

Pan American Health Organization

PAHO/ACMR 9/P/3

NINTH MEETING OF THE  
ADVISORY COMMITTEE ON MEDICAL RESEARCH

Washington, D.C. 15-19 June 1970

PANEL ON MEDICAL EDUCATION

A STUDY OF THE MEDICAL DIAGNOSTIC PROCESS:  
METHOD AND PRELIMINARY FINDINGS

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A Study of the Medical Diagnostic Process:  
Method and Preliminary Findings

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The Medical Inquiry Project of the Office of Medical Education is studying the reasoning processes of expert physicians in a setting resembling, as closely as possible, the natural one in which physicians do their diagnostic work. Through detailed study of the procedures by which physicians elicit data from patients and reason about their data, we hope to improve our understanding of this complex process and to develop better methods of teaching these skills to medical students. We also hope to contribute to the psychological theory of problem-solving. Since diagnostic problems are a significant class of complex problems, an understanding of the procedures by which they are solved would be an important contribution to the psychology of thinking.

Setting and Procedure

Three simulated problems are used to study physicians' reasoning. They are intended to represent the kinds of diagnostic complexities and issues often encountered in clinical practice. A room has been designed to resemble a physician's office; two television cameras are mounted near the ceiling of this room and the entire interaction between the doctor and the "patient" is videotaped. The simulations presented to the physician-subject are based on actual clinical records. Actors from the MSU drama school have been trained to simulate the patients. Each is provided with a comprehensive history

of the case and has available far more data about the patient than is ordinarily requested in the course of a workup. The actor knows everything about the patient that he needs to know to present a convincing performance; he has been coached in how to describe his symptoms and how to carry himself so as to look convincingly sick. He has no fixed script beyond his opening statement of the chief complaint. After that point he responds to the physician's inquiries with as much detail as he feels like giving the physician in question; i.e., the actors have been instructed that if a physician makes them feel unwilling to talk they should, within reason, limit their verbal productivity. If, on the other hand, a certain physician makes the "patient" feel very willing to talk and enlarge upon his story, this should be done, again within reason.

#### Method

In two of the cases, the actor-patient is interviewed for the history of the present illness and the functional inquiry. When the physician is ready to begin the physical examination, the actor leaves the room and a medical student enters who serves as a "data bank." The physician-subject is instructed that this data bank contains all the information from the physical examination that he could possibly want but that it is available to him only upon questioning. The data bank can offer only the findings from the physical, not any interpretations. For example, if the physician asks for the blood pressure, he is told the reading but is not told if this is normal or deviant. The physical examination can be as

extensive or abbreviated as the physician chooses.

For the third case, a neurological problem, an actress has been trained to simulate both the history and the physical findings of the disease so the physician can conduct both a physical examination and an interview. This case has been specifically designed to confront the physician with the emotional problems of an acutely ill patient who is understandably agitated and upset by the sudden onset of severe motor deficits. The patient places a good deal of pressure on the physician to tell her what is wrong and to do something quickly to alleviate her distress. Here we can study the effect of intense emotional demand on the conduct of clinical inquiry.

In all three cases, the physician may order any laboratory tests he wishes, whenever he chooses. Any reports the physician requests are provided on the regular forms used by our university health service. It is stressed that the subject is free to elicit as much or as little data as he feels is necessary for the adequate solution of the diagnostic problem posed by the case, and that he may elicit these data in any order he chooses. The instructions ask only that the physician work in his customary manner and that he do whatever he feels is appropriate for the case at hand.

In summary, these three simulated cases provide an opportunity to observe the data-gathering and reasoning processes in physicians in moderately controlled circumstances. The situation resembles that of a doctor's office or a hospital emergency room and standardization has been introduced by

pre-designing the problems with which our physician-subjects will be confronted. In this way we gain an appropriate degree of experimental control without having created such an artificial situation that generalization to real clinical settings would be compromised.

Whenever a natural break occurs in the workup of the patient, the physician is asked to review and consolidate his findings aloud so as to provide an ongoing record of his reasoning about the problem at spaced intervals. The points at which this ongoing review is most usually obtained are (1) between the history and the physical examination, and (2) at the conclusion of the physical examination before ordering the laboratory tests. This latter point is one at which physicians characteristically review and consolidate their findings to determine what laboratory tests are needed. We routinely use this natural summary point in the clinical workup to have the physician record his thinking up to that moment.

After the full workup has been completed, the "recall" section of the experiment begins. At this stage the videotape of the physician's workup is replayed for him. He is given a stop-start switch with which he can control the playback, and he is asked to stop it whenever there is an event on which he can elaborate. He is encouraged to use the tape as a vehicle to stimulate his memory and to relate what he was thinking at the instant that he stops the tape. In this way, we try to get behind the observable behavior to the thoughts, feelings and associations that were going through his mind at the moment

that the events that he now observes were occurring. The review of an entire tape is a lengthy and demanding process. Generally, however, scrutiny of the first fifteen to twenty minutes of the encounter, a procedure ordinarily requiring one to one-and-a-half hours, provides an effective clarification of the thoughts and feelings the physician experienced during his contact with the patient.

Twenty encounters involving 17 physicians have been studied thus far with the simulation technique just described. The clinicians who served as experimental subjects have enthusiastically endorsed the simulation technique as an approach that is totally engaging and sufficiently real so as to demand their full attention and the mobilization of all of their resources. The simulations, in short, are convincing. Indeed, some physicians who have worked with the patient with the neurological problem report that they find themselves as exhausted by the strain of working with this actress-patient as they do from working with any real young patient who has been confronted with a really serious debilitating or life-threatening disease. Thus, we feel quite satisfied that we have created a situation which replicates the emotional involvement and intensity of actual clinical encounters while providing the degree of experimental control necessary for a scientific study of the process of clinical inference. Furthermore, the events produced in our simulated office are sufficiently like those which occur in actual settings that we believe that the findings generated by our studies will be generalizable back to the natural

setting for which they are intended.

Based on a preliminary analysis of data from the simulations, a tentative theory of medical inquiry has been outlined and an experimental study of association processes in physicians and third-year medical students designed to test one portion of this theory. The results of this experiment will be reported in more detail in a forthcoming publication. For the present, it is sufficient to state that the evidence suggests that physicians and students do, in fact, differ in the way they think about medical problems. A physician's strategy in asking questions changes as the problem becomes increasingly defined by the information already available to him. However, the medical students showed no changes in their pattern of questioning. This finding implies that while third-year medical students have already learned to ask questions, they have not yet learned to explicitly connect their questioning to specific hypotheses to be tested with the same facility as do physicians.

#### Educational Implications

This phase of the Medical Inquiry Project is intended to develop, on the basis of empirical data, an analytic scheme of the cognitive skills characterizing the diagnostic work of expert physicians. Based on this analysis, several steps of relevance to the education of medical students will be investigated and tested:

1. A series of instructional videotapes for medical students will be developed to make available to medical students

examples of expert clinicians solving complex clinical problems while offering a detailed commentary on the reasoning strategies employed and the difficulties encountered. These instructional tapes will supplement the students' more usual experience of accompanying a physician on ward rounds and obtaining a description from the teacher of how he worked through a case. In the real world of clinical service, these valuable encounters between master and student are, unfortunately, all too often abbreviated because of the pressures of clinical service. The simulation-with-recall format enables a physician to comment at length on his reasoning strategy and on the rapport problems which he experienced with a patient. Simultaneously, videotape makes it possible for a student to study the work of a physician at a leisurely pace and in a detailed manner. Comparison of the data that have been obtained from physicians in stimulated recall in contrast to the data obtained in asking for a discussion of the case on ward rounds indicates that the stimulated recall procedure provides a much more detailed exploration of the thought processes than can ordinarily be obtained in the natural hospital setting with its attendant pressures for service. It is expected that medical students will benefit significantly from the opportunity to observe medical reasoning closely in the manner facilitated by videotape. A number of medical students who have worked with us in the videotaping of the simulations have reported that the opportunity to observe was extremely valuable, for they could see the strategies and tactics of experienced physicians in much finer detail than was ordinarily



available.

2. It is our intention to devise a set of exercises in medical problem-solving to help medical students to develop problem-solving skills. Having identified these skills in the analysis of the simulations, we will be able to design instructional materials to assist students to acquire these skills more efficiently than is presently possible. A set of educational objectives based on an empirical analysis of physician performance can be written and used to design instruction specifically intended to help students meet those objectives.

One mark of the expert in the performance of complex intellectual skills is the capacity to resist being distracted by irrelevant data and non-contributory findings (noise). An important but unanswered question for instructional planning is at what levels of information to noise (I:N), or with what sequence of changing I:N ratios does learning best proceed? We plan to design various versions of the same simulated medical case with accurately determined and varying I:N ratios. A characteristic tendency to date in designing simulated medical instruction has been to strive to approximate reality at all stages and to have a consistently high noise level throughout the student's practice with the simulated materials. Work in other fields leads us to hypothesize that learning will be more efficient and effective if the noise level is not held steady but is, rather, sequentially increased from near zero at the outset to higher than characteristic levels toward the

conclusion of practice. Three experimental student groups will each be subjected to one of the following instructional patterns: (1) repeated practice with low noise simulated cases, (2) repeated practice with high noise simulated cases, and (3) practice with a sequence of cases having increasing proportions of noise. This study should provide a much needed guide to the improvement of design of simulations for use in instructing medical students.

3. Finally, it is possible that the problem-solving and reasoning skills involved in superior medical diagnostic performance are so ingrained in a physician's personality as not to be significantly alterable by the time he enters medical school. That is to say, it may be that medical school teaches a corpus of medical knowledge to which already existing superior problem-solving skills are applied by a subset of entrants. These problem-solving skills themselves may be entering characteristics of the students and may not be appreciably altered by medical training. If this is the case, then it would be desirable to identify these skills by means of new appraisal techniques employed at the time of applicant selection. In this way, a certain group of medical students could be selected on the basis of their possessing superior problem-solving abilities with the expectation that these students would go on to become the expert diagnosticians of the future.

Thus the third implication of our work would be at the point of selecting students for entry into medical school while the first two implications are aimed at modifying the

student's behavior once he is in medical school, through specially designed instructional programs.

Probably the most important implication of this entire project is that it will begin the long overdue process of filling the current void in our understanding of the most common and most fundamental of all processes in which physicians engage.