Screening

- **Objectives :**

1-Define the term “screening”.
2-Explain the concept of screening and the lead time.
3-Explain the difference between “screening”, “case finding”, “periodic examination” and “diagnosis”.
4-State the uses of screening programs.
5-State the criteria of health problems amenable for screening.
6-Outline the differences between screening and diagnostic test.
7-Distinguish between “mass screening” and “high risk screening”.
8-State the criteria of an ideal screening test.

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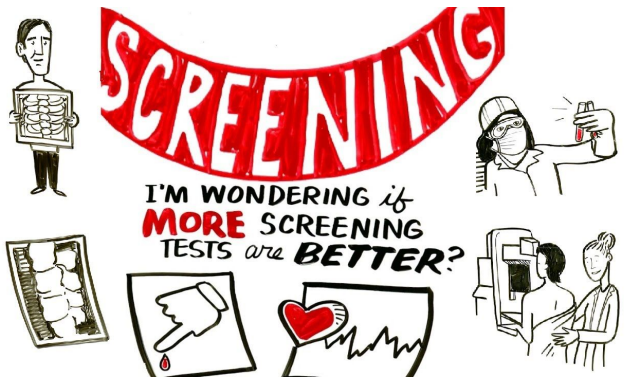
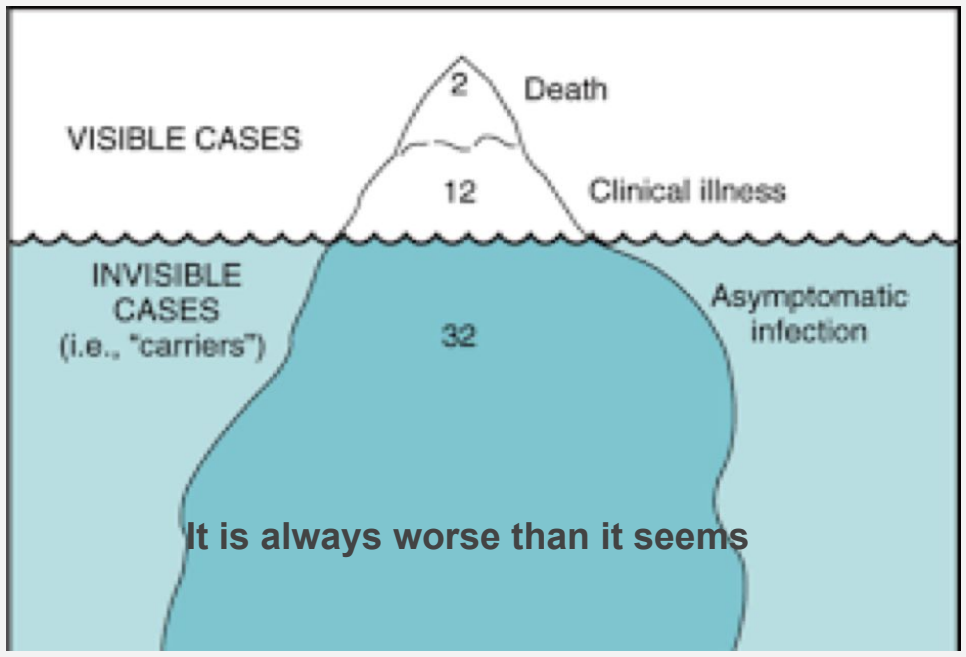
- **Resources :**
  Slides.
  Doctor’s notes.



[Colors index : Important | Notes | Note | Slides | Extra] [Editing file | Share note]

Iceberg Phenomenon of Disease



Iceberg Phenomenon of Disease

It shows that the health problems are bigger than the number of the patients in a hospital

•This concept gives a better idea of progress of disease from its subclinical stages to overt or apparent disease.

•Submerged portion of Iceberg: Represents the hidden mass of disease (sub clinical cases, carriers and undiagnosed cases)

•Floating tip: Represents what the physician sees in practice.

"boys slides"

- Sceaning: The search for **unrecognized** disease or defect by means of **rapidly** applied tests, examinations or other procedures in apparently **healthy** individuals.

- Concept of "Lead Time":

The goals of the screening tests are to detect the disease during the early processes before the clinical symptoms appear and make the outcomes better

-Lead time is the advantage gained by screening.
-It is the period between diagnosis by early detection and diagnosis by other means.
-The benefit of the program must be seen in terms of its outcome.
-A is the outcome of the disease.
-B is the outcome to be expected when the disease is detected **at the earliest possible moment.**
-B-A is the benefit of the program.

The important thing is that screening should have benefits that outweigh the risks

What're the benefits of lead time? To diagnose early and expect of the clinical prognosis.
Some diseases the prognosis is the same so what other than it? Quality of life

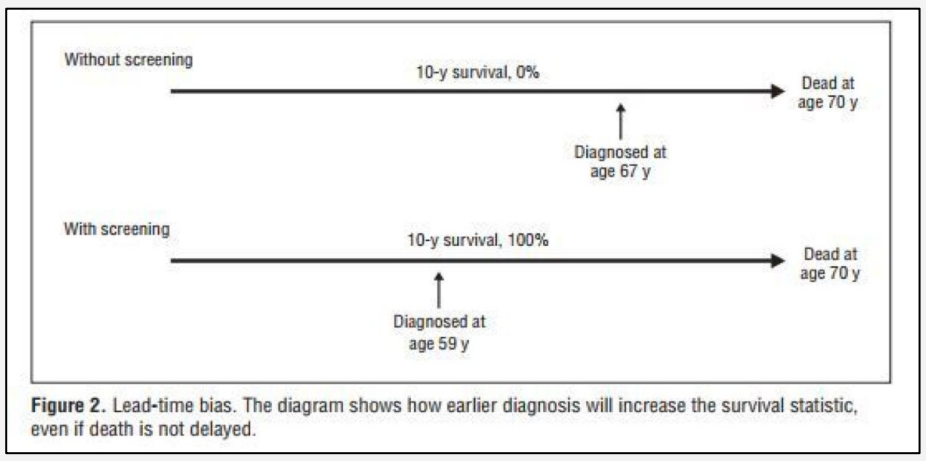


Figure 2. Lead-time bias. The diagram shows how earlier diagnosis will increase the survival statistic, even if death is not delayed.

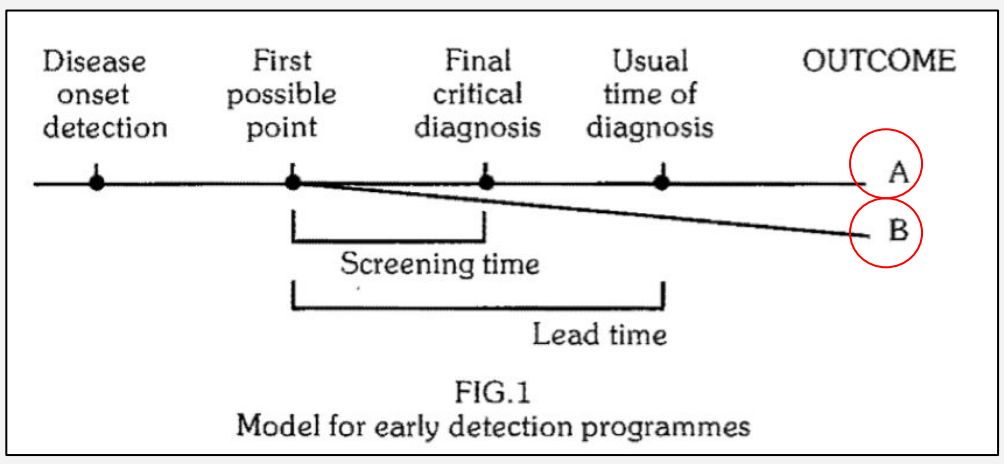
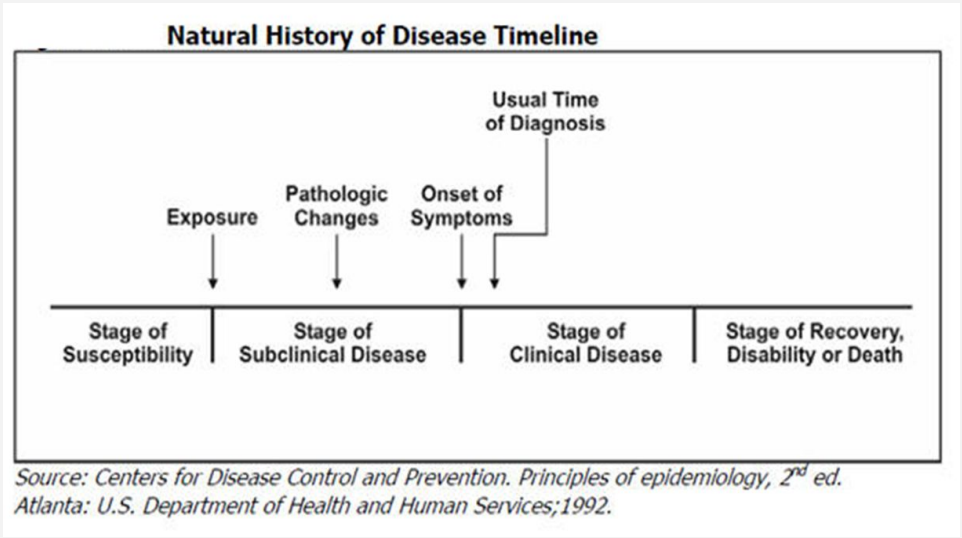
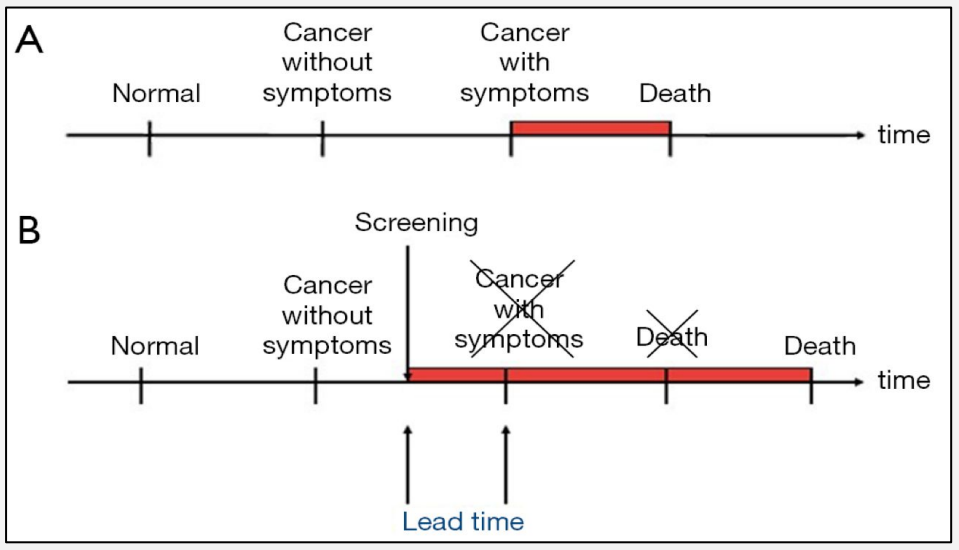


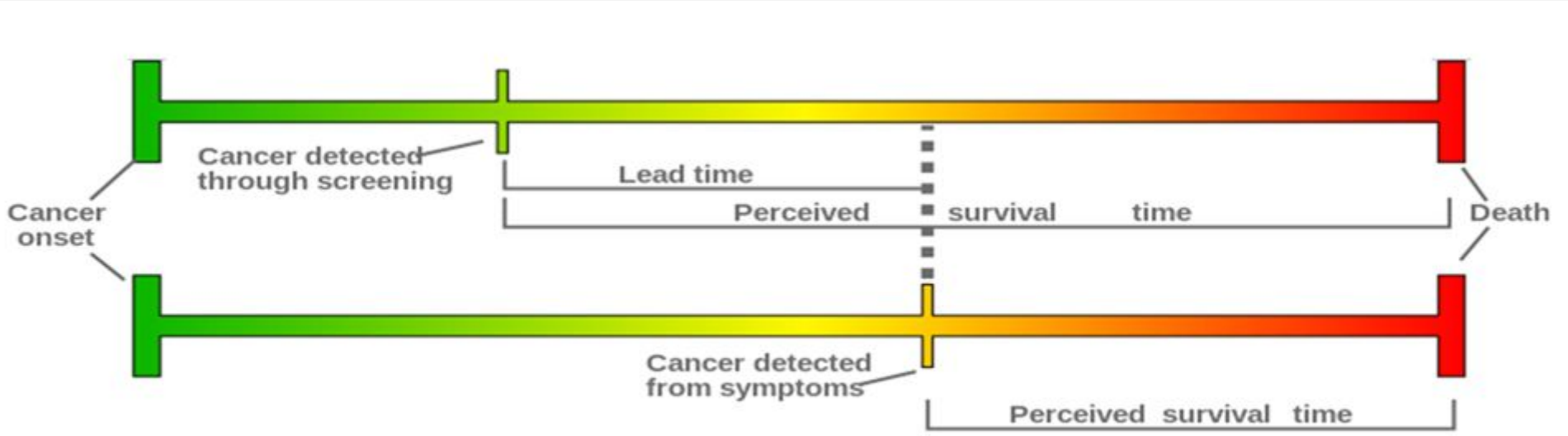
FIG.1
Model for early detection programmes

Lead time

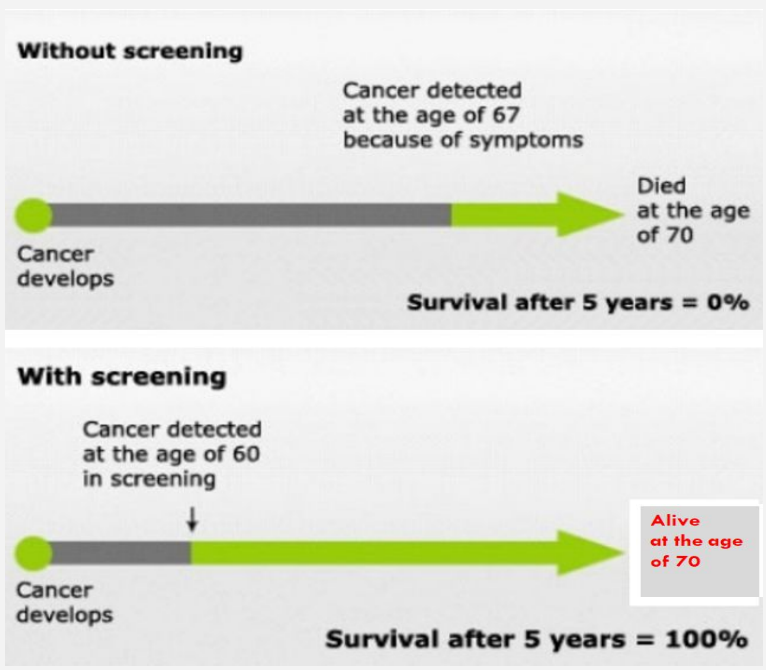


Source: Centers for Disease Control and Prevention. Principles of epidemiology, 2nd ed. Atlanta: U.S. Department of Health and Human Services;1992.

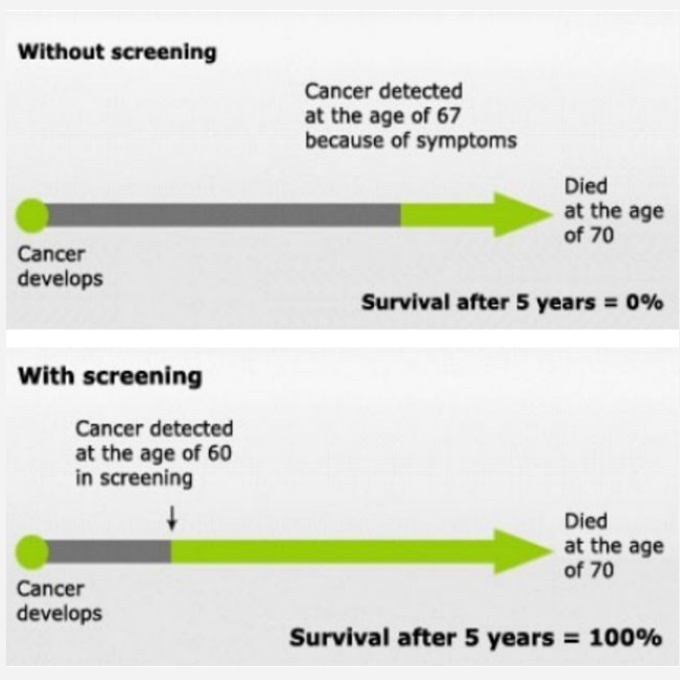




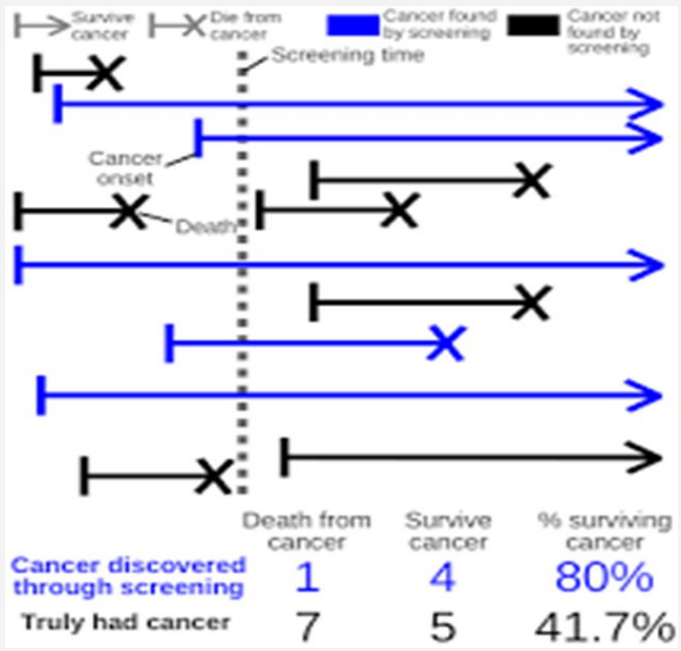
This means that it increased the time they spent living as cancer patients by several years



Live longer



Improve the quality of life



Relationship between screening and lead time

Concepts related to screening:

- Periodic examination
- Diagnosis
- Case finding

Physical examination:

- Applied individually
- Consumes physicians' time
- Consumes money

"Physical Examination requires special training (to be physician) while screening does not require that"

Screening	Case-finding	Diagnostic tests We do it for symptomatic people
is testing for infection or disease in populations or in individuals who are not seeking health care. for example, serological testing for AIDS virus in blood donors, neonatal screening, premarital screening for syphilis. 1- we do the screening tests on healthy individuals 2- we don't treat the people who are positive screening tests but we do diagnostic tests then we treat	The use of clinical and/or laboratory tests to detect disease in individuals seeking health care for other reasons. for example, the use of VDRL test to detect syphilis in pregnant women. Other diseases include pulmonary tuberculosis in chest symptomatics, hypertension, cervical cancer, breast cancer, diabetes mellitus. Patients come to the hospital with problem and we do tests for other problems that related or not related to the main problem	Use of clinical and/or laboratory procedures to confirm or refute the existence of disease or true abnormality in patients with signs and symptoms presumed to be caused by the disease. for. example, VDRL testing of patients with lesions suggestive of secondary syphilis; endocervical culture for N. gonorrhoeae.

Periodic Health Examination

Evaluation of apparently health Individuals in certain time periods, using a number of standard procedures such as counseling, physical examination, immunization, and laboratory investigations

IMPORTANT

TABLE 1
Screening and diagnostic tests contrasted

	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.

Uses of screening:

1- **Case detection:** people screened for their own benefit. (eg.: breast cancer, PKU, deafness in children,…)

2- **Control of disease:** people are screened for the benefit of others (eg.: TB to protect population)

3- **Research purposes:** prevalence, incidence.

4- **Educational opportunity:** public awareness, education to health professionals.

Continue uses of screening

1- Case detection:

- Is the presumption identification of unrecognized disease, which does not arise from a patient request.
- Neonatal screening.
- The people are screened primarily for their own benefit.

2- Control of disease:

- People are examined for the benefit of others.
- Screening of immigrants from infectious diseases like Ebola, TB and syphilis to protect the home population.
- Screening for HIV, STD etc.
- Leads to early diagnosis to permit more effective treatment and reduce the spread of infectious disease and mortality.

3-Research purposes:

- To know the history of many chronic diseases like cancer, HTN etc.
- Screening may aid in obtaining more basic knowledge about the natural history of such diseases.
- Initial screening provides a prevalence estimate and subsequent screening provides and incidence figure.

4-Educational opportunities:

- Acquisition of information of public health relevance.
- Providing opportunities for creating public awareness.

Examples of screening:

-Women receive regular screening tests beginning in young adulthood for cervical cancer (Pap smear).

-Physicians assess blood pressure and cholesterol as screening tools for the development of cardiovascular disease.

-Women use home pregnancy tests to screen for presence of an embryo or fetus.

-FASTING BLOOD GLUCOSE, BLOOD PRESSURE, PSA TEST(prostate cancer), PAP SMEAR(cervical cancer), MAMMOGRAPHY(breast cancer), FECAL OCCULT BLOOD TEST(colon cancer).

Mass screening	High risk/ selective screening
Mass screening simply means the screening of a whole population or a sub-group, as for example, all adults. It is offered to all, irrespective of the particular risk individual may run of contracting the disease in question (e.g., tuberculosis). We test all people Take all schools without exceptions	Screening will be most productive if applied selectively to high-risk groups, the groups defined on the basis of epidemiological research (e.g., diabetes, hypertension, breast cancer in patients with positive family history), Screening for risk factors. "New concept, screening for risk factors before disease occurs" Isn't benefit that we do screening test for all people in a disease that only happens for elderly or specific gender

Concept of screening

We screen for disease when we have the opportunity to **reduce costs and risk** associated with diagnoses on large proportions of at-risk individuals:

1. We screen for health indicators that affect population health principally, not for rare diseases (although there are exceptions for rare diseases screen in utero)
2. There should be sufficient time between biological onset of disease and appearance of signs and symptoms of the disease exist so that screening could detect the presence of the disease earlier than it would come to clinical attention
3. There should be available treatment for the disease so that early detection improves the lives of affected people
4. Screening tests should be cheaper and less invasive than best available diagnostic tool

Criteria of screening (Disease)

This criteria is used for the disease that can be screened

Like if a disease that it is prevalent only in Egypt here we don't need to do it in KSA.

B/c we detect the diseases in the latent period so if the disease doesn't have latent period we can't detect it

- Important health problem
- Recognizable latent or early symptomatic stage
- The natural history of the condition should be understood
- There is a test that can detect the disease
- Good evidence that early detection and treatment reduces morbidity and mortality
- There should be an agreed-on policy concerning whom to treat as patients
- Has an effective treatment
- Facilities should be available for confirmation of the diagnosis

عندي الامكانية على متابعة المرضى اللي يطلع لهم positive screening test

- Expected benefits (e.g., the number of lives saved) of early detection exceed the risks and costs

- some diseases like flu its natural disease is known and the prognosis is good and economic burden.
- If the preclinical stage is too short screening program is not efficient.

Continuous criteria of screening"boys slides"

1. Disease
2. Significant burden of disease
3. Detectable and long preclinical stage of disease
4. Adequately understood natural history of disease
5. Appropriate test available for early detection of disease
6. Facilities for diagnosis of disease
7. Early detection of disease has outcome benefit
8. Effective treatment available for disease
9. Policy of screening program for disease

It is similar to the previous criteria but it is stated in different expression

Screening Test VS Diagnostic Tests

	Screening Test	**Diagnostic Tests**
Purpose	To detect potential disease indicators	To establish presence/absence of disease
Target population	-Applied to groups. -Apparently healthy. -The initiative comes from the investigator or agency providing care.	-Single -Patients or Symptomatic individuals -Positive screening test -The initiative comes from a patient with a complaint
Test method	-Simple, acceptable. -Based on one criterion or cut-off point. -Cheap, benefits should justify the costs. -Not a basis for treatment.	maybe invasive, expensive but justifiable as necessary to establish diagnosis Based on evaluation of a number of symptoms, signs and laboratory findings More expensive

screening Test

The test must satisfy the following criteria :

يكون مقبول وسهل وسريع مثل ماينفع اسوي
bone marrow as a screening test

- **Acceptability**: acceptable to people at whom it is aimed. Painful, discomforting or embarrassing examinations are not likely to be acceptable to the population in mass campaigns.

- **Repeatability** (precision , reproducibility): the test must give consistent results when repeated more than ones on the same individual under the same conditions.

- **Validity**: refers to what extent the test accurately measures which it purports to measure. expresses the ability of a test to separate or distinguish those who have the disease from those who do not have it.

Accuracy refers to the closeness with which measured values agree with **"true values".**

Example: Glycosuria VS Glucose tolerance test for Diabetes

Components of validity

TABLE 3–A

Screening test result by diagnosis

Screening test results	Diagnosis		Total
	Diseased	Not diseased	
Positive	a (True-positive)	b (False-positive)	a+b
Negative	c (False-negative)	d (True-negative)	c + d
Total	a + c	b + d	a + b + c + d

- Sensitivity = a/ (a+c) x 100
- Specificity = d/ (b+d) x100
- predictive value of a positive test =a/(a+b)x100
- predictive value of a negative test =d/(c+d)x100
- Percentage of false-negative =c/(a+c)x100
- Percentage of false-positive =b/(b+d)x100

Continue components of validity..

-Sensitivity:

the ability of the test to identify correctly all those who have the disease, that is *"true-positive"*.

Example: 90% sensitivity means that 90% of the diseased people screened by the test will give a "true-positive" result and the remaining 10% a "false-positive" result.

Sensitivity and specificity
تمشي على الاعمدة

-Specificity:

the ability of a test to identify correctly those who do not have the disease, that is *"true-negatives"*

Example: 90% specificity means 90% of non-diseased persons will give "true-negative" result, 10% of non-diseased people screened by the test will be wrongly classified as "diseased" when they are not.

Predictive accuracy
تمشي على الصفوف

-Predictive accuracy:

- Reflects the diagnostic power of a test.
- Depends upon sensitivity, specify and disease **prevalence.**
- The probability that a patient with a positive test result has, in fact, the disease in question.
- The more prevalent is a disease in a given population, the more accurate will be the predictive value of a positive screening test.

Training

Diagnosis of brain tumours by EEG

EEG results	Brain tumour	
	Present	Absent
Positive	36	54,000
Negative	4	306,000
	40	360,000

Sensitivity = 36/40 × 100 = 90 per cent
Specificity = 306,000/360,000 × 100 = 85 per cent

Diagnosis of brain tumours by computer assisted axial tomography

CAT results	Brain tumour	
	Present	Absent
Positive	39	18,000
Negative	1	342,000
	40	360,000

Sensitivity = 39/40 × 100 = 97.5 per cent
Specificity = 342,000/360,000 × 100 = 95 per cent

This illustrates what happens if you got different results for the same test

Predictive value of a positive gram-stained cervical smear test (with constant sensitivity of 50% and specificity of 90%) at three levels of prevalence

	Prevalence 5%			Prevalence 15%			Prevalence 25%		
	Culture			Culture			Culture		
	+	−	Total	+	−	Total	+	−	Total
Smear +	25	95	120	75	85	160	125	75	200
Smear −	25	855	880	75	765	840	125	675	800
Total	50	950	1000	150	850	1000	250	750	1000
Positive predictive value	$\frac{25}{120} \times \frac{100}{1} = 21\%$			$\frac{75}{160} \times \frac{100}{1} = 47\%$			$\frac{125}{200} \times \frac{100}{1} = 63\%$		

The Problem of The Borderline (the cut-off point)

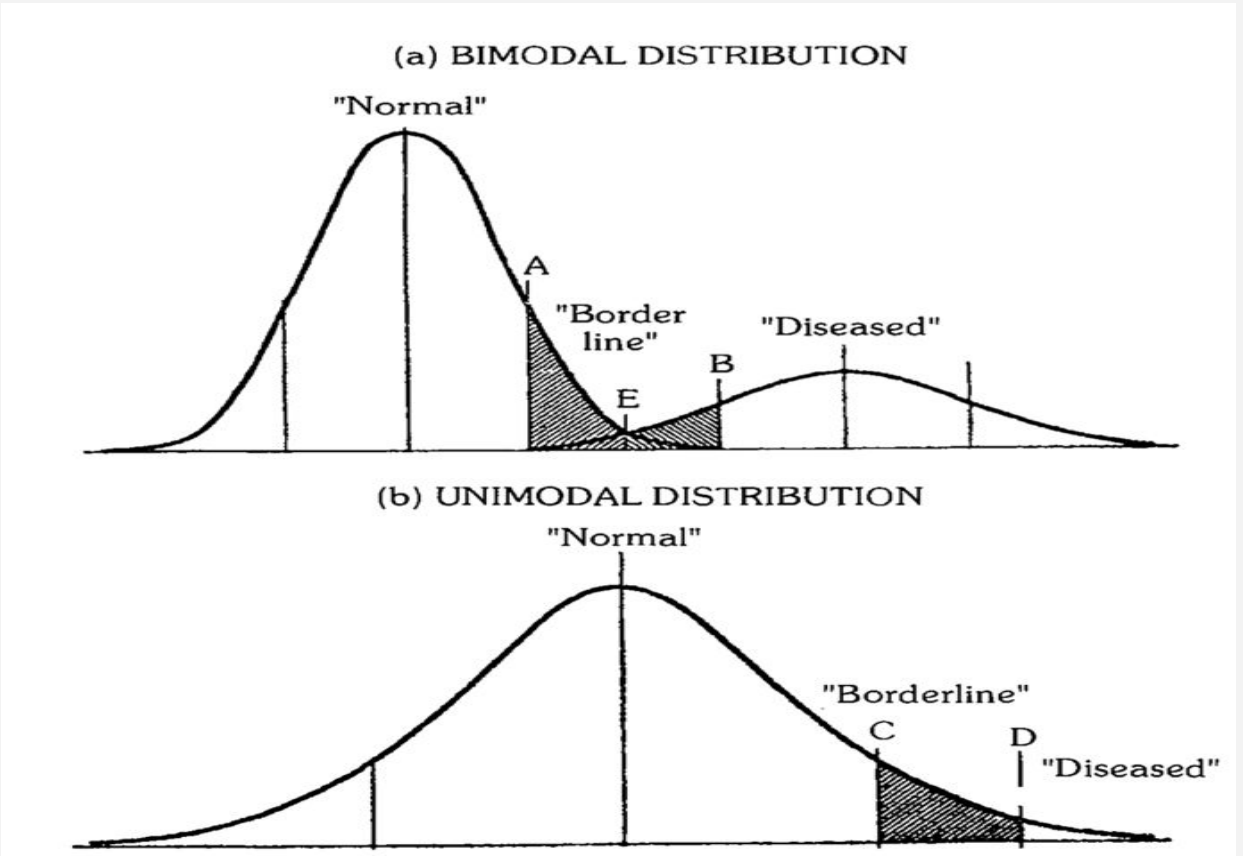


FIG. 3
Distribution of a variable in a population

Summary

- Screening for common health issues is integral part of improving population health.
- Screening predicts who will develop a specific disease and detects disease among those in early stages.
- Screening tests need to be studied for validity (sensitivity and specificity)
- We often have a trade-off between sensitivity and specificity.
- Predictive value of screening test is maximized in populations with high prevalence of health indicator of interest.
- Value of screening program will depend on cost-effectiveness, minimal invasiveness, availability of effective treatment.

“Summary”

Sceaning: The search for **unrecognized** disease or defect by means of **rapidly** applied tests, examinations or other procedures in apparently **healthy** individuals.

Lead Time”: it is the period between diagnosis by early detection and diagnosis by other means

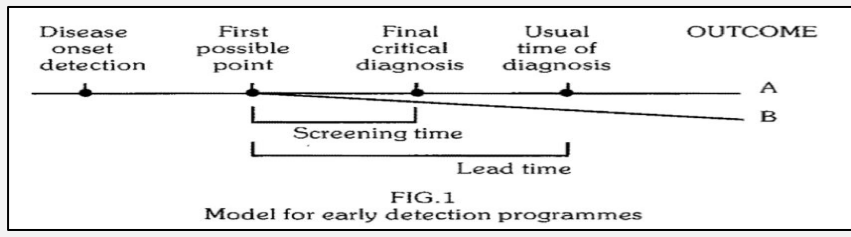
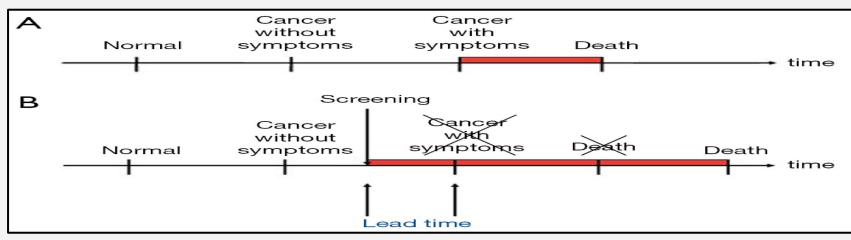


FIG.1
Model for early detection programmes



	SCREENING	CASE FINDING	DIAGNOSTIC TEST
DEFINITION	is testing for infection or disease in who are not seeking health care.	is testing for infection or disease in who are seeking health care.	Use of clinical and/or laboratory tests to confirm or refute the existence of disease or true abnormality in patients with signs and symptoms.
EXAMPLES	neonatal screening, premarital screening for syphilis	the use of VDRL to detect syphilis in pregnant women.	VDRL of patients with secondary syphilis; endocervical culture for N. gonorrhoeae

Uses of screening

- A **Case detection**
- B **Control of disease**
- C **Research purposes**
- D **Educational opportunity**

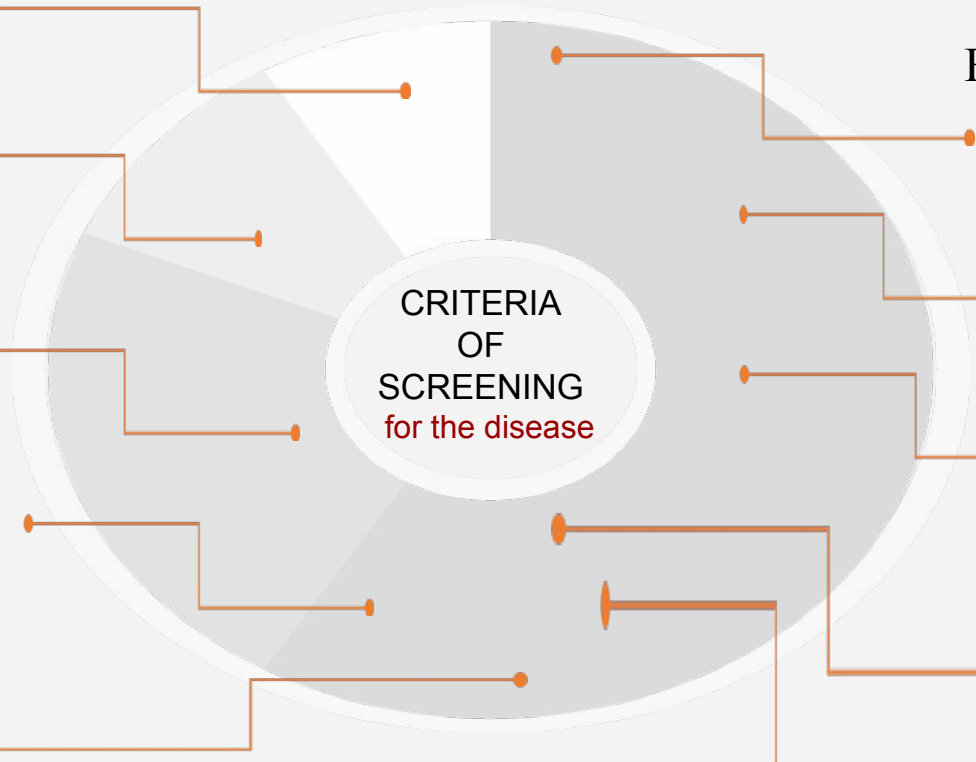
- **Mass screening：**

screening of a whole population or a sub-group, as for example, all adults.

It is offered to all

- **Selective screening：** Screening will be most productive if applied selectively to high-risk groups, the groups defined on the basis of epidemiological research (diabetes)

summary



Important health problem

Recognizable latent or early symptomatic stage

The natural history of the condition should be understood

Good evidence that early detection and treatment reduces morbidity and mortality

Has an effective treatment

Facilities should be available for confirmation of the diagnosis

Expected benefits

There should be an agreed-o policy concerning whom to treat as patients

There is a test that can detect the disease

Acceptability,
Repeatability and validity

COMPONENTS OF VALIDITY:

1	2	3	4	5	6
Sensitivity	Specificity	predictive value of a positive test	predictive value of a negative test	Percentage of false-negative	Percentage of false-positive
= a/ (a+c) x 100	=d/ (b+d) x100	=a/(a+b)x100	=d/(c+d)x100	=c/(a+c)x100	=b/(b+d)x100

01

Sensitivity *true-positive*:

((90% sensitivity means 90% is a “true-positive” and the remaining 10% is “false-positive”)).

02

Specificity *true-negatives*:

((90% specificity means 90% is”true-negative” result, 10% is wrongly classified as “diseased” when they are not)).

03

Predictive accuracy:

1.The diagnostic power of a test.
2.Depends upon sensitivity, specify and prevalence**.**
3.The more prevalent, the more accurate will be the predictive value of a positive test.
4.The probability that a patient with a positive test has, in fact, the disease in question.

Exercise 1:

•In a survey, 100 persons were positive to the **reference** test for disease A and 900 were negative. The **screening** test identified 200 persons to be positive. Of these 80 were positive to the reference test.

1. **Calculate sensitivity, specificity, predictive value positive and predictive value negative for screening test.**

2. **Calculate percentage of false-positive and false-negative.**

		Reference test		
		+ve	-ve	Total
Screening test	+ve	80	120	200
	-ve	20	780	800
	Total	100	900	1000

•**Sensitivity** = a/ (a+c) x 100

= 80/100 X 100 = 80%

•**Specificity** = d/ (b+d) x100

=780/900 X 100 = 86.7%

•**predictive value of a positive test**=a/(a+b)x100

= 80/200 X100 = 40%

•**predictive value of a negative test**=d/(c+d)x100

= 780/800 X 100 = 97.5%

•**Percentage of false-negative**=c/(a+c)x100

= 20/100 X 100 = 20%

•**Percentage of false-positive**=b/(b+d)x100

= 120/900 X 100 = 13.3%

Exercise 2:

•A new non invasive test has been developed to diagnose breast cancer. Of 1000 patients; 50% were diagnosed positive. Of those who tested positive, a Biopsy test yielded 475 with positive results. Of those who tested negative; 50 patients were actually Cancer breast positive when tested against the Biopsy.

1.Calculate sensitivity, specificity, predictive value positive and predictive value negative for screening test.

2.Calculate percentage of false-positive and false-negative.

		Biopsy		
		+ve	-ve	Total
New test	+ve	475	25	500
	-ve	50	450	500
	Total	525	475	1000

•**Sensitivity** = a/ (a+c) x 100

= 475/525 X 100 = 90.5%

•**Specificity** = d/ (b+d) x100

=450/475 X 100 = 94.7%

•**predictive value of a positive test**=a/(a+b)x100

= 475/500 X100 = 95%

•**predictive value of a negative test**=d/(c+d)x100

= 450/500 X 100 = 90%

•**Percentage of false-negative**=c/(a+c)x100

= 50/525 X 100 = 9.5%

•**Percentage of false-positive**=b/(b+d)x100

= 25/475 X 100 = 5.3 %

Quiz

300 known diabetics (positive on the glucose tolerance test) and 250 normal volunteers (negative on the glucose tolerance test) are given finger prick tests, the results are:

		Glucose tolerance test		
		+	-	Total
Finger Prick	+	282	20	302
	-	18	230	248
	Total	300	250	

1- Sensitivity of the test is:
a)20%
b)90%
c)94%
d)98%
Answer: C

2- Specificity of the test is
a)90%
b)92%
c)94%
d)98%
Answer: B

3- The capacity of a test or procedure to screen as "negative" those NOT having a specific disease is

a)sensitivity

b)specificity

c)positive predictive value

d)negative predictive value

Answer:B

Match the following sentences with the appropriate term:
(sensitivity, specificity, PP+ve, PP-ve)

1.The ability of a test to correctly identify those who have a disease.

2.The proportion of those without the disease correctly identified as negative by screening test.

3.Ability of the test to detect true negative cases.

4.Probability of disease in patients with positive test result.

5.Probability of not having the disease in a subject with negative test result.

MCQs IMPORTANT

1- what is the most effective method for prevention of sexual transmission of in the
Mediterranean Region?
a) Mutual fidelity and condom use
b) Adherence to religious teachings and health education
c) screening measures in blood banks
d) Genetic and premarital counselling and services

ANSWER: C

2- Which of the following represents an error of a screening test?
a) Sensitivity
b) Specificity
c) False results
d) Predictive value

ANSWER: C

3- Which of the follow indicator is preferable in a screening test?
a) Sensitivity
b) Specificity
c) Predictive value
d) Reliability

ANSWER: D

4- PSA screen test for prostate cancer is tested against prostate biopsy, The PSA test was able to detect 22 cases among 45 subjects who were confirmed positive by the Biopsy among 64 who were identified as free of prostate cancer by the biopsy, the PSA test reported 4 cases affected with prostate cancer
What is sensitivity of the PSA test?
a) 49%
b) 51%
c) 85%
d) 72%

ANSWER: A

5- The following is a cross tabulation of 100 000 women screened for breast cancer using breast mammogram followed by pathological examination of biopsy specimen for Confirmation. What is the sensitivity of the screening test?
a) 2500/98300
b) 200/96000
c) 1500/4000
d) 1500/1700

Breast Mamogram	Biopsy results		Total
	Present	Absent	
Positive	1500	200	1700
Negative	2500	95800	98300
Total	4000	96000	100000

ANSWER: C

6- A New Screening test for corona Virus Infection (MERSCoV) is tested against PCR analysis.The new screening test was able to Detect 22 case among 45 subjects who were confirmed positive by PCR analysis Among 64 who were identified as free of MERSCoV By PCR, the new Test reported 4 cases affected with MERSCoV. Which one is the sensitivity of the new test?
A. 49% B. 51%
C. 85% D. 72%

Answer: A

7-Which one of the following is the main preventive measures for hepatitis ?
A. Vaccination
B. Screening of blood donors
C. Hand washing
D. Inspection of food handlers

Answer: B

8-Which one of the following is preventive measure for hepatitis A?

A. Avoid Tattooing
B. Screening for blood donors
C. Universal Infant Vaccination
D. Prevention of sexual transmission

Answer: C

9- Which one of the following is most applicable for screening of health problem?
A. It from subjects' request.
B. It is basis for treatment
C. Because there is Asymptomatic
D. It is Conclusive

Answer: C

10-New screening test was applied and it showed the same result when repeated to the same
subjects but it correlates poorly with the confirmatory test. Which one of the following is applied to the test?
A. Accurate
B. Reliable
C. Sensitive
D. Specific

Answer: B

11- A new screening test can detect 22 out of 45 patients with positive PCR test. And shows negative result for 2 patients with negative PCR, What is the sensitivity of the new screening tool ?
A. 33%
B. 84%
C. 48%
D. 50%

Answer: C

12- Which one of the following diseases is suitable for screening programs?
A. A disease with high fatality rate
B. A disease with high prevalence of asymptomatic cases
C. Diseases with no effective treatment
D. A disease with fast development of clinically apparent signs and symptoms

Answer: B

Ans : 1.C 2.C 3.D 4.A 5.C 6.A 7.B 8.C 9.C 10.B 11.C 12.B