Screening

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Objectives

- Definition of screening
- Concept of screening and the lead time
- Difference between “screening”, “case finding”, “periodic examination” and “diagnosis”
- Uses of screening programs
- Criteria of health problems amenable for screening
- Differences between screening and diagnostic test
- Distinguish between “mass screening” and “high risk screening”
- Criteria of an ideal screening test

Cont. objectives

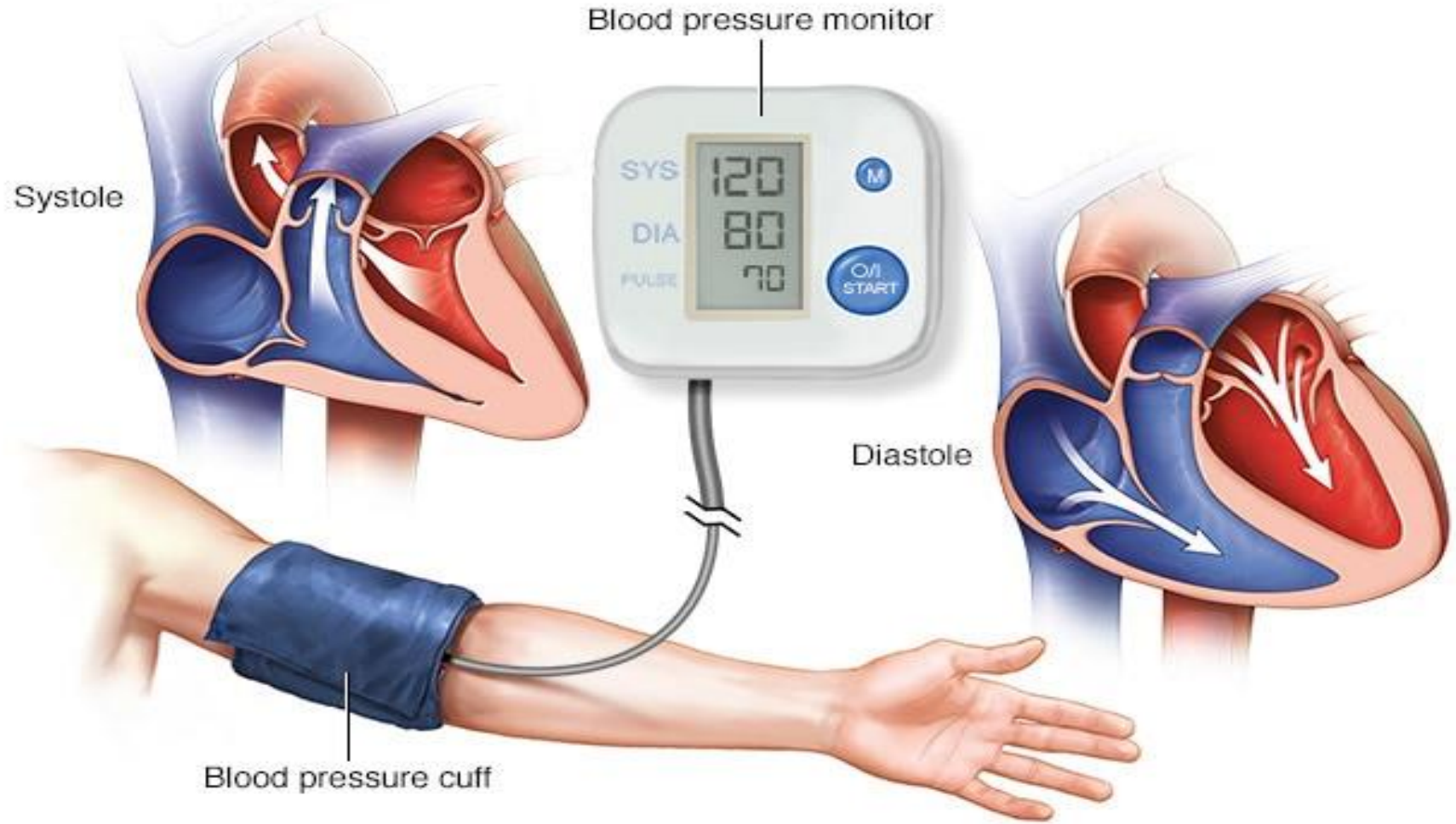
- Validity of screening test and its calculations:

1. Sensitivity
2. Specificity
3. Positive predictive value
4. Negative predictive value
5. False Positive Rate
6. False Negative Rate

1. Definition of screening

- Screening: actively searching for **unrecognized disease** or defect by means of rapidly applied tools in apparently **healthy** individuals **not seeking** medical care

Tools and examples of screening



2. Concept of Screening

Table 1. Natural history of disease and levels of prevention

Natural history of disease	Preventive measure	Example
Person at risk	Primary prevention	Giving advice to a middle-aged obese man to reduce the risk of developing elderly onset diabetes.
Asymptomatical sick	Secondary prevention	Blood sugar levels of a middle-aged obese man that feels well.
Symptomatically sick	Terciary prevention	Follow up care for a person who is taking oral hypoglycaemics.

3. Concept of Lead Time

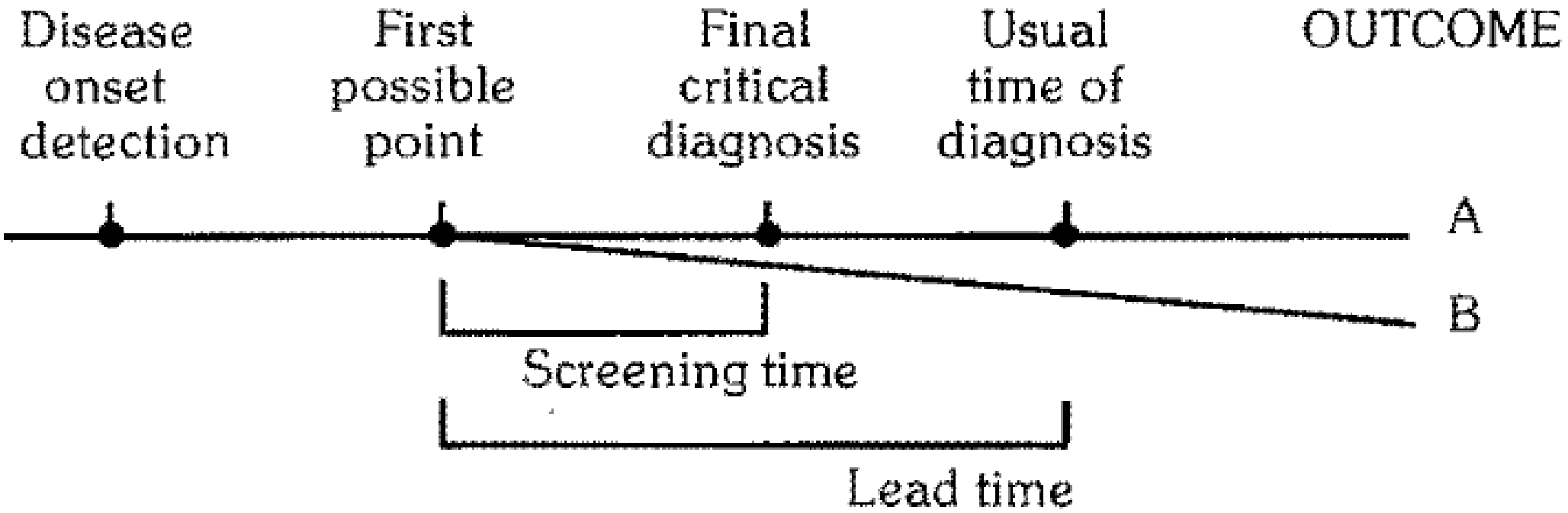


Figure 1. Model for early detection program

4.

Table 2. Difference between screening, case finding, periodic examination and diagnosis

Screening	Periodic examination	Case finding	Diagnosis
• The search for unrecognized disease or defect by means of rapidly applied tools in apparently **healthy individuals not seeking medical care.**	• Seeking of medical care at **intervals** to evaluate health status and to detect any health problem **without** the presence of any complaint. • In periodic examination, different systems are looked at and a series of investigations are applied.	• The use of a clinical, laboratory or non laboratory test to detect disease in individuals **seeking health care** for other reasons. • The aim of identifying diabetes among pregnant women is an example of case finding.	• A procedure to confirm or refute the **existence** of a disease or abnormality among those **seeking medical** care with a specific complaint. • Achieved by obtaining medical history, clinical examination and the application of laboratory or non laboratory tests.

5. Uses of screening programs

Table 3. Uses of screening tests

No.	Use of screening program	Definition	Example
1	Case detection	• **Prescriptive screening** • Identification of unrecognized disease or defect that doesn't arise from patients' request	Neonatal screening
2	Control of diseases	• **Prospective screening** • Prevention of the transmission of the disease to healthy community members	Screening of immigrants from infectious diseases such as tuberculosis and syphilis
3	Research purposes	• Initial screening is conducted to estimate the prevalence of a disease and subsequent screening will provide data on the incidence	Screening of chronic diseases whose natural history is not fully known (e.g. cancer)

6. Types of screening programs

1. **Mass screening:**

Applied to the whole population or population subgroups as adults, school children, industrial's workers irrespective of their risk.

2. High risk or selective screening:

Applied to a selective population subgroups who are at a high risk. Among high risk population, the disease is more likely to be prevalent and the screening will result in a better yield.

7. Criteria of screening

It is related to:

A. The disease

B. The screening test

A. The disease

The disease to be screened should fulfil the following criteria before it is considered suitable for screening:

1. The condition sought should be an important health (in general, prevalence should be high)

2. There should be a recognizable latent or early asymptomatic stage

3. The natural history of the condition, including development from latent to declared disease, should be adequately understood (so that we can know at what stage the process ceases to be reversible)

4. There is a test that can detect the disease prior to the onset of signs and symptoms

5. Facilities should be available for confirmation of the diagnosis

6. There is an effective treatment

7. There is good evidence that early detection and treatment reduces morbidity and mortality

8. The expected benefits (e.g., the number of lives saved) of early detection exceed the risks and costs

Screening and diagnostic test

Table 4. Difference between screening and diagnostic test

No.	Screening test	Diagnostic test
1	Done on apparently healthy	Done on those with indications or sick
2	Applied to groups	Applied to single patients, all diseases are considered
3	Test results are arbitrary and final	Diagnosis is not final but modified in light of new evidence, diagnosis is the sum of all evidence
4	Based on one criterion or cut-off point	Based on evaluation of a number of symptoms, signs (e.g., diabetes) and laboratory findings
5	Less accurate	More accurate
6	Less expensive	More expensive
7	Not a basis for treatment	Used as a basis for treatment
8	The initiative comes from the investigator or agency providing care	The initiative comes from a patient with a complaint

7. Cont. Criteria of screening

It is related to:

A. The disease

B. The screening test

B. The Screening Test

1. **Feasibility:** Simple, inexpensive, capable of wide application
2. **Acceptability:** Acceptable by the people to whom it is intend to be applied
3. **Reliability (precision):** Consistent results on repeated application on the same individual under same circumstances
4. **Validity (accuracy):** Ability to distinguish between those who have and those who don't have the disease as confirmed by a gold standard

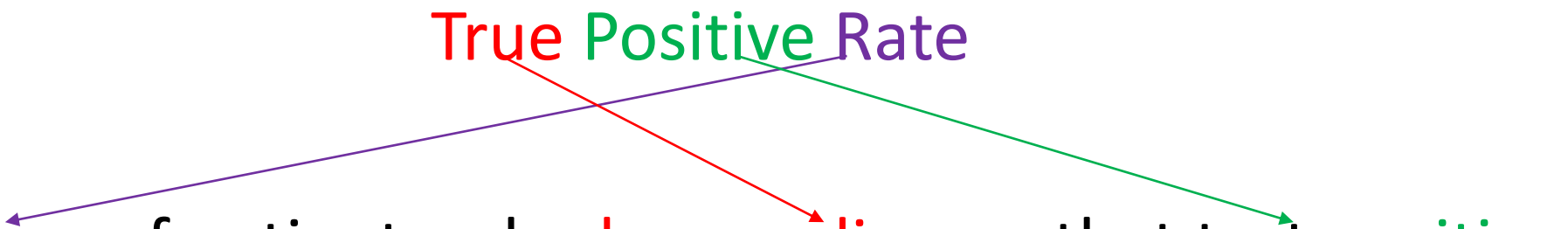
8. Validity of screening test

1. Sensitivity: ability of the test to detect correctly those who truly have the condition (true positive)

2. Specificity: ability of the test to detect correctly those who truly do not have the condition (true negative)

1. Sensitivity

- It is called as true positive rate.



Sensitivity= True positive/$T_{Disease}$ × 100

2. Specificity

- It is called the true negative rate.

True Negative Rate

Percentage of patients who do not have the disease who test negative on the test.

Specificity= True Negative/ $T_{\text{Non-Disease}} \times 100$

3. False Positive Rate

Percentage of patients who have a positive test result but do not have the disease.

4. False Negative Rate

Percentage of patients who have negative test results but have the disease.

False positive result

1. is referred to as adverse effect or errors of screening is not desirable
2. is a waste of resources; incurring the cost of the screening and the confirmation of the diagnosis
3. leads to unnecessary exposure of subjects to the hazards of the tests
4. causes emotional strain of being a probable case

False negative resuIt

1. is not desirable
2. gives a false re-assurance that they are free from the condition

Truth

Test Result	Disease **(number)**	Non-Disease **(number)**	Total **(number)**
Positive **(number)**	**A** (True Positive)	**B** (False Positive)	$T_{\text{Test Positive}}$
Negative **(number)**	**C** (False Negative)	**D** (True Negative)	$T_{\text{Test Negative}}$
	T_{Disease}	$T_{\text{Non-Disease}}$	**Total**

- **Sensitivity**= A/(A+C) × 100
- **Specificity**= D/(D+B) × 100
- **False Positive Rate**= B /(B+D) × 100
- **False Negative Rate**= C /(A+C) × 100

Example

Test	Breast cancer		Total
	Positive	Negative	
Positive	900	1980	2880
Negative	100	97020	97120
Total	1000	99000	100000

- **Sensitivity= A/(A+C) × 100**

(900/1000)x 100 = 90.00%

- **Specificity= D/(D+B) × 100**

(97020/99000) x 100 = 98.00%

- **False Positive Rate= B /(B+D) × 100**

(1980/99000) x100= 2%

- **False Negative Rate= C /(A+C) × 100**

(100/1000) x100= 10%

Interpretations of sensitivity and specificity:

- Breast cancer screening test was capable to identify correctly 90% of the those who have the cancer
- Breast cancer screening test was capable to identify correctly 98% of the those who don't have the condition

5. Positive predictive value

Percentage of the time that a positive test correctly identifies people who have the disease.

Positive Predictive Value= True Positive/ $T_{\text{Test Positive}} \times 100$

6. Negative predictive value

Percentage of time that a negative test correctly identifies people without the disease.

Negative Predictive Value= True Negative/ $T_{\text{Test Negative}} \times 100$

Meaning of positive predictive value

- Reflects the diagnostic **power** of the test.
- The predictive accuracy depends upon sensitivity, specificity and disease **prevalence**
- **Low value** is a waste of resources; very few of those who tested positive will be found to have the condition
- **High value** is desirable in screening program; detecting and bringing into care subjects with the condition at a pre-clinical stage

Truth

Test Result	Disease **(number)**	Non-Disease **(number)**	Total **(number)**
Positive **(number)**	**A** (True Positive)	**B** (False Positive)	$T_{\text{Test Positive}}$
Negative **(number)**	**C** (False Negative)	**D** (True Negative)	$T_{\text{Test Negative}}$
	T_{Disease}	$T_{\text{Non-Disease}}$	**Total**

- **Positive Predictive Value=** $A/(A+B) \times 100$
- **Negative Predictive Value=** $D/(D+C) \times 100$

Example

Test	Breast cancer		Total
	Positive	Negative	
Positive	900	1980	2880
Negative	100	97020	97120
Total	1000	99000	100000

- **Positive Predictive Value=**
  A/(A+B) × 100

(900/2880) x 100 = 31.3%

Out of those who are positive by the test only 31.3% are found to have breast cancer

- **Negative Predictive Value=**
  D/(D+C) × 100

(97020/97120) x 100 = 99.9%

Out of those who are negative by the test, 99.9% are found to be free from the cancer

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Thank you