Unit IX – Problem 4 – Epidemiology: Critical Appraisal

- **There are five categories of research papers, two of which are explained to you in this unit:**
  - **Therapeutic paper** (this was explained in the previous workshop by Dr. Adel Alsayyad).
  - **Diagnostic paper.**
- **Diagnosis is constituted from:**
  - **History taking**: representing 70% of your diagnosis.
  - **Physical examination.**
  - **Investigations.**
    Notice that each of these components is considered as a diagnostic test.
- **What are the benefits of diagnostic tests?**
  - They help us in changing provisional (مؤقت) diagnosis to a confirmed diagnosis (e.g. a patient presents to your clinic with chest pain → you will do an ECG "investigation" for him → therefore, you will confirm that he has myocardial infarction).
- **Probabilities:**
  - **A probability before doing the diagnostic test is known as**: pre-test probability.
  - **A probability after doing the diagnostic test is known as**: post-test probability.
    e.g. when a patient presents to your clinic with chest pain → there is a 50% chance that he is suffering from myocardial infarction (MI). after performing the diagnostic test (checking for cardiac enzymes which will appear to be elevated) → the probability changes to become 95% that the patient is suffering from (MI).
- **Results of diagnostic tests:**

Screening Test Results:	Actually Have Condition?		Totals
	Yes (Column 1)	No (Column 2)	
Positive (Row 1)	a	b	a + b
Negative (Row 2)	c	d	c + d
Totals	a + c	b + d	a + b + c + d

  - **They are either true-positive or true-negative, but there are exceptions:**
    - ✓ The test might be positive → but the disease is absent (this is known as false-positive).
    - ✓ The test might be negative → but the disease is present (this is known as false-negative).
  - **Notice that:**
    - ✓ The rate of true-positive is known as: sensitivity (from those who had the disease, how many were detected positive by the test?).
      - ❖ *What does an 80% sensitivity means*? It means that 80% of patients who has the disease had positive test results (true-positive) while 20% of patients who has the disease had negative test results (false-negative).
      - ❖ *Sensitivity = [a/(a+c) x 100] = the percentage of individuals with the condition under study with a positive test divided by the total number of individuals with the condition.*
    - ✓ The rate of true-negative is known as: specificity (from those who did not have the disease, how many were detected negative by the test?).
      - ❖ *What does a 40% specificity means*? It means that 40% of patients who don't have the disease had negative test results (true-negative) while 60% of patients who don't have the disease had positive tests results (false-positive).
      - ❖ *Specificity = [d/(b+d) x 100] = the percentage of individuals without the condition under study with a negative test divided by the total number of individuals without the condition.*

- **Predictive value:**
  - ✓ Positive predictive value: if an individual has a positive test, what is the likelihood of having the disease?
    - ❖ *Calculation = [a/(a+b) x 100]*
  - ✓ Negative predictive value: if an individual has a negative test, what is the likelihood of not having the disease?
    - ❖ *Calculation = [d/(c+d) x 100]*
  - ✓ Notice that the predictive value is very good/high when the prevalence of the disease is high.
- An important variable in evaluating tests and test results is the prevalence of the disease in the question. Prevalence is defined as the percent of individuals in the population under study that have the disease. (This differs from incidence which refers to how many new individuals acquire the disease in a given time period).
  - ✓ Prevalence = number of individuals with disease/total population
- **Likelihood ratio:**
  - ✓ Likelihood ratio of a positive test: probability of the test being positive in someone who has the disease (sensitivity) in comparison to the probability of the test being positive in someone who doesn't have the disease.
    - ❖ *Calculation* = $\frac{Sensitivity}{1-specificity}$
    - ❖ *The bigger the positive likelihood ratio the better (you will understand this more by using the graph below).*
  - ✓ Likelihood ratio of a negative test: probability of the test being negative in someone who has the disease in comparison to the probability of the test being negative in someone who doesn't have the disease (specificity).
    - ❖ *Calculation* = $\frac{1-sensitivity}{specificity}$
    - ❖ *The smaller the negative likelihood ratio the better.*
  - ✓ Examples:
    - ❖ *Sensitivity = 80%, specificity = 80%... what is the positive likelihood ratio?*
      - ➢ +LR = $\frac{80}{100-80} = \frac{80}{20} = 4$
    - ❖ *Sensitivity = 95%, specificity = 99%... what is the positive likelihood ratio?*
      - ➢ + LR = $\frac{95}{100-99} = \frac{95}{1} = 95$
  - ✓ Importance of likelihood ratio: it doesn't change with the change in the prevalence of the disease.
  - ✓ The graph:
    - ❖ Example (1):
      - ➢ Pre-test probability = 70
      - ➢ Likelihood ratio = 4
      - ➢ Draw a line connecting 70 and 4 then extend it till it reaches the post-test probability.
      - ➢ Post-test probability = 90
    - ❖ Example (2):
      - ➢ Pre-test probability = 20
      - ➢ Likelihood ratio = 99
      - ➢ Draw a line connecting 20 and 99 then extend it till it reaches the post-test probability.
      - ➢ Post-test probability = > 95