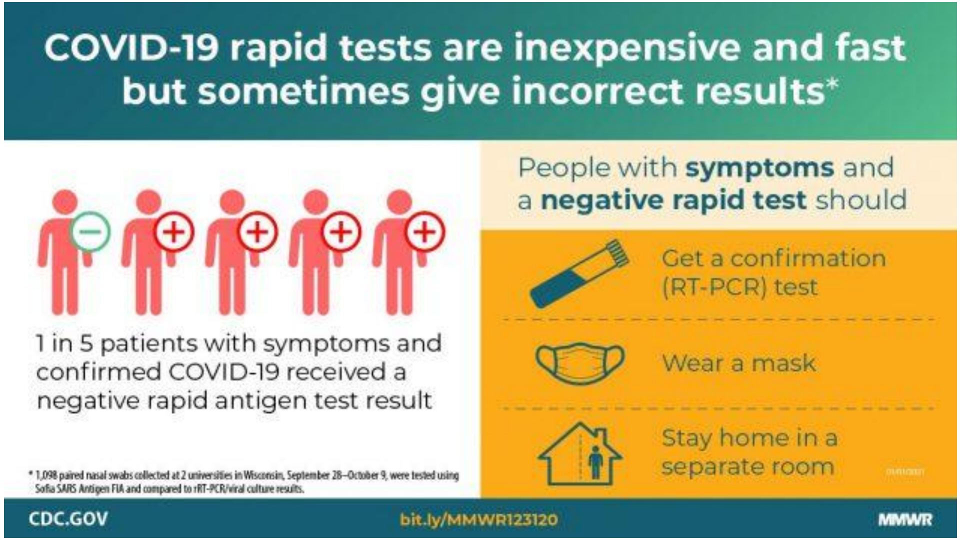
Utilize records

- Analyze testing, hospital, or vaccine records in search of associations



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Conclusion

Conclusion

- Epidemiology is a multi-faceted field.
- Epidemiology fits an important niche within health science and statistics.
- Utilized to prevent and reverse negative health outcomes.
- Considers factors important to unearthing negative exposures in communities.
- Influences public health policy.

Contact

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