Community Medicine

Screening

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
- 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

Performance objectives

•Compute sensitivity, specificity and predictive values of a screening test

•Evaluate the performance of a screening test

Important | **Notes** | **Extra**

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Feedback - Editing File

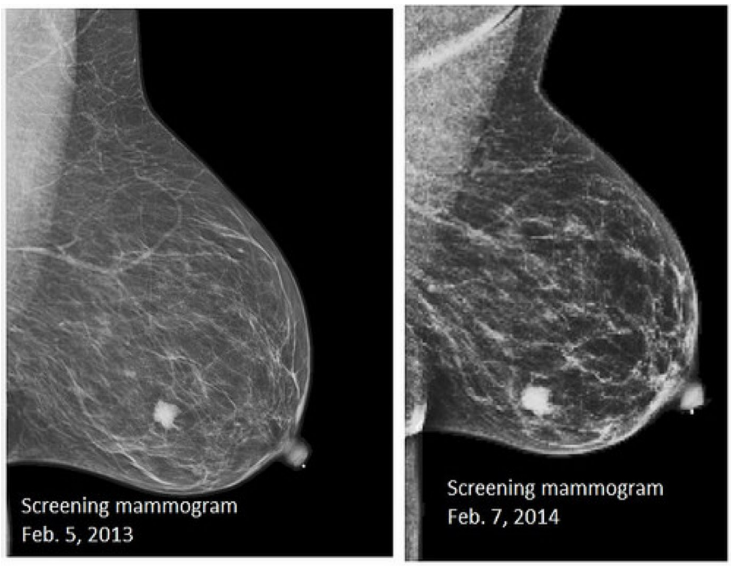
1. Definition of screening Objectives

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

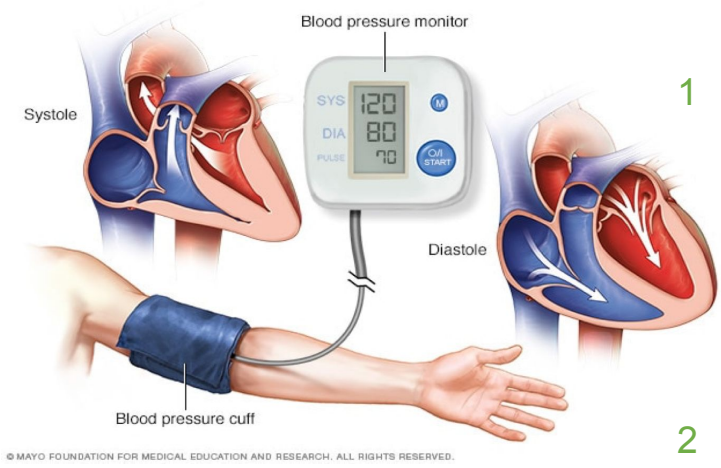
- Test consisting a series of questions
- Instrument to measure a parameter
- Medical examination
- Radiological test
- Laboratory test

eg. colon cancer screening , mammogram.



hs-CRP Value	Cardiovascular Disease Risk Level*
< 1 mg/L	**low** risk
1-3 mg/L	**average** risk
> 3 mg/L	**high** risk

* Risk levels published in 2003. American Heart Association / Centers for Disease Control and Prevention Scientific Statement



Nutritional Screening Tool for Vitamin B12 Deficiency in Older Adults

Last Name: First Name: Date:

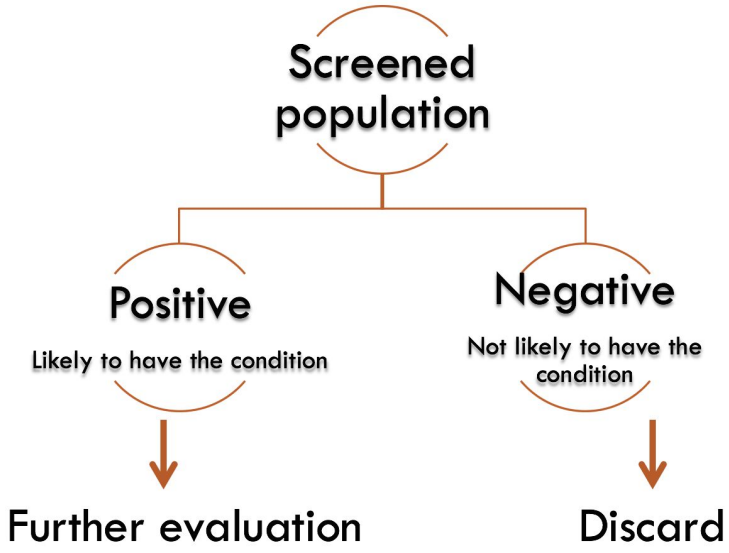
Age: Sex: Weight (kg): Height (cm):

Please complete the following questions and tally up the final score.

Screening Questions

A	Are you above 50 years of age? 2 = Yes 0 = No	H	Do you eat cereal every day? 0 = Yes 1 = Sometimes 2 = No
B	Are you pregnant or lactating? 2 = Yes 1 = Maybe or don't know 0 = No	I	Do you take folic acid supplements every day? 2 = Yes 1 = Sometimes 0 = No
C	Which diet do you most closely follow? 2 = Vegan (ie: avoids all animal products) 1 = Lacto-ovo vegetarian (ie: eats dairy and eggs) 1 = Pescatarian (ie: eats seafood) 0 = Non-vegetarian	J	Do you eat dark leafy greens, asparagus, lentils and/or beans every day? 2 = Yes 1 = Sometimes 0 = No
D	Do you have a disease related to your digestive system? (May choose more than 1) 1 = Crohn's disease 1 = Celiac disease 1 = Maybe or don't know 0 = No	K	Do you experience any of the following symptoms? (May choose more than 1) 1 = Fatigue, weakness and/or shortness of breath 1 = Constipation 1 = Loss of appetite and/or unintentional weight loss 1 = Numbness and/or tingling in hands, legs and/or feet 1 = Difficulty maintaining balance 1 = Soreness of mouth and/or tongue 1 = Constant eye twitch 1 = Poor memory, dementia, confusion and/or depression 0 = None of the above
E	Did you have surgery related to digestive system (ex: gastric bypass, partial removal of small intestine)? 2 = Yes 0 = No		
F	Do you have parasites and/or diarrhoea? 2 = Yes 1 = Maybe or don't know 0 = No		
G	Do you take vitamin B12 supplements and/or prescribed vitamin B12 medication every day? 0 = Yes 1 = Sometimes 2 = No	Total Score out of 28	**Scoring System for Risk of Vitamin B12 Deficiency** 14 or more points: High risk — Continue to Total Serum B12 Test 10 to 14 points: Moderate risk — Consider Total Serum B12 Test 9 or less points: Low risk — Do not need Total Serum B12 Test

Outcome 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	1- 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	2- Terciary prevention	Follow up care for a person who is taking oral hypoglycaemics.

1- the most important to detect asymptomatic people

2- screening here is pointless, damage already done

3. Concept of Lead Time

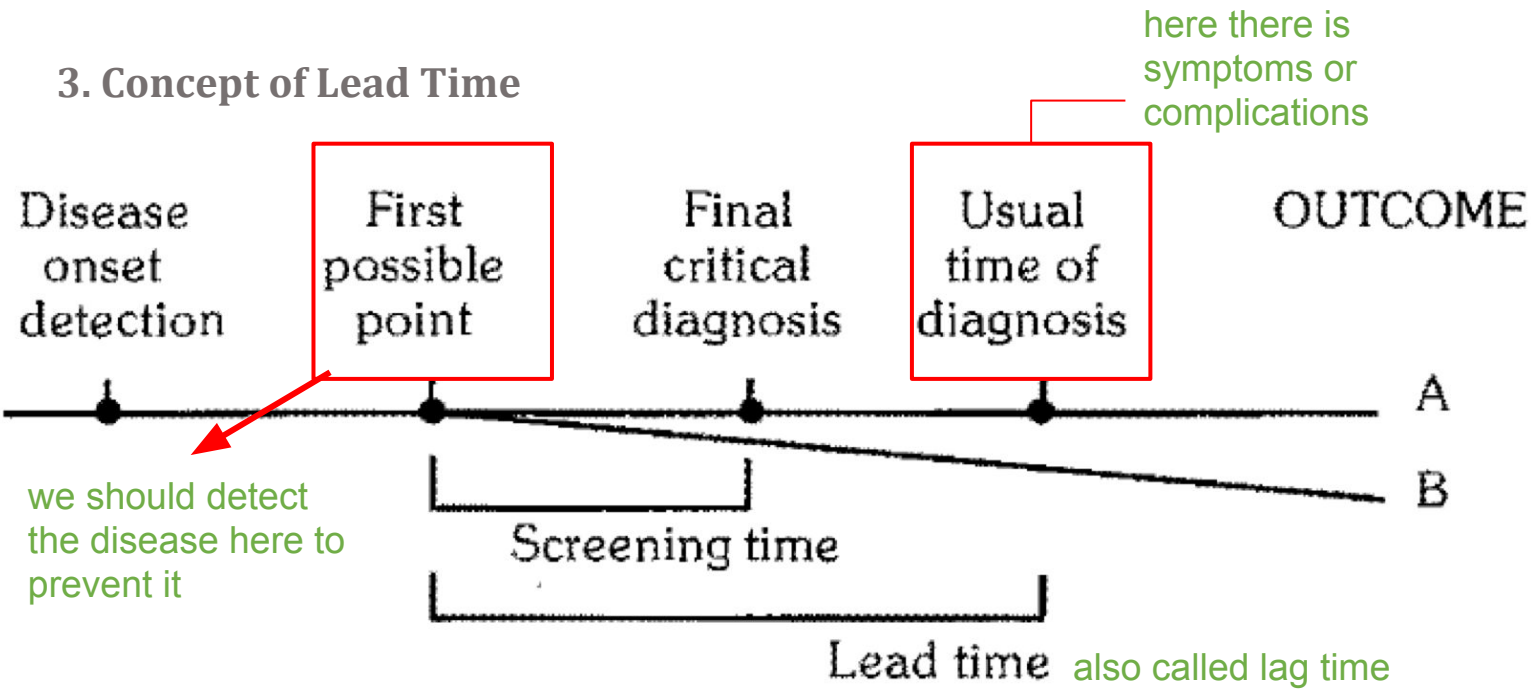


Figure 1. Model for early detection program

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

Screening	The search for unrecognized disease or defect by means of rapidly applied tools in apparently **healthy** **individuals not seeking medical care.**
Periodic examination	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. example, anyone who's above 40 should measure blood glucose level
Case finding	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.
Diagnosis	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 patient's 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.

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) (if there is no cure then there is no point of screening).

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 we should know if the disease can be treated, no need for screening if there's no cure

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 risk and costs
9. Agreed-on policy whom to treat as a patient

B. The Screening Test the tool

1. Feasibility: Simple, inexpensive, capable of wide application

2. **Acceptability:** Acceptable by the people to whom it is intend to be applied

(example of socially unacceptable tests: pap smear, PR for prostatic cancer)

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

details in the next slides

Screening and diagnostic test

Table 4. Difference between screening and diagnostic test (very important)

No.	Screening test	Diagnostic test
1	Done on apparently healthy main and big difference	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
9	Results are not conclusive	Results are conclusive and final

*They may trick you in the exam so be careful :

- Healthy individual who is **not** seeking medical advice= Screening test.
- Sick patient =Diagnosis test

Example of screening programs

Blood pressure for hypertension

Fasting blood sugar level for diabetes

Pap smear for cervical cancer

Mammogram for breast cancer

PSA for prostate cancer

Elisa followed by RIBA for hepatitis C antibodies

Thyroid hormone from blood cord for hypothyroidism in newborn

Hip examination for congenital hip dislocation in the newborn

8. Validity of screening test

Validity of the test reflects its "accuracy" compared to a gold standard.

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

It is called as true positive rate.

True Positive Rate

Percentage of patients who have a disease that tested positive.

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

T disease = total number of those who have the disease

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

•It is called the true negative rate.

True Negative Rate

Percentage of patients who do not have the disease who tested negative.

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

T non disease = total number of those who don't have the disease

True positive result is desirable

- ❑ It is money well spent
- ❑ Bringing subjects with the condition into care
- ❑ Subjects who incurred the hazards of screening and confirmation of the diagnosis will benefit from therapeutic intervention

True negative result is desirable

- ❑ Reassurance that they are free from the condition

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	False negative result
is referred to as adverse effect or errors of screening is not desirable	is not desirable
is a waste of resources; incurring the cost of the screening and the confirmation of the diagnosis	gives a false reassurance that they are free from the condition
leads to unnecessary exposure of subjects to the hazards of the tests	
causes emotional strain of being a probable case	

	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:

- sensitivity: Breast cancer screening test was capable to identify correctly 90% of the those who have the cancer
- A sensitive test will result in few false negative
- Test with high sensitivity is preferable in screening

- specificity: Breast cancer screening test was capable to identify correctly 98% of the those who don't have the condition
- A specific test will result in few false positive
- Test with high specificity is preferable for diagnosis

•Yield of the test reflects the number of correctly unrecognized subjects with the condition who have been identified and brought into care

•Yield of the test is measured by its predictive value

5. Positive predictive value

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

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

*here we talk about the Tests not Patients

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

•Predictive value positive increases considerably with the increase in the prevalence of the condition among the screened population

•In condition with relatively lower prevalence among the general population but higher prevalence among high risk population, it is recommended to avoid mass screening and to opt for “selective screening” of high risk population

	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**= $D/(D+C) \times 100$

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

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

(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=** $D/(D+C) \times 100$

(97020/97120) x 100 = 99.9%

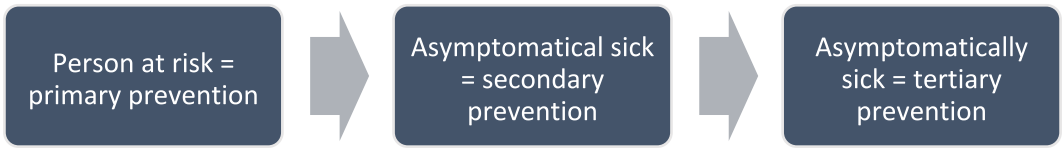
Out of those who are negative by the test, 99.9% are found to be free from the cancer

Summary

1-Definition of screening:

searching for unrecognized disease in apparently healthy individuals not seeking medical care.

2-Concept of Screening:



3-Concept of Lead Time:

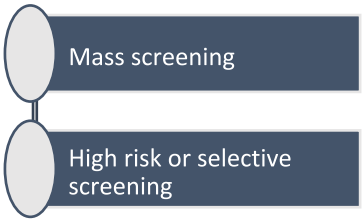
It is the time that precedes the usual age of presentation by which the disease can only be detected by screening tests.

4-Difference between screening, case finding, periodic examination and diagnosis:

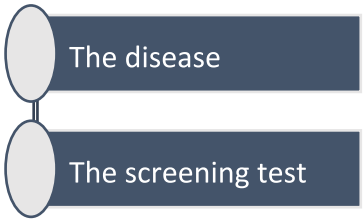
Screening	Periodic examination	Case finding	Diagnosis
•healthy individuals not seeking medical care.	•Seeking of medical care at intervals without the presence of any complaint.	•seeking health care for other reasons	•confirm the existence of a disease among those seeking medical care with a specific complaint.

5-Uses of screening programs:

6-Types of screening programs:



7-Criteria of screening:



8-Validity of screening test :

1. **Sensitivity** = True Positive Rate = Percentage of patients who have a disease that test positive on the test.
2. **Specificity** = True Negative Rate = Percentage of patients who do not have the disease who test negative on the test.
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.
5. **Positive predictive value** = Percentage of the time that a positive test correctly identifies people who have the disease.
6. **Negative predictive value** = Percentage of time that a negative test correctly identifies people without the disease.

THE END