Decision Making of Clinical Teams:

Communication Patterns and Diagnostic Error

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This study examined the discussion of information among mixed-status clinical teams while constructing differential diagnoses. Twenty-four ad hoc teams, each consisting of a resident, an intern, and a third-year medical student, were given two hypothetical patient cases to discuss and diagnose. Prior to discussion, team members individually viewed different versions of a videotaped interview with a "patient" (trained actor). Each videotape contained some information that was present in all three versions (shared information) and some that was present in only that version (unique information). In addition, half of the time, the cases were constructed so that the unique information that appeared in only one tape was crucial for a correct diagnosis (a "hidden profile" condition). After viewing the videotapes, team members met to discuss the case and develop a differential diagnosis. Discussions were videotaped and analyzed. Overall, shared information was mentioned more often than unique information ($p < 0.0001$). Furthermore, teams offered incorrect diagnoses significantly more often for hidden-profile cases than for control cases ($p < 0.01$). The teams' overreliance on previously shared information (inability to appropriately utilize unique information) was detrimental when a correct diagnosis demanded the inclusion of such information. Clinical discussions that require the consideration of uniquely held information may be susceptible to error. *Key words*: clinical teams; decision making; communication patterns; diagnostic error; information sharing. **(Med Decis Making 2000;20:45–50)**

Professional teams are created for a number of reasons. In medicine, teaching rounds, interdisciplinary consults, and case conferences serve both clinical and educational functions. Collaborative efforts of this sort are designed to ensure that relevant information is brought to bear on clinical decisions, to facilitate the coordinated action of all involved toward appropriate and mutually agreeable treatment goals, and to train novices in the art of clinical reasoning.[1]

Perhaps the greatest potential advantage of team care is that it can allow for a larger and more diverse pool of information to be incorporated in decision making. Different members of a clinical team may attend to and analyze different aspects of the case and may take very different actions to evaluate potential solutions. For example, the management of a seriously ill geriatric patient may require input from specialties such as internal medicine and oncology, as well as from such allied health care professionals as nurses and nutritionists. In a teaching hospital, the management of the patient includes not only a cross-section of disciplines, but also the participation of medical students, interns, residents, and attending physicians. Such teams have the potential to make better decisions than lone problem solvers because they have the collective power to consider larger and more varied constellations of facts.

Research concerning the decision-making performances of teams in a variety of settings (both experimental psychology studies utilizing undergraduate students and a more limited number of field studies focusing on professional teams outside of medicine), however, has revealed that teams often fail to live up to their potential.[2,3] In general, teams seldom make decisions that are as accurate as that of the best individual on the team. The term "process loss" has been used by several researchers to refer to the interpersonal influences that lead groups to make less-than-optimal decisions.[4]

For example, some studies have shown that information that is possessed by all team members (previously shared) prior to discussion has an extremely

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strong influence on group decisions. In one study, researchers asked groups of university students to study written descriptions of three hypothetical candidates running for student body president. Some of the candidate information was read by all students in a group (shared information), whereas some was read by only one student (unique information). Although the students were told in advance that they were going to receive a mix of shared and unshared information, no one knew precisely which pieces of information were shared and unshared. Audiotape records revealed that, overall, the groups discussed 44% of the information they shared, but only 24% of the unshared information. Moreover, of the information that was mentioned, 41% of the shared information, but only 30% of the unshared information, was repeated.[5]

Similar results concerning group process were demonstrated by Larson et al. among medical decision-making teams.[6] Three-person groups, each consisting of a third-year medical student, a first-year resident, and a third-year resident, were shown hypothetical clinical cases. The subjects first individually viewed patient cases presented via videotape. Information was distributed across the videotapes so that some of it was seen by all members of a team (shared), while some was provided to only one team member (unshared). That is, each team member was supplied with a "personalized" set of information, some of which was unique to his or her videotape. When brought together to discuss the cases, the subjects mentioned 75.5% of the previously shared information and 63.5% of the unshared information. This reliance on previously shared information is not an optimal use of group resources, since uniquely held or previously unshared information may be most enlightening for the team as a whole.

The subjects in the present study faced a similar decision-making situation. Such situations arise because patients may offer different information to different health care providers and may also be inconsistent across time with the same provider. Consider the following case description:

> Jane Reynolds, a 45-year-old woman, presents at her doctor's office. The physician she is seeing today is covering for her regular doctor, who is away. Jane has a history of recurrent pneumonia and has not been feeling well. She thinks that she has the flu and is concerned about the possibility of having pneumonia again. Jane reports she has been having trouble swallowing food and has had a cough, fever, and swollen lymph nodes. She also complains of being bothered by some sores in her mouth and a rash on her face. In addition, Jane mentions that she is suffering from joint pain, swelling, and stiffness, for which she has been taking a lot of aspirin. She has a history of arthritis, as does her mother.

Jane's regular physician recently found that her white blood cell count was less than 4,000 and her ANA was positive (she does not report this to the current physician). Jane mentioned to a medical student (on clerkship) on the way into the office that she is not looking forward to summer this year, as she loves outdoor activities but burns very easily in the sun.

Given the constellation of symptoms described, Jane is most likely to have lupus. This diagnosis, however, may not be immediately obvious to the physician that Jane is seeing, since she is not aware of Jane's blood results or photosensitivity. The photosensitivity, in fact, is a factor that could easily be overlooked by many patients and physicians if they are not already considering particular diagnoses. The correct diagnosis of Jane Reynolds' case requires that information from numerous sources be combined.

One important mechanism for integrating case information is the patient's chart. The chart is designed to be a standard, fixed, reference point for depositing and retrieving information that is relevant to the case. Unfortunately, patient charts seldom offer a truly comprehensive record of all of the information that has actually been acquired. There is wide variablity in the amounts and details of the information that is catalogued, some of the information may not be fully understandable to all members of a decision-making team, and certain types of information (e.g., psychosocial information, patient desires or preferences, conflicting opinions of staff members) are not always included.[7,8]

Hence, the goal of the present study was to explore how thoroughly teams of physicians could discuss and integrate patient case information and how such discussion impacted diagnoses. Three-person groups, each consisting of a third-year medical student, a first-year resident, and a third-year resident, were asked to diagnose hypothetical cases. The subjects first individually viewed patient cases presented via videotape. Information was distributed across the videotapes so that some of it was seen by all members of a team, while some was provided to only one team member (i.e., each team member was supplied with a "personalized" set of information). In addition, half of the time, the cases were constructed so that the unique information that appeared in only one tape was crucial for a correct diagnosis (a "hidden profile" condition). In the hidden-profile condition the information most crucial for making a decision was distributed such that no one member held enough information to be able to reach the correct decision by him- or herself.[9] That is, prior to discussion, the correct diagnosis was "hidden" from the individual team members, despite the fact that the team as a whole had all of the

relevant case information. This stands in contrast to the control condition, where the information most crucial for diagnosing the case was contained in every tape, so that every team member should have been able to make the correct diagnosis by her- or himself. After viewing the videotapes, team members then joined together to discuss the case, generate a list of plausible diagnoses, and complete a series of questions regarding the clinical case and their perceptions of group processes.

Method

SUBJECTS

Twenty-four residents, 24 first-year interns, and 24 medical students were recruited from a large teaching hospital in the northeastern United States to participate in the study. Nine of the 24 residents were female, and the residents averaged 31.5 years of age, with 35.43 months of clinical experience. Eight of the 24 interns were female, and the interns had an average age of 29.7 years, with 18.25 months of clinical experience. Ten of the 24 medical students were female, with the medical students citing an average age of 26.5 years, with 9.3 months of clinical experience. As compensation for participating in the study, the residents, interns, and medical students were paid $40, $30, and $20, respectively. The pay differential was intended to make salient the member's differential status.

CASE MATERIALS

Two hypothetical clinical cases were created for the study. The diagnoses for the cases (lupus and Parkinson's disease) were chosen because they were moderately common and could include a variety of symptoms that would allow the consideration of other diagnoses. Case information was selected with the aid of Quick Medical Reference (QMR), one of the oldest and best-developed medical expert systems available, which at the time supported the diagnosis of over 600 complex diseases in internal medicine. The information included in each case was selected such that, when considered together, the target diagnosis (either lupus or Parkinson's) was ranked first by QMR. Thirty-one pieces of information were included in each case.

Multiple videotaped versions of each case were created, with slightly different versions to be viewed by the resident, the intern, and the medical student (versions A, B, and C). Each tape contained some information that was present in all tapes (shared information) and some information that appeared only in one tape (unshared information). Each tape contained 21 cues, five of which were unshared and 16 of which were shared.

In the hidden-profile condition, information appeared in the three tapes such that any one tape would lead to the wrong diagnosis (according to QMR). To construct hidden-profile cases, the most crucial pieces of diagnostic information were divided among the videotapes, making it impossible to generate a correct diagnosis without discussion. Tapes in the control condition also contained a mix of shared and unshared information; however, the critical information in this instance was shared (available in all tapes) so as to lead to a correct diagnosis without having to pool team members' information. Regardless of the particular distribution of information across tapes in any condition, each team, collectively, possessed a complete set of available case information (all 31 cues).

PROCEDURE

Each team of three subjects participated in the study separately. When the subjects arrived for the study, team members were introduced and it was explained that they would be individually viewing videotaped versions of patient interviews and would then join together in a lounge area and diagnose the case as a team. The subjects were informed that each member of the team would see a different version of the interview, containing somewhat different information (to simulate a clinical situation in which physicians independently examine a patient).

After the team members viewed their first tapes, they joined together and the resident was handed a "team diagnostic report form" that asked for the four most likely diagnoses and associated probabilities. The resident was told that as the senior member of the team, he or she would be responsible for the team's deciding on a diagnosis. Teams were informed that their discussions would be videotaped. No team took more than 25 minutes to complete a case discussion. After completing the team discussion, each person was handed an individual diagnostic form, upon which he or she listed personal diagnostic decisions and associated probabilities, as well as factors considered important in generating the diagnoses. The same procedure (viewing of tapes, team discussion, questionnaire completion) was then repeated for a second case.

To control for order effects, half of the subjects viewed the lupus case first and half viewed the Parkinson's case first. Further, half of the subjects in each case-order condition saw a hidden-profile case of the lupus patient and the other half viewed a hidden-profile case for the Parkinson's patient. In addition, three different tape-assignment patterns were used, such that across teams, the three ver-

sions (A, B, and C) were viewed equally often by each member of the team (resident, intern, student).

Results

A chi-square analysis (collapsing across case) revealed that the correct diagnosis was listed first more often by teams diagnosing control cases than by those diagnosing hidden-profile cases, χ^2 (1, 1) = 8.19, $p < 0.01$. Overall, 17 of 24 hidden-profile cases were correctly diagnosed, while all of the control cases were correctly diagnosed. The lupus case and the Parkinson's case revealed similar patterns based on hidden profiles. For the lupus case, the teams correctly diagnosed 9/12 hidden-profile cases and 12/12 control cases, while for the Parkinson's case, the teams correctly diagnosed 8/12 hidden-profile cases and 12/12 control cases.

In order to analyze the discussion of information, the videotapes were coded by two raters who were unaware of the study hypotheses or of which information (cue set A, cue set B, cue set C) had been seen by each subject. "Shared information" was that which had been in all three videotapes prior to discussion, while "unshared information" had appeared in only one tape. Coding was undertaken with the aid of a manual constructed by a panel of 15 general internists. The manual contained a variety of alternative expressions for each cue item. Intercoder reliability was relatively high ($r = 0.93$). A mixed-design analysis of variance, in which type of information was a within-teams factor, revealed a significant type of information main effect, $F(1, 36) = 80.90$, $p < 0.0001$. As predicted, the teams mentioned a larger percentage of their shared information ($M = 0.67$) than of their unshared information ($M = 0.46$).

Finally, an analysis of accuracy by expertise, revealed that experience did not significantly impact individual team members' overall performances [χ^2 (1, 2) = 1.77, $p > 0.05$]. The residents and the interns diagnosed cases correctly 77% of the time and 75% of the time, respectively, while the medical students were correct 85.42% of the time. The similarity in accuracy rates is coupled with high agreement between the group diagnoses and those diagnoses offered after discussion by each individual team member (the residents agreed with the team 92% of the time, the interns 90% of the time, and the students 94% of the time). It should be noted that all of our subjects completed the individual diagnostic form after team discussion and may have been unduly influenced by a push for consistency in reporting. (The decision to have a less biased picture of group decision making at the expense of a pure measure of individual decision making was necessary given the difficulty of recruiting large samples of teams).

Discussion

Findings from the present study indicate that open group discussion of a patient's case is a less-than-optimal means of pooling members' unshared information in clinical teams. As predicted, shared information that was possessed by all team members prior to discussion had a distinct advantage over unique information that was brought to discussion by only one team member. These results replicate those found in other studies in non-medical settings regarding the process of group discussion.[5,9] They also extend research on the weaknesses of clinical teams beyond the results of Larson et al.[6] by demonstrating, with another set of clinical cases, not only that group process is less than optimal for hidden-profile cases, but that team diagnosis may be prone to error in cases where unique information is essential for reaching a correct conclusion.

The failure to give adequate consideration to unshared information during group discussion can be attributed, in part, to the statistical fact that when fewer people hold a given piece of problem-relevant information beforehand; there is simply a lower probability that information will be mentioned. Thus, what occurs during the group's discussion is similar to what would happen if a single individual were to draw random samples from multiple, partially redundant pools of information—he or she would over-sample the redundant (shared) information and undersample the non-redundant (unshared) information. Research has found that the tendency to mention more shared than unshared information during a group discussion can be expected to increase as 1) the group's size increases, 2) the overall amount of problem-relevant information increases, and 3) the percentage of shared (vs unshared) information held in advance by individual group members increases.[9,10–13]

An important consequence of this suboptimal pooling is that unshared information is apt to have less impact on the groups' final decision than comparable shared information. In cases wherein uniquely held information is essential for a diagnosis (such as the hidden-profile condition), suboptimal pooling of information may lead to errors. While there may be many clinical situations where the quality of the diagnostic decision may not be harmed by the failure to appropriately utilize unshared or uniquely held information, it is not difficult to imagine how a hidden-profile situation may arise in clinical settings. Clinical decisions often involve people from different subspecialties and those with diverse amounts and types of previous experience. Different team members may attend to and analyze different aspects of a case using different tools and procedures, and may take very different

kinds of actions in order to evaluate potential solutions. As previously mentioned, the management of a critically ill geriatric patient with multiple medical problems may require input from several physicians in specialties ranging from internal medicine to psychiatry, as well as from such allied health care professionals as nurses and nutritionists. Because of their different roles and orientations, when they first approach the case these various individuals will naturally seek out and obtain different types of patient information. Moreover, different members of the medical team may be privy to different sets of information because of differential access to family members and/or variability in the patient's self-report.[14] To the extent that the different types of information obtained by team members are all relevant to the case, successful decision making requires that information be appropriately integrated.[15]

Given the difficulty that groups have in surfacing unshared information during discussion and the potential consequences for diagnostic decision making, it is of interest to speculate about what can be done to improve the situation. One suggestion might be to structure the problem-solving discussion in such a way that greater opportunity is given for problem-relevant information to emerge before any solution alternatives are considered. Larson et al. found that unshared information came to light earlier and more systematically when subjects considered the decision alternatives one at a time, that is, when they discussed one alternative before turning to the next.[5] Another possibility is to heighten group members' awareness of the types of information likely to be possessed by different individuals. For example, Stasser[9,16] found that when members knew who in the group had expertise in which specific knowledge domains, the amount of unshared information discussed increased significantly. In the clinical domain, this would argue for an explicit understanding of the specific information-gathering roles and interests (not just the medical specialties) of each group member. It may even be that certain types of leadership styles or techniques may be most helpful in trying to encourage the discussion of uniquely held information (e.g., the organizational leader who solicits information first from individuals before moving to team discussion).

As always, one might argue that the results of studies using hypothetical cases may not generalize beyond the laboratory to the clinical setting. In this case, however, one might question whether the errors of our subjects might even be amplified in the field setting. Our subjects knew that their diagnostic conversations were being videotaped and were made aware that they had all viewed somewhat different tapes of the same patient. Yet, they still demonstrated an overreliance on previously shared information and a tendency to misdiagnose the case more often in the hidden-profile condition (when the correct diagnosis could be found only if each team member shared a uniquely held piece of critical information). Real-world decision makers are seldom cued as to when a hidden-profile situation may exist, and may be quite vulnerable to diagnostic errors.

Furthermore, although the use of videotaped actors (vs written cases) provided a reasonably realistic presentation of patient cases, there is always the possibility that unintentional cues appearing in the tapes influenced diagnostic decisions. Finally, all of our subjects were chosen from the same teaching hospital and may therefore have been prone to an insitutitional or training bias in terms of group performance. Like most other teaching institutions, group process was learned through modeling. If the results of the present study are further replicated, it may be useful to offer training in group decision making to medical students and residents.

The present study clearly reveals a need to learn more about the prevalence, significance, and process of group decision making in medicine. If groups are shown to consistently make errors in diagnosing cases that require the inclusion of uniquely held information, it may be necessary to develop methods to ensure that information is properly exchanged and integrated in the decision making of clinical teams.

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QUOTATION

"The fact is basic. No one is going to rescue us. If we remain here, the chances are good that we will shortly be killed. If we go out to hide upon the moors we gain two months of wet clothes and misery, and then we will be killed anyway. If we pursue the original plan, at best we gain a great advantage and at worst we die in dignity, doing our enemies as much damage as possible."

"The chances of 'best' are few and of 'worst' many," grumbled Sul. "I for one am fatigued with these visionary schemes."

From *The Asutra*, by Jack Vance. New York: Dell, 1973.