

Levels of Prevention

Definition of Disease Prevention

- **“Activities designed to protect patients or other members of the public from actual or potential health threats and their harmful consequences.”**

OR

- **“Prevention is the action aimed at eradicating, eliminating or minimizing the impact of disease and disability.”**

Levels of Prevention

- 1) Primordial Prevention**
- 2) Primary Prevention**
- 3) Secondary Prevention**
- 4) Tertiary Prevention**

LEVELS OF PREVENTION

Whole population
through public health
policy

PRIMORDIAL PREVENTION

establish or maintain
conditions to minimise
hazards to health

Advocacy for social
change to make physical
activity easier

Whole population
selected groups and
healthy individuals

PRIMARY PREVENTION

prevent disease well
before it develops
Reduce risk factors

Primary care advice
as part of routine
consultation

Selected individuals
with high risk patients

SECONDARY PREVENTION

early detection of disease
(e.g. Screening &
Intervention for
Pre diabetes)

e.g. primary care risk
factor reduction for
those at risk of chronic
disease, falls, injury

Patients

TERTIARY PREVENTION

treat established
disease to prevent
deterioration

e.g. exercise advice
as part of cardiac
rehabilitation

***Prevention
is better Than
Cure...!***

Primordial Prevention

- “This is a prevention of Development of risk Factors in a Population group , which they have not yet appeared.”
- Special Attention is Given in preventing Chronic Disease.
- **Main Intervention is Health Education.**
- In this efforts are dedicated towards discouraging people from adopting Harmful Life styles/Habits through Individual & Mass Education

Primordial Prevention

- **Primordial prevention, a relatively new concept, is receiving special attention in the prevention of chronic diseases. Ex., many adult health problems (e.g. obesity, hypertension) have their early origins in childhood, because this is the time when lifestyles are formed(Ex., smoking, eating patterns, physical exercise).**



Primary Prevention

- **“Primary prevention can be defined as the action taken prior to the onset of disease, which removes the possibility that the disease will ever occur.”**
- **In this Action are taken before the onset of Disease.**
- **Normal healthy persons but at danger, risk factors, cost effective, No loss.**

Primary Prevention

- **It signifies intervention in the prepathogenesis phase of a disease or health problem.**
- **It includes the concept of "positive health", a concept that encourages achievement and maintenance of "an acceptable level of health that will enable every individual to lead a socially and economically productive life".**



Primary Prevention

Achieved by

Achieved by

Health promotion

- Health education
- Environmental modifications
- Nutritional interventions
- Life style and behavioral changes

Specific protection

- Immunization and seroprophylaxis
- chemoprophylaxis
- Use of specific nutrients or supplementations
- Safety of drugs and foods
- Control of environmental hazards, e.g. air pollution

INTERVENTIONS:

- **General Health promotion**
- **Specific protection:**

General Health promotion

- Health education
- Environmental modifications
- Nutritional interventions
- Lifestyle and behavioural changes

General Health promotion-

- Health education to improve healthy habits and health consciousness in the community.
- Improvement in nutritional standards of the community.
- Healthful physical environment (Housing, water supply, excreta disposal, etc.,)
- Good working condition
- Marriage Counseling
- Periodic Selective examination of risk population

Specific protection

- Use of Specific immunization (DPT,MMR vaccines)
- Use of specific nutrients (vitamin A for Children, iron- folic acid tablets for Pregnant mothers)
- Protection against accidents (Use of helmet, seat belt, etc.,)
- Protection against occupational hazards.
- Avoidance of allergens.
- Protection from air pollution.

SECONDARY PREVENTION

- **It is defined as “ An Action which halts the progress of a disease at its incipient stage and prevents complications.”**
- **The specific interventions are:**
 - **(i) early diagnosis (e.g. screening tests, breast self examination, pap smear test, radiographic examinations etc.)& Treatment**
 - **(ii) Referral**

Objectives of secondary prevention:

- Complete cure and prevent the progression of disease process.
- To prevent the spreads of disease by curing all the known cases.
- To prevent the complications and sequel of disease.
- To shorten the period of disability.

INTERVENTIONS:

- Individual and mass case-finding measures.
- Screening surveys(urine examination for Diabetes , etc.,)
- Selective examination

4. Tertiary Prevention

- **It is defined as “all the measures available to reduce or limit impairments and disabilities, and to promote the patients’ adjustment to irremediable conditions.”**
- **Intervention that should be accomplished in the stage of tertiary prevention are disability limitation, and rehabilitation.**

4. Tertiary Prevention

- **Intervention in Late Pathogenesis Phase**
- Sick person with complications, very high cost, may lose for instant job.
- Permanent damage.

MODES OF INTERVENTION

- i) Disability limitation
- ii) Rehabilitation

REHABILITATION:

- **Medical rehabilitation:** (restoration of bodily function)
- **Vocational rehabilitation:** (restoration of the capacity to earn a livelihood)
- **Social rehabilitation:** (restoration of family and social relationship)
- **Psychological rehabilitation:** (Restoration of personal dignity and confidence)

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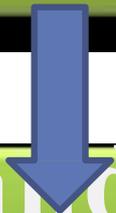
Disease



Impairment



Disability



Handicap

Disability limitation

- To prevent or halt the transition of disease process from Impairment & Handicap.
- **Impairment**: any loss or abnormality of psychological, physiological or anatomic structure or function.
- **Disability**: any restriction or lack of ability to perform an activity in the manner considered normal for a human being.
- **Handicap**: disadvantage for a given individual, resulting from impairment or disability, that limits or prevents the fulfillment of a role that is normal for that individual



Disease - dental caries



Impairment – loss of tooth



Disability – cant talk

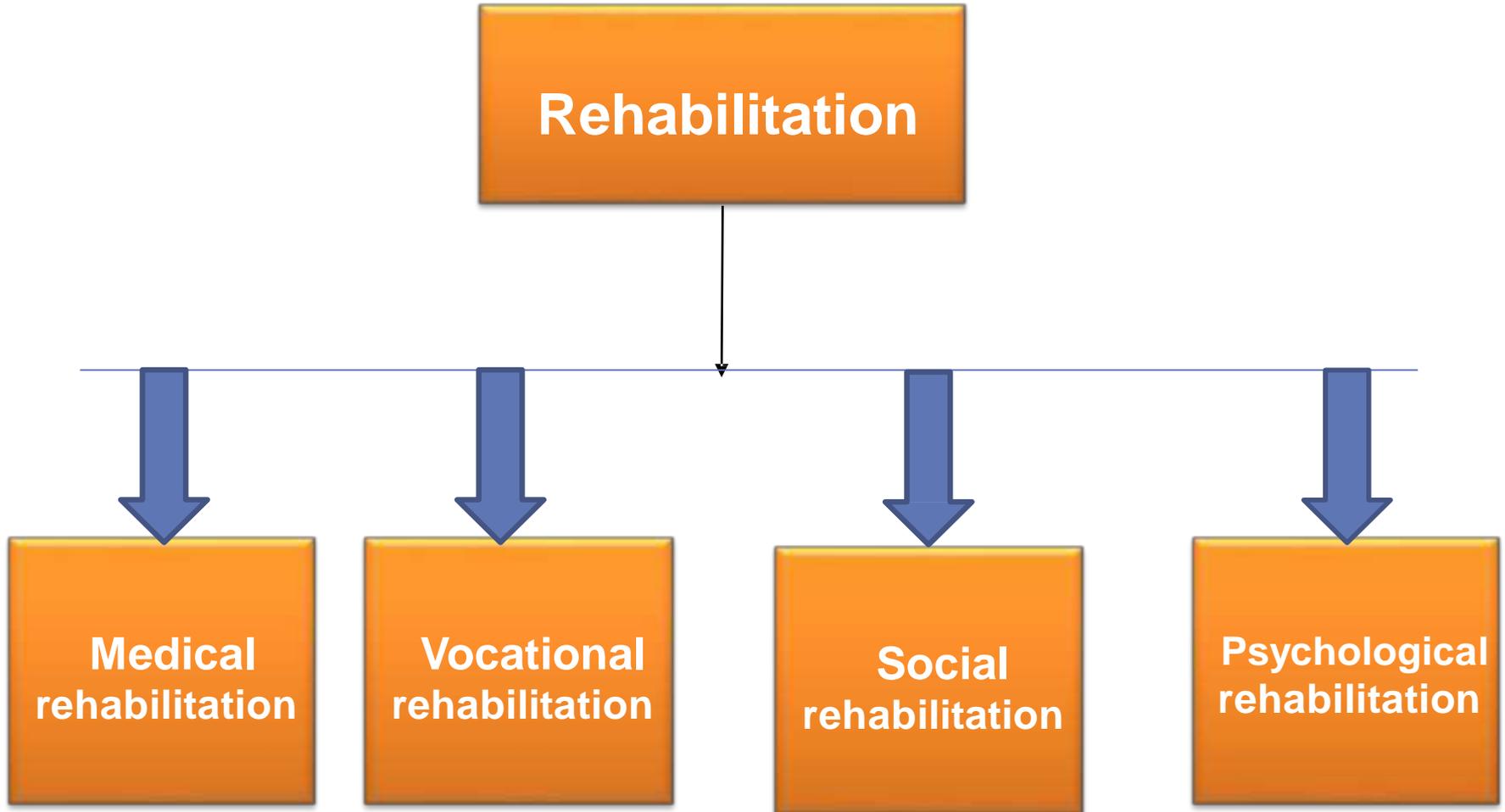


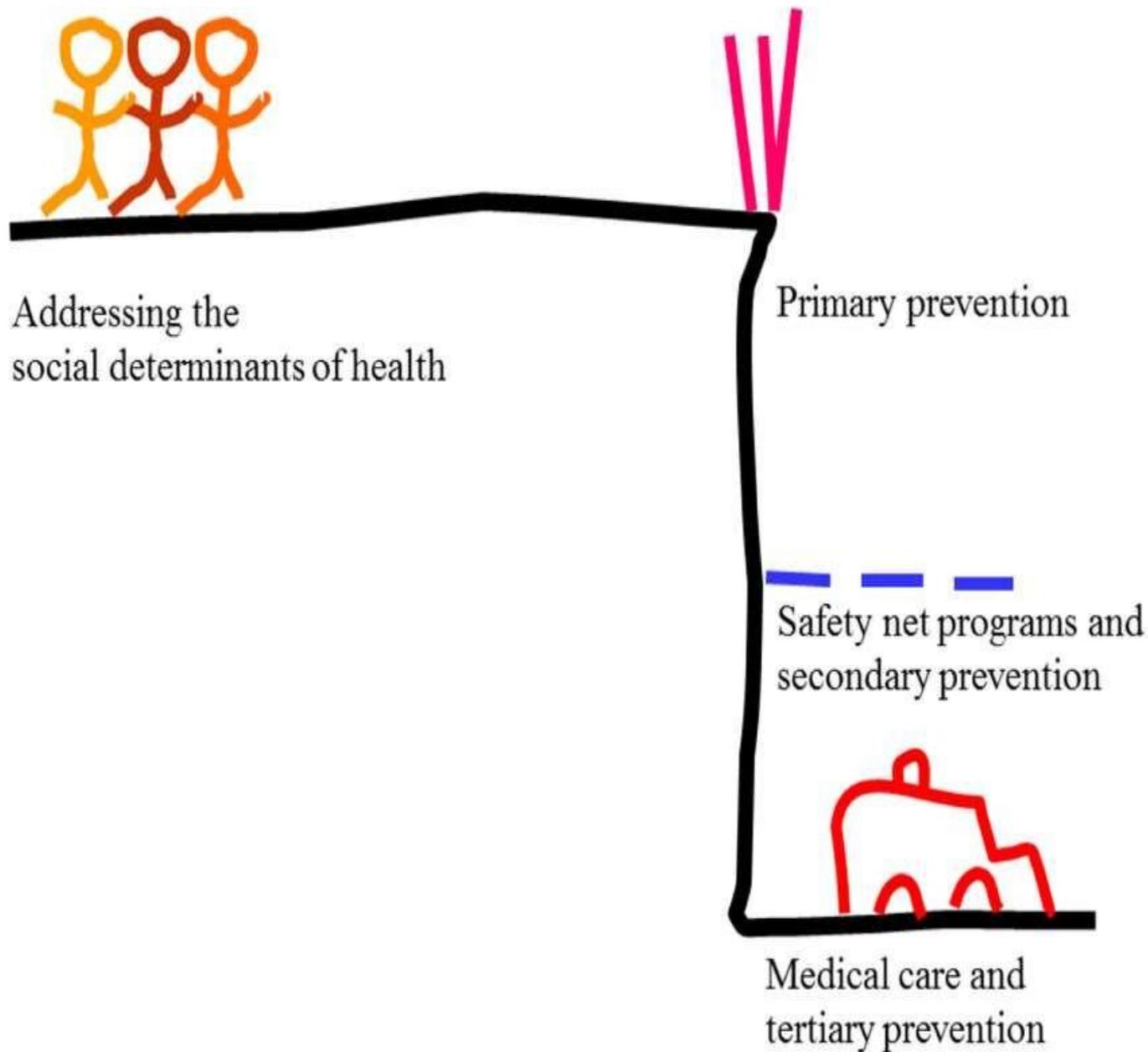
Handicap – cant socialize

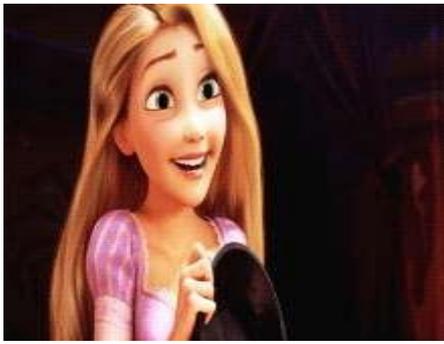
Rehabilitation

- **Rehabilitation is “ the combined and coordinated use of medical, social, educational, and vocational measures for training and retraining the individual to the highest possible level of functional ability.”**
- **Requires cooperation from different sections of society.**

Types of Rehabilitation







Key To Remember

Primary = Prevention

Secondary = Screening

Tertiary = Treatment

Screening

"every adverse outcome of screening is iatrogenic and entirely preventable"

- Grimes & Schulz, Lancet, 2002

- A basic tenet of public health is that primary prevention of disease is the best approach
- If all cases of the disease cannot be prevented, the next best strategy is secondary prevention – i.e., early detection of disease in asymptomatic, apparently healthy persons

- In some diseases the causes are complex and may be the result of hereditary factors or minimal exposure of susceptible individuals over long periods to causative agents whose nature and mechanism of action may not be fully understood
- Educating people in safe habits or behaviors is difficult especially when the cause of disease is obscure
- This poses challenges for the application of successful primary prevention methods

- Furthermore, in many diseases the pathological process is established long before the appearance of symptoms which alert the patient to the need to seek care
- Phenylketonuria (PKU) is an inborn metabolic deficiency that usually does not declare itself until irreversible brain damage has occurred. This can be averted if detected in neonatal period and the affected infant is given a diet low in phenylalanine

- Detection of the organism in asymptomatic carriers of infection is of public health benefit
- Carriers can be treated or isolated from situations that may be dangerous to others (e.g., hospital employee carrier of penicillin resistant staphylococcus)

- Detection of persons with high cholesterol levels may be advocated in order to reduce the risk of CHD through dietary and other lifestyle modifications (secondary prevention)

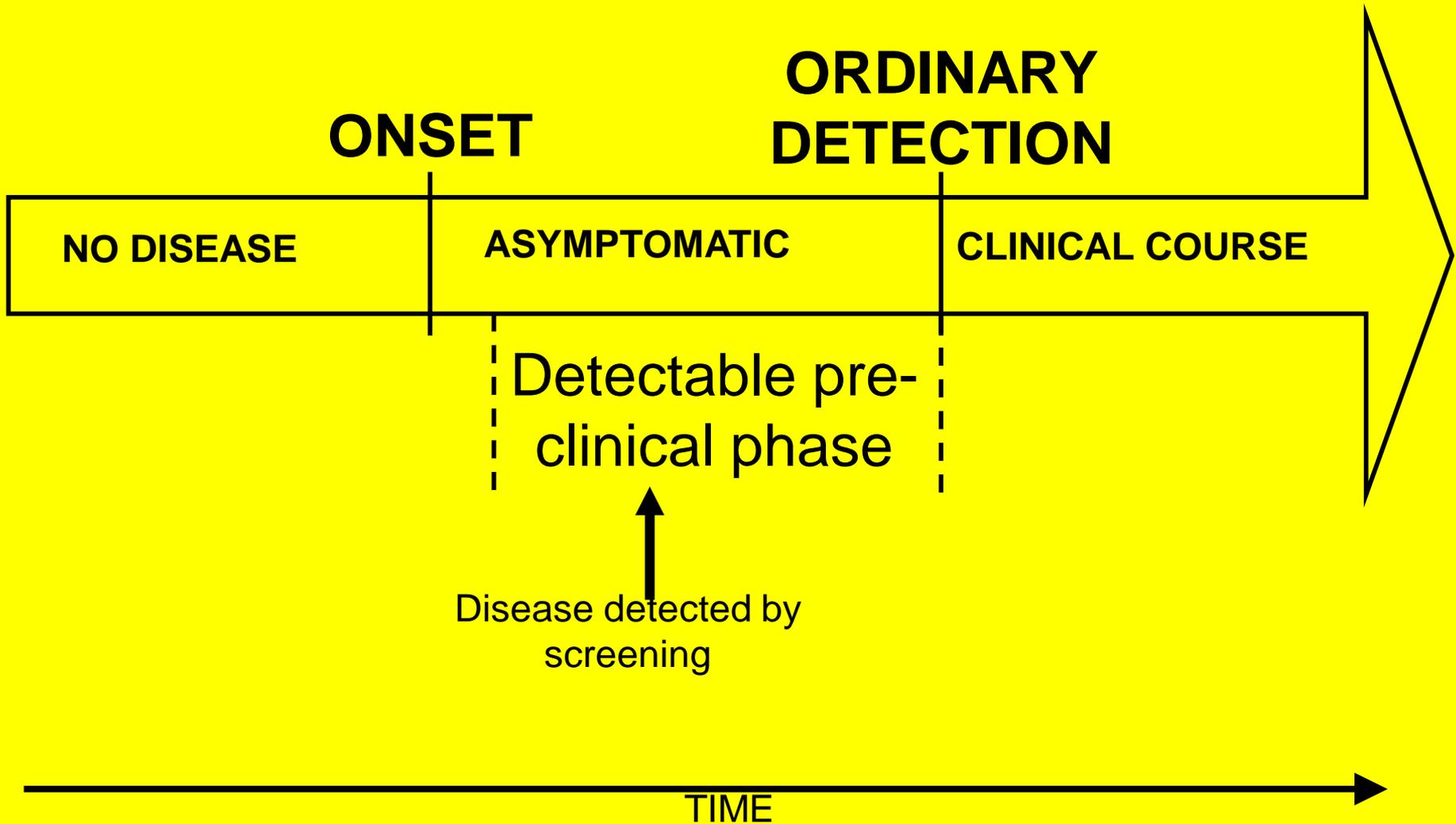
SCREENING

- “Identification of preclinical disease by a relatively simple test”
- “The presumptive identification of unrecognized disease or defects through the application of tests or examinations that can be rapidly and easily applied”

SCREENING

- The objective of screening is to reduce mortality or morbidity or to improve quality of life
- The underlying assumption justifying a screening program is that early detection of the condition improves prognosis

Natural history of a disease



Criteria for successful screening- Disease, Test, Population

- Condition should be an important public health problem
- There should be a recognizable latent or early symptomatic stage
- The natural history of the disease should be well understood
- There should be an accepted treatment for patients with the disease
- Facilities for diagnosis & treatment should be available

Criteria for successful screening

- There should be a suitable screening test
- The test should be acceptable to the population
- There should be an agreed policy on whom to treat as patients
- The cost should be economically balanced in relation to possible expenditure on medical care as a whole

Criteria for successful screening

- If a disease can be successfully treated after it manifests clinically, there is no need for screening
- Screening should not be applied to untreatable conditions/diseases
- The disease should be common enough to justify screening

Characteristics of a good screening test

- Simple
- Rapid
- Inexpensive
- Safe
- Acceptable
- Accurate

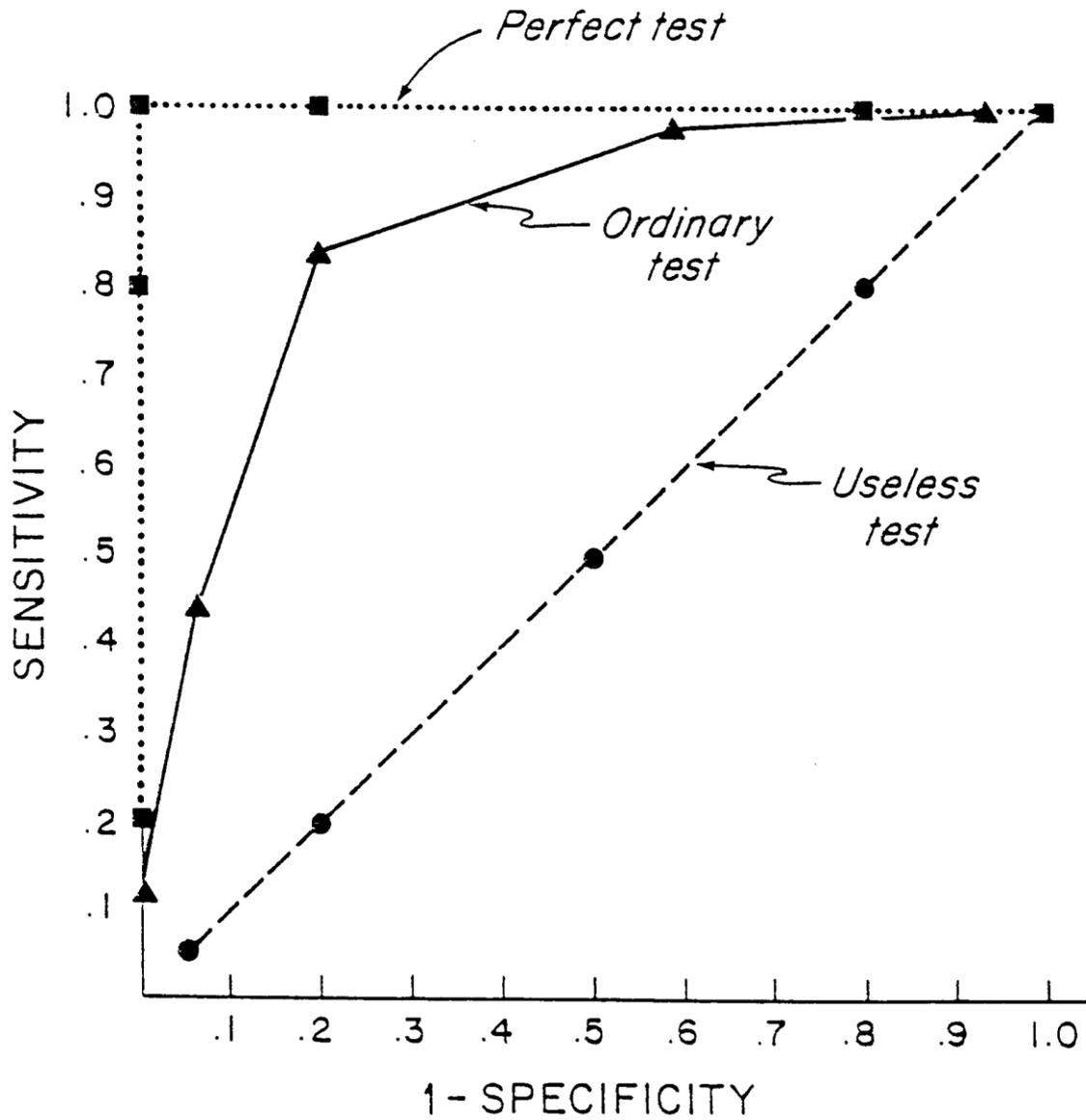
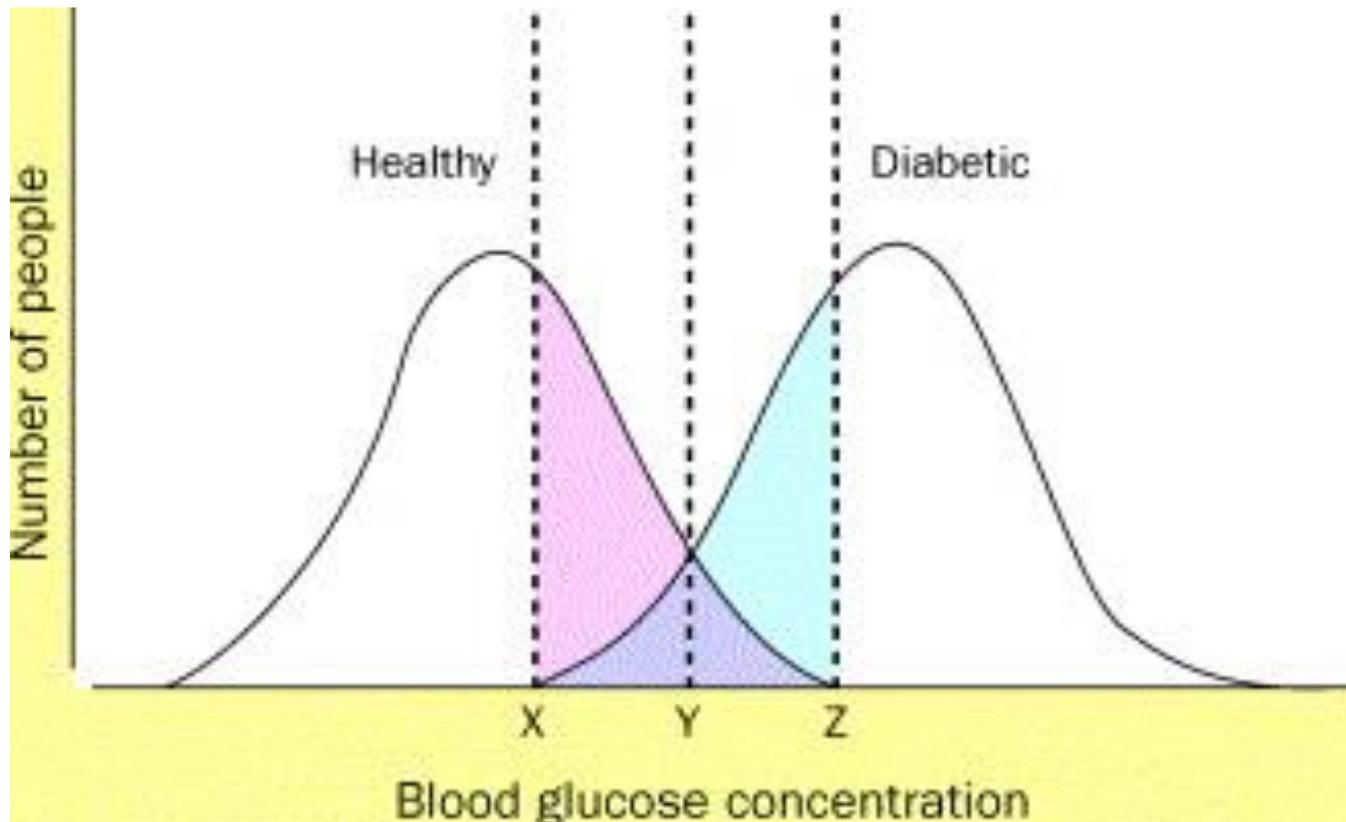


Figure 25-4. ROC curves for the three sets of distributions shown in Figure 25-3.



Hypothetical distribution of blood glucose concentrations in people with and without diabetes. Setting cut-off for abnormal at X yields perfect sensitivity at the expense of specificity. Setting cut-off at Z results in perfect specificity at the cost of lower sensitivity. Cut-off Y is a compromise.

Important points to remember before embarking on a screening program

1. In contrast to clinical practice which involves the patient asking for care to address established symptoms, in screening programs apparently healthy people are invited to present themselves for examination.

They have a right to assume this will benefit them or at least do them no harm

Important points to remember before embarking on a screening program

2. Screening large numbers of people can be expensive and time consuming. It is essential therefore to evaluate screening programs adequately before they are implemented and weigh potential gains for screened persons and for the health of the community against gains from alternative uses of the same resources.

Important points to remember before embarking on a screening program

3. To achieve the aim of reducing levels of mortality or morbidity from a particular disease, screening programs require a high uptake rate especially among vulnerable groups. This is not always easy to achieve.

Indicator of a successful screening program

- Incidence, not prevalence, is the appropriate indicator of the success of a screening program since postponement of death will result in increased prevalence
- Pre-clinical detection will result in a prolonged period of morbidity, spanning from the time of screening to the hypothetical time of clinical diagnosis

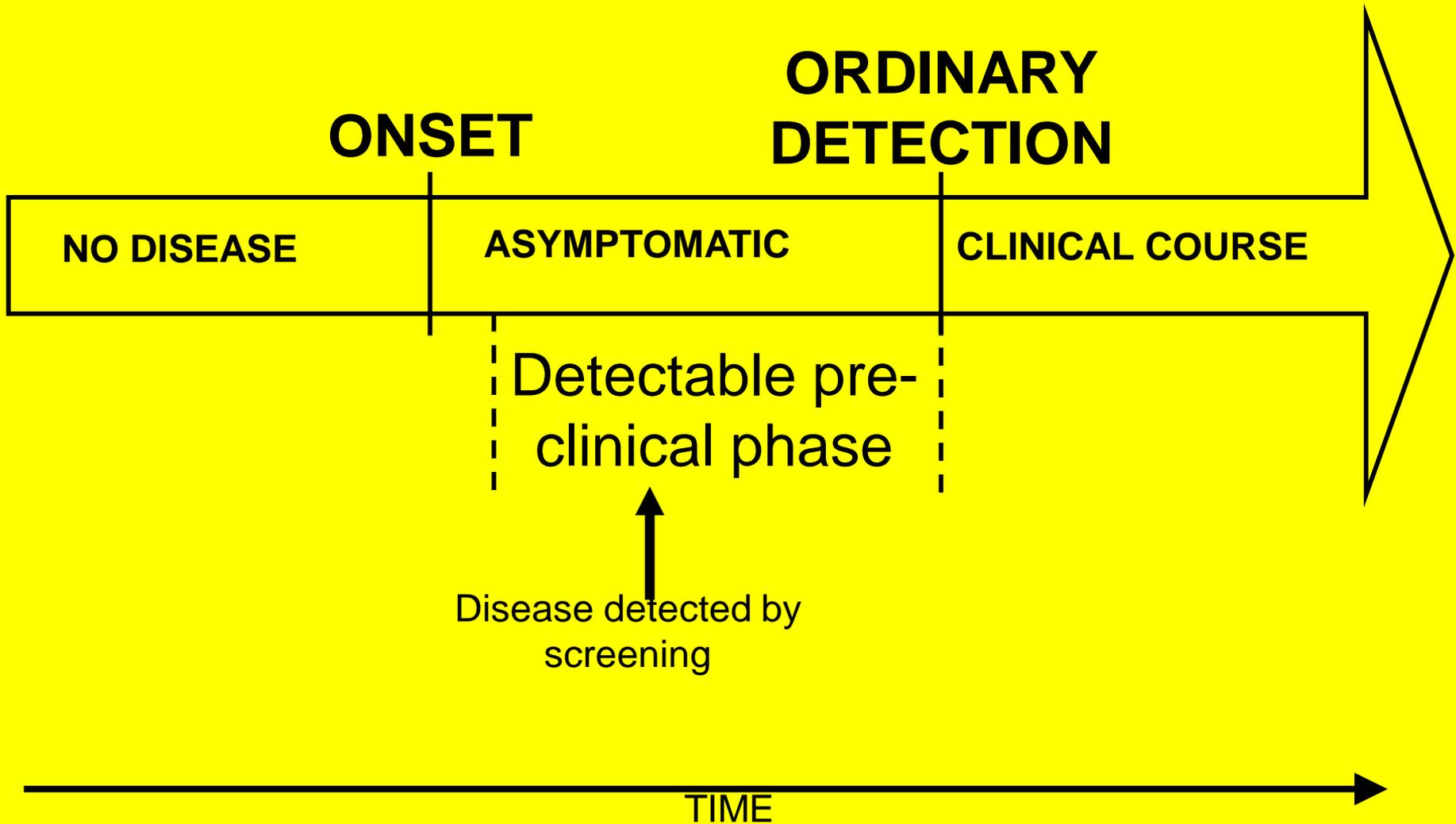
Evaluation of a screening program

- Individuals who are motivated enough to participate in screening programs may have a different probability of disease than individuals who refuse participation (selection bias)

Evaluation of a screening program

- Reduction in cause-specific (and all-cause) mortality in pop screened
- Increased Survival
- Reduced case fatality in screened individuals
- Increased % cases detected at earlier stages
- Reduction of complications/recurrences/metastases
- Improved Quality of Life in screened individuals

Natural history of a disease



ONSET

**ORDINARY
DETECTION**

NO DISEASE

ASYMPTOMATIC

CLINICAL COURSE

Detectable pre-
clinical phase

A

Death

Disease detected by
screening

B

Death

Disease detected by
symptoms

ONSET

**ORDINARY
DETECTION**

NO DISEASE

ASYMPTOMATIC

CLINICAL COURSE

Lead time

A

Death

Disease detected by
screening

B

Death

Disease detected by
symptoms

LENGTH TIME BIAS

- Slowly progressing tumors are more likely to be detected through screening
- Slowly progressing tumors take longer to result in death than faster progressing tumors
- Therefore, screen-detected cancers will appear to have an increased survival time

2 approaches to population screening

Selective Screening: restrict screening to high risk persons

- more cost-effective and more likely to yield TPs, if HR persons can be identified
- e.g., chest x-rays for evidence of pneumoconiosis in coal miners; amniocentesis for fetal chromosomal abnormalities in older women; BRCA mutations in high risk families; antenatal exams of pregnant women;

2 approaches to population screening

Mass Screening: screening of all persons regardless of risk level

- justified when impossible to define HR groups with sufficient specificity and sensitivity to ensure that they include a high proportion likely to develop the disease
- e.g., mammography for breast cancer; fecal occult blood for colon cancer; routine health check-ups;

Sensitivity & Specificity

“TRUTH”

Dis⁺

Dis⁻

Dis⁺

**TEST
RESULT**

Dis⁻

**True
Positive**
have disease
and test positive

**False
Positive**
disease-free
but test positive

**False
Negative**
have disease
but test negative

**True
Negative**
disease-free
& test negative

MEASURES OF CRITERIA VALIDITY

Sensitivity: proportion of true positives among all diseased individuals

Sensitivity

$$TP / TP+FN$$

False Negative Rate

$$FN / TP+FN$$

		Truth		
		Dis+	Dis-	
Test Result	Dis+	TP	FP	TP+FP
	Dis-	FN	TN	FN+TN
		TP+FN	FP+TN	

MEASURES OF CRITERIA VALIDITY

Specificity: proportion of true negatives among all non-diseased individuals

Specificity

$$TN / TN+FP$$

False Positive Rate

$$FP / TN+FP$$

		Truth		
		Dis+	Dis-	
Test Result	Dis+	TP	FP	TP+FP
	Dis-	FN	TN	FN+TN
		TP+FN	FP+TN	

MEASURES OF CRITERIA VALIDITY

Positive Predictive Value: proportion of true positives among all those with a positive screening test

Positive Predictive Value

$TP / TP+FP$

		Truth		
		Dis+	Dis-	
Test Result	Dis+	TP	FP	TP+FP
	Dis-	FN	TN	FN+TN
		TP+FN	FP+TN	

MEASURES OF CRITERIA VALIDITY

Negative Predictive Value: proportion of true negatives among all those with a negative screening test

Negative Predictive Value $TN / TN+FN$

		Truth		
		Dis+	Dis-	
Test Result	Dis+	TP	FP	TP+FP
	Dis-	FN	TN	FN+TN
		TP+FN	FP+TN	

MEASURES OF CRITERIA VALIDITY

Sensitivity: proportion of true positives among all diseased individuals

Specificity: proportion of true negatives among all non-diseased individuals

Positive Predictive Value: proportion of true positives among all those with a positive screening test

Negative Predictive Value: proportion of true negatives among all those with a negative screening test

These measures (particularly PVs) are not properties of the method of measurement, but rather of the method of measurement as applied to a specific population

		Heart Disease		
		+	-	
ECG	+	55	7	62
	-	49	84	133
		104	91	195

		Heart Disease		
		+	-	
ECG	+	55	7	62
	-	49	84	133
		104	91	195

Disease Prevalence: $104/195 = 0.53$

		Heart Disease		
		+	-	
ECG	+	55	7	62
	-	49	84	133
		104	91	195

Sensitivity: $55/104 = 0.53$

Specificity: $84/91 = 0.92$

Positive PV: $55/62 = 0.89$

Negative PV: $84/133 = 0.63$

		Heart Disease		
		+	-	
ECG	+	55	42	97
	-	49	546	595
		104	588	692

Disease Prevalence: $104/692 = 0.15$

		Heart Disease		
		+	-	
ECG	+	55	42	97
	-	49	546	595
		104	588	692

Sensitivity: $55/104 = 0.53$

Specificity: $546/588 = 0.92$

Positive PV: $55/97 = 0.57$

Negative PV: $546/595 = 0.92$

- **A test with a high sensitivity will identify a high percentage of the cases with the outcome**
- **A test with a high specificity will generally be negative for healthy individuals**
- **Usually, there is trade-off between sensitivity and specificity**

High Sensitivity or High Specificity: which do I want?

Issues to consider

- **Severity of the outcome**
- **Infectivity of the outcome**
- **Consequence of FP & FN results**
- **Risks of diagnostic tests & early treatment**
- **# of FPs the system can handle**
- **# of FNs the system can handle**
- **Cost of the diagnostic test**