Discriminative Information in the Diagnosis of Dysphagia

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This article is concerned with the different types of information used to make a diagnosis, and how it can be collected. The first grouping is (1) indicative, (2) descriptive, (3) discriminative, (4) corroborative or confirmative, and (5) duplicative or repetitive.

Indicative information tells us that something is wrong. The information may be offered, as when the patient complains of a pain or of losing weight, or we may find it when we feel the spleen, or we may search for it by routine screening tests such as the ESR or the blood urea. None of these items defines a disease or is helpful by itself in making a diagnosis; it merely indicates disorder. Complaining that food or drink will not go down or that food hurts when it is swallowed is indicative.

Descriptive information describes or amplifies indicative information but does not separate one disease from another. The patient may complain that he has a terrible squeezing pain in his chest that spreads to his shoulders and throat. This describes some of the features of the pain, but not those that separate one cause from another and by which we can make a diagnosis. The detailed description of a disease that we find in standard textbooks is descriptive information. For example, the oesophagus may become enormous in achalasia, regurgitation is common and may occur during sleep, causing pulmonary fibrosis and arthropathy, haematemesis occurs occasionally, and sometimes squamous carcinoma. None of these features is necessary for, nor points to, the diagnosis of achalasia. Something that happens in a variety of conditions, such as weight loss associated with dysphagia, is descriptive and useless in deciding on the cause of the dysphagia. Cancer of the oesophagus or fundus is usually extensive and disseminated long before weight is lost, and all forms of benign obstruction can cause weight loss.

Discriminative information distinguishes one condition from another. The statement that pain develops in the chest when the patient bends over or turns on to his right side in bed makes the diagnosis of reflux on to a hypersensitive oesophageal mucosa. A pain in the chest that occurs within 10 seconds of

swallowing a solid bolus makes the diagnosis of bolus obstruction upon a benign or malignant stricture. If the sensation of pain, or that food has stuck, comes on after the meal and not while eating, the diagnosis is a pseudodysphagia from a referred sensation. These pieces of information are discriminative because they characterise a situation. One item of discriminative information is adequate to distinguish between two conditions.

Corroborative or confirmative information is additional discriminative information that is obtained deliberatively, and is necessary to exclude error in the collecting or interpretation of the original discriminative information. When the patient gives the characteristic history of cancer of the oesophagus a barium swallow is a legitimate examination and if this shows the characteristic features of cancer, all additional information will be redundant unless, for example, management depends on the cell type. Only one item of corroborative information should be necessary if it is properly chosen.

Duplicative or repetitive information is that which does not or cannot alter a decision already made. Often it is descriptive, sometimes it is discriminative.

I would like to elaborate this point. Another classification of information is into—

1. what is necessary
   and
2. what is unnecessary or merely interesting.

If we look out of an aircraft window and see the Post Office Tower we know we are over London, and no other information would be necessary.

We could describe the right-hand drive cars and the form of their number plate, but this descriptive information would be unnecessary and unhelpful in deciding that we were over London. There are many disease conditions that have discriminative features like the Post Office Tower, and for economy's sake we ought to be looking for those features rather than at the cars when we are making diagnostic and management decisions.

The basis of this Post Office Tower analogy is—

1. there must be a unique or discriminating characteristic, which clearly separates one condition from another with a high probability;
2. we must know that the characteristic exists;
3. we must be able to recognise the characteristic when we see it or the information when it is presented; or we must know how to get the information out of the patient. If discriminative information is difficult to get, or the error in recognising it is high, the information, even if discriminating, is not good.

The answer to this problem of error is not necessarily to do more tests, because two bad tests may be no better and may increase the state of confusion or scale of error. In decision Table 1 we have one test or question A, which gives a result or answer of either 'yes' (Y), 'no' (N), or 'don't know' (DK); ('don't know' includes uncertainty due to error and lack of experience in recognition).

TABLE 1

	Result		
Test A	Y	N	DK
Action	Treat	Not treat	?

Before doing the test or recording the result, we should decide what action is appropriate to each answer. In this instance there are 3 action decisions. If we now do another test, B, the possible combinations of results are in Table 2 and we now have 3^2 action decisions to make; and if we do 3 tests there will be 3^3. How many of us think beforehand what we will do with each set of answers? How often do we carry out tests that rarely produce an answer upon which we can act directly?

TABLE 2

	Result								
Test A	Y	Y	Y	N	N	N	DK	DK	DK
Test B	Y	N	DK	Y	N	DK	Y	N	DK
Action	T	T	T	NT	NT	NT	?	?	?

If we look again at Table 2 we find that, in spite of the number of action decisions we have to make, there are, in general, only 3 actions: to treat or not to treat, or to think again. If we set up tables in this way we shall often find that what action we take is determined by the results of one test, in this instance by those of test A. The other test or tests are at best corroborative and probably duplicative or repetitive and, therefore, unnecessary.

Physicians seem to require duplicative or redundant information for several reasons. One is fear of missing something usually undefined or ill thought out. I am not now talking of deliberate screening procedures which are a planned search for indicative information. Another reason is that scientists are beginning to destroy our nerve by developing more and supposedly better tests that

we do not fully understand, so we do the test in case someone wants to know why we have not done it. A third reason is the 'rule out' philosophy in which we think of all the possible causes of abdominal pain and do a test to rule out each one and see what turns up in the end. This is both intellectually and economically highly wasteful but seems to be growing in popularity as a form of gamesmanship. Generally it is because we are not thinking clearly about the information we already have and what we need in addition.

A fourth reason is the collection of information because 'it would be interesting if', or 'to document the case fully', or 'we ought to see if antibodies are present to remind the students or the housemen or the other chaps at grand rounds that they are sometimes present'. Here we are collecting information for our benefit, not for that of the patient. I think this characterises the difference between what is necessary and what is merely interesting. Many of us get carried away with what is merely interesting and forget what is necessary.

I want now to discuss ways of collecting discriminative information. When I started a study of discriminative information in the symptom patterns of dysphagias I wrote on a card whatever I thought might be useful information, including the standard textbook descriptions of the dysphagia, putting it in the form of a question with a 'yes-no' answer that would determine whether the item of information was present. After accumulating about 500 cards I began to wonder what to do with them. A rational method would have been to ask each of 500 patients with dysphagia each of the 500 questions and compare the answers with the final diagnosis. This would have been a formidable clinical exercise and the computing equally so. Mr Teather (1975) has illustrated how the choice of a few questions can be made mathematically in this way but from the clinician's viewpoint this choice is empirical, because there is no physiological or pathological logic behind it and no explanation of why the questions are the best. Another disadvantage of this approach is that it compares items of information that have traditionally been collected and does not lead us towards seeking different and better information. We do everything we have thought of, and then see which works best.

Because of the impracticability of testing all the questions, I took each in turn and asked 'What diseases are included by this question and how do the answers separate the diseases?' I did what I have already described in Table 1. This made me realise two things: firstly, that I must define the disease classes that I was hoping to separate; and, secondly, that most of the items of information I was proposing to seek were unhelpful in discriminating one condition from the other. The concept of indicative, descriptive and discriminative was born. Because so little information was discriminative I sought new

information by considering the differences between, rather than the descriptions of, the different diseases. For example, achalasia is a tube closed by a sphincter which does not open reflexly with a swallow so it is closed to both liquids and solids, whereas a stricture is open to liquids but closed to solids. A question about whether there is dysphagia for liquids as well as solids gives useful information. Achalasia is associated with severe spontaneous chest pain; other dysphagias have pains that are continuous or associated with other factors. A question about spontaneous chest pain is useful. The oesophagus may be closed to liquids as well as solids by cancer, but in cancer the progression to dysphagia for liquids is very much faster than in achalasia and dysphagia for liquids is always preceded by a period when solids obstruct dramatically but fluids flow easily. Appropriate questions can discriminate the two conditions. A ring stricture commonly causes mild symptoms for years before the patient sees a doctor, is not associated with oesophagitis ad rarely with much heartburn or reflux, so that if the patient has not given up hot drinks and gin because they burn, the obstruction is a ring rather than a peptic stricture. These are some examples of the way of thinking and creating questions, by looking for the differences and discriminating features and discarding anything that is not one. It is irrelevant to ask if there is much belching or nausea, or distension, or if pain occurs at night, or what food sticks. The site at which the patient indicates the sense of block is highly misleading because more often than not it is wrong.

I should at this point digress to emphasise that I am not suggesting that radiology is irrelevant. The purpose of the exercise was to see what accuracy of diagnosis was possible on symptoms alone, and to develop a technique of creating or sifting discriminative information by thinking about it rather than by using a computer. The same technique is being applied to the radiological examination; for example, the absence of a peristaltic wave means that either muscle or nerve is damaged or there is chronic severe obstruction to liquids, and the cause is either systemic sclerosis, achalasia or cancer. The free flow of barium in both directions through the weakened sphincter of systemic sclerosis discriminates it from the other causes, which can equally easily be discriminated. In a study of 323 dysphagias, cancer was correctly diagnosed by symptoms in 90 per cent of those in whom it was present. Radiology was a corroborative procedure and, together with the symptom pattern, resulted in an overall diagnostic accuracy of better than 95 per cent. Where these two were incorrect, endoscopy and biopsy also failed to establish a diagnosis and in this context could be considered duplicative or descriptive.

Discriminative questions for dysphagia were arranged into a mixed branching and linear tree sequence to economise further in the search for

information. Over a period of a year some minor changes in detail were made and 39 questions were decided upon, leading to 21 diagnoses. These questions were not changed until 323 patients complaining of a dysphagia had been interrogated. The results are shown in Tables 3 and 4. For simplicity the 18 infrequently occurring diagnoses have been grouped together.

TABLE 3. Clinician's Diagnosis by Symptom Pattern Compared with Final Diagnosis

Clinician's diagnosis	Final diagnosis				Outside scope
	Achalasia	Cancer	Benign	Other	
Achalasia	53	0	1	2	4
Cancer	4	75	12	8	0
Benign obstruction	3	3	77	9	3
Other	0	1	0	38 right 9 wrong	2
Uncertain	7	4	2	5	1

TABLE 4

53 of 67 cases of achalasia were correctly diagnosed	79%
75 of 83 cases of cancer were correctly diagnosed	90%
77 of 92 cases of benign stricture were correctly diagnosed	85%
38 of 62 cases of other diagnoses were correctly diagnosed	61%
10 of 323 cases were outside the scope of the scheme	3%
In 19 of 323 cases the clinician could not define a pattern	6%

Mr Pankhurst undertook the analysis of the performance of the questions and his methods and conclusions are reported elsewhere (Edwards and Pankhurst, 1974).

After some experience it seemed likely that some of the 39 questions about symptoms were also duplicative or at least not good discriminators. Mr Pankhurst found that 13 of the original 39, arranged in a different order, would distinguish the four main groups of diagnosis with an overall accuracy of 79 per cent, closely similar to the performance of the original tree and, by a computational process of matching, he achieved an overall accuracy of diagnosis of 83 per cent (Edwards and Pankhurst, 1974).

An interesting and, I think, important point is the fallibility of the clinician in deciding which questions are good ones at discriminating, and the need for a mathematical check on performance. Table 5 illustrates the difference between what the physician thought and what the mathematician found.

The details of these numbers are not important, but they serve to show that it is possible drastically to reduce the amount of information necessary to

TABLE 5

		Physician thought	
		good	bad
		26	13
Mathematician found	good	19	7
	bad	7	6

arrive at a decision and that there are four mutually helpful ways of developing discriminative information—

1. thinking about the biochemical, pathological or mechanical mechanisms that differ between the diseases we are trying to separate, and looking for manifestations of these differences;
2. considering, on the basis of experience, whether the information is likely to be indicative, descriptive, discriminative or duplicative;
3. considering whether the information is necessary or merely interesting, that is, for our benefit rather than that of the patient; and
4. finally testing our hypothesis and attempting to reduce by a mathematical process the discriminative information required.

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