Introduction to Cancer Screening

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Definitions

Cancer screening is defined as the systemic application of a test to individuals who have not sought medical attention because of symptoms. In other words, cancer screening refers to looking for cancer in people who have no symptoms of the disease.

Cancer screening can be opportunistic (offered to patients consulting their doctor for another reason) or population-based (covering a pre-defined age range, with call and recall systems).

As the mortality of cancer always increases with its degree of spread, the aim of screening is to detect cancer in its early, asymptomatic stage.

Advantages and Disadvantages of Cancer Screening

The advantages and disadvantages of screening must be carefully considered and may vary between cancers and tests.

Advantages	Disadvantages
Better outcome	Longer morbidity if prognosis is not altered
Less radical treatment needed	Over-treatment of borderline abnormalities
Reassurance for those with true negative results	False reassurance for those with false-negative results
Psychological benefit to population	Unnecessary investigations of false-positive results
Savings may occur because treatment for early stage screened-detected cancer may be less complicated	Resource costs of screening system

Problems encountered in assessing the benefit of a screening test include the following:

Lead-time bias	• Lead time bias occurs when there is apparent increase in duration of well-being or survival in screened-diagnosed cancer only due to detection of cancer at an earlier stage instead of a true prolongation of well-being or survival.

Length bias

- Length bias occurs when a test detects a disproportionate number of slow-growing less aggressive tumours and to miss more aggressive tumours that usually present in the population briefly because of rapid progression.
- This occurs because natural history of cancer tend to be heterogenous. Those with a long preclinical phase are more readily detectable by screening than more rapidly progressing cases with a short preclinical phase.
- In other words, length bias results in diagnosis of less aggressive tumours while missing those rapidly growing cancers with poor prognosis.
- Length bias can lead to overestimation of the effectiveness of a screening test.

Selection bias

- Selection bias occurs even in the best-organized healthcare systems because compliance of screening test varies between different communities.
- In general, worried but healthy individuals (who would present with cancer symptoms early) tend to comply with screening programmes well whereas less well-educated and socially deprived individuals do not.

Indicators of accuracy of a screening test are summarized in the following table:

	Condition present	Condition absent	Total
Test positive	a (True positive)	b (False positive)	a + b
Test negative	c (False negative)	d (True negative)	c + d
Total	a + c	b + d	a + b + c + d

Sensitivity = proportion of persons with the condition correctly tested as positive by the screening test = a / a +c

Specificity = proportion of persons without the condition correctly identified as negative by the test = d / b+d

Positive predictive value = proportion of persons with positive test who have the condition = a / a+b

Negative predictive value = proportion of perons with negative test who do not have the condition = d / c+d

A sensitive test can correctly identify a large proportion of persons with the condition. On the other hand, an insensitive test will miss a lot of real cases (false negative result) and the person may be falsely reassured, which in turn can lead to delay in diagnosis and treatment.

A test with high specificity can reliably rule out the condition when the test is negative. On the contrary, a non-specific test will wrongly label a person as having the condition (false positive result) and thus lead to unnecessary anxiety and follow-up testing. Investigation of patients without cancer (false-positive patients) is a major factor in the cost of screening.

Ideally, a 100% sensitive test will detect all cancers in the screened population whereas a 100% specific test will give no false-positive results.

Factors to consider before developing a screening programme include the following:

- Rational decision-making about cancer screening requires a detailed analysis of factors that may vary between different populations.
- The cancer should be common and its natural history understood.
- The screening test should be effective (high sensitivity and specificity) and acceptable to local population.
- The health-care system must be able to cope with patients who produce positive results and thus require further investigation. This may be a particular problem at the start of a population-based study.

Assessing the Benefits of Cancer Screening Programmes:

The ultimate measure of success in a cancer screening programme is a demonstrable reduction in mortality in the screened population. This needs large number of individuals and at least 10 years' assessment for most of the common cancers. Besides, it should be remembered that the expertise available to a study population may be considerably greater than that achievable under subsequent field conditions.

Summary

Cancer screening remains a topic of much debate. A screening test may be cheap, but its territory-wide application costly. The success of a screening programme is ultimately measured by a reduction in mortality of the screened population. In areas where the overall benefits of screening are uncertain (e.g. PSA for prostate cancer screening), patient's preference has become more relevant. Future developments in cancer screening will lead to further ethical, educational, commercial and medical challenges.