EPIDEMIOLOGY LEVEL II NOTES 2014

COMPILED BY EFFIE NAILA

OVERVIEW OF LEVEL II EPIDEMIOLOGY

1. DEFINITION, PURPOSE, ACTIVITIES & APPLICATION OF EPIDEMIOLOGY
2. DISEASE DETERMINANTS & NATURAL HISTORY OF DISEASE IN RELATION TO PREVENTION
3. MEASUREMENTS USED IN EPIDEMIOLOGY
4. STANDARDIZATION OF RATES
5. EPIDEMIOLOGIC STUDY DESIGNS
6. SCREENING & DIAGNOSTIC TESTS

1. DEFINITION, PURPOSE, ACTIVITIES & APPLICATION OF EPIDEMIOLOGY

BY: MR. LAMBERT NYABOLA

WHAT IS EPIDEMIOLOGY?

- This is the study of distribution & determinants of health – related states or events in specified population & the application of this study (epidemiologic methods) to the control & prevention of health problems.
- It studies how disease & other health – related problems are distributed and factors affecting their distribution
- It aims to improve health status of the population by reducing:
  - Morbidity
  - Mortality
  - Injuries etc.

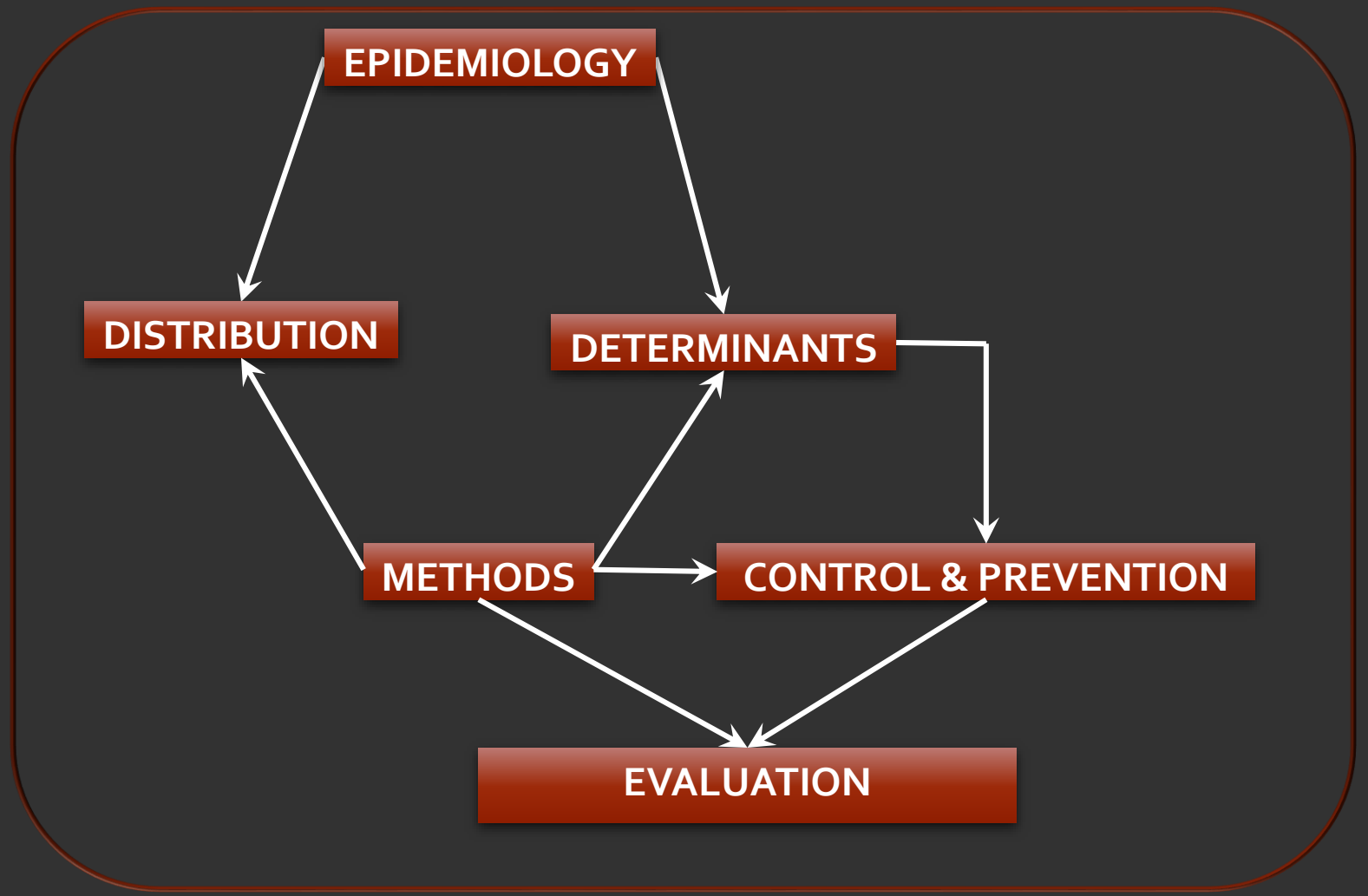
KEY WORDS

- Population:
- Disease:
- Frequency:
  - Quantification of disease and health related events in a population
  - The following are used: counts, rates, proportions & ratios
- Distribution
- Determinants
- Control/ prevention

CONT. STUDY

- This is the process epidemiology undergoes in order to:
  - Determine magnitude or determinants of health related events
  - Take action for improvements of health related events
  - Control/ prevent health related events
- Types of studies:
  - Observational: Experimental, cohort, case – control
  - Descriptive: frequency & distribution of disease or other health related event
  - Analytical: identifying determinants or risk factors of disease or other health related event

PRINCIPLES OF EPIDEMIOLOGY



PURPOSE OF EPIDEMIOLOGY

- Determining the amount of diseases and other health related conditions in the population.
- Finding out the presence, nature and distribution of health and disease among the population, i.e. community diagnosis
- Searching for the causes of disease or health related events, i.e. determinants.
- Control and prevention: planning, implementing monitoring & evaluation of health programs
- Natural history of disease (NHD) and pathogenesis.

CONT.

- Surveillance for specific health conditions in the population
- Evaluation of preventive and control measures
- Identification and investigation of outbreaks & epidemics
- Intervention strategies
- Screening for diseases & risk factors
- Classification of disease

WHICH MEASURES ARE USED TO QUANTIFY HEALTH RELATED PROBLEMS IN POPULATIONS?

- These include
  - Proportions
  - Ratios
  - Rates
- Measures are used to:
  - Quantify the problem
  - Compare the experience in different populations

APPLICATION OF EPIDEMIOLOGY

- Behavioral sciences
- Nutrition
- Clinical medicine
- Occupational health
- Infectious disease

SOURCES OF DATA

- Surveillance data
- Surveys (morbidity & mortality)
- Census data
- Health reports
- Disease notifications
- Lab investigations
- Reports

2. DISEASE DETERMINANTS & NATURAL HISTORY OF DISEASE IN RELATION TO PREVENTION

BY: MR. LAMBERT NYABOLA

WHAT IS A DETERMINANT

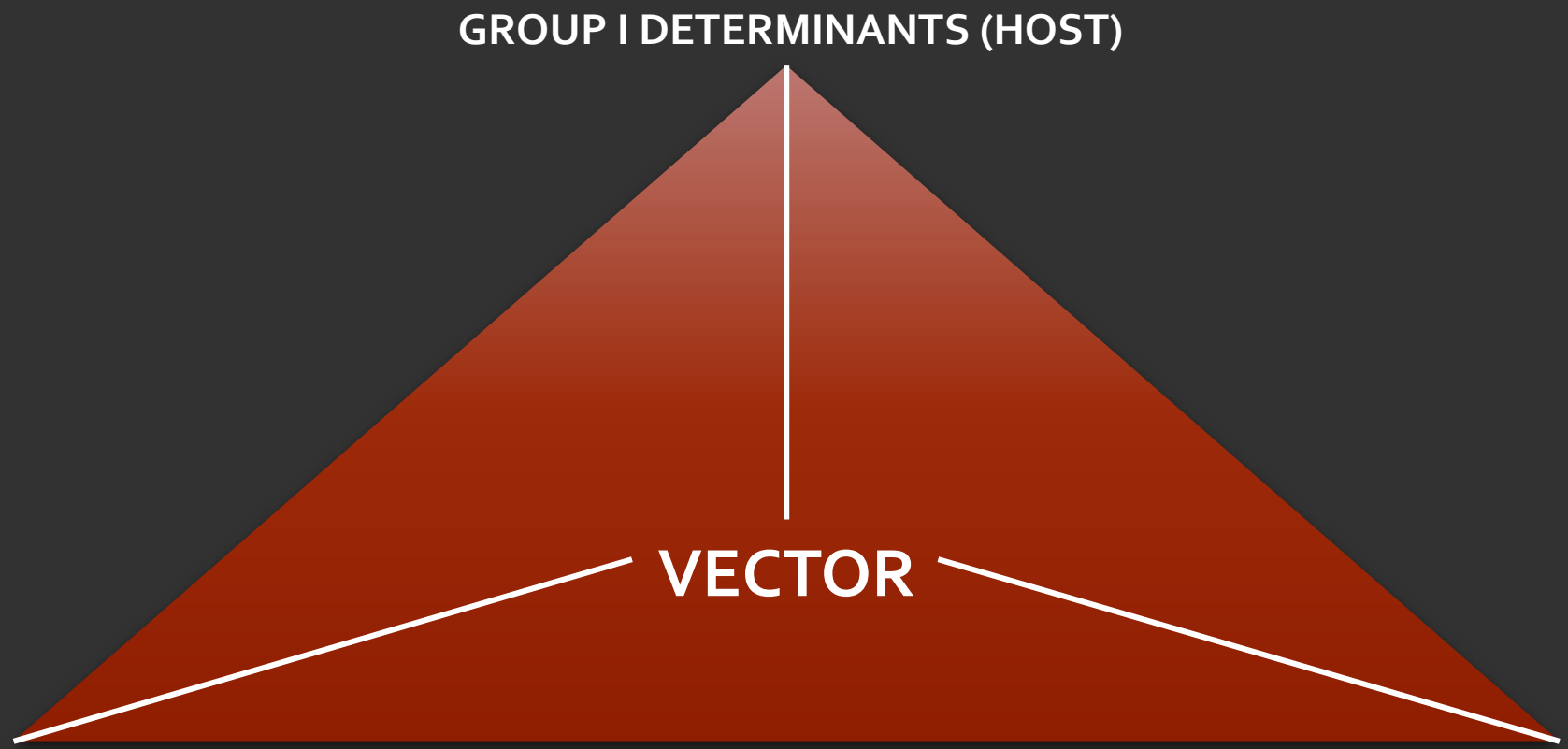
- This is a factor that influences the occurrence of disease or other health – related problem in a population
- This epidemiology is referred to as analytic epidemiology.
  - Analytic epidemiology attempts to provide the why and how of such health related events
- The statistical test of significance that can be applied in this case is the chi square
- Determinants influence courses of diseases i.e. natural history
- Examples of determinants: poor sanitation, noisy environment, risky behavior etc.

IMPORTANCE OF KNOWLEDGE OF DETERMINANTS

- They may be altered to influence prevention and control of disease e.g. malaria and coronary heart disease
  - Some determinants of malaria include:
    - Age, gender, bushy environment etc.
  - Some determinants of coronary heart disease include:
    - Cigarette smoking, high BP, stress etc.

INTERPLAY OF DISEASE DETERMINANTS 'EPIDEMIOLOGIC TRIAD'

- The triad depicts a relationship among 3 key factors in the occurrence of disease &/ or injury



CLASSIFICATION OF DETERMINANTS: GROUP 1 (HOST DETERMINANTS)

- These are intrinsic factors that influence individuals' exposure, susceptibility or response to causative agents.
- They include:
  - Age, gender, lack of immunity, inadequate knowledge, level of education, non – use of insecticide – treated mosquito nets (ITNs)
  - Demographic, biological and socioeconomic characteristics.

GROUP 2 (ENVIRONMENTAL DETERMINANTS)

- These are extrinsic factors within the environment which affect the agent and the opportunity for exposure.
- Thee are phenomena that bring the host and pathogen together.
- Types:
  - Biological, physical & social
- Include:
  - Bushy environment, climate, temperature, presence of stagnant water, humidity, rainfall etc.

GROUP 3 (AGENT DETERMINANTS)

- These are factors whose presence or absence, excess or deficit is necessary for a particular disease or injury to occur.
- Types:
  - Biological
  - Chemical e.g. alcohol etc.
  - Physical e.g. fire
  - Nutritional e.g. deficiencies
  - Mechanical
- Include:
  - *Plasmodium falciparum*, Presence of mosquitoes

NATURAL HISTORY OF A DISEASE

- This is the uninterrupted progression of a disease from exposure to causal agents until recovery or death i.e. course of disease from inception to termination if there's no intervention.

OTHER DEFINITIONS

- Infectivity: this is depicted by the proportion of exposed persons who become infected
- Pathogenicity: proportion of infected persons who develop clinical apparent disease
- Virulence: proportion of clinically apparent disease that becomes severe or fatal

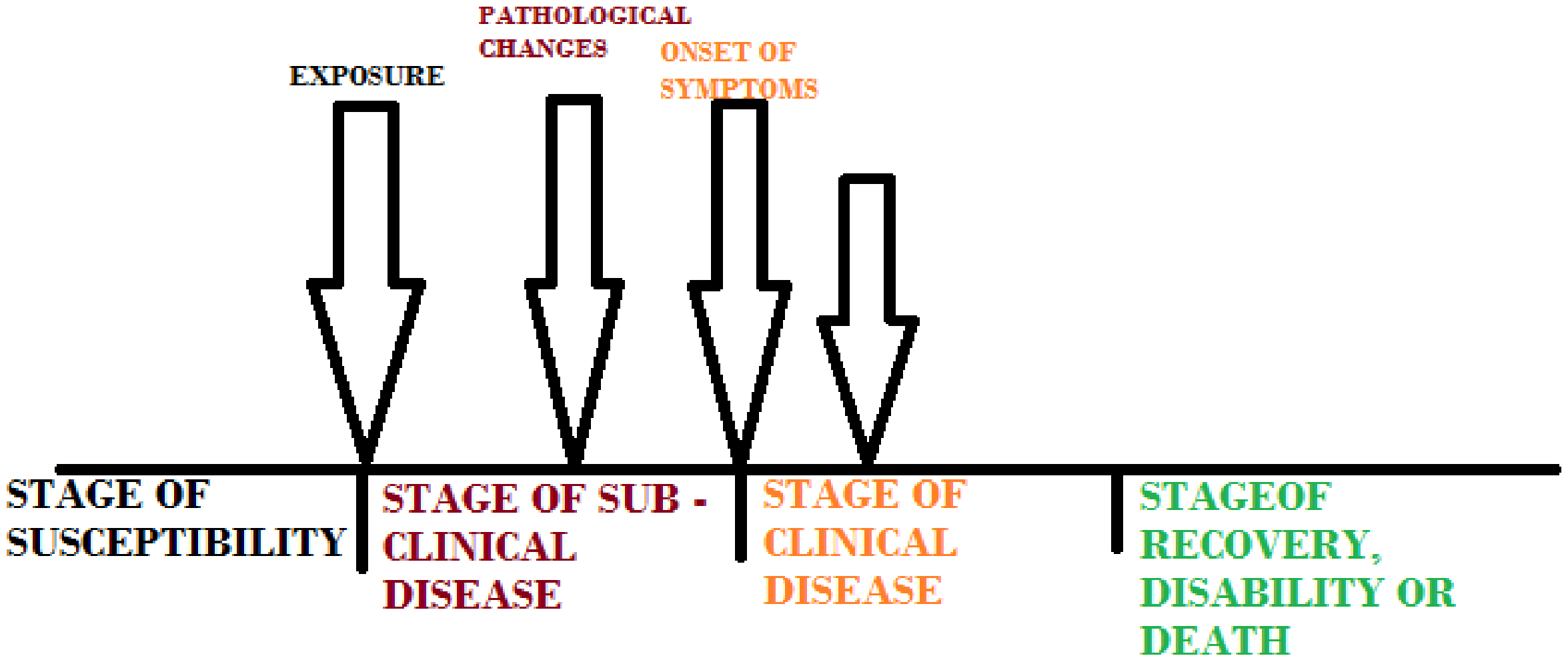
IMPORTANCE

- Causal understanding is important for prevention & control
- To enable the making of a correct prognosis

STAGES

SUSCEPTIBILITY STAGE	• No disease (signs or symptoms) but risk factors are present • There is appropriate exposure sufficient enough to cause disease in a susceptible host
PRE – SYPTOMATIC/ SUB – CLINICAL STAGE	• Screening tests are positive for disease e.g. mammography for breast cancer, pap smear for cervical Ca., BP for HTN • No signs or symptoms but the etiologic agent is present. Pathological changes occur without the individual being aware
SYMPTOMATIC/ CLINICAL STAGE	• Onset of symptoms occur. This is the usual stage of diagnosis. • The end of this stage is the resolution of disease either through recovery, death or disability
RECOVERY/ DISABILITY/ DEATH STAGE	• Damage to tissue has happened

NATURAL HISTORY OF DISEASE



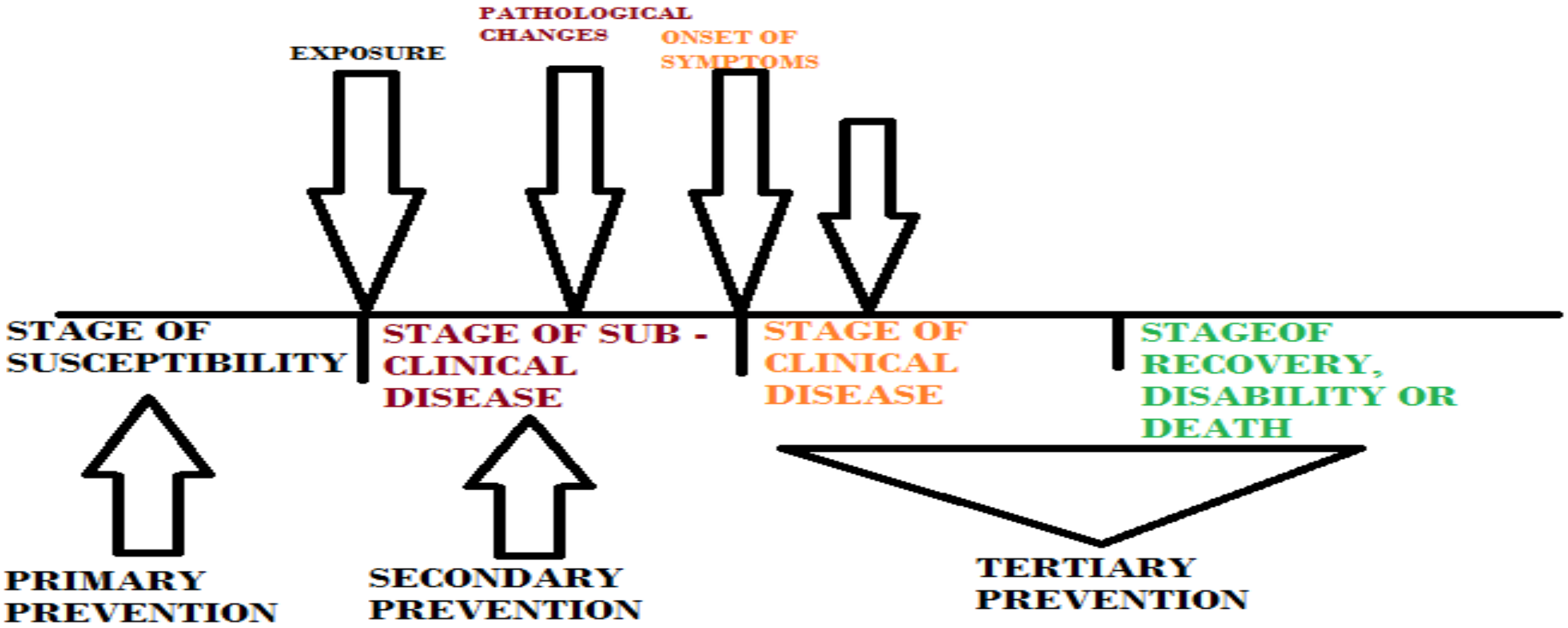
PREVENTION

- An intervention is an action taken to modify the natural history of disease
- Examples:
  - Prescribing a drug
  - Educating a community on paper use of latrines
- Types of interventions:
  - Individual: diagnosis and treatment of a sick patient
  - Community: immunization program
  - Individual & community level: e.g. in prevention of spread of TB (isolation)

METHODS OF DISEASE PREVENTION

Primary prevention:	• This is done before a disease happens.
Secondary prevention:	• This involves early diagnosis and prompt treatment of a disease or injury to limit disability and more severe disease e.g. visiting a doctor for regular check – ups.
Tertiary prevention:	• This is rehabilitation and prevention of further disease or disability e.g. chemotherapy, dialysis, surgery, long term check up for lepers, care of mentally retarded
Primordial prevention	• Actions taken to minimize future hazards to health and hence inhibit the establishment factors.

CONT.


PATHOLOGICAL CHANGES
EXPOSURE
ONSET OF SYMPTOMS
STAGE OF SUSCEPTIBILITY
STAGE OF SUB - CLINICAL DISEASE
STAGE OF CLINICAL DISEASE
STAGEOF RECOVERY, DISABILITY OR DEATH
PRIMARY PREVENTION
SECONDARY PREVENTION
TERTIARY PREVENTION

ENDEMIC, EPIDEMIC & PANDEMIC

Endemic:

- The habitual/ usual presence of a disease in a population.

Epidemic:

- Occurrence of an infectious disease that has been present, clearly in excess of the normal, expected frequency.

Pandemic:

- This is an epidemic of an infectious disease that spreads through human populations across a large region

ASSIGNMENT

- An outbreak of gastritis occurred on a cruse ship. The data in the following table were obtained shortly after the outbreak, from a questionnaire completed by everyone on board the ship.

	PEOPLE WHO ATE FOOD		PEOPLE WHO DID NOT EAT	
FOOD	**SICK**	**WELL**	**SICK**	**WELL**
HERRING	200	800	100	900
CHICKEN	650	350	100	900
SPINACH	200	800	500	500
OYSTERS	300	700	400	600
CHOCOLATE MOUSSE	600	400	450	550

CONT.

- Calculate the rates of become sick for people who ate and those who did not eat each of the listed food items. What name is given to the calculated rates?
  - Cumulative incidence i.e. attack rate
- Calculate the relative risks of developing gastritis from various foods consumed.
- Which food item is most likely to have caused gastritis? Explain.

3. MEASUREMENTS USED IN EPIDEMIOLOGY

BY: MR. LAMBERT NYABOLA

1. COUNTS

- These are used for surveillance and planning purposes
- They involve counting cases or events in the population.
- They forms the basis of disease surveillance, i.e., continuous monitoring of the population for occurrence of disease or other health related event.
- They are also used for planning & resource allocation.
- Counts alone are deficient in:
  - Comparison of 2 or more populations
  - Describing characteristics of a population
  - Determination of risk

2. RATIOS, PROPORTIONS & RATES

- Ratios & proportions describe the characteristics of population.
- Proportions & rates:
  - Quantify morbidity, mortality and other health related evens.
  - Enable inference of risk among different groups
  - Detect an increase in risk groups in the population.

PROPORTIONS

- This is an expression where a number of cases with a condition is divided by the number of persons in the population from which cases were derived.
- The numerator is part of the denominator.

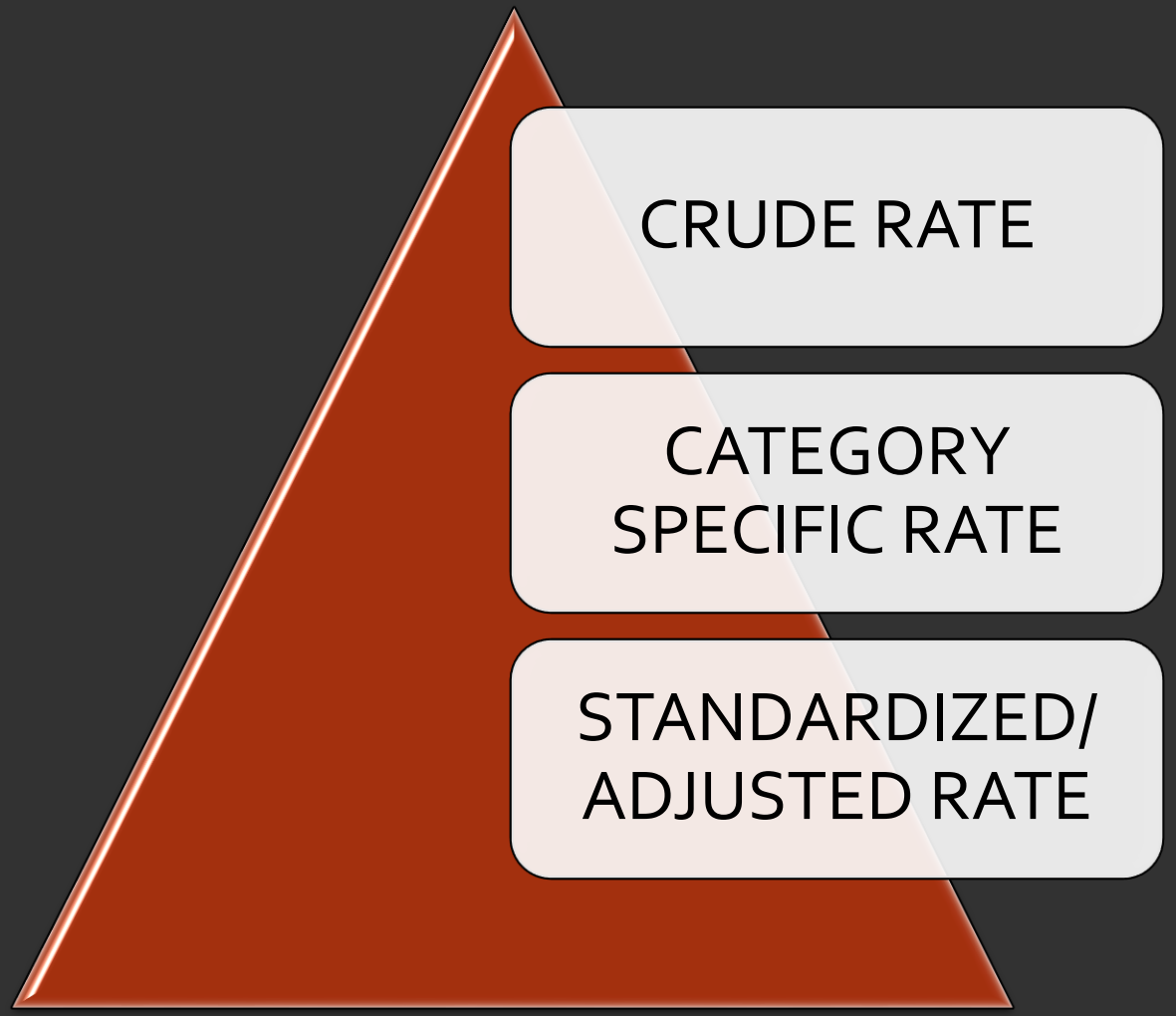
RATIOS

- This is an expression in which the numerator is not part of the denominator.
- It is expressed as: x:y or 1:z
- They can be used for planning purposes

RATES

- This is an expression of a change in 1 quantity per unit change in another.
- The elements used in its determination include:
  - Event of interest
  - Population at risk
  - Time (period & point in time)
- Rate = $\frac{\text{Number of events in the defined population at a specified time}}{\text{population at a risk of experiencing event}} \times k$
  - Where k = 10, 100, 1000 etc.

TYPES OF RATES



CRUDE RATE

- This is a summary rate calculated using the actual number of events in a population at a specified time.
- Examples include crude death rate, crude birth rate etc.
- It doesn't take into account the structure or composition of a population
- Crude Rate = $\frac{\text{Count}}{\text{Population}}$ X k

CATEGORY SPECIFIC RATES

- They give more information than the crude rate since they use a number of events in a sub – group of the population e.g. age – specific rates.
- They are, however, difficult to interpret when dealing with many sub - groups

EXAMPLE OF CATEGORY SPECIFIC RATES

AGE GROUP	**A**			**B**		
	Population	Deaths	Rate	Population	Deaths	Rate
20 – 39	2, 000	10	5.0	5, 000	30	6.0
40 – 59	3, 000	24	8.0	3, 000	30	10.0
60+	5, 000	200	4.0	2, 000	100	5.0
TOTAL	10, 000	234	**23.4**	10, 000	160	**16.0**

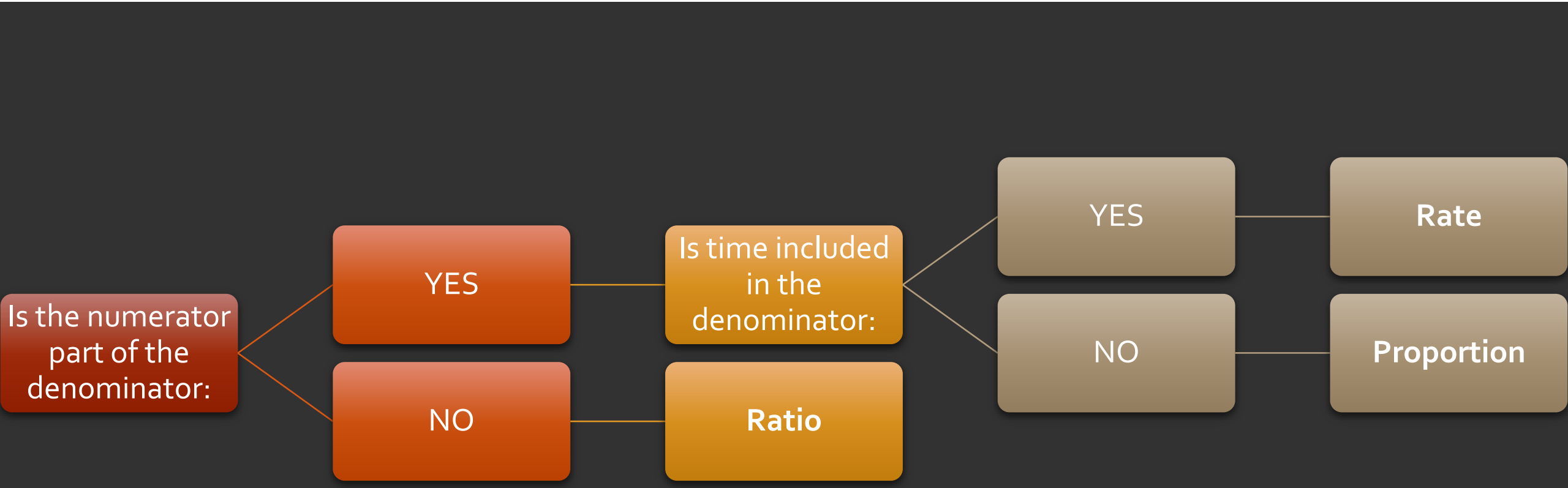
STANDARDIZED/ ADJUSTED RATES

- These are obtained when statistical methods are used to eliminate/ control the effect of some factor in the comparison between/ among different populations.
- Examples include, age distorting comparison of mortality between 2 populations with different age distributions

EXAMPLES OF STANDARDIZED RATES

AGE GROUP	**A**			**B**		
	Population	Deaths	Rate	Population	Deaths	Rate
20 – 39	2, 000	10	5.0	5, 000	30	6.0
40 – 59	3, 000	24	8.0	3, 000	30	10.0
60+	5, 000	200	4.0	2, 000	100	5.0
TOTAL	10, 000	234	**23.4**	10, 000	160	**16.0**
	AGE – ADJUSTED RATE: 18.15			**AGE – ADJUSTED RATE: 22.6**		

SUMMARY OF RATES, RATIOS & PROPORTIONS



3. MEASURES OF DISEASE OCCURRENCE

- These include:
  - Incidence
  - Prevalence
- The elements used in their determination include:
  - Event
  - Number of at – risk persons in the population
  - Time period during which these events are observed

DISEASE INCIDENCE

- This is expressed as:
  - Cumulative incidence = $\frac{\text{Number of new events (E) in a time period (T)}}{\text{Total population at risk at start of time period (T)}} \times k$
    - This can be used to determine the risk (probability)
  - Incidence density = $\frac{\text{Number of new events (E) in a time period (T)}}{\text{Total person – time}} \times k$
- Incidence is used for:
  - Determining risk
  - Studying the etiology of a disease

CUMULATIVE INCIDENCE

- Types of cumulative incidence include:
  - Attack rate: used when the period of exposure is short
  - Secondary Attack Rate
    - This is used among subjects exposed to the primary/ index cases
    - It is a measure of the infectivity of disease
    - $\text{SAR} = \frac{\text{Number of cases among contacts of primary cases}}{\text{Total number of contacts}} \text{ X } 100\%$

INCIDENCE DENSITY

- This is a sum up of the times people in a study were at risk.
- Censoring occurs in the following ways:
  - Death
  - No follow up
  - End of study observation
- Each subject either experiences the outcome or is censored

PREVALENCE

- This is the proportion of a defined population with a clinical condition o outcome at a given point in time
- It is expressed as:
  - $$\frac{\text{Number of cases observed at a time (t)}}{\text{Total number of individuals}}$$
- It ranges from 0 – 1%

POINT PREVALENCE

- This is expressed as:
  - $\frac{\text{Number of persons with a specific disease at a point in time (particular date)}}{\text{Total population}}$
- Includes the pre – existing cases
- This is a proportion

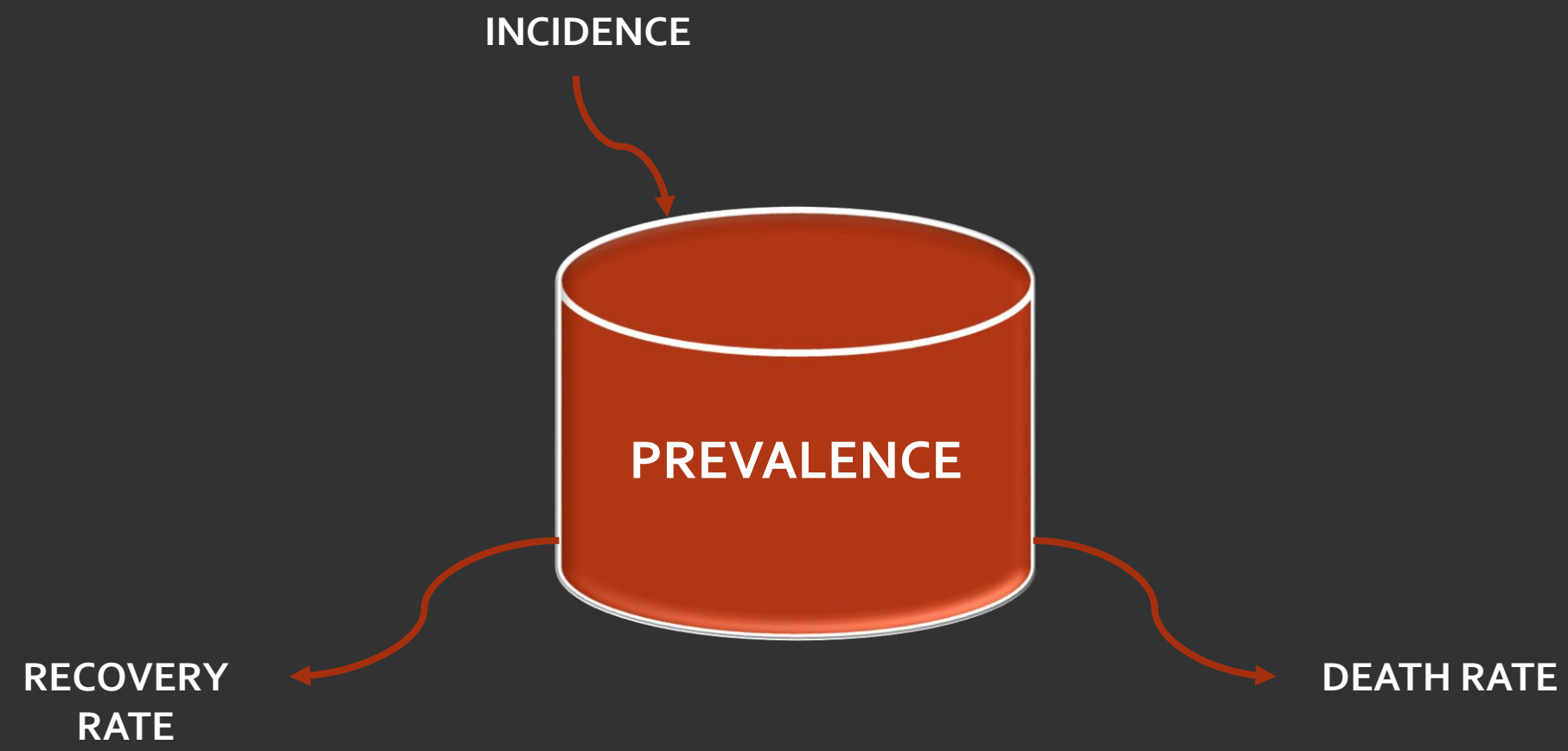
PERIOD PREVALENCE

- This is expressed as:
  - $\frac{\text{Number of persons with a specific disease in a time interval}}{\text{Total population}}$
- This is the prevalence at a start of period + any incident cases

PREVALENCE VS. INCIDENCE

- Prevalence: refers to the existing disease diagnoses at a single point in time
  - It is suitable for chronic disease
- Incidence: refers to new disease diagnoses within a define period of time.
- The presence of disease in a population may reflect:
  - Increased risk
  - Prolonged survival with no cure
- Reduced prevalence means:
  - Reduced incidence
  - Rapidly fatal disease process
  - Rapid recovery
- Prevalence ≈ Incidence X duration

CONCEPT OF PREVALENCE POOL



MORTALITY MEASURES

- Mortality rate is a measure of the frequency of death occurrence in a defined population during a specified interval.
- They can be:
  - Crude mortality rate
  - Category specific mortality rate
  - Adjusted mortality rate

CONT.

- Crude Mortality rate:
  - From all causes of death
  - K = 1000 or 100, 000
- Category Specific Mortality rate
  - This is from a specified cause
  - The numerator is the number of deaths attributed to a specific cause
- CFR
  - This is the proportion of persons with a particular condition who die of it
  - $\text{CFR} = \frac{\text{NUmber of cause specific deaths among incident cases}}{\text{number of incident cases}} \text{ X } 100$
  - This is a measure of the severity of disease

PROPORTIONATE MORTALITY

- This describes the proportion of deaths in a population over a period of time attributed to different causes
- Each cause is expressed as a percentage of all deaths
- This is not a mortality rate as the denominator is all deaths and not the population in which the deaths occurred.
- $PM = \frac{\text{deaths due to a particular cause}}{\text{deaths}} X\ 100$
- This shows the major causes of death but doesn't tell the risk of getting the disease or of dying of it.
- Proportionate morbidity: proportionate distribution of different diseases among patients in a health facility

4. STANDARDIZATION OF RATES

BY: MR. LAMBERT NYABOLA

OBJECTIVES

- Compare the mortality & morbidity experience between/ among different populations
- Adjust rates using either of the following procedures:
  1. Direct method
  2. Indirect method

INTRODUCTION

- Comparison of rates among different populations can be done using either:
  - Stratum – specific rates e.g. age – specific rates
  - Crude rates
  - Stratum – adjusted rates e.g. age – adjusted rates
- A crude rate is a weighted average of stratum – specific rates.
  - Weights are the population totals of the strata
- The differences between crude rates of 2 populations involves differences in both the stratum – specific & rates as wells as the population composition.
- Comparison of crude rates is therefore confounded by these differences and is not appropriate. An adjustment procedure is, therefore, needed to make an appropriate comparison of the overall risk of dying (or experiencing the event of interest) between 2 populations.

DEFINITION & IMPORTANCE OF STANDARDIZATION

- Standardization is a procedure that adjusts for differences in the population structure providing a single summary measurement for comparison of populations.
- Standardization of rates takes into account population structures & adjusts for differences in them so that comparisons are interpretable.
- It is done since examining of crude rates alone can be misleading especially if underlying populations are different.
  - Age specific rates are better but they are cumbersome for large number of comparisons

WHAT STANDARDIZATION DOES

- It removes the effect of unwanted variables from a comparison between 2 variables.
- It can be carried out using the following methods:
  - Direct standardization → whenever stable stratum – specific rates are available
  - Indirect standardization → whenever stratum specific rates are unavailable or unstable due to a small number.
- These 2 methods are commonly used in vital statistics & in epidemiology
- Note that standard rates are average across all strata and a standard rate can conceal differences between strata. Looking at standard rates, therefore, shouldn't substitute specific rates whenever possible.

CHOICE OF STANDARD POPULATION

- This is arbitrary.
- The figure obtained may vary with standard population chosen but interpretations remain the same.
- An appropriate standard population:
  - Reflects the average structure of the population over the time period
  - Is similar to the population of interest
  - Has known distributions of the characteristics being adjusted for
  - Should be used consistently to ensure comparability of rates

A. DIRECT METHOD

- This method uses rates from the study population to derive the expected number of events in a standard population.
- Requirements:
  - Standard population
  - CSR of population being compared
  - Distribution of characteristic in standard population

PROCEDURE: STEP 1

- Select the standard population with known distribution of the characteristic being adjusted for.
  - The standard population could be the external population such as the population of a country or a combined population can be used.
- Use the category specific rates (CSRs) of the population being compared.
- Apply the CSRs of the populations being compared to the standard population to get 'Expected' values
  - These are the values that would be expected if the CSRs were applied in the standard population.

EXAMPLE

AGE GROUP	A			B		
	Population	Deaths	Rate	Population	Deaths	Rate
20 – 39	2, 000	10	5.0	5, 000	30	6.0
40 – 59	3, 000	24	8.0	3, 000	30	10.0
60+	5, 000	200	4.0	2, 000	100	5.0
TOTAL	10, 000	234	23.4	10, 000	160	16.0

CONT.

AGE GROUP	TOTAL POPULATION (A + B)	EXPECTED VALUES	
		A	B
20 – 39	7, 000	$7,000 \times \frac{5}{100} = 350$	$7,000 \times \frac{6}{100} = 420$
40 – 59	6, 000	$6,000 \times \frac{8}{100} = 480$	$6,000 \times \frac{10}{100} = 600$
60+	7, 000	$7,000 \times \frac{4}{100} = 280$	$7,000 \times \frac{5}{100} = 350$
TOTAL	20, 000	1, 110	1, 370

STEP 2

- An adjusted rate is obtained by dividing the total expected cases/ deaths by the size of the standard population
  - Adjusted rate = $\frac{\text{Total expected values}}{\text{Size of standard population}} \text{ X } k$
- Note that the adjusted rates depend upon the standard population chosen. Using different standard populations will give rise to different adjusted rates but the interpretation will be the same.

CONT.

- Adjusted rate = $\frac{\text{Total expected values}}{\text{Size of standard population}}$ X k
- Population A = $\frac{1110}{20,000}$ X 1000
  - 55.5 per 1, 000
- Population B = $\frac{1370}{20,000}$ X 1000
  - 68.5 per 1, 000
- Conclusion: the rate of mortality is better in population A than in population B.

B. INDIRECT METHOD

- This method uses the rates from a standard population to derive expected number of events in a study population
- Requirements:
  - Standard population with known CSRs
  - Distribution of characteristic in population being compared

PROCEDURE

- Select the standard population with known CSRs.
- Use the distribution of the characteristic of interest of the population to be compared.
- Calculate the expected number of deaths/ cases in each population as specific rates for the standard population are applied.

CONT.

- For each population determine the Standardized Mortality/ Morbidity Ratio (SMR)
  - $SMR = \frac{\text{Observed deaths/ cases}}{\text{Expected deaths/ cases}} X\ 100$; If SMR is:
    - Equal to 100 → Observed cases (O) = Expected cases (E); > 100 → O > E & < 100 → E > O.
- Calculate the adjusted rate (AR) = SMR X Crude Rate (Standard population)

EXAMPLE

AGE GROUP	A			B		
	Population	Deaths	Rate	Population	Deaths	Rate
20 – 39	2, 000	10	5.0	5, 000	30	6.0
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60+	5, 000	200	4.0	2, 000	100	5.0
TOTAL	10, 000	234	23.4	10, 000	160	16.0

CONT.
STANDARD POPULATION (COMBINED)

AGE GROUP	TOTAL POP. (A + B)	TOTAL DEATHS	RATE (k = 1, 000)	EXPECTED VALUES	
				A	B
20 – 39	7, 000	40	$\frac{40}{7,000} \times 1,000 = 5.7$	$2,000 \times \frac{5.7}{1000} = 11.4$	$5,000 \times \frac{5.7}{1000} = 28.5$
40 – 59	6, 000	54	$\frac{54}{6,000} \times 1,000 = 9$	$3,000 \times \frac{9}{1000} = 27.0$	$3,000 \times \frac{9}{1000} = 27.0$
60+	7, 000	300	$\frac{300}{7,000} \times 1,000 = 42.9$	$5,000 \times \frac{42.9}{1000} = 214.5$	$2,000 \times \frac{42.9}{1000} = 85.8$
TOTAL	20, 000	394	$\frac{394}{20,000} \times 1,000 = 19.7$	11.4 + 27.0 + 214.5 = 252.9	28.5 + 27.0 + 85.8 = 141.3

CALCULATING THE SMR FOR EACH POPULATION

- $\text{SMR} = \frac{\text{Observed deaths/ cases}}{\text{Expected deaths/ cases}} \text{ X } 100$
- Population A
  - $\frac{234}{252.9} \text{ X } 100 = 92.5\%$
    - Hence the number of observed deaths in this population is less than what would be expected in the standard population by 7.5%
- Population B
  - $\frac{160}{141.3} \text{ X } 100 = 112.7\%$
    - Hence the number of observed deaths in this population is more than what would be expected in the standard population by 12.7%

CALCULATING THE ADJUSTED RATE FOR EACH POPULATION

- Adjusted rate (AR) = SMR X Crude Rate of the Standard population
- Population A = 92.5 X 19.7
  - 18.22 per 1, 000 people
- Population B = 112.7 X 19.7
  - 22.2 per 1, 000 people
- Conclusion: mortality is higher in population B than in A after the adjusted age rate.

ASSIGNMENT

- Compare the death rates from disease in 2 communities. Adjust for age (using combined populations as the standard population)

AGE	NUMBER OF PEOPLE	NUMBER OF DEATHS	NUMBER OF PEAOPLE	NUMBER OF DEATHS (DISEASE)
YOUNG	8, 000	69	5, 000	48
OLD	11, 000	115	3, 000	60
ALL	19, 000	184	8, 000	108

CONT.

1. Calculate crude rates
2. Calculate age – specific rates
3. Compare the above rates
4. Calculate the adjusted rates

5. EPIDEMIOLOGIC STUDY DESIGNS

BY: MR. LAMBERT NYABOLA

TYPES OF STUDY DESIGNS

	OBSERVATIONAL STUDIES	EXPERIMENTAL/ INTERVENTIONAL STUDIES
DESCRIPTIVE	• Case series/ reports • **Cross – sectional studies** • Ecological studies	• Clinical trials • Laboratory experiments • Fields & community trials
ANALYTICAL	• **Case control studies** • **Cohort studies**	• Quasi – experimental studies

FACTORS TO CONSIDER WHEN SPOTTING THE STUDY DESIGN:
AIM OF THE STUDY

- If it was to simply describe a population/ examine the patterns → **descriptive study.**
- If it was to quantify the relationship between factors or the effect of some intervention → **analytic study.**

CONT.
IF ANALYTIC, PRESENCE OF MANIPULATION OF EXPOSURE BY INVESTIGATOR

- Manipulation present:
  - **Experimental study** i.e. the researcher manipulates the exposure. (S)he allocates the subjects to the intervention or exposure group.
- Manipulation absent:
  - **Observational study**, i.e. the researcher just observes the events as they occur. (S)he has no control over the circumstances.
  - The type of observational study depends on the timing of the measurement of the outcome.

CONT.
TIMING OF THE MEASUREMENT OF THE OUTCOMES

- Some time after the exposure/ intervention → **Cohort prospective study.**
- At the same time as the exposure/ outcome → **cross – sectional study/ survey.**
- Before the exposure was determined → **case – control/ retrospective study.** (Based on recall of the exposure)

1. DESCRIPTIVE/ PREVALENCE STUDIES

- These are usually conducted when little is known about the disease occurrence, natural history or determinants of the health issue.
- They are often employed for public health planning, but also used in studies of etiology.
- Descriptive studies always come before analytical ones.

OBJECTIVES OF DESCRIPTIVE STUDIES

- Estimating the magnitude of the disease or health related problem.
- Determining the characteristics of persons with particular outcomes on exposure.
- Generate specific etiologic hypothesis.
- Determining the time – trend in a particular population.

TYPES OF DESCRIPTIVE STUDIES

- Cross – sectional prevalence studies
- Case studies
- Case – series studies (case & characteristics)
- Longitudinal studies (follow up)
- Ecological studies (can also be analytical)

FEATURES OF DESCRIPTIVE STUDIES

- There is no comparison group.
- No conclusion can be made on cause – effect relationship.
- Usually a sample is selected to represent the entire population.

USES OF DESCRIPTIVE STUDIES

- Magnitude of problem in the population (planning purposes, intervention).
- Provision of data necessary for planning purposes.
- Disease surveillance – patterns and identifying occurrence of epidemics & outbreaks.
- Evaluation of preventive measures.

CONT.

- Descriptive studies consider questions such as:
  - Who: the person getting the disease within a population; age, gender & occupation
  - Where the disease occurs
  - When the disease occurs
- Such questions may involve comparisons between:
  - Different populations at a give time
  - Sub – groups of a population
  - Various periods of time

CONT.

- Characterizing epidemiologic data along these dimensions (i.e. persons, place & time) serves several purposes:
  - Identifies changes in morbidity & mortality over time
  - Provides a detailed characterization of the problem on basic terms that can easily be communicated & understood
  - Identifies populations at increased risk of the health problem under investigation enabling one to generate testable hypotheses relevant to the etiology

ADVANTAGES & DISADVANTAGES OF DESCRIPTIVE STUDIES

ADVANTAGES	DISADVANTAGES
• Cheap • Takes less time as compared to prospective cohort studies • More representative as compared to case – control studies	• Cause – effect relationship cannot be measured • A series of prevalent causes will have a higher proportion of cases with long duration than a series of incident cases • Aren't suitable for acute disease

CROSS – SECTIONAL STUDY

- This is a type of observational study that involves data collection in a population.
- It is descriptive as it can be used to describe the odds ratio absolute risks and relative risks from prevalence.

2. ANALYTIC STUDIES: A. COHORT STUDY DESIGNS

- A cohort study design is where 1 or more samples (called cohorts) are followed up prospectively & subsequent status evaluations with respect to a disease or outcome are conducted to determine which participants exposure characteristics (risk factors) are associated with it.
- It is a longitudinal study that's an analysis of risk factors and follows a group of people who do not have the disease yet. It uses correlations to determine the absolute risk of subject contraction. Observations are made more than once.
- Cohort studies are undertaken to support the existence of association between a suspected cause and a disease
- The presence or absence of a risk factor is determined before the outcome occurs.
- Suited for a common outcome.

ELEMENTS OF A COHORT STUDY INCLUDE:

- Selection of study subjects
- Obtaining data on exposure
- Selection of a comparison group
- Follow up
- Analysis

FEATURES OF COHORT STUDIES

- Longitudinal, forward – looking study (exposure – outcome)/ forward directionality
- Prospective/ retrospective
  - Prospective/ concurrent: begins with exposure with follow – up happening from present to future
  - Retrospective: begins with exposure with follow – up happening from past to present
- Incidence study
- Starts with people free of disease
- Assesses exposure at baseline & disease status at follow – up.

ANALYSIS: CALCULATION OF INCIDENCE RATES

	DISEASED	NON - DISEASED	
EXPOSED	a	b	(a + b)
UNEXPOSED	c	d	(c + d)
	(a + c)	(b + d)	a + b + c + d = n

- Incidence among exposed = $\frac{a}{a+b}$ X k
- Incidence among non – exposed = $\frac{c}{c+d}$ X k

CONT.
ESTIMATION OF RISK

- Relative risk (RR) → a measure of strength of association
  - $RR = \dfrac{\text{Incidence of disease among exposed}}{\text{Incidence of disease among non – exposed}}$
  - $\dfrac{\frac{a}{a+b}}{\frac{c}{c+d}}$
  - Interpretation of RR:
    - RR = 1: no association
    - RR > 1: +ve association
    - RR < 1: -ve association

CONT.

- Attributable risk (AR) ratio → tells how much of the outcome/ disease is due to the exposure. It is, therefore, a measure of impact of exposure.
- The factor must be causal.
  - AR = Incidence of disease among exposed – incidence of disease among unexposed, i.e.,
    - $AR = \frac{a}{a+b} - \frac{c}{c+d}$
  - $AR\% = \frac{AR}{\text{Incidence of disease among the exposed}} X\ 100$

ADVANTAGES & DISADVANTAGES OF COHORT STUDY DESIGNS

ADVANTAGES	DISADVANTAGES
• We can find out incident rate & risk • Can be used for more than one disease related to a single exposure (can determine more than one outcome) • Can establish a cause – effect relationship • Good when exposure is rare • Minimizes selection & information bias	• Losses to follow up • Often requires a large sample • Ineffective for rare diseases • Long time to complete • Expensive • Ethical issues

B. CASE CONTROL STUDY DESIGNS

- This is a type of observational study in which 2 existing groups differing in outcome are identified.
- One group of individuals has the disease outcome (cases) &, for purposes of comparison, the other group doesn't have the disease outcome (controls). These groups are otherwise similar.
- The 2 are compared to establish the possible causal relationship of an exposure to the particular disease outcome. & compared on the basis of some supposed causal attribute to a medical condition comparing subjects who have the condition/ disease, with patients who don't but are otherwise similar.
- Therefore, the individuals in case control studies are of a particular characteristic hence the study is suited for a rare outcome.

WHEN SELECTING CASES CONSIDER:

- Clear case definition
- Prevalent vs. incident cases
- Sources

WHEN SELECTING CONTROLS CONSIDER:

- Purpose:
  - What rate to expect in case group.
  - Should be comparable to cases
    - Should have the potential to become cases (must be susceptible to the disease of interest)
- Sources:
  - Health facilities
  - General population
  - Relatives/ siblings
  - Neighborhood, friends/ associates

THE FOLLOWING ARE USED TO OBTAIN PAST EXPOSURE DATA AMONG STUDY PARTICIPANTS:

- Interviews
- Records
- Employment record files

ANALYSIS OF DATA FROM CASE CONTROL STUDIES

COMPARISON	CASE VS. CONTROLS; PROPORTION EXPOSED IN THE 2 GROUPS
MEASURES OF ASSOCIATION	• Strength of association: odds ratio (ad ÷ cb) • Impact/ effect: AR% can be estimated

- Interpretation of the odds ratio
  - If OR = 1; implies no association; If OR > 1; implies +ve association; If OR < 1; implies –ve association (protective factor)
- NB
  - Relative risk is estimated by the OR;
  - AR cannot be determined in case – control studies
    - $AR\% = \frac{OR - 1}{OR}$

ADVANTAGES & DISADVANTAGES OF CASE - CONTROL STUDY DESIGNS

ADVANTAGES	DISADVANTAGES

• Relatively simpler to carry out
• Inexpensive
• Reasonably rapid
• Suited to infrequent rare conditions
• Permit examining multiple possible risk factors
	• Incidence and risks cannot be determined
	• Case – effect relationship cannot be determined
	  • Temporal sequence o events: exposure → outcome
	• Selection of suitable control is a problem
	• Not suitable for rare exposures
	• Information bias
	  • Missing or incomplete data (if records are being used)
	  • Recall bias

RANDOMIZED STUDIES IN EPIDEMIOLOGY

- These are clinical trials in which all patients are assigned randomly to be in experimental groups (receiving the experimental treatment) or the control group (receiving the placebo).
- In a **quasi – experimental study**, the randomization is not done.
- The best way to conduct an interventional study is using the double – blind methodology where neither the investigations nor the study participants know who is getting active agents or placebo

CONT.

- Some interventional studies are single – blinded were none of the participants know whether they are receiving placebo or active agents
- Others can also be triple blinded
- Randomized studies are the gold – standard of epidemiologic research

ANALYZING RANDOMIZED STUDIES

- Straightforward:
  - Calculate, RR, IRR or OR
- Critical rule: analyze the subjects the way they were randomized

ADVANTAGES & DISADVANTAGES OF RANDOMIZED STUDY DESIGNS

ADVANTAGES	DISADVANTAGES
• They allow for very tight control over all confounding variables, including the unknown • Incident rates and risk are determined • Possible to assess cause – effect relationships • Multiple outcomes for the intervention can be studied	• Feasibility: requires many subjects • Interventional studies are very costly to conduct • As regards ethics, the have limited applicability

6. SCREENING & DIAGNOSTIC TESTS

BY: MR. LAMBERT NYABOLA

OBJECTIVES

- Definitions
- Disease eligibility for screening
- Test accuracy
- True & apparent prevalence
- Predictive values
- ROC curve

DEFINITION

- Screening is the use of tests to help diagnose diseases or risk factors in an earlier phase in their natural history.
- They can be carried out to identify
  - Who has been exposed to some substance of interest
  - Who is at an increased or decreased risk of contracting a disease of interest
  - Who has developed an illness and is at the pre – clinical stage

AIM

- To reverse, halt, slow the progression of the disease
- To protect the society so that subjects do not get infected in the case of infectious disease
- To select out unhealthy people or those at a higher risk of some unfavorable event or outcome in future e.g. a job or insurance
- To help allocate health care resources
- To identify disease at an early stage and start early treatment for better outcome

CRITERIA:
IF THE ANSWER FOR THESE QUESTIONS IS 'YES' THEN THE SCREENING IS SOUND:

- Is there effective intervention?
- Does intervention earlier than usual improve outcome?
- Is there an effective screening test that recognizes the disease earlier than usual?
- Is the test available and acceptable to the target population?
- Is the disease one that commands priority?
- Do the benefits exceed the cost?

REQUIREMENTS FOR A DISEASE SUITABLE DOR SCREENING

- Serious consequences of the disease or condition in terms of morbidity and mortality if detected late
  - There should be a high disease burden in terms of morbidity & mortality
  - Better prognosis if treatment is started early enough
- High prevalence in the pre – clinical phase of the disease among the screened population
- Its natural history should be well understood
- A screening test for the disease should be available
- Availability of health facilities to confirm disease among those tested positive
- Screening should confer benefits
  - Consider the benefits of treating early vs. treating late once the signs/ symptoms have appeared.
  - Treatment given before symptoms develop must be of greater benefit than that given after a person develops them.

FEATURES OF SCREENING TESTS

- Should be available
- These are tools used to identify the presence o absence of a disease or target disorder
- Tests aren't diagnostic and those subjects that test positive need to be confirmed by diagnostic tests
- Examples:
  - Breast cancer → mammography
  - Diabetes → blood sugar
  - Cervical cancer → pap smears
  - HTN → BP

CRITERIA FOR TESTS SUITABLE FOR SCREENING

- Inexpensive
- Able to give results within a short time, i.e., immediately
- Acceptable to the target population
- Easily administrable
- Confer minimum harm to the subjects to be screened as well as to those people who are administering the test (harmless)
- Reliable:
  - This is the repeatability of the results when the test is performed several times under the same conditions
- Valid
  - This is the ability to measure what it is intended for; correctly identify those with the disease and those without

HOW THE PERFORMANCE OF A SCREENING TEST IS ASSESSED: VALIDITY

- Sensitivity
  - Ability of a test to give a positive result where a person with the disease is identified.
  - A very sensitive test rules out the disease i.e., if a person tests –ve, it is very unlikely (s)he has the disease.
- Specificity
  - Probability that an individual who does not have the disease will test –ve on the screening test.
  - This is the ability os a test to correctly identify the disease.

CONT.

DISEASE	SENSITIVITY	SPECIFICITY
Test (+)	True (+)	False (+)
Test (-)	False (-)	True (-)

- By increasing the cut – off point at which we define a condition, we increase the specificity of the test but we are also likely to miss a few cases (false –ves increase). In so doing, sensitivity will go down.
  - Sensitivity = $\frac{\text{True positives}}{\text{True positives + False negatives}}$
  - Specificity = $\frac{\text{True negatives}}{\text{True negatives + False positives}}$

HOW THE PERFORMANCE OF A SCREENING TEST IS ASSESSED: PREDICTIVE POWERS OF DIAGNOSTIC TESTS

- Predictive values answer the following questions:
  - What is the chance that someone who tests (+ve) will actually have the disease or what proportion of the subjects who tested +ve actually have the disease?
  - What is the chance that someone who tests –ve will actually not have the disease or the proportion of the subject who tested –ve and actually did not have the disease?

CONT.

- These are determined by 2 predictive values:
  - Positive Predictive Value (PPV)
    - Probability that an individual who tests +ve on the screening examination actually has the outcome of interest.
    - $\text{PPV} = \dfrac{\text{Number of true +ves}}{\text{Number of true +ves + Number of false +ves}}$
  - Negative predictive value (NPV)
    - This is the probability that a person who has a negative screening result actually does not have the disease of interest
    - $\text{NPV} = \dfrac{\text{Number of true –ves}}{\text{Number of true –ves + Number of false –ves}}$

WHAT DO PREDICTIVE VALUES DEPEND ON

- Sensitivity: ability of test to give correct result when a person who has the disease has been identified
- Specificity: ability of test to correctly identify the disease
- Prevalence of disease
  - When prevalence of the disease changes, the PV changes as well even if you're using a test with a high sensitivity or specificity

CONT.

- These 4 measures, sensitivity, specificity, NPV & PPV are the main ways to assess the performance of a screening test.
- For an ideal screening test:
  - Sensitivity = specificity = 100%
- It is rare to get an ideal test

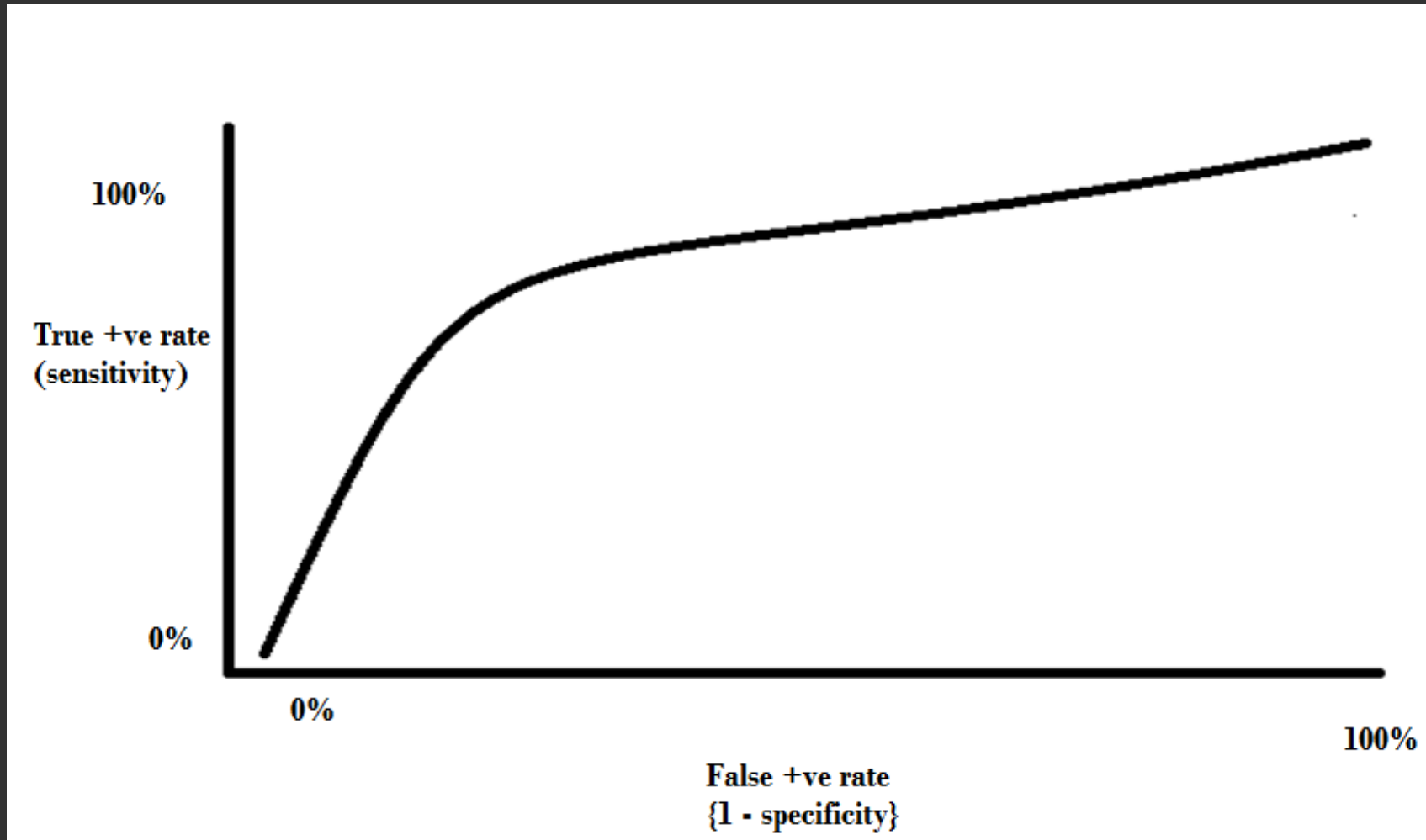
CONT.

- There is an inverse relationship between sensitivity and specificity. This relationship can be demonstrated when:
  - Sensitivity is plotted against (1 – specificity) for different cut off points i.e., the false positive rate
  - Resulting graph is called a Receiver Operating Characteristic [ROC] curve
- It is a normal distribution/ Gaussian curve

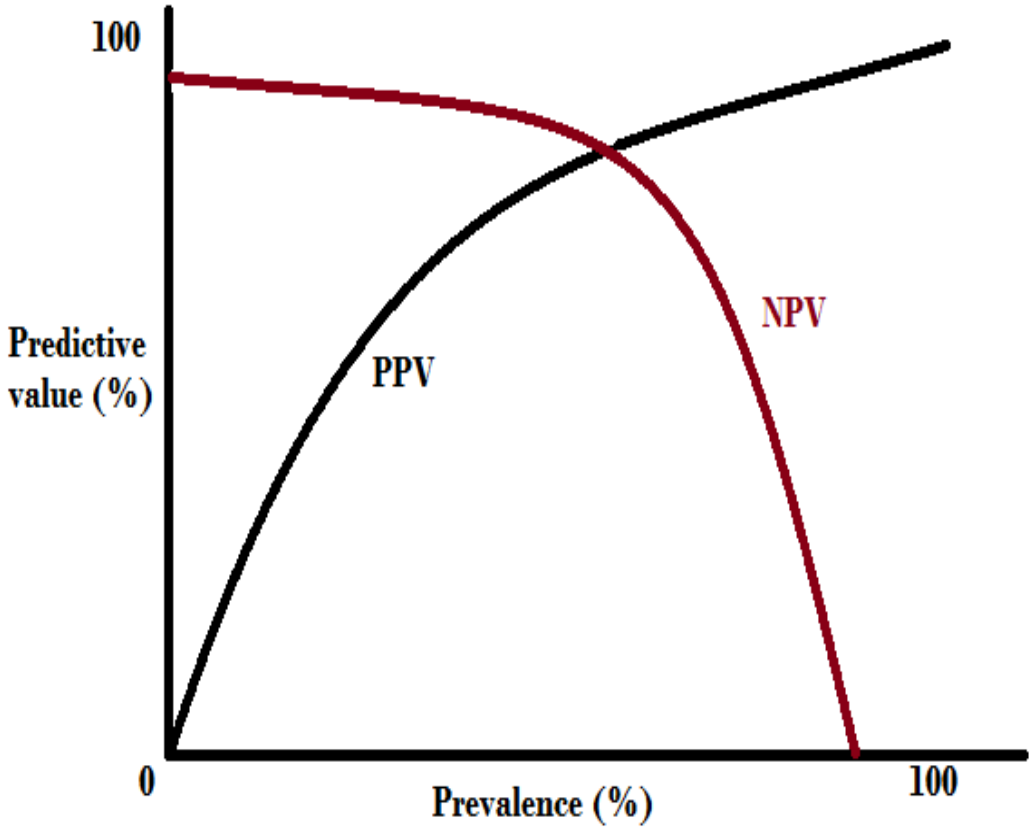
USES OF THE RECEIVER OPERATING CHARACTERISTIC CURVE

- To identify the best cut off pointes for screening tests
- Compare performance of tests for specific conditions with more than one screening test
  - If you have 2 tests for a given condition and you want to find out which is better
    - Plot an ROC curve for both and the one that gives a higher area under the curve is better.

BEST CUT OFF POINTS GIVES THE LEAST NUMBER OF FALSE –VES & +VES



HOW PREVALENCE VARIES WITH PREDICTIVE VALUES



$$NPV = \frac{\text{Specificity X (1 – Prevalence)}}{\text{Specificity X (1 – Prev.) + (1 – Sensitivity) X Prev.}}$$

MOST PEOPLE NEED **LOVE AND ACCEPTANCE** A LOT MORE THAN THEY NEED ADVICE. LOVE IS ALWAYS THE ANSWER.

WHAT YOU ARE CRAVING FOR IS TO BE LOVED FOR WHO YOU ARE.

GOD, YOUR CREATOR, IS LOVE (*1ST JOHN 4:8*). JESUS CHRIST IS THE ONLY WAY TO HIM (*JOHN 14:6*)

SURRENDER YOUR LIFE TO JESUS CHRIST TODAY. YOU WILL NOT REGRET IT.

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