Biostatistics

Types of Studies

Case Control = "ODDS RATIO" (ODDs of having Dx in exposed vs. ODDs of having Dx in unexposed) → $\frac{a/b}{c/d}$ = or $\frac{ad}{bc}$

- Compares people w/ Disease to people w/o.

Case Control = A O (Think they a different # of one with Dx, one w/o.)

Retrospective: looks backwards at risk factors or exposure

Cohort Study "Relative Risk" (RR)

- compares a group with given exposure or risk.

COHORT = O O (They are the same → like "relatives")

- look backwards (Retrospective) and forwards (Prospective)

Cross-Sectional aka "Prevalence Study"

Simultaneous measurement of outcome and exposure

Reality	+	−
Risk factor +	a	b
Risk factor −	c	d

Reality	+	−
Test or (exposure) +	TP	FP
Test or (exposure) −	FN	TN

Sensitivity = "used for Screening"

Probability of detecting Dx when Dx is present.

→ rules OUT (SnOUT = sensitivity rules out)

- If Sensitivity is 100% then FN = 0

$\frac{TP}{TP+FN}$

ie. Elisa

Specificity = "used for confirmation"

Probability of Test indicating non-disease when Disease is absent.

→ rules IN (SpIN = specificity rules IN)

- If 100% specificity then FP = 0

$\frac{TN}{TN+FP}$

ie. Western-Blot

Positive Predictive Value (PPV) Probability of having Dx when Test is + for Dx

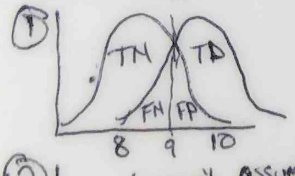
influenced by sample size

$\frac{TP}{TP+FP}$

Negative Predictive Value (NPV) Probability of not having Dx when Test is Negative

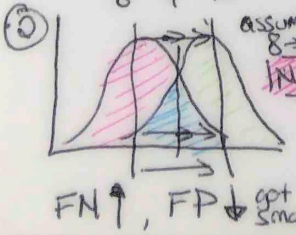
$\frac{TN}{FN+TN}$

If we moved the cutoff point from 8→10, or 9→10 what happens to sensitivity and specificity



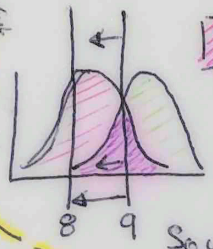
Sensitivity = $\frac{TP}{TP+FN}$ = ↓ Decrease

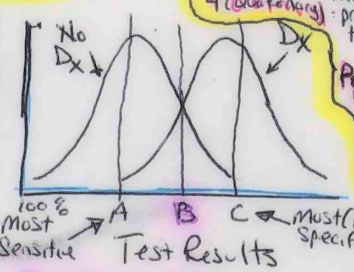
Specificity = $\frac{TN}{TN+FP}$ = ↑ Increased (Basic math of Denominator goes down the overall number increases.)



Note: All you have to do is move the line right or left and see how it affect the FN and FP..... That's it.

FN ↑, FP ↓ got smashed



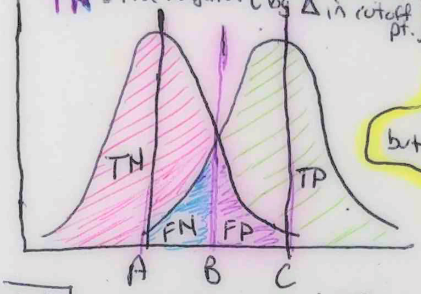


B = most accurate.

TP = True Positive

TN = True Negative

Both Not affected by Δ in cutoff pt.



Note: only the FN and FP are affected when we move the cutoff pts. (ie Move C→A or A→C)

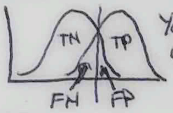
The scenario will be that when we move the cutoff point for a Test from 10 units to 8 units (or from C→A) what happens to PPV, NPV, sensitivity Specificity.

ex.



if we ↓ the cutoff for a Test from 10 to 8, what happens to Sensitivity and Specificity?

Step 1 Label chart



You Must label correctly. "Each side will keep their last name. ie Negative is always on left"

Step 2 Depending on if we were going ↑ (8→9) or ↓ (9 to 8) we only move the middle line and Smash the FN or FP

In this scenario we go from 9→8, to the left, smashing the FN (blue)

So what just happened? we moved to the left (the middle line) smashing the blue (or FN). We ↑ the purple (FP).

Soooo... when moving from 9-8 we ↑ FP, ↓ FN, TN/TP Never affected.

STEP 3 Recall Formulas for Sensitivity and Specificity

	+	−
+	TP	FP
−	FN	TN

Sensitivity = $\frac{TP}{TP+FN}$ = $\frac{TP}{TP+\downarrow FN}$ = ∴ Sensitivity got Bigger (Increased)

Specificity = $\frac{TN}{TN+FP}$ = $\frac{TN}{TN+\uparrow FP}$ = ∴ Specificity got smaller (decreased)

Clinical Trials

- Phase I - Is it safe?
- Phase II - Does it work? "Does it work?"
- Phase III - Does it work better?
- Phase IV - Post Market surveillance "rare events"

1° prevention: action taken before pt. develops Dx

2° prevention: halt Dx at initial phase before permanent damage

3° prevention: All actions to prevent duplicate tests using records

4° (Quaternary): Primordial prevention - prevent risk factors themselves (obesity in Kids)

Drug Schedules

5 classes based on drugs acceptable use and abuse of dependency potential

Schedule I - Drugs w/ No accepted medical use and high abuse potential

- Heroin severe dependence
- LSD
- Peyote

Schedule II - High abuse potential but Less physical and psychological dependence than Class I "Dangerous"

- Vicodin
- Cocaine
- methamphetamine
- methadone
- hydromorphone (Dilaudid)
- meperidine (Demerol)
- oxycodone
- Fentanyl
- Adderall, Ritalin

Schedule III - mod to low potential

- Tylenol w/ Codeine
- Ketamine
- Steroids
- Testosterone

Schedule IV low potential for abuse or dependence

- Xanax
- Soma
- Valium
- Ativan
- Ambien
- Tramadol

Schedule V Lower potential for abuse. Very limited quantities of narcotics (low amounts of <200 mg codeine per 100 ml)

- Robitussin
- Lomotil
- Lyrica

Dx = Disease

Reliability = refers to reproducibility

Accuracy = the degree to which the avg measurement matches that of gold standard (must be given)
"The true-ness of the test" = Validity

Precision = consistency and reproducability (reliability)

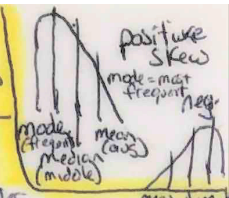


Prevalence vs Incidence

Prevalence = $\frac{\text{total \# of persons with Dx}}{\text{Total Population at a given time}}$

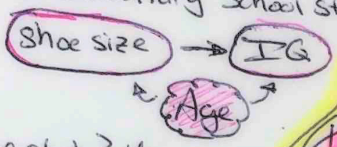
Incidence = $\frac{\text{\# of new cases over a given time}}{\text{Total Population at risk}}$ (Do Not include people + for Dx)

Prevalence > Incidence in chronic Diseases.
Prevalence = Incidence in Acute Dx (colds)



Selection Bias = Non-random assignment
Recall Bias = affected by time and presence of Disease
Sampling Bias = samples aren't reflective of population.
Late-look = info gathered after most patients died

Confounding = occurs with 2 closely affected factors. 1 factor affects the other.
i.e. when comparing shoe size to IQ in Elementary School students



But wait, what about "Age"?
Does age affect the outcome of study? Yes b/c older kids have larger shoe size and most likely a ↑ish IQ
∴ Age is a **Confounder** (it affects both)
exposure outcome

Note we can control confounding in a Case Control Study by Matching when we are in design stage. Equal Distribution of Ages etc...

Note: we also control Confounding also by "Stratified Analysis"

Summary:
Confounding = affects both groups (outcome and exposure)
effect modulation: when something affects only one of the groups.
stratified analysis: differentiates b/n confounding and effect modulation

STEP 1 ⇒ You just need to Know basic definition!!

Lead time bias = when early detection is confused with ↑ survival.

Pygmalion effect = when researcher's belief changes the outcome.

Hawthorne Effect = when the group being studied changes their behavior (i.e. they could start eating better if the study was to give them vitamins)

Berkson Bias = using only sick pts. (i.e. Hospital pts)

Quantifying Risks

Odds Ratio (Case Control) = Odds of having Dx in exposed divided by having Dx in unexposed group. $\frac{a/b}{c/d}$

Relative Risk ("HAZARD RATIO") = probability of getting Dx in exposed vs. unexposed group.
Cohort Study
RR (Relative Risk)

$\frac{\text{prob + exposed}}{\text{prob − exposed}} = \frac{a/a+b}{c/c+d}$

If RR is ≥1, then Dx is more likely in exposed group.
(i.e. if RR is 1.5, then you are more likely (1.5x) to get cancer from smoking etc.)
If RR = 1, then no risk (no difference b/n exposure and not)
If RR < 1, then less likely to have Dx with exposure.

RR does not account for chance. That is covered by Confidence Interval (CI).

Reality	+	−
Test (exposure) +	a	b
Test (exposure) −	c	d

Attributable Risk = The difference (means subtract) b/n exposed and unexposed groups. $\frac{a}{a+b} - \frac{c}{c+d} = AR$

Absolute Risk Reduction (ARR): Reduction in risk a/w Tx vs. Placebo

we need these for formulas

$NNT = \frac{1}{ARR}$ (number needed to treat)

or $ARR = ER_{control} - ER_{Tx}$ (Event Rate control) (Event Rate Tx)

and $NNH = \frac{1}{AR}$ (number needed to Harm)

(most of Time the AR is a simple subtraction of two values in the problem.)

Important facts

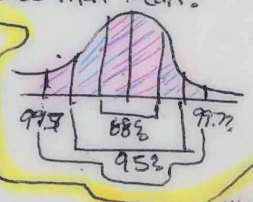
p-value: needs to be ≤ 0.05.
Did something occur by "chance".
If p-value is > 0.05 then not a good study.
(maybe it was poor sample size)

Confidence Interval (CI)
Cannot contain 1.0 *
if it does then it means RR has No significance (bad Study)
If CI = 1.7 − 2.1 (good)
If C.I = 0.8 − 1.3 (bad) contains 1.0
Note: they will give you a C.I. on exam.

Statistical Distribution

Standard deviation (S.D.) = calculated how far from the group they are.
1 S.D. = 68%
2 S.D. = 95%
3 S.D. = 99.7%

Be able to calculate % of a group or if they say > 2 S.D., what does that mean?



Statistical Hypothesis

H_0 (Null) = No Association exists
H_1 = there is an association

Note: You ↑ Power by ↑ sample size.

Reality / Study	H_1	H_0
H_1	Power (1 − β)	α
H_0	β	

Type I error (α-error) = States there is an effect when one doesn't exist (i.e. p-value) (by chance)

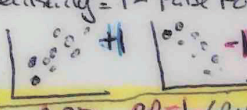
Type II (β) = States no association exists when it really does.

(STEP 1 exam will ask you to work backwards. Give you p in words then ask for Power)

Meta-Analysis = Pools from multiple sources
t-test = checks means b/n 2 groups
ANOVA = compares means b/n 3 or more groups
Chi-Square = uses 2x2 table $\begin{array}{|c|c|}\hline a & b \\ \hline c & d \\ \hline\end{array}$
Likelihood Ratios → >1 that Test result is a/w presence of Dx
→ <1 that Test result is a/w absence of Dx

Miscellaneous

Sensitivity = 1 − False Neg Rate.
Specificity = 1 − False Pos Rate



p-value < 0.05 means Statistical Significance.

ARP = $\frac{RR-1}{RR}$ (Risk of Dx due to exposure)

Control Bias

1) Double-Blind studies
2) Placebo responses
3) Cross-over (Each subject acts as their own control)
4) Randomization (↓ Selection Bias, ↓ Confounding Bias)