# Chapter 9 Screening – answers

Self assessment

Question 1 of 8

Answer C. The role of screening is to identify people at increased risk of the disease.

Identifying people with the disease is a feature of diagnostic tests. Although screening might pick up some people with the risk factors, this is not its main purpose. Screening is undertaken on apparently asymptomatic people.

Question 2 of 8 Answer D Question 3 of 8 Answer A

Breast cancer is the most common cancer in women worldwide; and lung cancer is the most common cancer in men. (<https://www.wcrf.org/cancer-trends/worldwide-cancer-data/>)

Question 4 of 8

Answer C – Down’s syndrome as this is screened for antenatally.

(See: <https://www.gov.uk/guidance/nhs-population-screening-education-and-training#screening-timeline> for up to date Screening programmes in the UK)

For the

Question 5 of 8

Answer A – a sensitive test has few false negatives. It identifies a high proportion of those with disease as diseased.

A specific test correctly identifies a high proportion of those without the disease. The higher the positive likelihood ratio of a test, the better its performance. Screening is particularly useful for diseases which have a short course and a known cure. Diagnostic tests have better performance compared to screening tests

Question 6 of 8 Answer E

The data from the question can be used to construct a 2x2 table thus:

Sensitivity = 30/50 x 100 = 60%; specificity = 90/100 x 100 = 90%.

The sensitivity and specificity are independent of the disease prevalence in the population being tested.

|  |  |  |  |
| --- | --- | --- | --- |
|  | | *True diagnosis* | |
| *Seizures* | *No seizures* |
| *EEG test result* | Positive | 30 | 10 |
| Negative | 20 | 90 |
| Total | 50 | 100 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| The low sensitivity of EEG implies an unacceptably high false negative rate for a serious condition such as seizures.  The positive predictive value is a test's ability to identify those persons who truly have the disease from among all those persons whose screening tests are positive. In this example the positive predictive value (75%) is the number of persons with disease who screen positive (30) divided by the total number of persons who screen positive (40).  At a prevalence of 5%, out of 1000 people screened, 50 will have the disease. A new 2x2 table can be drawn. We know that 50 people have the disease so *a* (true positives) + *c* (false negatives) = 50. With a sensitivity of 60%, this means that *a* = 30 and *c* = 20. With a specificity of 90%, *b* (false positives) + *d* (true negatives) must equal 950, thus *d* = 855 and b  = 95. | | | | | | |
|  |  | | *True diagnosis* | | |  |
| *Seizures* | *No seizures* | *Total* |  |
|  | *EEG test results* | Positive | 30 | 95 | 125 |  |
| Negative | 20 | 855 | 875 |  |
| Total | 50 | 950 | 1000 |  |

Question 7 of 8

Answer D – positive and negative likelihood ratios.

Likelihood ratios are independent of prevalence. Positive and negative predictive values are influenced by prevalence.

Question 8 of 8

Answer B – period between early detection of disease and the time of its usual clinical presentation. Lead time bias occurs when detection by screening seems to increase disease-free survival but this is only because disease has been detected earlier and not because screening is delaying death or disease. The period between early detection of

disease and the time of its usual clinical presentation needs to be subtracted from the overall survival time to avoid the lead time bias

Short answer questions

Question 1 of 6

The National Screening Committee has defined screening as ‘a public health service in which members of a defined population, who do not necessarily perceive they are at risk of, or are already affected by, a disease or its complications, are asked a question or offered a test, to identify those individuals who are more likely to be helped than harmed by further tests or treatment to reduce the risk of a disease or its complications’.

All screening programmes require quality assurance systems. The core of the system are standards that set agreed parameters of process measures such as uptake, coverage, detection rate and time to referral for diagnostic assessment. Quality assurance also includes protocols and guidelines that explain how to carry out all aspects of the screening pathway.

Question 2 of 6

Screening can be termed mass screening when it is applied to the whole population, targeted screening when it is aimed at specific parts of the population, or opportunistic screening when it is applied to those who seek medical attention for another, perhaps unrelated, condition.

Question 3 of 6

According to the UK National Screening Committee, the following criteria should be met before screening for a condition:

# The condition

1. The condition should be an important health problem.
2. The epidemiology and natural history of the condition, including development from latent to declared disease, should be adequately understood and there should be a detectable risk factor, disease marker, latent period or early symptomatic stage.
3. All the cost-effective primary prevention interventions should have been implemented as far as practicable.
4. If the carriers of a mutation are identified as a result of screening, the natural history of people with this status should be understood, including the psychological implications.

# The test

1. There should be a simple, safe, precise and validated screening test.
2. The distribution of test values in the target population should be known and a suitable cut- off level defined and agreed.
3. The test should be acceptable to the population.
4. There should be an agreed policy on the further diagnostic investigation of individuals with a positive test result and on the choices available to those individuals.
5. If the test is for mutations, the criteria used to select the subset of mutations to be covered by screening, if all possible mutations are not being tested, should be clearly set out.

# The treatment

1. There should be an effective treatment or intervention for patients identified through early detection, with evidence of early treatment leading to better outcomes than late treatment.
2. There should be agreed evidence based policies covering which individuals should be offered treatment and the appropriate treatment to be offered.
3. Clinical management of the condition and patient outcomes should be optimised by all relevant providers of health care prior to participation in a screening programme.

# The screening programme

1. There should be evidence from high-quality randomised controlled trials that the screening programme is effective in reducing mortality or morbidity. Where screening is aimed solely at providing information to allow the person being screened to make an ‘informed choice’ (e.g. Down’s syndrome, cystic fibrosis carrier screening), there must be evidence from high-quality trials that the test accurately measures risk. The information that is provided about the test and its outcome must be of value and readily understood by the individual being screened.
2. There should be evidence that the complete screening programme (test, diagnostic procedures, treatment/intervention) is clinically, socially and ethically acceptable to health professionals and the public.
3. The benefit from the screening programme should outweigh the physical and psychological harm (caused by the test, diagnostic procedures and treatment).
4. The opportunity cost of the screening programme (including testing, diagnosis and treatment, administration, training and quality assurance) should be economically balanced in relation to expenditure on medical care as a whole (i.e. value for money).
5. There should be a plan for managing and monitoring the screening programme and an agreed set of quality assurance standards.
6. Adequate staffing and facilities for testing, diagnosis, treatment and programme management should be available prior to the commencement of the screening programme.
7. All other options for managing the condition should have been considered (e.g. improving treatment, providing other services) to ensure that no more cost-effective intervention could be introduced or current interventions increased within the resources available.
8. Evidence-based information, explaining the consequences of testing, investigation and treatment, should be made available to potential participants to assist them in making an informed choice.
9. Public pressure for widening the eligibility criteria for reducing the screening interval, and for increasing the sensitivity of the testing process, should be anticipated. Decisions about these parameters should be scientifically justifiable to the public.
10. If screening is for a mutation, the programme should be acceptable to people identified as carriers and to other family members.

Question 4 of 6 Answers A, C and E Explanation:

The sensitivity of a screening test is the test’s ability to identify correctly those individuals who truly have diabetes. For this test it is 34/150 = 22.7%.

The specificity is the test’s ability to identify correctly those individuals who do not have the disease. For this test it is 9,830/9,850 = 99.8%.

Lowering the screening cut-off level increases the sensitivity and number of false positives, and decreases the specificity and number of false negatives.

The first time that screening is carried out is called the ‘prevalence screen’, since cases of diabetes will have been present for varying lengths of time. Most cases will have had their onset between the first and second screening. Therefore second and subsequent screenings are called 'incidence screens.'

Question 5 of 6

Population 1

a) Prevalence 10% (100/1000)

* 1. Sensitivity 90% (90/100)
  2. Specificity 90% (810/900)

d) PPV 50 (90/180)

e) NPV 98.8 (810/820)

f) Likelihood ratio 9 (0.9/1-0.9)

Population 2

a) Prevalence 1.0% (10/1000)

1. Sensitivity 90% (9/100)
2. Specificity 90% (891/990)

d) PPV 8.3 (9/108)

e) NPV 99.9 (891/892)

f) Likelihood ratio 9 (0.9/1-0.9)

You can also use the online calculator at <http://www.hutchon.net/Diagnostic-test.htm>to verify your answers.

Question 6 of 6

The major biases include selection bias, lead time bias and length time bias.