Clinical Judgment: Psychological Research and Medical Practice

Interdisciplinary effort may lead to more relevant research and improved clinical decisions.

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The importance of judgment in medicine has never been doubted. In a major study of physician performance (*1*), good clinical judgment was rated as the foremost attribute desired in physicians. Judgment and decision-making have also been the focus of extensive psychological research for more than a decade, and a number of thorough reviews of its various facets have appeared (*2–4*). Yet if Feinstein's publications (*5*) and a standard medical text (*6*) are any guide, psychological research on human judgment and decision-making has had little impact on medical practice. In this article, I discuss why this has been so and venture to suggest modifications in research directions and paradigms in psychology and alterations in medical attitudes toward that research, both of which may lead to more clinically relevant psychological research and to a more positive response from medicine.

Clinical as Compared to Statistical Prediction

It is convenient to begin with a discussion of clinical versus statistical prediction (*7–11*) and to focus on those aspects of each approach most troubling to adherents of the other. In this context, "statistical" prediction means any method of reaching diagnostic decisions in which formal quantitative techniques or formulas, including Venn diagrams and flow charts, are used. "Actuarial" will be used synonymously. "Clinical" means any of the artful, informal, qualitative, or not explicitly quantitative strategies generally employed by clinicians for this task. The underlying issues will be clarified by drawing the distinction between these two modes of information processing more sharply than may be the true state of affairs. When the problem of clinical as compared to statistical prediction was in the center of the research arena in clinical psychology, it was capable of arousing partisans on both sides and it was difficult for researchers and clinicians not to become polarized (*8*, p. 527).

This inner preference which most people feel toward one or the other of the two modes of prediction is reflected in much of the writing on the topic. Thus by its proponents the statistical method has been described as operational, objective, reliable, sound, and verifiable, whereas by its opponents it has been called atomistic, pedantic, artificial, static, and pseudoscientific. The clinical approach on the other hand has been called dynamic, meaningful, deep, genuine, and sophisticated by its adherents but by its opponents, vague, hazy, subjective, unscientific, and verbalistic.

In clinical psychology, the debate revolved initially around two questions: (i) Suppose that a given level of diagnostic accuracy may be achieved by routine application of rules of thumb or quantitative formulas derived somehow from experienced clinicians. What does a clinician's artful combination of data contribute beyond that level? (ii) In any given prediction situation, which method is more accurate? These questions recur in but slightly altered form in studies of medical diagnosis as well, for example, whenever human performance is compared with computer-assisted diagnosis or an equation for combining data (*12*).

But the controversy also involved deep-seated and at times poorly articulated assumptions about several other issues that are also relevant to clinical medicine: the significance of qualitative and quantitative factors in judgment, the place of implicit and explicit rules for decision-making, and whether the aim of research on judgment and decision-making was to develop an account of the way clinicians actually processed information (*13*), or whether it was to find a formula that could replicate or even improve upon a clinician's conclusions without necessarily mirroring human information processing (*14*). The first two questions were the subject of many studies in psychology. On balance, the research has supported an actuarial or statistical approach (*15*). Similar results have been found in medicine whenever programs for computer-assisted diagnosis with the use of algorithmic routines exceed the diagnostic accuracy of clinicians (*16*).

Holt (*9*) early attacked the ground rules of the research paradigm in psychology, but his criticism seems not to have swayed the course of research for some time. He pointed out that, in most of the psychological research on clinical judgment, the task of the clinician was to render a judgment, usually a diagnostic classification, on the basis of a set of data provided by the experimenter. Setting aside the question of the meaningfulness or practical implications of the categories of judgment (a matter to which we shall return later), Holt cogently argued that the ground rules of the research paradigm were so constructed as to favor the actuarial approach. The judgmental task had been defined as that of combining a set of data to reach a classification decision, an assignment that might well be accomplished mechanically. This research paradigm, however, slighted other crucial aspects of clinical activity, such as determining what data are needed, gathering them effectively, and, if the data were qualitative, transforming them to be suited to an actuarial rule. These tasks, claimed Holt, were fundamental aspects of clinical activity and could not be ignored in any relevant research. His arguments touched on all the issues identified above and indirectly raised one more that would become increasingly central: psychological research on clinical judgment had first employed a model that was basically nonsequential, while most clinicians had viewed judgment or decision-making as fundamentally sequential opinion revision. There is, of course, a model for handling sequential opinion revision—Bayes' theorem—but it was not widely used in research on clinical judgment in the 1950's and 1960's.

A Clinical View of Clinical Judgment

Before turning to the question of sequential as compared to simultaneous data combination, let us consider the clinical view of judgment as an artistic-

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qualitative process as compared with viewing it as mechanical and quantitative. A dislike of quantified approaches to decision-making appears to be widely held among clinical practitioners. They hold, in effect, that it is a mistake to treat clinical data with more quantitative precision than the subject matter warrants. While experienced clinicians can rank diagnostic possibilities in order of subjective probability with little difficulty, they are generally unwilling to assign more precise probabilities to their ordered rankings (*17*). Thus arises the issue of how much can be meaningfully quantified, and especially whether the gains or losses that might derive from various clinical outcomes and treatments can be handled quantitatively. Here statistically oriented research on clinical judgment or medical decision-making has been of little help, for until recently it was largely concerned with maximizing diagnostic accuracy and not with the consequences of alternative actions (*16*).

Furthermore, to clinicians untrained in formal decision theory, it has been unclear how population probabilities, even if they were available, could or should be applied to individual decision-making. The clinical approach aims to do what is best for a particular patient, and, since no two patients are alike, the relevance of statements describing characteristics of populations is not immediately apparent. It can always be claimed that these statements either describe group trends that may well not prevail in a particular case, or omit salient features of an individual problem that significantly alter probabilities and utilities.

This objection may apply with equal force to physiology, to biochemistry, and indeed to all of biological science in relation to clinical medicine. Yet these sciences have made significant contributions to understanding disease and making decisions concerning treatment. The argument that science deals in general principles whereas clinical practice deals with the specifics of a case cannot by itself rule out a formal approach to decision-making. It does, however, suggest that an educational task exists.

Experienced clinicians are undoubtedly aware of the probabilistic, uncertain character of much of their data. The clinical approach generally combines these uncertain data by informal rather than formal means, justifying this strategy by arguing that clinical judgment cannot be easily quantified since it involves detecting subtle patterns and weighing conflicting evidence. The clinical approach holds in effect that analysis of complex patterns of data with simple quantitative techniques is more sensitive to the multiple factors involved in a clinical problem of any substantial magnitude than is a more formal approach. The more formal approach, it is alleged, cannot deal sufficiently with those aspects of a problem that make it unique. Since few explicit rules beyond broad generalizations are available for these situations, the capacity to analyze them is acquired by experience. For these reasons, clinicians hold that judgment is more art than science.

Response of Actuarial Approach

The statistical or actuarial approach agrees with this analysis of clinical judgment on several significant points: (i) data must be combined or aggregated in some way to make clinical decisions; (ii) as the use of the term "data" implies, more than one bit of evidence must generally be taken into account in reaching a decision; (iii) the relationship between disease states and symptoms, and hence between evidence and actions, is one of probability rather than logical necessity. But these points, which served to justify the clinical method of inference, are to be used now to argue for a more formalized quantitative approach. What additional principles can account for this shift?

As the terms themselves imply, advocates of a statistical or actuarial approach have favored more quantification and formalization of inference than clinicians have thought appropriate. But the heart of the actuarial approach is not an insistence on quantification. It is an insistence that decision rules can be made explicit and that it is desirable to make them so. One reason for this shift is that it is far easier to teach a skill to a novice when the component steps are clear than when only the output of the clinician's thought processes are made known. But even were instruction not the concern, psychological research in human judgment and decision-making suggests that the practice is desirable. This research may be summarized by observing that decisions made in complex probabilistic environments are often less than optimal and at times inconsistent with the stated values of the decision-maker, and that not all the information embedded in multiple cues has been utilized. Hence, a scheme that facilitates consistency and more efficient use of information is desirable (*4, 18*).

Thus the actuarial approach asserts that, given the probabilistic, soft, or uncertain character of clinical data, it is better to combine data by a formal, explicit system than by intuition to achieve more efficient and consistent information processing. The evidence in support of these assertions is diverse, some of it deriving from clinical medicine or clinical psychology and some from the experimental psychological laboratory. The general strategy of the laboratory investigations has been to demonstrate some inefficiency either in the conclusions or in the judge's policy, by comparing the inferences of unaided judges with those reached by application of a statistical rule, usually either Bayes' theorem or a regression equation (*3*).

Several studies (*14, 19*) have shown that it is difficult to be consistent in applying implicit decision rules over large numbers of cases. More accurate judgments and predictions can be made when a formula derived from the judge's prior behavior (capturing a policy) is applied to subsequent cases, a procedure called "bootstrapping." Psychological research has shown that it is difficult to process probabilistic information optimally, and clinical data certainly are probabilistic. When data are processed sequentially, there is a common tendency to overprediction. Apparently, uncertainty in the data is ignored and each cue is treated as perfect or nearly perfect information (*20, 21*). When probabilistic data are processed simultaneously, the reverse phenomenon, conservatism in judgment, is generally observed (*3, 4*). The decision-maker fails to appreciate the impact the data should have on revising prior opinion and updates less than is warranted. Decisions or inferences can be improved by employing any of a number of statistical procedures because they compensate for these common mistakes or biases in human judgment. In clinical medicine, conservatism would lead to ordering more tests than are actually necessary to reach any desired level of diagnostic certainty.

Excessive numbers of laboratory tests may be ordered for another reason: limitations on the human capacity for indirect inference (*22*). Here research has demonstrated that, in unfamiliar situations or those lacking much meaningful content, there is a tendency not to draw all the inferences that are logically implied in a set of data. The problem-solver prefers instead to seek direct evidence of what could be logically deduced, leading again to collecting more data than would be needed by a more efficient information processor. This phenomenon can occur even with familiar, meaningful material, as shown by a study of the use of a battery of 12 laboratory tests (*11*) in

which most of the meaningful information could be accounted for by a formula derived by discriminant function analysis for weighting results on just four tests. Positive correlations between the tests account for the redundancy. This study suggests that unnecessary laboratory expenses may be incurred when all the information potentially available in a smaller set of tests is not extracted and additional tests are ordered instead. It may be another illustration of the use of redundancy to bolster confidence in a clinical inference, whereas on statistical grounds, this redundancy is noninformative (*21*).

In the role of interpreter of clinical data, the physician must contend with the limited size of working memory. The quantity of data that can be managed at one time is much less than the size of the long-term memory store (*23*). This feature dictates either that information be processed serially rather than simultaneously or that not all the information collected be utilized in decision-making. Algorithms, flow charts, decision trees, regression equations, and discriminant function analysis are techniques that can increase the capacity for systematically processing large quantities of complex information and ensuring that all the data that should contribute to making a decision are utilized.

These claimed advantages have not led to rapid diffusion and adoption of formal systematic approaches to decision-making in clinical medicine. Resistance to an innovation should be taken seriously, particularly when it arises in a profession that embraces most innovations eagerly. Consider, for example, how medicine has long sought more precise means of assessing the functional or anatomical status of the organism by means of new laboratory tests or radiographic procedures. Consequently, the quantity of conceivably relevant data is steadily increased by advances in biomedical technology, while the strategies used for drawing clinical inferences or reaching clinical decisions remain fundamentally unchanged. It is almost as if clinical judgment were, by definition, that aspect of clinical medicine that cannot be formally analyzed and systematized. To an undetermined extent, the psychological studies cited and others in that research paradigm have contributed to their cool reception by offering a critical, unflattering view of a very highly prized human faculty, our judgment. The message of the research is often that we are not as adept as we thought we were; this viewpoint emphasizes our limitations, instead of increasing our power, as does adding a new diagnostic or therapeutic technique to the clinical kit.

Other Conceptions of Judgment

In addition, by focusing on a fairly narrow definition of judgment and inference, this genre of psychological research has neglected a number of topics and issues that physicians can rightly feel ought to be considered when one speaks of judgment—affective sensitivity, the problem of values, and the creative conceptualization of diagnostic formulations or treatment alternatives.

Sometimes good judgment is said to be displayed when a physician is sensitive to the emotional needs of a patient as well as to the psychological and social problems that frequently arise in coping with a grave illness or as a consequence of certain therapies. These are undeniably important issues and have stimulated a revival of interest in the contributions that behavioral science might make to improve patient care. Research on the psychology of judgment and decision-making has basically ignored these topics in favor of focusing on how information is or ought to be integrated into a decision.

As we have seen earlier, psychological research on clinical judgment has led to a search for formulas, rules, or strategies for optimal, consistent information processing over fairly large numbers of cases. The practical outcome of a successful research and development program would then be a decision strategy, or a flow chart or algorithm for decision-making. In one widely used sense of the term, this outcome, if and when achieved, bypasses judgment. Quite commonly in medicine, judgment is said to be employed whenever it is necessary to depart from standard procedures and to display an understanding of underlying principles in doing so. There are situations where a sound clinician recognizes that it is incorrect to apply an ordinarily appropriate, straightforward rule. A revision of standard procedures must be constructed in accordance with underlying principles and this requires judgment. A particularly vivid and instructive use of judgment, in this sense of the term, arises when it is necessary for a clinician to reconcile two apparently competing or conflicting principles, sometimes by invoking a more inclusive or deeper principle. These actions require a sound grasp of basic principles of therapy, because strictly algorithmic statements could hardly ever cover all possible contingencies. In the case of a patient with congestive heart failure who develops a bleeding complication, when is adequate blood volume restored? Or consider the treatment of a child with congestive heart failure who is also in an asthmatic state. The first condition requires a decrease in fluid intake to ease edema, while the second requires administering fluids to compensate for water loss. A physician with good judgment knows how to reconcile these apparently competing demands.

In the context of clinical medicine, good judgment may also be seen in the selection of diagnostic hypotheses or treatment alternatives to be evaluated. A limited number of alternatives must be evaluated, particularly if time is limited, and it is neither possible nor necessary to consider every conceivable option; only the most relevant can be considered. Likewise, judgment is also employed when new possibilities, especially potentially adverse ones, are anticipated. A clinician shows good judgment when he foresees probable difficulties or consequences of an illness or a therapy under particular conditions, and plans in advance to cope with these problems.

In general, psychological research on judgment has dealt more with evaluating than generating alternatives. It has been more concerned with rules for classifying instances into one of a given number of categories than with the problem of constructing the best set of alternatives for a particular problem. True, some previous studies in problem-solving and creativity (*24*) do address this issue, but have not specifically addressed clinical situations. Moreover, research on the psychology of problem solving and research on the psychology of judgment and decision-making have been largely pursued independently (*4*).

Psychological research has concentrated either on the problem of judgmental accuracy or on determining an equation for duplicating or improving upon the judge's decisions. The research has largely ignored the question of what difference these categorical classifications make and, given each outcome, what is at stake for the patient. Perhaps recognizing the highly subjective character of discussions of value, psychologists have concentrated on the problems of revising probabilities and diagnostic classification and have tended to neglect the role of the utility of alternative outcomes. Yet, complex clinical situations are often marked by multiple, sometimes

conflicting, outcomes; a major problem may be how to maximize a combination of values when it is not possible to achieve the maximum of each simultaneously.

Problems of balancing and reckoning with multi-attribute utilities are vexing to clinicians. Many medical and surgical situations involve reckoning with a number of uncertainties, either simultaneously or sequentially, and a number of distinct, perhaps competing, values that do not seem commensurable. A common strategy for choice in this situation is to focus on one attribute at a time, in a process of serial elimination (*25*). Decision analysis (*26*) offers a more complex strategy to assist the decision-maker in these situations, providing a rationale and technology for combining probabilities and values to make difficult choices, and directing attention to aspects of the situation that might otherwise be overlooked. By incorporating the cost of various errors and the value of different outcomes into the overall decision, the emphasis on maximizing judgmental accuracy may be significantly decreased.

Despite a number of descriptions of medical applications of these techniques (*27*), diffusion of the innovation has been slow. Several objections to decision analysis arise frequently. One is that the conditional independence required to use Bayes' theorem is rarely a property of clinical data. It may be possible, however, to cluster the data so as to meet this assumption (*28*), to tabulate the relative frequency of all combinations of a small set of cues (*10*), or to act as if the assumption were met while proceeding with research on the robustness of Bayes' theorem (*29*). Nonindependence of cues may be troublesome for both clinical and statistical modes of information processing, and so should not necessarily rule out the usefulness of the latter.

A second objection is that decision analysis is simply not worthwhile because man is a perfectly adequate intuitive decision-maker. Values are personal, and if only personal probabilities are available to be processed, it may be argued that there is little to be gained by subjecting two types of personal estimates to formal analysis. It is precisely the adequacy of intuitive decision-making, however, that is questioned by the research cited. Serious biases in estimates of subjective probability in nonmedical situations have been demonstrated (*30*). In one study of computer-assisted diagnosis, the diagnostic accuracy of the clinicians was not improved upon by the computer because the personal probabilities provided for the computation were often erroneous (*12*). Other research on clinical decision-making has suggested that personal probabilities can replace unknown objective probabilities quite satisfactorily, provided that they are revised properly by applying Bayes' theorem (*28*). Formal analytic techniques cannot directly remedy the problem of errors in subjective probabilities, although they may well identify points where the estimates are particularly doubtful and sensitivity analysis may reveal what alterations in probability estimates would change the overall decision. Decision analysis and other formal combinatorial techniques can help with the often formidable problem of finding the optimally weighted combination of a number of variables, ensuring that each contributes properly to the decision.

Moreover, the scientific information needed for objective probabilities is not, in principle, unobtainable. If obtaining solid data about risks and probabilities were identified as a major priority for improving clinical decision-making, more efforts would be made to collect the relevant data or to reanalyze existing bodies of data. Needed relative frequencies would become more available and an actuarial approach could then be more easily employed. An analysis of the clinical presentation of cases of abdominal pain (*10*) illustrates how the necessary probabilities could be developed for major clinical decisions.

A final objection to statistical approaches to decision-making is that they try to fit all clinical problems to the model and thereby slight important aspects of a problem. Clinicians' resistance may rest in the perception, often unarticulated, that no single model of decision-making is appropriate for all situations. There may be a clinical practical wisdom that is not adequately represented by Venn diagrams, decision trees, utility curves, or regression equations. If so, advocacy of quantitative strategies might be modest in tone and open to the possibility of error. Different models may be better adapted to different tasks, and the clinician may seem disadvantaged with respect to any particular model's prediction because the assumptions of the model are not met in reality or because he was taking into account some factors it neglected. Studies of the behavior and decision-making of clinicians in more phenomenological terms might help determine the best fit of model to task. While there is ample reason to believe that clinical decision-making can be improved, there is also warrant for continued study of the aims and behavior of clinicians.

The development of algorithms and flow charts for frequently encountered clinical problems may be a useful area for interdisciplinary study. Psychological research suggests that some clinical algorithms may not be optimal, since they may fail to reckon adequately with redundancies in the data and may neglect the costs and penalties associated with misclassifications of well persons. Those with a clinical perspective, however, have concentrated more on finding cases of disease so as to bring the benefits of care to as many persons as possible. Psychologists and physicians can share the aim of increasing the efficiency of utilization of information by analysis of clinical algorithms in decision-theoretic terms.

The clinical decision-maker is ordinarily concerned with taking action and with maximizing the benefits of action; diagnostic accuracy per se is of secondary importance. Studies of decision-making have attended to issues of subjective expected utility, but the psychological literature on clinical judgment generally has not. Perhaps psychological research on this theme can become more relevant to clinical decisions by attention to problems of identifying and clarifying competing values and by study of value conflicts and trade-offs, either in the framework of multi-attribute utility or with other conceptual outlooks. The evaluation of social and educational programs seems to be moving in that direction (*31*). Research on clinical judgment might find it appropriate, too.

Conclusion

Although judgment is a central topic in both medicine and psychology, there has not been much productive interdisciplinary exchange on the subject.

Psychological studies of judgment have usually been concerned with classification and categorization, and only more recently with decision-making. Psychologists might bear in mind that when physicians speak of judgment, they generally do not have in mind classification into two or more static diagnostic categories of doubtful reliability and clinical utility, although this has been the paradigmatic task of so many psychological studies of clinical judgment. There is more to clinical judgment than the diagnosis of psychosis or neurosis from the Minnesota Multiphasic Personality In-

ventory (MMPI), a theme explored repetitively in clinical psychology. Equally, physicians might recognize that the artistic, intuitive view of judgment is yielding to increasingly sophisticated modes of analysis and that a variety of models or representations of judgment are available and may have practical utility as well as theoretical interest.

Psychological research on judgment has generally involved quantification and statistical modeling to a degree that has had relatively little appeal for most clinicians. But simplification of reality and quantification are characteristic of all experimental research and they have not prevented fruitful exchange between biomedical researchers and clinicians. The difficulty of developing quantitative data needed for a sound decision analysis of a particular problem does not imply that such analysis is in principle unsuited to the problem, for subjective probabilities may be used in formal analyses as well as in intuitive judging. Indeed, a self-fulfilling prophecy may be at work here, for the more it is insisted that a clinical situation cannot be analyzed in terms of risks and likelihoods, estimated however roughly, the more investigation in these terms is discouraged.

There may be yet another problem underlying the paucity of interdisciplinary effort. Physicians, as well as their patients, prize their good judgment highly. Contemporary cognitive psychology, on the other hand, has been vigorously exploring the limitations and biases of human judgmental capacities. The applicability of these results to medical decision-making might be considered seriously by physicians. Psychologists, in turn, might recall that the results of laboratory research using unfamiliar tasks do not necessarily generalize to problem-solving in a domain where prior experience and practice play a large role. Experienced, competent practitioners of an art may well know more than formal theories encompass.

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NEWS AND COMMENT

Health Manpower Act: Aid but Not Comfort for Medical Schools

The Health Professions Educational Assistance Act of 1976, which grandly proclaims that doctors are a "national resource," is the most far-reaching and complex health manpower bill to pass the Congress since 1963, when the government first went into the business of direct support of medical education. The act—a monumental piece of social legislation designed to cure the ills of the rural and inner city poor by putting a doctor in their midst—defines a new set of relationships between the government and the nation's medical schools in which the government says, in effect, we are paying your bills so we should have a hand in running your school.

By and large, the medical schools, having long since realized that they cannot exist without federal support, are taking it all quite calmly, though underneath they hate the idea of giving the feds what amounts to a seat on the board. But one surprise provision of the new bill, written as a last-minute political compromise by Senate and House staffers, is regarded by some schools as so galling an intrusion into academic affairs that they are considering turning down some types of federal support as a matter of principle. The law requires that medical schools taking money under the health manpower bill accept a certain number of American students studying at foreign medical schools into their third year classes. Yale president Kingman Brewster is among those ready to say "thanks but no thanks" before agreeing to what he calls "an outrageous federal intrusion upon academic self-determination."

The federal government's involvement in medical education has come gradually, beginning indirectly about 20 to 25 years ago with support of research. But recently, the government has been supporting medical education more directly.