High Yield Behavioral Sciences

USMLE/COMLEX Review Notes

Medicine made simple

Disclaimer

Behavioral sciences

The field of Medicine is an ever-changing profession and as new evidence based studies are conducted, new knowledge is discovered. Ftplectures has made tremendous effort to deliver accurate information as per standard teaching of medical information at the time of this publication. However, there are still possibilities of human error or changes in medical sciences contained herein. Therefore, ftplectures is not responsible for any inaccuracies or omissions noted in this publication.

Bias

- Due to systematic error or favor particular direction

1. ***Selection bias***-

   Berkson's bias –

- case/controls selected from hospitals
  Eg- sampling bias- sample selected in a way that does not represent the population on which the study is intended.
- They lack external validity.
- Like you pay money to people who are low in their socioeconomic status and enrol them for study and then collect data and try to generalise it on the rest of the population.
- Another eg- heart disease being studied in a population that does not subjects above 65 years of age.
- Such a study will have internal validity but no external validity.
- Random sampling should be done to eliminate sampling bias.

2. Recall bias

- The patients taken for study are unable to recall the experience that they had after an exposure and that is going to influence the course of your study.
- Eg- Non-smokers with lung cancer report significant exposure to second-hand smoke as a child.

- Solution- Conduct a prospective study or confirm objective sources of information.

- Recall bias happens mostly in retrospective study.

3. **Sampling bias-** sampling bias is a bias in which a sample is collected in such a way that some members of the intended population are less likely to be included than others. It results in a biased sample, a non-random sample of a population (or non-human factors) in which all individuals, or instances, were not equally likely to have been selected. If this is not accounted for, results can be erroneously attributed to the phenomenon under study rather than to the method of sampling.

   Medical sources sometimes refer to sampling bias as ascertainment bias. Ascertainment bias has basically the same definition, but is still sometimes classified as a separate type of bias

4. **Late-look**- Information that was gathered too late to make useful conclusions.

- Patients are severely incapable or dying during the study.
- Eg- Survey of patients with pancreatic cancer shows patients with minimal symptoms as they are too sick to respond or they die during the survey.
- Solution-stratify patients by severity.

5. **Procedure**-
    a. Surgical intervention
    b. Not getting any surgical intervention-

- One arm (arm a) of the study is getting better treatment than arm b.
- Solution- double blind study is conducted

6. **Attrition bias**-

- Patients start to drop off during the study.
- Eg- A- study group for a drug to reduce acne Placebo

From 200, 120 pts drop off because the drug was not working. Remaining 80 of them find that the Drug is working in reducing their acne.

- Solution- Gather as much data from the patients who have dropped out.

7. Confounding bias

- Occurs when Factors related to both exposure and outcome but is not the causal pathway.
- Factors distort or confuse the effects of exposure on the outcome.
- Eg- study done to find the link between the drinking coffee and lung cancer.
- Drinking coffee----------lung cancer

  ↓

  Are smokers generally
- Smoking is a confounding variable
- Solution- Matching

8. **Lead time bias**- early disease detection is misinterpreted is increased rate of survival
   - At the age of 75 years a man came with back pain and was diagnosed of prostate cancer and died after about 5 years at the age of 80.
   - if that man at the age of 60 underwent PSA test and found that the level was more than 24 and had undergone treatment and died at the age of 80 after 20 years.
   - We conclude wrongly that it was because of PSA test the patient survived for another 20 years.
   - **Solution**- Scrutinize any study screening test for lead time bias.- does this improve survival or is it merely disease detection. Breakdown patients depending on their severity. Use TNM staging.

9. **Observer expectancy effect-** Researcher is the observer. This researcher believes the efficacy of the treatment and that belief influences the result of the study.

10. **Hawthorne effect-** The bias that happens when people change their behaviour during the study. (Dr. Hawthorne is watching you!)
- **E.g-** you inform the patient that they are being given a drug to reduce BP and being studied for that. The patient modifies his lifestyle so that the BP lowers.
- **Solution-** put a placebo group.

11. **Susceptibility bias**- Patients who are sicker are selected to get more invasive procedures. For e.g- CAD patients managed surgically compared with the others who receive medical management.
Solution- Randomize patients and place them both in medical and surgical arm of the study.

Decrease the bias by-

i. Randomized controlled double blinded study reduces bias mostly.
ii. You can do cross-over study
iii. Randomization

Calculating risks and odds

Outcome/disease

Exposure		Yes	No
	Yes	A	B
	No	D	C

Exposure----------→ Risk Factor----------→ Good/Bad

Gets treatment

Carcinogen, Harmful Meds

A – You got exposed and so you have the disease.

Outcome is always greater than exposure

YES precedes NO in both the axes.

Risk (exposed group) = a/a+b

Risk (unexposed group) = c/c +d

Risk difference

Absolute Risk Reduction (ARR) = reduction in incidence of associated with treatment compared to the control group.

ARR= Risk in the control group - Risk in the Treatment group.

Example

- In a study , 5% of patients on statin had MI.
- 9% of those on placebo develop MI.

- One got exposed to statin and another to placebo and the outcome remains same- MI
- ARR = 9% - 5% = 4%
- Risk of MI is reduced by 4% in those who take statins.
- The incidence of MI is reduced by 4%.

Attributable risk

Increase in the incidence of A DISEASE associated with exposure.

AR = risk in exposed- risk in unexposed= a/a+b - c/c+d

Example-

9% exposed to asbestos- bronchogenic carcinoma

2% without exposure- bronchogenic carcinoma

AR = 9% - 2% = 7%

Number needed to treat/Harm (NNT/NNH)

NNT = Number of patients required to receive a treatment /intervention before presenting one adverse outcome (death/MI)

NNH = no of patients needed to be exposed to a risk factor for 1 patient to be harmed.

Formula:

NNT = 1/ ARR

Example if ARR of statin therapy is 4% so NNT = ¼% = 25

We need to treat 25 people with statin to prevent MI in one patient.

The smaller the number to treat the better the medication.

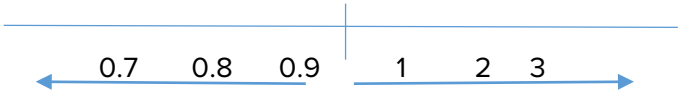
NNH= 1/Attributable risk = 1/0.02 = 50

Relative risk (RR)- used in cohort studies

Ratio of incidence in two groups. RR= Risk in exposed = a/a+b

Risk in unexposed c/c+d

RR



Beneficial treatment or exposure Harmful treatment (negative outcome)

Eg :

I. 21% of smokers- lung cancer
1% non-smokers – lung cancer
RR = 21%/ 1% =21
Smokers are 21 times more likely to develop lung cancer than non-smokers.

II. 50% of diabeteic pts develop CVD
10% of control develop CVD
RR= 50%/10% = 5
Diabetics are 5 more times likely to develop CVD than the rest of the population.

Relative Risk Reduction (RRR)

Defn- Percentage of disease prevented by the treatment.

Risk in unexposed – Risk in the exposed population
Risk of unexposed

c/c+d – a/a+b

c/c+d

Eg- 5% of pts on statins develop MI

9% pts on placebo develop MI

RRR = 9 – 5/9= 4/9 = 0.44 or 44%

Odds ratio (used in case control studies)

Defn- odds that group with diseases (cases) was exposed to a risk factor divided by the odss that the group w/o the disease (control) was exposed.

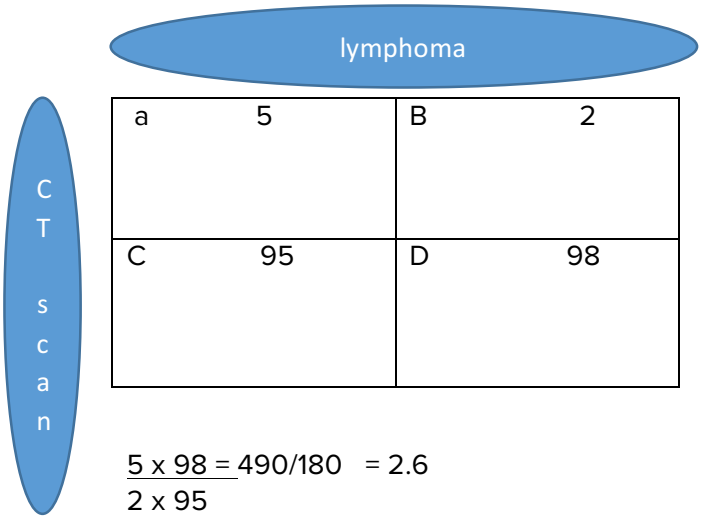
Odds ratio = a/b = ad
c/d bc

OR > 1 = ⇧ likelihood of an event in exposed group

OR <1 = ⇩ likelihood

OR = No difference between the exposed group & control group

Eg- Researcher conducts a case-control study to determine risk of lymphoma due to CT scans. 100 people were selected with Lymphoma, 180 people W/O lyphoma were selected as control. 5 patients with lymphoma had received a CT scan at some point their life. 2 pts without lymphoma had received a CT scan. Calculate CT scan-



a 5	B 2
C 95	D 98

$\frac{5 \times 98}{2 \times 95} = \frac{490}{180} = 2.6$

Those who had CT scans are 2.6 more likely to develop lymphoma than those who were not exposed to CT scans.

Clinical Studies

Case control study

- Compares the people with disease to people without disease.
- Example- COPD patient- increased odd ratio of smoking hsitory VS nonsmoker
- We look for Exposure

Cohort study

- Also called observational study
- Can be prospective or retrospective study
    1. Prospective study- Patients with a disease are followed for few years. You try to find out if the exposure is increasing the likelihood of the disease.
    2. Retrospective study- The study goes backwards in time. To find out what was the factor that caused the patients to develop a particular disease. This means that the subjects have a disease already and we need to know the causative factors or exposure.
- Cohort study measures the relative risk.

Cross-sectional study

- Prevalence of a disease in a cross-section of the population.
- Prevalence is the number of people with the disease at a given time.
- Example- no of people who are suffering from AIDS in the US, i.e. 100,000 out of 320 million
- Another eg- no of people who have hyperlipidemia and suffer from coronary artery disease.

Twin concordance study

- Compares the frequency with which Monozygotic twin or dizygotic twin develop a disease.
- Heritability is measured.

Adoption study

- Compares siblings raised by biological vs adoptive parents.
- You check for any disease inherited or the influence of environmental factors.

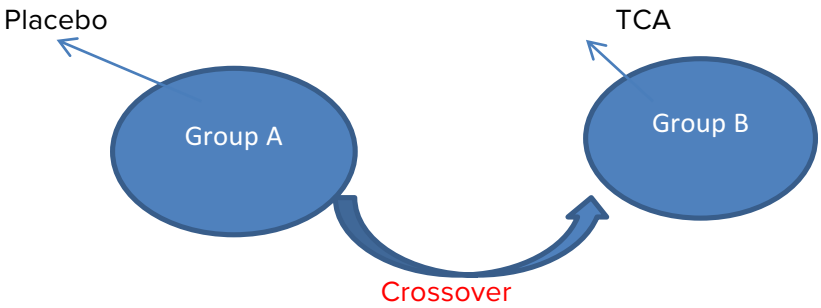
Randomized clinical trial

- One of the best trials that can be conducted as a researcher.
- Used mostly by pharmaceutical drug companies.
- Example- if you have a sample size of n=400, you break them blindfolded into two equal groups namely **control** arm and **exposure arm.** Persons in control arms are given placebo and those in exposure arm are given the drug in question (lipid lowering drug- statin).

- The pills look same so no one knows who is getting the placebo and who is getting the drug.
- Over the next 10 years the patients are followed up.
- It is found that statins reduce the incidence of myocardial infarction by 20% and there is no change observed in the placebo group.
- Hence, you can conclude that lipid lowering drugs can lower the risk of MI.

Cross-over study

- A type of prospective study
- For example- Fibromyalgia is being studied
- Two groups are there-



- Patients in Group B taking TCA find themselves better. No change in the condition of patients in Group A.
- Later the groups are exchanged so that the patients of group A now receive the drug for fibromyalgia and group B patients receive the placebo.
- We find that the patients of Group A start getting better and patients in Group B start getting their symptoms than earlier.
- Hence, both the groups got a chance to become control and exposed groups of a cross over study

Meta-analysis study

- Increase sample size by gathering data from similar studies and then review them.
- Can produce most convincing level of evidence if done well.
- Can produce poor results if done on the basis of poor articles or reources.

Clinical Trials

- Conducted by pharmaceutical companies to determine of a drug is bale to cure a disease.
- The quality of the study is considered best when it is randomized control and double blinded.
- 4 phases before a drug reaches to the market-

Phase I

- Test the drug on healthy human volunteers.
- Test the safety, pharmacokinetics and pharmacodynamics of the drug.

Phase II

- Study on the diseased population (small in number)
- For example, action of aspirin on those who have MI- does it decrease mortality
- To know the drug efficacy
- Optimal dosing- 81mg of daily dose will help prevent MI or 325mg of aspirin at the time of MI will decrease mortality.
- What are the adverse effects of the drug?- tinnitus, respiratory alkalosis and metabolic acidosis

Phase III

- We take up Randomized Control Trial in that
- Sample size/n is more than 10,000.
- It is divided into two equal groups – one that receives placebo and one that receives the drug.
- Double-blinded - The investigator, the physician and the person receiving drug/placebo are not aware as to who receives what.
- Prove safety and efficacy compared to the gold standard.
- Requires FDA approval.- make sure that the new drug is better in efficiency or has low toxic effects.
- If a drug is approved here then it moves to Phase IV.

Phase IV

- Marketing of the drug.
- Determine the long term effects or any adverse effects or reactions cause by the drug.

Incidence and Prevalence

Incidence rate = Number of new cases in a specific time period

Population at risk during the same time period

Example- in a population of 5000 that is studied for over 10 years 500 new cases of Ebola are reported. Hence incidence rate= 500/5000 = 10%

Prevalence = number of existing cases

Population at risk

= 5000/50000 = 10%

Prevalence = incidence rate x average disease duration

Prevalence is greater than incidence for chronic diseases.

Incidence rate is higher in Acute diseases.

Medicare and Medicaid

Two types of federally sponsored medical insurances- Medicare and Medicaid

Medicare-

- **E** for elderly
- For people more than age of 65 years.
- For people who are less than 65 years of age and disabled
- For those who have end stage renal failure

Medicaid

- AID is for the poor.
- Joint federal and health assistance for those with low income.

Positive and Negative predictive Values

Positive predictive value

- Definition- What is the chance or the given probability that given a positive test, the patient has the disease.
- Used to calculate the post-test positivity of a + test.

	• **Have disease**	**Don't have disease**
✚	TP	FP
−	FN	TN

- PDV = TP/TP+ FP
- According the previous example-

	• **Influenza**	**No influenza**
✚	80	5
−	20	95

PDV = 80/ 80+ 5 = 80/85= 94%

Negative Predictive value

- Definition- What is the chance or probability that a patient does not have a disease given a negative test.

	• **Have disease**	**Don't have disease**
✚	TP	FP
−	FN	TN

- NPV= TN/TN+ FN
- According the previous example-

	• **Influenza**	**No influenza**
✚	80	5
−	20	95

- NPV= 95/20+95 = 95/115= 83%
- False negative rate = 20/20+95 = 17%= 1-NPV

Precision and Accuracy

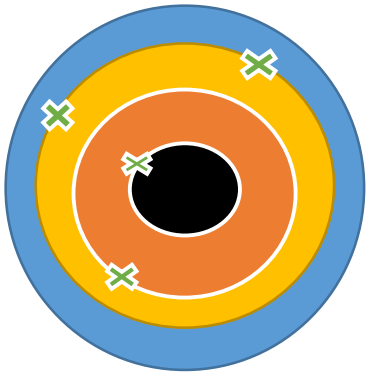
Precision

Defn- It is called as reliability as well. It is the measure of consistency and reproducibility of a test.

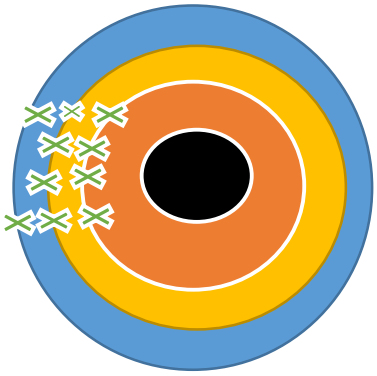
Accuracy

Defn- also called as Validity. It is the ability of a test to measure what it is intended to measure.

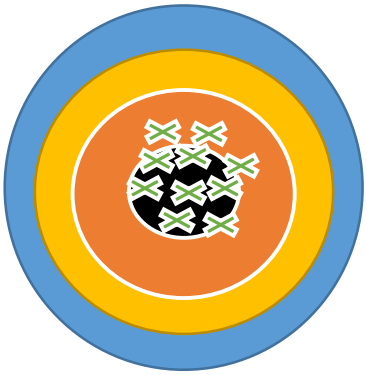
Accurate



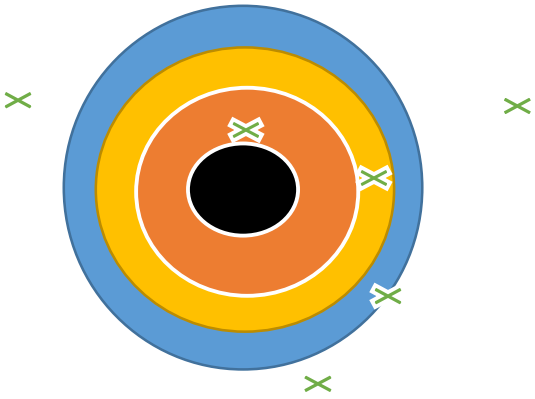
Precise



Accurate & Precise



Neither accurate nor precise



Precision $\propto \frac{1}{\text{Random error}}$

Increased precision = decreased standard deviation

Accuracy $\propto \frac{1}{\text{Systematic error}}$

P R A V

Precision reliability accuracy validity

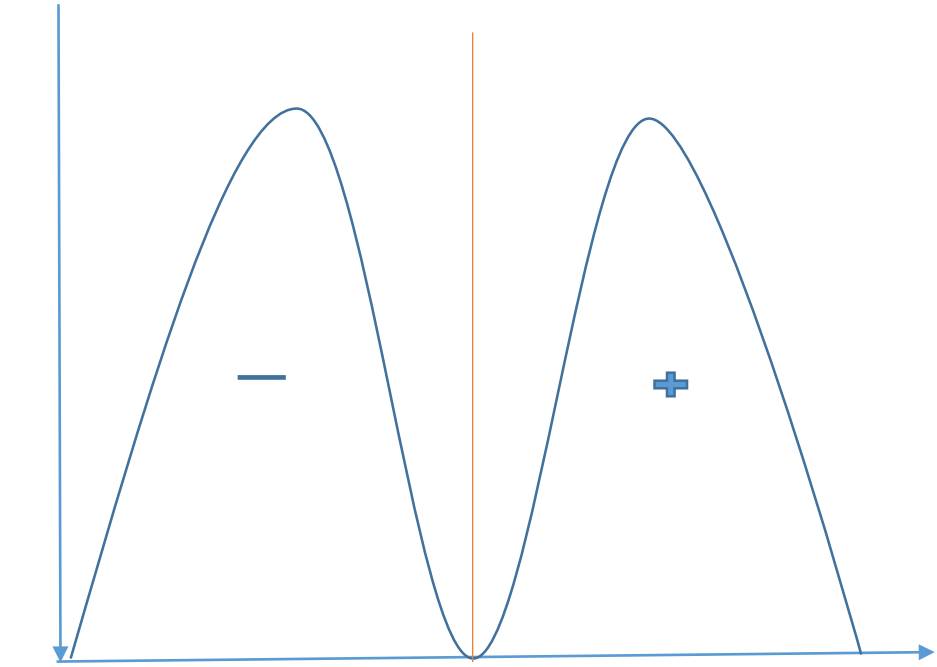
Preventative Medicine and Healthcare

Primary prevention	***Secondary prevention***	***Tertiary prevention***
It is preventing a disease process from ever occurring. Eg- vaccination like HiB.	First diagnose the disease and then prevent it from getting worsened. Eg- mammography and colonoscopy for cancer screening.	Prevention of disabilities caused by the disease in patients. Eg- 1. Prescribing diuretics for patients who have congestive heart failure. 2. Recording HbA1c- If it is less than 6.5 then the blood sugar level is normal.

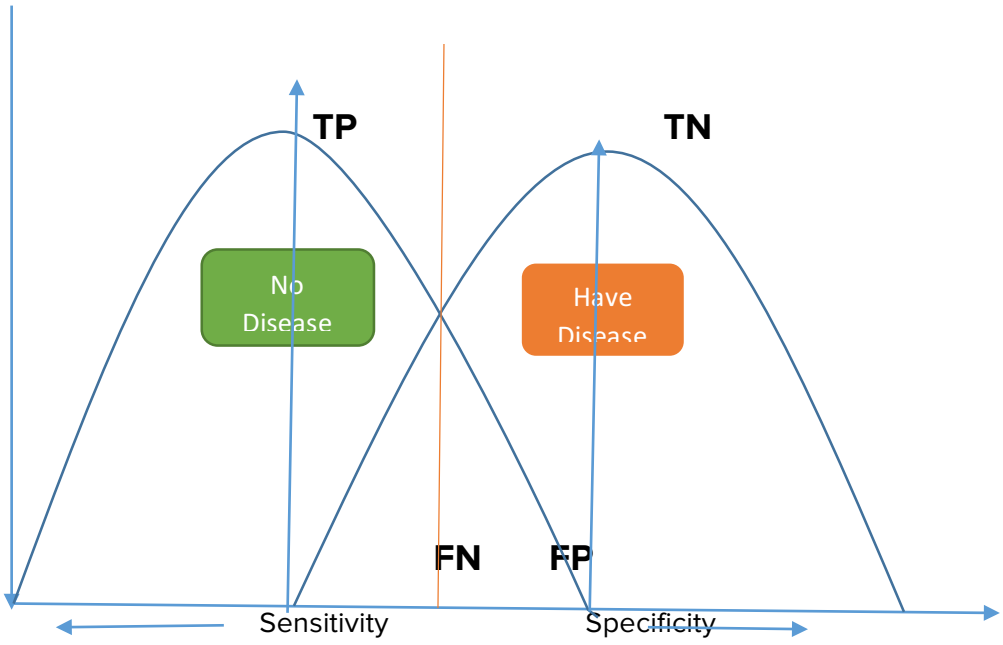
HMO's	**PPO's**
Health maintenance organizations	Preferred provider organization
It is a type of managed care organization with integration of payments and delivery of healthcare in which a group of providers contract with the insurance company or agency to provide complete care for the patients in exchange for a referral base.	Provide care to their own clients at a reduced rate.
Mostly those from primary health care center	Patients do not need to be referred from their doctor of PPO before going to a specialist. They can directly access the specialist.
Mostly those who have done family medicine	

Sensitivity and Specificity Graph

Double hump graph



This is seen in ideal cases but in real life the tests overlap-



	Have disease	Don't have disease
✚	TP	FP
−	FN	TN

- We require a sensitive test to make a correct diagnosis.

Sensitivity

Terms-

1. True positive- If you order a test for a disease and that comes positive for the disease.
2. True negative- - If you order a test for a disease and that comes negative for the disease.(patient doesn't have the disease)
3. False positive- The patient does not have disease but test comes back positive.
4. False negative- The patient has disease but test comes negative.

2 x 2 table

The truth (disease)

	Have disease	**Don't have disease**
✚	TP	FP
−	FN	TN

Definition of sensitivity

Sensitivity or true positive rate is the proportion of people who test positive and have the disease.

OR

Sensitivity is the probability that the test detects a disease actually when the disease is there.

- It is a Rule out test as it rules out the disease.
- Formula for sensitivity: SN= TP/TP+FN

Problem based learning

200 patients are enrolled in a study to evaluate the accuracy of a new ELISA based test for influenza. 100 patienst were diagnosed with influenza by the reference

standard culture of respiratory secretion. 80 of those patients with Influ had a positive ELISA based test as did 5 patients without Influ.

Calculate sensitivity-

Total-200

	Have Influenza	**Don't have Influenza**
✚	80	5
−	20	95
	100	100

SN= 80/80+20 =80/100 = 80%

- It means that if 100 people have disease this test will catch about 80 people with the disease.
- Mnemonic- SNOut
- Lower the false negative the higher the sensitivity test.
- Another formula for sensitivity : SN=1- FN rate

Specificity

Definition- It is the proportion of all people without disease who test negative.

	Have disease	**Don't have disease**
✚	TP	FP
−	FN	TN

- Rule In disease
- Used as a confirmatory test after a positive screening test.
- Example- a patient turns positive for ELISA test and then a more specific test namely Western Blot test comes negative proving that the patient does not have HIV.
- Formula- SP= TN/ TN+ FP

Problem based learning

200 patients are enrolled in a study to evaluate the accuracy of a new ELISA based test for influenza. 100 patienst were diagnosed with influenza by the reference standard culture of respiratory secretion. 80 of those patients with Influ had a positive ELISA based test as did 5 patients without Influ.

	Have Influenza	**Don't have Influenza**
✚	80	5
−	20	95
	100	100

SP= 95/ 95+5 = 95/100= 95% specific.

SP = 1- FP rate

So if FP = 0 then SP becomes 100 %, hence reduce the rate of False positives.

Statistical Distribution

Sample value set – 1,1,2,4,5,7,7,25 n=8

Mean- Average of all the above numbers together divided by 8= 52/8 = 6.5

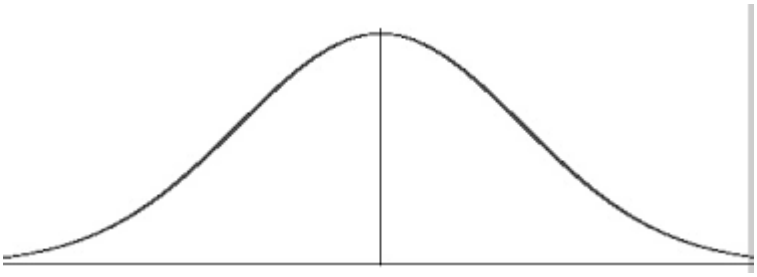
Mode= Most common number = 1 and 7

Median = 50th percentile- take he middle two numbers, add up and then divide by 2= 4+5/2=9/2=4.5

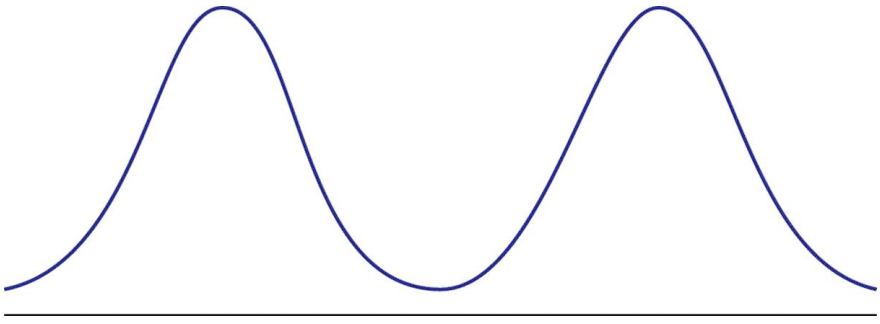
1. Normal bell curve-

- Mean, median and mode are the same thing
- X is the mean

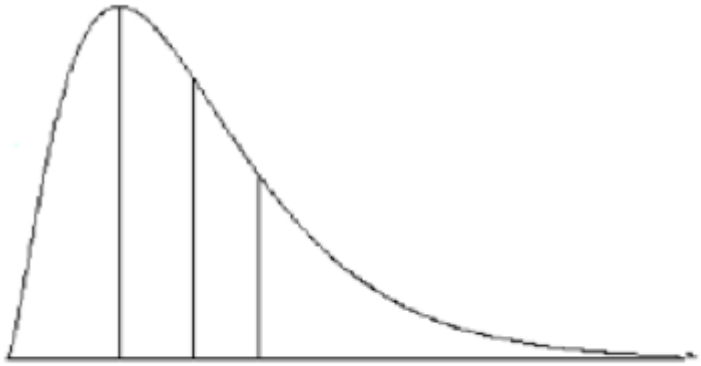
X= mean



2. Bimodal curve- when two modes are there like 1 and 7

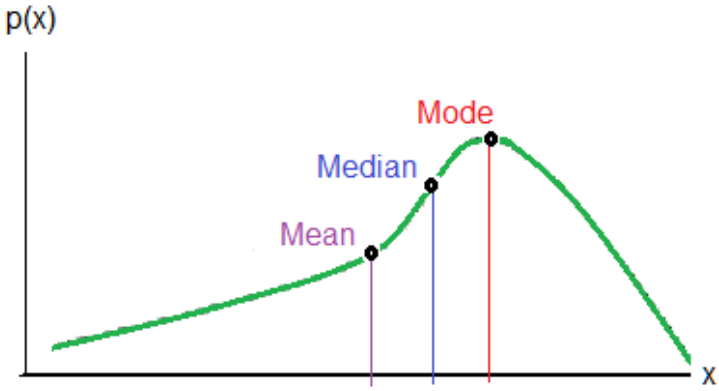


3. Positive skew ness graph – Mean> Median>Mode



Mode < Median < Mean

4. Negative skewness graph- Mean <Median<Mode



Standard deviation

- Average distance from the mean.
- Eg:- Sample set = {1,2,3,4.5} do n=5 and mean =3
- Standard deviation = 2+1+0+1+2/5 = 6/5 = 1.2

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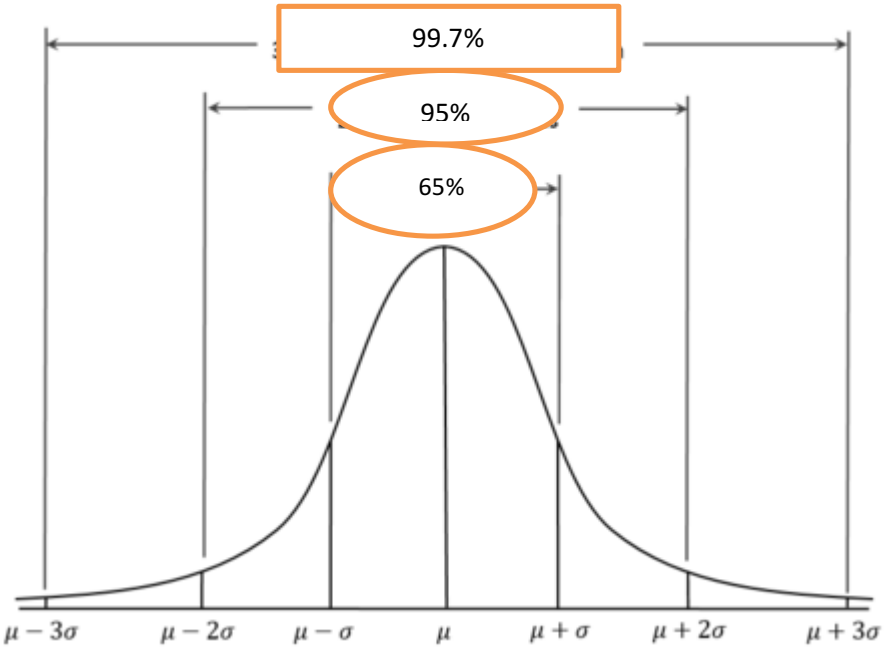

Standard error of the mean

SEM = SD/Square root of sample size= 1.2/√5

Statistical Hypothesis

Null Hypothesis (Ho)

- The hypothesis of No association between two variables. No association between the risk and outcome.
- Should I accept or reject?

Alternative hypothesis (H1)

- Hypothesis of some difference
- Association between the disease and the risk factor

Study results		Reality: H1	Reality: H0
	H1	Power 1- B	Alpha Type 1 error
	H0	B Type 2 error	Correct

- Eg;- A study to compare the action of metronidazole with a placebo on giardia.
- Null hypothesis says no increased rate of resolution.
- Alternative hypothesis says the contrary.

Types of Error

1. **Alpha error**

- False alarm
- Type 1 error
- False positive error
- Researcher states- I found a difference/association in the study
- Reality- there is none.
- Eg:- Use of Vitamin C improves the recovery of URT infection patients. Reality- it does not.
- Alpha = probability of making type 1 error
- P <0.05 means there is less than 5% of chance that the data will show something that is not really there.

2. **Beta error**

- Type 2 error
- False negative error
- There was a difference which you did not get.

- You missed the difference and you were blinded.
- Beta= Probability of making type 2 error.

Power= 1-B

- To increase power, increase sample size
- Increase expected effect size
- Increases the precision of measurement.

Core Ethical Principles

1. **Patient Autonomy**- The principle that states that all patients have the right to take their own informed decision.
   - Your patient has the ultimate say.
   - One cannot force the patient for a treatment.
2. **Beneficence**- The physician has the fiduciary duty to act in the patient's best interests. Do what is best for your patient
3. **Nor maleficence**- Do no harm. If a surgery or treatment procedure poses more harm than benefit to the patient then it is better not to be done.
4. **Justice**- All people should be treated in a similar way regardless of their age, caste or creed.

Informed consent

- Oral/written
- Eg- introduction of central line into the patient's IJ for administration of blood or vasopressors as a part of resuscitation. This needs to be discussed with the patient before performing it on the patient.
- **BRAIN mnemonic**
- **Benefits**- Inform the patient about the benefits about the procedure.
- **Risks** – Inform the patient about all possible risks that the patient may have to face- like puncture of neighbouring carotid artery in this example. This may lead to increase bleeding. There are chances for pneumothorax.
- **Alternative** – Do nothing. Use peripheral lines but that may not suffice or introduce from femoral vein.
- **Indication of the procedure**- Tell the patient why the procedure is being done.
- **Nature of the procedure**- Tell the patient about the procedural steps.

Exceptions-

1. **Waiver**- Patient comes up personally and says that he does not want to know about the procedure and asks the doctor to do what is best.
2. **Incompetence**- When the patient is not capable to decide for themselves due to mental incapability.
3. **Therapeutic privilege**- If we tell something to the patient he may commit suicide, so rather not tell him about it.
4. **Emergency implied consent**- No need to ask in a case of emergency.

Futility- Patient cannot demand unnecessary treatment from the physician and the doctor cannot carry on with the same treatment if it has failed already.

Advanced directives-

If a patient has given a directive about something that may happen to him in future- what to be done and what not to be done like Do Not Intubate/ Resuscitate - patient's decision needs to be respected.

If no advanced directive present then do what is best for the patient.

Medical Malpractice

4D's

1. Duty to the patient – Duty of the doctor to treat the patient.
2. Derelict in the patient care – negligence of the doctor
3. Direct cause
4. Damages to the patient