

Problem Solving and Decision-Making In Primary Medical Practice

I. R. McWHINNEY, MD

This article is condensed from Dr. McWhinney's Albert Wander Lecture to the Royal Society of Medicine in London, England (June, 1972).

A version of the Lecture is currently in press with the *Proceedings of the Royal Society of Medicine*, and we are indebted to the editors of that publication for permission to use Dr. McWhinney's material in CANADIAN FAMILY PHYSICIAN.

SOME YEARS AGO I heard a discussion between a general practitioner and a professor of medicine. The discussion was about the potential contribution of general practice to medical education. "What can you teach?" said the professor. "Well, for one thing, there is the diagnostic process in general practice", replied the general practitioner. To which the professor replied: "Is it different?" The answer of course is "Yes." But how is it different? And why is it different?

I have avoided using the word diagnosis in the title because medicine has yet to evolve a universally acceptable definition of diagnosis. It is well-known, also, that general practitioners solve many problems without making a diagnosis in the sense of making a statement about etiology, or of assigning the patient's illness to a place in the taxonomy of disease.

Problem-solving and decision-making are not, of course, separate processes. The solution of a problem usually results in a decision. In the course of solving a clinical problem, however, we also make many decisions about what questions to ask the patient and what procedures to carry out. The problem-solving process is itself, therefore, a sequence of decisions.

One of the basic processes in all thinking, whether it is in medicine, in science, or in everyday life, is categorization. For example, once a certain cluster of signs and symptoms has been categorized as measles, it is no

longer necessary to study and describe each case as if it were a new phenomenon. When we recognize the pattern, we can make inferences about the infective agent, we can predict the course of the illness, and we can study the relationship between measles and other categories, such as pneumonia and otitis media.

The act of categorization follows the presentation of a cue. Cues are of two kinds: certain and probabilistic. A certain cue enables us to place the object into its correct category immediately and with certainty. A probabilistic cue enables us only to form a hypothesis about the category to which it probably belongs. To validate our hypothesis it is therefore necessary to search for further defining attributes. The method used to obtain the necessary data is called the search strategy.

The Clinical Situation

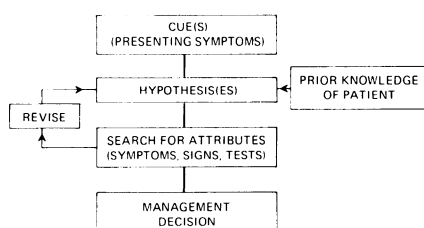
What happens when a physician solves a clinical problem? There are a

number of theories. The one I am going to describe here (and which is illustrated in Fig. 1) is based both on experimental evidence (Kleinmuntz, 1968, Elstein et al, 1972) and personal introspection.

The clinician's cues are symptoms, signs, the results of pathological tests, and patterns of behavior. Sometimes the cue is single; more often there is a cluster or pattern of related cues. Although in medicine the cues are occasionally certain, in the great majority of cases they are probabilistic. When presented with a probabilistic cue the clinician forms a hypothesis — or a number of hypotheses — about the category to which the patient's illness belongs. He arrives at his initial hypothesis by matching the cues with his memory of previous experiences with similar cues, or his memory of previous experiences with the same patient. The clinician's capacity for picking-up cues — identifying problems — is just as important as his skill in solving problems. When the clinician makes a number of initial hypotheses, he puts these in ranking order of importance.

The ranking order depends chiefly on two factors: probability and 'pay-off'. In clinical practice, of course, we estimate probability intuitively, without being aware of making calculations. Nevertheless, we base our personal probabilities on our experience of the incidence of disease, and the significance of symptoms. The term personal probability is used to emphasize the fact that the estimate is

FIGURE 1
The Diagnostic Process



the physician's own, and cannot be expected to conform exactly to that of other physicians. We would, however, expect physicians with similar experience to be similar in their judgment of conditional probabilities. And the more precise and objective the physician's knowledge, the more will his estimate approximate the actual conditional probability.

Obviously, the more serious the disease and the more amenable to treatment, the greater the 'pay-off' of making the correct diagnosis. If a disease has a high 'pay-off' it may be ranked high even though it has a low probability. In a child with abdominal

pain, for example, acute appendicitis may be ranked high — even though of low probability — because of the high expected value of a correct diagnosis. The choices can be illustrated by using the device of the pay-off matrix. (Fig. 2)

The Use of Personal Knowledge

Besides the presenting symptoms there are other conditions which affect the physician's estimate of probability. These include the patient's past history, constitution, previous behavior and environment.

Having formulated his initial hypotheses, the clinician embarks on a

search for attributes which will support or refute his hypotheses — symptoms, signs, and the results of tests. The experienced clinician looks first for those attributes which have the greatest utility in discriminating between categories. One of the differences between experienced clinicians and inexperienced ones is the utility of the questions they ask (Kleinmuntz 1968). For the experienced clinician every question gives significant information.

In the course of his search, the clinician looks for both positive and negative defining attributes. It is obviously important that he should support his hypothesis not only by positive evidence — the presence of attributes — but also by negative evidence — the exclusion of other diseases. This is one of the chief purposes of the routine review of systems and the general physical examination.

The extent to which we search for negative attributes and for unsuspected problems is one of the most difficult questions in family practice. It is obvious that a routine systematic inquiry is neither possible nor desirable in every case. The extent of this aspect of the search has to be related to the presenting symptom and to the seriousness of the complaint (Hull, 1969). Even in referral practice, there are choices of this kind to be made. In family practice the choices are even more difficult. Bruner et al (1956) and Kleinmuntz (1968) describe a general tendency in all problem-solving for positive instances to be preferred over negative instances.

We must now consider two important factors determining the course of the search and the point at which it is considered to have ended:

1. *The Objectives of the Search.* The objectives will obviously vary widely between different types of clinician. There is an enormous difference between the objectives: "to exclude serious illness" and to "establish exact histological diagnosis prior to surgery". The choice of search strategy in the two cases will be correspondingly different. This question of objectives has important implications for family practice.

2. *Risk, Benefit and Cost Calculations.* The choice of actions taken in the course of the search is influenced not only by the utility of the action, but also by the risks and benefits which follow from it. I have already referred to this as the pay-off.



LET'S FACE IT BRĀSIVOL

cleanses acne away
simply, safely, effectively

Let's face it — cleansing the acne skin with Brāsivol's graded particles helps keep the pores open, removes excess oil, loosens plugs in follicular openings and fights bacterial invasion.

Patients benefit emotionally and therapeutically. The compulsion to pick and squeeze is channeled into an active cleansing program. There is less physical and psychological scarring.

Brāsivol **FINE** for initial therapy

Brāsivol **MEDIUM** for second stage treatment

Brāsivol **ROUGH** for maintenance therapy.



WINLEY-MORRIS CO. LTD.
MONTREAL CANADA

One of the main features of the theory I have described is the formulation of hypotheses very early in the diagnostic process. As Elstein et al (1972) have pointed out, this is contrary to the more orthodox view that clinicians collect a large body of data before formulating their hypotheses. The early formulation of hypotheses is theoretically very useful, for it converts the problem from an 'open' one, in which the end point is unknown, into the more easily-handled 'closed' one, in which the end point is known (or at least hypothesized) (Bartlett, 1958).

The ultimate in uniformity of search strategy is a computer program and it is interesting that diagnostic computer programs have been developed chiefly for relatively discrete problems like congenital heart disease and endocrine disorders. The search strategies of specialists represent "the end point of a total medical strategy, the first part being the pre-referral search by the family physician". (Smith, 1972) It may be some comfort to us to know that family physicians will probably be the last to be replaced by the computers.

Problem-Solving in Family Practice

The features of problem-solving in family practice are a direct result of the characteristics of family practice, which are summarized in Fig. 3. Now in what respects is problem-solving in family practice different?

Family practice differs from all other special fields of medicine in that, by definition, no assumptions can be made about the type of problem likely to be encountered. Because of this, family physicians have not – and cannot – develop a common search method which will serve them for a large proportion of the problems they encounter. As Crombie (1963) and Hull (1969) have described, the method must vary with the presenting problem and with the prior information about the patient which is already available.

The need for an infinite variety of search strategies poses peculiar difficulties for family physicians. In every problem he encounters, the doctor has to decide how rigorously he will test his hypothesis. It may not be too difficult in the case of positive tests, but in the case of negative instances – the possibilities of which are so numerous – the decision may be very difficult.

The decision as to how rigorously a

hypothesis must be tested depends on the nature and seriousness of the presenting problem. In a patient with a straightforward acute sore throat, there is little to be gained by a routine systematic inquiry. But in a patient with loss of weight, or dyspnea on exertion the search must include all systems which could possibly be involved. In between these two instances are many in which the choice is less clearcut.

Do family physicians develop similar search strategies for the same presenting symptom? Considering the similarity of their experience, we might have expected most family

physicians to use the same search strategy in dealing with a problem like fatigue. Hull's investigations (1972) suggest, however, that search strategies are not as uniform in family practice as we might think.

Do the search strategies of family physicians differ from those used by specialists in solving the same problem? A recent study by Mr. D. H. Smith and myself does demonstrate differences between family doctors and internists. Eighteen doctors, nine family doctors and nine internists, were presented with three common clinical problems by a research assistant (Mrs. Helen Edward) playing

FIGURE 2

Pay-Off Matrix For Patient With Acute Abdominal Pain

Decision Alternatives	Anticipated Event and Outcome Values	
	Appendicitis	Not Appendicitis
Diagnose Appendicitis And Admit	Early Appendectomy Quick Recovery	Unnecessary Admission Quick Recovery
Diagnose "Not Appendicitis" And Discharge	Appendix Perforates Delayed Recovery or Death	Quick Recovery
Estimated Likelihood of Events	0.1	0.9

FIGURE 3

Features of Primary Medical Practice

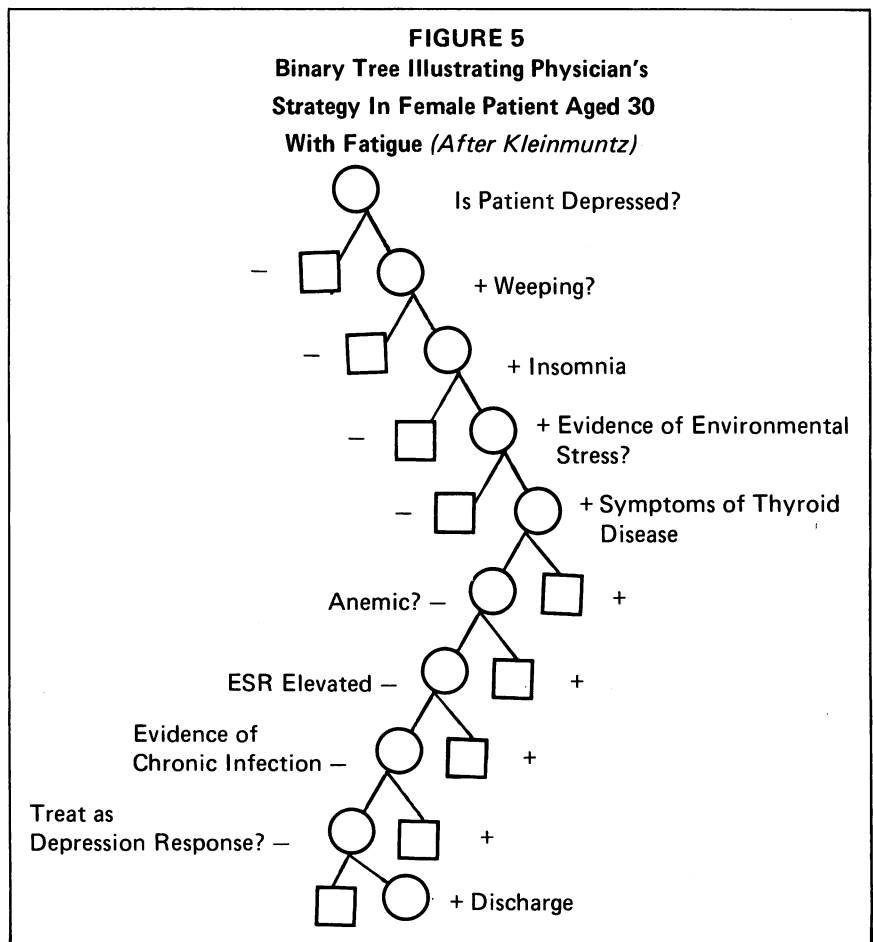
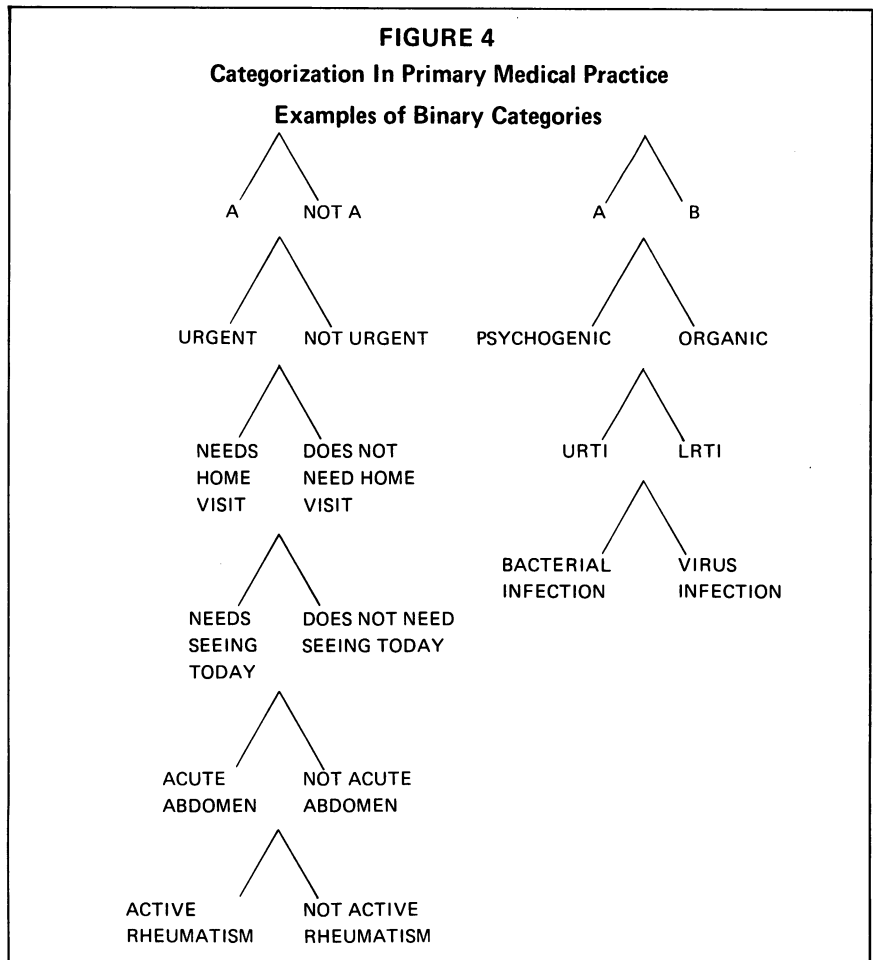
1. The pattern of illness approximates to the pattern of illness in the community, i.e. there is:
 - a) A high incidence of transient illness.
 - b) A high prevalence of chronic illness.
 - c) A high incidence of emotional illness.
2. The illness is undifferentiated, i.e. it has not been previously assessed by any other physician.
3. Illnesses are frequently a complex mixture of physical, emotional and social elements.
4. Disease is seen early, before the full clinical picture has developed.
5. Relationship with patients is continuous and transcends individual episodes of illness.

the role of the patient. The physicians were asked to take a history, ask the research assistant for items from the physical examination and investigation, then tell the 'patient' their conclusions and treatment. No time limit was set. The three interviews were recorded, transcribed and analyzed. Although there were no significant differences in the final diagnosis between the two groups, there were statistically significant differences in the methods used to arrive at these diagnoses. The family physicians asked fewer questions, ordered fewer investigations and asked a higher proportion of questions about the patient's life situation.

The objectives of the family physician are often different from those of a referral specialist. The family physician sees many patients with self limiting, harmless disorders. In these a precise diagnosis is not required; it is sufficient to know that serious illness has been excluded. Crombie has called this 'eliminative diagnosis' (1963). The physician also sees many patients with psychogenic disorders in whom the only categorizing task may be to decide whether the patient's symptoms are psychogenic or organic.

In many cases, therefore, the objectives of the family physician are to sort patients into binary categories (Fig. 4). The objectives of the referral specialist are more usually to categorize the illness according to a system of disease taxonomy. If the objective is to sort the patient's illness into one of two categories, this will affect not only the end point of the search, but also the discriminatory tests which are used. The tests which are useful for discriminating between binary categories are often of little use for discriminating one from a larger number of categories. One excellent example of this is the ESR which we use so effectively for dividing patients into broad categories like "active rheumatic disease" and "no active rheumatism". I find that students are taught that the ESR is of little value because it is so non-specific. It is, of course, this very lack of specificity which makes the ESR so useful for discriminating between binary categories and therefore so useful for the family physician. This instance also illustrates, incidentally, the limitations of medical education if students are taught only by referral specialists.

Since the pattern of disease in family practice is similar to that in the



community, the prior probabilities of disease are very different from those seen in specialty practice, where the probabilities are distorted by selection. This difference in prior probabilities affects the choice of initial hypotheses and consequently the search strategy used. As an example I have taken a patient with depression presenting as fatigue, and Fig. 5 shows in the form of a flow sheet my own concept of an ideal search strategy for a family practitioner. In family practice the probability of depression is so high that the practitioner will begin his search by looking for evidence of depression. The old adage 'exclude the organic', which usually meant 'look for organic disease first' does not hold good in these circumstances. When both the prior and conditional probabilities are so heavily in favor of a psychogenic disorder, it is irrational to begin the search by looking for organic disease. You will notice that the initial hypothesis has been tested first by positive instances (evidence of depression), then by negative instances (Hb and ESR). Organic disease has been excluded, but *after*, not before, the collection of positive instances.

The family physician sees disease in its earliest stages, often before the full clinical picture has emerged. This has several consequences:

a) At this stage, physical signs are very often absent and decisions must be made on the basis of symptoms. This means that the history, important in any field of medicine, is of even greater importance in family medicine and occupies an even greater proportion of the time available.

b) Decisions have to be made without the help of defining attributes which become available in later stages of the disease. This means that decisions have to be taken at lower levels of probability than in the later stages of disease. This is not because the family physician has no time to search for more evidence, but because the evidence is not available. Since diagnosis in all fields of medicine is probabilistic, this difference is quantitative rather than qualitative.

c) A family physician soon finds, after going into practice, that the presenting symptoms of disease are very different from the symptoms described in textbooks. In other words, the cues available in the early stages are different from those available in the later stages. He has therefore to categorize illnesses, not only

with fewer cues, but with different cues. And, since he has learned medicine from the later stages of disease and from textbooks, he has to relearn it when he enters family practice.

d) Opportunities for validating one's hypotheses in family practice are often long-delayed. A doctor who suspects disseminated sclerosis in a patient with transient attacks of blurred vision may have to wait ten years before his tentative diagnosis is confirmed. Some of our hypotheses are never validated beyond a very low level of probability.

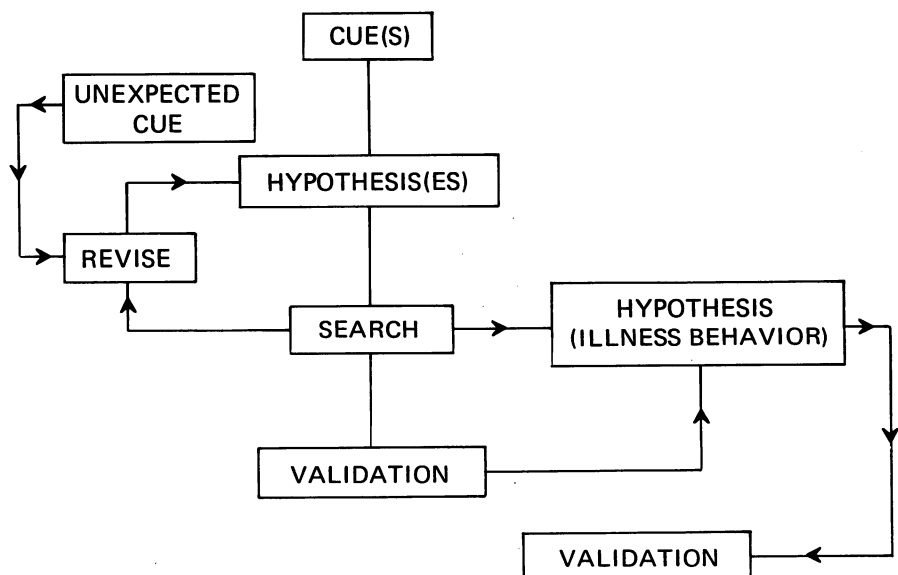
The family physician deals with undifferentiated problems, many of which are complex mixtures of physical, emotional and social elements. One result of this is that the illness he sees is often in that state described by Balint (1964) as 'un-organized' — not presented by the patient in a neatly-packaged sequence of symptoms based on his ideas of etiology. Patients often present with two, three or more problems at the same time. Multiple cues are common, and these may be separate cues to separate problems or a cluster of cues all related to one problem. Important cues may be thrown in at any time during the problem-solving process, a situation illustrated in Fig. 6. This can occur in any field of medicine, but I believe it to be more common in family practice.

Another result is that the family physician has to pick up cues not only about the illness, but about the patient's behavior, i.e. about his motive for attending and the social factors which lie behind the illness. This situation is also illustrated in Fig. 6. Cues about patient behavior may also be thrown in at any stage of the consultation. They are frequently non-verbal and may lie in the situation itself rather than anything which is said or done by the patient. An example of this is the cue of incongruity, in which a patient's concern over a trivial illness alerts the physician to the fact that some special stress has motivated his attendance. I believe family doctors to be especially skilled in picking up cues about patient behavior.

All doctors have to work to a time schedule. The family physician differs from most in having a workload which can be manipulated only within certain limits. There are things that have to be attended to immediately or before the end of the day. The family physician knows that he has certain fixed resources to be distributed among all the demands on his services. He knows that more time spent on one patient will mean less time on another. His search strategies have therefore to be highly appropriate to the task in hand and carried out with the maximum regard to utility. This is the secret of the skilled family physician's

FIGURE 6

Flow Chart Illustrating Unexpected Late Cues And Cues To Illness Behavior



well-known capacity for 'zeroing in' on the main problem with great rapidity. The search must also often be distributed in time — discontinued on one day and resumed on another when more time is available.

Implications for Medical Education

Clinical training is a process in which the trainee learns to recognize certain concepts which we call diseases. In this it is no different from other learning processes, for all learning depends on the attainment of concepts. Until recently a clinician's training took place entirely in a hospital setting, where each disease exhibited only a limited number of its total range of attribute values. The attribute values associated with the early stages of disease and with the less severe cases were excluded by selection. According to Bruner et al, (1956) "the range of positive defining values of an attribute used by a person in making inferences will reflect the range in which he obtained discriminative training". If we wish clinicians to discriminate between diseases in all grades of severity, and in all stages of evolution, it is surely necessary for some of their clinical training to take place in family practice. The selection process which goes on before patients reach a teaching hospital also distorts beyond recognition the pattern of illness in the general population. As a result, students often develop bizarre notions about the prior probabilities of disease which may never be corrected if they proceed directly to specialty training. How long, therefore, can we continue to justify the limitation of clinical training to that tiny segment of human disease encountered in the teaching hospital?

Clinical textbooks are usually written about one part of the range of a disease's attribute values. When listing the signs and symptoms of a disease, a textbook will not usually comment on the discriminatory value of the symptom, or of its range of variation, or of its utility at different stages of the disease's evolution. Surely it is possible, however, to write a textbook of medicine which is more in accordance with reality. With a change in the setting of clinical training and some new textbooks, it might become unnecessary for doctors entering family practice to relearn clinical medicine.

The second implication is that students should be taught to make

clinical decisions in the way they are made by experienced clinicians. It has been customary to teach students a method of clinical diagnosis which is different from that used by experienced clinicians. The view has been expressed that the methods of experienced clinicians are shortcuts which, although necessary, are less than perfect and should not be revealed to students. This I believe to be wrong. The best path to the solution of a clinical problem is the shortest which will solve it without avoidable risk. If the patient's problem has been solved in this way, then the diagnostic pathway was not a shortcut but the optimum path.

The third implication is that students should be taught the theory of diagnosis. There are four reasons why this should be done: first, medicine has yet to feel the full impact of computers; when it does, doctors will almost certainly be using computers as an aid to diagnosis and decision-making. Doctors who have no grounding in diagnostic theory will find it difficult to adapt to this change. Second, we are all going to face difficult decisions about the choice of investigations and treatment. Much of the increase in cost of medical care is due to increasing use of expensive resources by physicians. If they are to make effective use of limited resources, surely doctors should be aware of the cost-risk-benefit calculations which precede difficult decisions. Third, it is I think a reasonable hypothesis that a doctor who has insight into his own thought processes will be a better clinician. And fourth, it is an unjustifiable deception to conceal from students the facts of observer error and the probabilistic nature of all medical decisions. Such deception is out of keeping with the modern feeling that the young should be shown life as it is, and not as we would like it to be.

And what are the implications for family practice? A skilled family doctor is a highly efficient and effective problem-solver and decision-maker. One of his greatest potential contributions to medical education is his teaching of these skills. To make ourselves effective teachers, two things are necessary. First we must increase our knowledge of the incidence and prevalence of disease, the significance of symptoms, the discriminatory value of tests, and the risks and benefits of our procedures and treatments. And

then, we must learn to analyze, describe and justify the many intuitive judgments we make in the course of our day's work. A family doctor who has learned to do this and who has at his disposal a developing body of facts, will be a highly effective clinical teacher.

Acknowledgements

I am grateful to Dr. C. W. Buck and Mr. D. H. Smith for reading the manuscript and making many useful suggestions, to Mrs. Helen Edward for assistance with the research project and statistical analysis, to Mrs. S. Pownall for preparing the figures and for typing many drafts of the manuscript — and to Mrs. M. Braunton for transcribing the tape recordings of doctor-patient interviews. Finally, I wish to thank the members of The Department of Family Medicine, University of Western Ontario, with whom I have discussed these ideas on many occasions and who have contributed so much to their development. ◀

References

1. BAIN, S. T. and SPAULDING, W. B., 1967, *CMAJ*, 97, 953.
2. BALINT, M., 1964, *The Doctor, His Patient and the Illness*, 2nd ed., Pitman, London.
3. BARTLETT, F., 1958, *Thinking*, London: Geo. Allen & Unwin.
4. BRUNER, J. S., GOODNOW, J. J., and AUSTIN, G. A., 1956, *A Study of Thinking*, New York: John Wiley.
5. *College of General Practitioners*, 1958: *J. Coll. Gen. Practit.*, 1, 107.
6. CROMBIE, D. L., 1963 a, *The Diagnostic Process*, *J. Coll. Gen. Practit.*, 6, 579.
7. CROMBIE, D. L., 1963 b, *Diagnostic Methods of Practitioners*, 191, 539.
8. CROOKSHANK, F. G., 1926, *Lancet*, 11, 940, and 995.
9. ELSTEIN, A., KAGAN, JASON, SHULMAN, 1972, *J. Med. Educ.*, 47, 85.
10. ENGLE, R. L., Jr., 1963, *Arch. Int. Med. (Chicago)*, 112, 520.
11. HODGKIN, K., 1966, *Towards Earlier Diagnosis*, Med. Ed. E. & A. Livingstone, Edinburgh.
12. HULL, F. M., 1969, *J. Coll. Gen. Practit.*, 18, 65.
13. HULL, F. M., 1969, *Ibid*, 18, 148.
14. HULL, F. M., 1972, *J. Roy. Coll. Gen. Practit.*, 22, 241.
15. KLEINMUNTZ, B., 1968, *The Processing of Clinical Information by Man and Machine: In formal representation of human judgement*. New York, John Wiley.
16. LUSTED, L. B., 1968, *An Introduction to Medical Decision-Making*, c.c. Thomas, Springfield.
17. McWHINNEY, I. R., 1972, *N. Eng. J. Med.*, In press.
18. SMITH, D. H., 1972, *Personal communication*.