



A PRACTICAL GUIDE TO SCREENING PROGRAMS

Screening is the process of detecting markers of disease or abnormality in people who appear to be well. It is applied to the community at large, or to groups of people who are at greater risk than others of having the disease or abnormality. Screening programs have two key components: (i) a screening test, administered to the people in the target group, and (ii) a protocol to ensure those with an abnormal test result receive appropriate follow-up, which usually consists of further investigations and preventive procedures.

Decisions about the use of screening as a preventive measure are complex and might take account of a number of issues outlined below.

Is the condition suitable for screening?

In general, we screen only for conditions which cause a significant burden of morbidity and/or mortality in the community.

Is effective prevention or treatment available for people identified through the screening program to have the condition?

The effectiveness of the available measures may be controversial (e.g. treatments for some malignancies), or established (e.g. phenylketonuria). The treatment or prevention may benefit the affected individual (e.g. women with Down Syndrome pregnancies), or the public health (e.g. HIV), or both (e.g. syphilis).

Is there a good screening test?

This is a crucial question because almost all tests are imperfect. Some people who show a positive test result will turn out not to be affected (false positives), while some people who show a negative test result will turn out in fact to be affected (false negatives). In the screening context, the people who turn out to have false-positive results may have had to undergo possibly unpleasant, expensive, time-consuming and potentially hazardous diagnostic tests, and suffer anxiety while awaiting the definitive findings; people with false-negative results will be falsely reassured and will miss the possible benefits of early diagnosis and treatment.

Because of the potentially distressing effects of false positives and false negatives, and because screening programs usually consume a lot of health resources which are always scarce, a careful evaluation is mandatory before such programs are mounted on a large scale.

As part of this evaluation you need to know three basic things about a screening test:

- How good is the test at correctly identifying people who really do have the condition of concern, i.e. people who are truly affected?

This is indicated by the **sensitivity** of the test. If the sensitivity is 100 per cent, you can be sure that every truly-affected person who receives the test will show a positive result, that is, everyone would be correctly identified as being affected. Note that this does not mean everyone who tests positive is affected. Further, if the sensitivity is 90 per cent, a truly-affected person would have a 90 per cent chance of getting a positive test result, and a 10 per cent chance of getting a negative result (i.e. false negative).

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Correspondence

Please address all correspondence and potential contributions to:

The Editor,
NSW Public Health Bulletin,
Public Health Division,
NSW Health Department
Locked Bag No 961,
North Sydney NSW 2059
Telephone: (02) 391 9218
Facsimile: (02) 391 9232

Practical guide to screening programs

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Sensitivity is a characteristic of the test, and is a measure of the test's validity, i.e. a measure of the extent to which the test detects what it purports to detect. It does not matter how common or uncommon the target disorder is in the group of people to whom the test is applied — the sensitivity should not vary.

■ How good is the test at correctly identifying truly-unaffected people?

This is indicated by the **specificity** of the test. If the specificity is 100 per cent, you can be sure that every truly-unaffected person who receives the test will show a negative result, that is, everyone would be correctly identified as being *unaffected*. Further, if the specificity is 90 per cent, a truly-unaffected person would have a 90 per cent chance of getting a negative test result, and a 10 per cent chance of getting a positive result (i.e. false positive).

Like sensitivity, specificity is a characteristic of the test, is a measure of the test's validity, and should not vary with the occurrence of the disorder which the test purports to detect.

■ From a clinical perspective, how do you interpret a positive (or negative) test result?

As indicated before, screening tests do not have sensitivities and specificities of 100 per cent. Therefore if you are advising a person who has a positive or negative test result, you cannot be sure that he or she has or does not have the disorder. We will concentrate on someone who has a positive test result. While you cannot be sure that he or she does have the disorder, you want to be able to calculate the person's chance of being truly affected. The chance of someone being truly affected, if he or she has a positive test result, is called the **positive predictive value** of the test.

Unlike the sensitivity and specificity, the positive predictive value is not simply a characteristic of the test. It is determined both by the validity of the test *and by the occurrence of the disorder in the group of people to whom the test is applied*. This is termed "prevalence-dependent". If you test someone from a group of people in whom the disorder is common, the positive predictive value will be *higher* than it would be if the same test were applied to a person from a group in which the disorder is uncommon.

If you are advising a person who has a positive test result, and the positive predictive value of the test is 75 per cent in the group of people to whom the subject belongs, then you can tell the person he or she has a 75 per cent chance of truly

having the disorder tested for. He or she also has a 25 per cent chance of actually being unaffected, despite the test result. At this point the person would be referred for further testing to establish whether he or she actually had the condition.

Is a screening program effective in reducing the occurrence or health consequences of the condition?

Even if the answers to the preceding questions are affirmative, there are two main reasons a screening program may not lead to a reduction in the occurrence of the condition or its consequences. First, the program may not reach a large proportion of the people in the target group. Second, people with a positive result (indicating abnormality) may be unwilling to comply with follow-up. For example, women with positive results from a maternal serum screening test for Down Syndrome and neural tube defects may be unwilling to undergo further diagnosis (i.e. amniocentesis) and subsequent termination of pregnancy.

The only way to find out unequivocally whether the program does reduce the occurrence or consequences of the condition is to conduct a randomised controlled trial. In such a trial, subjects are randomly allocated to receive the screening program or not; typically the latter group receives usual treatment in the community. The incidence of the outcome is then assessed in the two groups.

To evaluate a program of universal maternal serum screening for Down Syndrome markers, one group might receive the screening program and subsequent follow-up protocol, while the other group receives the usual antenatal care (which might include serum screening and other procedures for some individuals). The incidence of Down Syndrome babies would then be assessed in the two groups, and compared. This trial would take into account not only the validity and reliability of the serum screening test(s) used, and whether or not the test(s) reach the majority of people in the target group, but also the willingness of screened women to undergo the follow-up procedures. The trial would also take into account whether or not individuals are receiving the definitive follow-up even in the absence of screening. Thus, unscreened women over a certain age may seek or be offered amniocentesis anyway.

Can the health system cope with the screening program?

The final issue that might be considered in determining the worth of a screening program is whether the health system can cope with the screening program. This issue refers not only to the administration of screening tests, but also to the follow-up of cases screened positive, and the costs of both the testing and the follow-up. The follow-up includes diagnostic procedures, counselling of people who were positive on screening but were subsequently found not to have the condition, and treatment of people actually diagnosed as having the condition. In practice, follow-up may be more of a problem and more expensive than the testing.

*Michael Frommer, Deputy Director,
David Lyle, Manager, Chronic Disease and Injury
Prevention Section,
Epidemiology and Health Services Evaluation Branch
NSW Health Department.*