are successful doctors may then be prepared to invest more time in them. Further consideration should be given to ways that general practitioners can deliver and follow up lifestyle interventions, including implementing the process of change model and undertaking motivational interviewing. The role of practice nurses, health visitors, and specialist clinics may be important in enhancing a general practitioner's initial intervention.

I am grateful to Dr Peter Alderson for commenting on a draft of this article.


Selected additional references
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::Related Reports::

A complete list of references can be obtained from the author.

Statistics Notes

Diagnostic tests 1: sensitivity and specificity

Douglas G Altman, JM Martin Blund

The simplest diagnostic test is one where the results of an investigation, such as an x-ray examination of biopsy, are used to classify patients into two groups, according to the presence or absence of a sympotm or sign. For example, the table shows the relation between the results of a test, a liver scan, and the correct diagnosis based on either necropsy, biopsy, or surgical intervention. How good is the liver scan as a diagnosis of abnormal pathology?

Relation between results of liver scan and correct diagnosis

<table>
<thead>
<tr>
<th>Pathology</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abnormal</td>
<td>Normal</td>
</tr>
<tr>
<td>Abnormal (x)</td>
<td>201</td>
<td>32</td>
</tr>
<tr>
<td>Normal (x)</td>
<td>27</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td>228</td>
<td>66</td>
</tr>
</tbody>
</table>

One approach is to calculate the proportions of patients with normal and abnormal liver scans who are correctly "diagnosed" by the scan. The terms positive and negative are used to refer to the presence or absence of the condition of interest, here abnormal pathology. Thus there are 258 true positives and 36 true negatives. The proportions of these two groups that were correctly diagnosed by the scan were 231/258=0.90 and 54/66=0.83 respectively. These two proportions have considerably similar confidence intervals.

Sensitivity is the proportion of true positives that are correctly identified by the test.

Specificity is the proportion of true negatives that are correctly identified by the test.

We can thus say on the basis of the sample studies, we would expect 90% of patients with abnormal pathology to have abnormal (positive) liver scans, while 83% of those with normal pathology would have negative (normal) liver scans.

The sensitivity and specificity are proportions, and confidence intervals can be calculated for them using standard methods for proportions.

Sensitivity and specificity are one approach to quantifying the diagnostic ability of the test. In clinical practice, however, the test result is all that is known, so we want to know how good the test is as predicting abnormality. In other words, what proportion of patients with abnormal test results are truly abnormal?

This question is addressed in a subsequent note.