Emergency Decision-Making by Nurses in the Context of Telephone Interactions

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Abstract

In Montreal, nurses respond to 9-1-1 emergency calls for medical help, backed up by physicians when needed. In this context, they have to make rapid decisions based on limited and sometimes unreliable information. The purpose of this study was to describe the decision-making processes used by nurses in telephone triage and to examine the relations among these processes in relation to nurses' characteristics and performance. The study was conducted in real emergency conditions. The sample included 34 nurses and 50 calls. Each call was transcribed and subjected to performance evaluation and content analysis. This paper focuses on the cognitive analyses of two protocols associated with different outcomes. The results show that nurses' decision-making in triage situations are often based on surface features (patterns of symptoms) rather than the underlying pathophysiology, particularly in high urgency cases. High performance was related to decisions based on the evaluation of the whole emergency situation. The contribution of training and the effects of experience on triage performance are discussed.

Introduction

Urgences santé, the Montreal system of Emergency Medical Services (EMS), introduced nurses into the pre-hospital chain of intervention in order to deal simultaneously with the rising cost of health care and the need to insure quality of care. Nurses assume the first-line response to emergency calls for medical help from the population through the 9-1-1 emergency line, assisted by an attending physician when needed. Established nine years ago, Urgences santé receives an average of a thousand calls a day, of which less than ten percent are serious emergencies and 35% result in the dispatching of emergency vehicles[1].

This task, referred to as triage, consists in assessing the level of urgency of a situation presented by a patient or someone calling for him[2], and in determining the appropriate intervention and delay[3]. It involves making decisions in the presence of several constraints. First, the telephone reduces the communication bandwidth. Second, triage represents an ill-structured domain and involves a high level of uncertainty. Third, time limitations constitute a "vital" constraint in this setting since the urgency and severity of any unattended call remain unknown and a delay can potentially cost a life.

Baumann (1987) defines decision-making in critical care situations in reference to "situations in which a choice is made among a number of possible alternatives, often involving trade-offs among the values given to diffferent outcomes" (p.1). She illustrates this distinction using the domain of medicine where problem-solving can lead to one solution, such as a diagnosis, while decision-making better describes the process of choosing among various therapeutic alternatives. Triage also involves both problem-solving and decision-making. Indeed, every triage situation represents a real-life problem of varying complexity whose solution must be reached in minimal time because of the impending urgency, but it also involves deciding among six alternatives[4].

Significant research has been done on clinical reasoning and decision-making processes in the medical domain where the diagnostic model is based on pathophysiological considerations (Barrows & Feltovich 1987; Elstein et al. 1978; Patel & Groen 1986). The clinical reasoning process used in medical diagnosis has been related to a

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[1] Emergency vehicles include ambulances with two technicians and Md-vehicles with a physician and a technician.

[2] In order to simplify the text, the feminine gender will be used to refer to a nurse an the masculine gender for a patient or a physician.

[3] The appropriate intervention may be "no" intervention and the implementation of this intervention may require some negotiation with the patient.

[4] These include: 1) sending a physician and an ambulance immediately; 2) sending an ambulance immediately; 3) sending an ambulance within 20 minutes; 4) sending an ambulance within 45 minutes; 5) referral and 6) advice. These decisions represent an hierarchy of the alternate solutions according to the associated levels of urgency.

hypothetico-deductive process (Barrows & Feltovich 1987; Feltovich et al. 1984). When solving ill-structured problems within their domain of expertise, medical experts formulate an initial diagnostic hypothesis, usually accurate (Patel 1988), which can be obtained from their highly organized knowledge base using pattern recognition and forward reasoning (Patel & Groen 1988). Medical experts also distinguish relevant from irrelevant information and attend only to the former (Patel & Groen 1988). As a result, their search is limited and their problem-solving efficient. However, experts may have insufficient domain-specific knowledge to solve an unfamiliar or novel problem, which brings them to rely more on backward reasoning (Joseph & Patel, 1986).

Triage represents a grey area between medicine and nursing where medical diagnoses may not be essential in order to make a decision about the appropriate interventions, and where the determination of the level of urgency becomes the primary focus of the reasoning process. The purpose of the present paper, drawn from a larger research on nurses' triage decision-making (Leprohon, 1991) is two-fold: 1) to identify the processes used by nurses in triage decision-making using a combination of cognitive methods; 2) to determine to which extent the relations among these processes, nurses' characteristics and triage performance confirm existing theories of problem-solving, decision-making and expertise.

Methodology

Based on ethnomethodological aspects of Suchman's work (1987), our methodological framework takes into account both the actor's "pre-understanding" (i.e. past experience and training) and the situation as it evolves in its context. Triage decision-making is dynamic and situated. Therefore, we chose to study it in its natural setting, in order to capture its authenticity and maintain its representativeness. We also combined several methods to get a more comprehensive view on decision-making processes and to enhance internal validity. These methods included discourse analysis of the calls, based on theories and methods developed within cognitive science for the analysis of reasoning processes during doctor-student (Evans and Gadd, 1989) and doctor-patient (Patel, Evans & Kaufman, 1989) dialogues. Another level of analysis represented information in terms of semantic networks based on discourse analysis and propositional representation of written discourse. Although the methodology used to evaluate the outcome of triage decision-making was derived from decision analysis theory, this paper focuses on the cognitive analyses that were used to describe telephone triage decision-making by nurses. The analysis of two calls associated with accurate and inaccurate decisions will serve to illustrate how the various methods have been assembled and lwill ead us into the discussion of some aspects of nursing expertise in the light of our present knowledge of medical decision-making. Data obtained in the larger study (Leprohon, 1991) will be brought in to corroborate some of these findings.

The final sample included 34 nurses actively working at Urgences santé who had a minimum of two years of clinical experience and who agreed to participate. Since the purpose of this study was to describe the decision-making processes involved, the calls were chosen by the nurses working in the triage setting based on three pre-determined exclusion criteria: 1) interactions where communication constraints interfered with decision-making; 2) interactions where the decision was not made exclusively by the nurse; and 3) interactions involving psychiatric cases. Each nurse was asked to select two calls within a specific period of time, approximately half a shift (i.e. three to four hours). After each selected call, she disconnected herself from the system in order to write down a summary and explanation of the case without being interrupted by another call coming in. The final sample included 50 calls.

Since all interactions were routinely audiotaped for legal purposes, the selected calls were transcribed verbatim and analyzed. Calls which resulted in the transportation of the patient by ambulance to the hospital or in a medical visit by an Urgences santé physician were followed up by consulting the hospital or Urgences santé's medical records, whereas for the other calls, the follow-up consisted of a telephone call within ten days from the initial call. Nursing records were also used to identify the decisions that were made. At the end of each call, nurses were asked to summarize the case and explain their decisions in terms of the patient's health status or prognosis. They were also asked to fill in a questionnaire including such information as their age, their experience and their working status.

Data Analysis

Although data analysis in the present paper focuses on the cognitive methods used for the fine-grain analysis of individual cases, the three levels of data analysis used in the larger study will be enunciated.

First, we used a methodology developed by Champagne et al. (1988) to determine the accuracy or inaccuracy of triage decisions. Each decision was thus compared to the optimal decision which experts determined by consensus based on the patient's medical diagnosis and/or his health status one week after the initial call. False negatives, generated by a lack of sensitivity, resulted in subobtimal interventions, and possibly in costs in terms of patients' health; whereas false positives, related to a lack of specificity, represented a "waste" of resources which could have been needed for other patients.

Second, at the process level, verbal protocols of real telephone interactions were first analyzed using discourse analysis in order to derive information about the nurse's reasoning from the flow of information going back and forth between the nurse and the patient. A medical expert

was then asked to elaborate a canonical network linking the final diagnosis and/or the patient's condition on follow-up to the relevant information obtained in the course of the real call. Finally, summaries and written explanations obtained retrospectively from nurses (immediately after completion of the call in order to minimize distortion), were analyzed using propositional analysis and represented in a semantic network.

These cognitive methods were combined as follows. Based on a summary of the discourse analysis, relevant information elicited by the nurse or volunteered by the caller and/or patient was mapped onto the causal network corresponding to the expert's representation in order to identify underlying reasoning stategies and to determine which information was available at the time the decision was made. The propositional representation of the nurse's explanation was used to elaborate another causal network which corresponded to the nurse's rationale for making a particular decision, or changing her decision, and for performing particular interventions. The final step of the analysis consisted of comparing these two causal networks and to examine any discrepancies since they may point out particular aspects of nurses' reasoning.

In the larger study, explanations were also subjected to content analysis which allowed for the macroscopic determination of decision-making processes, and decision times were measured on the basis of the number of exchanges comprising each call. Results from the latter analyses will only be reported punctually when they support the current findings.

Third, results from the survey on nurses' characteristics were analyzed and relations between these characteristics, process and outcome variables were derived. These will also only be reported when they support the findings resulting from the cognitive analyses.

Results and Discussion

Comparison of cases A and B illustrates the use of this multimethod approach. Case A, with a medical diagnosis of "subendocardial infarct", had a high urgency level and was associated with an accurate decision while Case B, with a medical diagnosis of "parietal chest pain", had a low urgency level and was associated with an inaccurate decision characterized by a lack of specificity.

Figure 1 presents excerpts from the summary of the discourse analysis of Case A. This call included two interactions: the first one between the nurse and the caller (i.e. the patient's wife) and the second one between the nurse and the patient. Figure 1 shows the opening statement of the wife and a few exchanges which preceded the nurse's decision. The black arrows point to observations elicited by the specific foci of the nurse's questions while the grey arrows indicate which of the nurse's questions refer to observations volunteered by the patient. The numbering of each piece of information according to the exchange containing it allows us to determine the timing of the decision with respect to the information available. In this case, the decision to send a physician and an ambulance immediately was reached at the 20th exchange (D20).

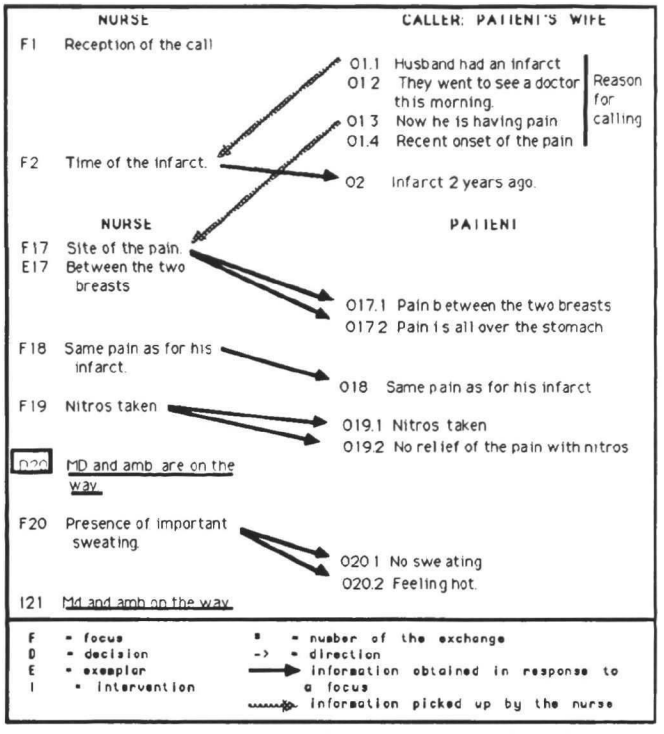

Fig. 1: Excerpts from the summary of Case A's discourse analysis

According to the ECN for Case A (Figure 2), the symptoms caused by the infarct and the supporting evidence had been obtained by the nurse prior to the decision. Although the information concerning the patient's heart failure condition only came up after the decision had been made, it was not directly related to the present diagnosis, hence not essential for decision-making.

According to the ECN for Case B (Figure 3), all the pieces of information from the discourse analysis corresponding to elements of the ECN had been obtained prior to the decision (D36) and were thus available to be used in the decision-making process.

At this stage of the analysis we have more information about the information available at the time of the decision and we can estimate whether the essential information pertaining to the diagnosis, as established by the medical expert (ECN), had been gathered when the nurse made her decision. However, we don't know exactly which of these pieces of information have actually been used by the nurse in making the decision nor do we know why she made that decision. In order to find out, we must examine the rationale underlying each decision.

The NCN for Case A (Figure 4) shows that the nurse considered cardiac arrest a direct potential consequence of the symptoms of cardiac distress that the patient was experiencing. This suggests that she made her decision

based on symptoms that she associated with a potentially fatal prognosis; there is no trace of any diagnostic hypothesis in her explanation. Also, retrospectively, the nurse included in her rationale information which had been gathered after her decision had been made. This suggests that she considered the heart failure condition of the patient confirming evidence for her decision and that she used this information in building a coherent representation of the situation. It also means that her rationale does not reflect her decision-making as it actually took place.

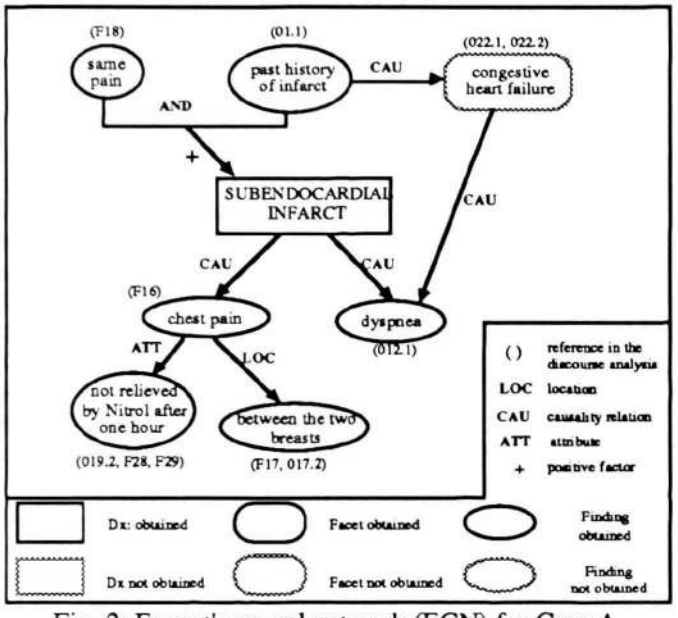

Fig. 2: Expert's causal network (ECN) for Case A

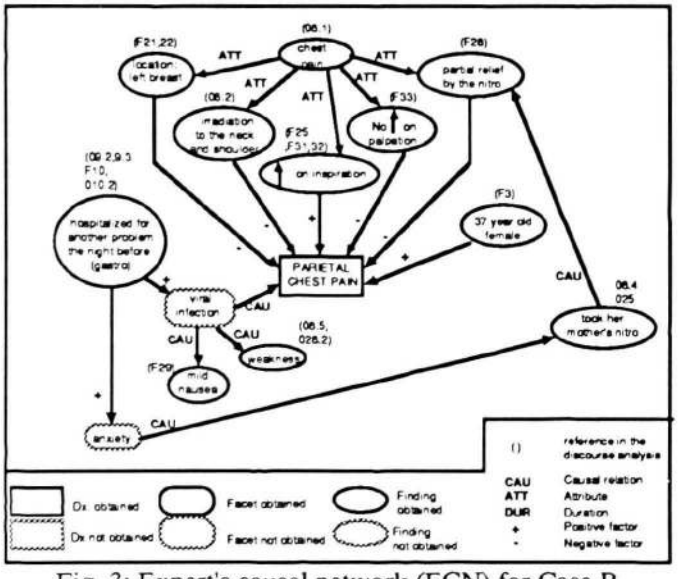

Fig. 3: Expert's causal network (ECN) for Case B

The NCN for Case B (Figure 5) shows that the propositions referring to the absence of modification on deep inspiration [10.1 and 10.3] contradict the information collected during the interaction and appearing in the discourse analysis (see ECN, Fig. 3: F31, 031; F32, 032). In the course of the interaction with the patient, the nurse seemed to collect information as if she had been guided by a prototype of cardiac chest pain, following a checklist of the important symptoms. Most of them supported the hypothesis of cardiac chest pain and she may have missed this divergent symptom. This error suggests that the nurse adopted the hypothesis corresponding to the schema or prototype of cardiac chest pain too soon in her interaction with the patient, orienting the remaining of the interview to gather confirming evidence for her hypothesis and ignoring information which did not fit the prototype, such as the fact that the pain increased on deep inspiration. This reflects a premature closure on the hypothesis of cardiac chest pain.

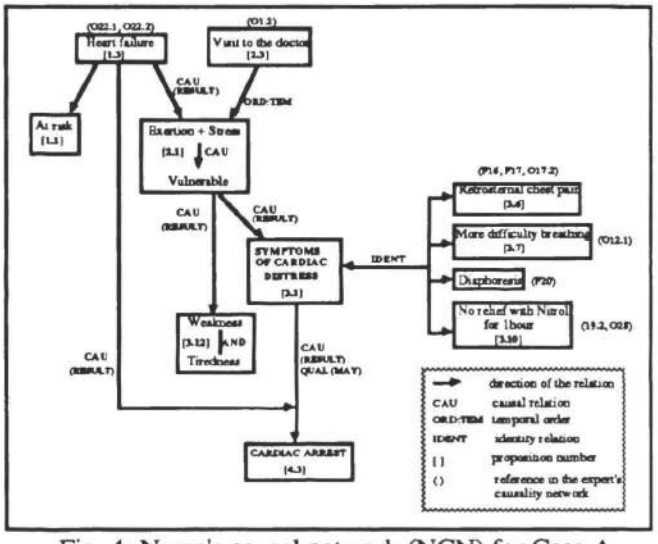

Fig. 4: Nurse's causal network (NCN) for Case A

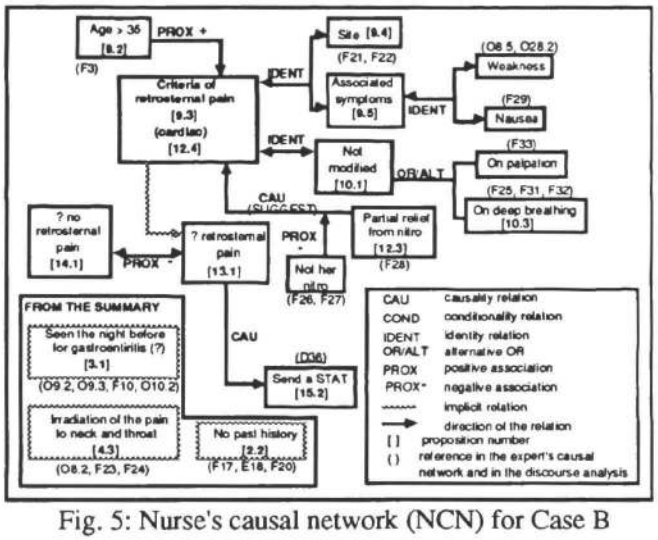

Fig. 5: Nurse's causal network (NCN) for Case B

When making her decision, the nurse could not establish beyond any doubt that the pain was not cardiac based on the extent to which the criteria for cardiac chest pain were met. As a result, she insured the sensitivity of her decision at the risk of reducing its specificity, conformingly to the organization's philosophy, and sent resources according to the worst situation, cardiac chest pain.

Since the ECN represents the pathophysiological explanation of the final diagnosis and/or the patient's condition while the NCN represents the pathophysiological explanation of the nurse's decision and interventions, the mapping of these two networks provides more information about the decision-making processes of the nurse. Hence, the two causal networks should overlap to the extent that the nurse bases her decision and interventions on a hypothesis corresponding to the patient's real condition. In Case A, we find that the symptoms caused by the infarct (O12.1, F16, F17, 017.2, F19, 019.2) according to the ECN (Figure 2) can be mapped onto the NCN (Figure 4), since they correspond to the symptoms of cardiac distress [3.6, 3.7, 3.10] identified by the nurse as potentially leading to cardiac arrest [4.3] and on which she based her decision to send a doctor and an ambulance immediately. On the other hand, a comparison of the ECN (Figure 3) and the NCN (Figure 5) for Case B shows that the nurse did not have a holistic perspective on the situation. She did not pick up the information pertaining to the patient's last hospitalization, although she did include it in her summary of the relevant information [3.1]. Consequently, she never considered the possibility that the pain may be related in some way to her recent gastroenteritis. Also, she did not detect the patient's anxiety, or at least did not attend to it, even though she mentioned reassurance as one of her interventions [8.1]. The addition of a false but important one to the list of criteria being met by this patient for the presence of cardiac chest pain has probably contributed to the inaccuracy of the nurse's decision. Indeed, she sent a doctor and an ambulance immediately while, according to the gold standard, the patient should have been referred to her doctor. In fact, this error represents one of the manifestations of the premature closure that the nurse demonstrated in her interaction with this patient. Her limited perspective on the situation constitutes another one.

Comparing the characteristics of the nurses who treated these two calls provides evidence supporting the role of experience in expert performance. The nurse in Case A had 20 years of experience in nursing, some emergency room and intensive care experience and she had been working in this organization for six years and a half. Her participation in the study involved two calls, one of high urgency and one of low urgency, and her decisions were accurate in both cases. The nurse in Case B, on the other hand, had seven years of experience in nursing, two years in an emergency department, and she had been working in this organization for four years. She also contributed two cases, one moderately urgent which was associated with an accurate decision, and this one, of low urgency, where her decision lacked specificity.

In fact, the nurse's explanation for Case B resembles to some extent the explanation provided by the other nurse for Case A (which really involved a cardiac problem), except for the type of reasoning involved. Case A involved forward reasoning, whereby a decision was made directly from the symptoms of cardiac distress. Case B, on the other hand, involved backward reasoning since the hypothesis of cardiac chest pain was directing the collection of supporting evidence. Another problem with Case B is the fact that the premature closure limited the scope of the triage assessment by adopting too soon an erroneous schema in a low urgency situation where several factors should have been considered in order to grasp the whole situation and make an accurate decision.

These results are in agreement with those obtained in the context of the content analysis and the interrelations observed among nurses' pre-understanding, calls' characteristics, process and outcome indicators. Indeed, general nursing experience of ten years or more has been associated with an accuracy rate of 64.9% as compared to 26.1% when experience is below this threshold. Also, decisions in the two calls (100%) whose domains were directly related to specific experience of the nurse and three out of the four calls (75%) where the relation was indirect were accurate as compared to only two calls out of four (50%) when it was unrelated.

These results suggest that nursing decision-making, at least in triage situations, is of a different nature than medical decision-making. 34% of the decisions were based on symptoms with an accuracy rate similar to the total sample's, i.e. 52.9%. Of these decisions, 58.8% were associated with calls in the high urgency category. This supports the finding that the decision can be made directly from symptoms in very urgent situations. These decisions must rely on prior instances in order to allow the nurse to determine, based on minimal information, the urgency of the situation and to make her decision.

Decisions based on a hypothesis, although there were only five, had an accuracy rate of 0%; while decisions based on the situation, with the same number, had an accuracy rate of 100%. Training may explain this difference. As opposed to physicians, nurses have not been trained to do medical diagnoses which involve the generation of hypotheses, but they have extensive training in assessing the patient's situation, inventorying the resources available and considering alternate interventions.

These results suggest that the nurse uses various approaches to decision-making, depending on the urgency of the situation. While ensuring that the intervention is implemented represents the priority in high urgency situations, representing exactly the situation, with the inventory of all available resources and reviewing alternate solutions is more important in low urgency situations.

Domain-specificity could also be found in relation to specific processes, but its effect seemed to some extent subsumed under the urgency-specificity. Clarifying the relationship between these two factors will require further investigation.

Conclusion

The predominant findings concern the decision-making processes used by nurses to make their decisions, which are based on symptoms, especially in situations involving a high level of urgency. Three main factors have been related to performance: the nurse's experience, the urgency and the domain of the call.

These results have important implications for practice and for training. First, hiring selection criteria, particularly with respect to experience, should be revised. Second, feedback on performance should be provided to ensure the acquisition of experience which, being specific to triage situations, may contribute significantly to increase triage performance. Training should as much as possible be situated and experiential. This could be achieved in the context of preceptorship which would also contribute to the evaluation of triage processes and performance.

These results thus enhance our knowledge and understanding of nursing clinical decision-making and this methodological approach should be applied to other domains.

References

Barrows, H.S., and Feltovich, P.J. 1987. The clinical reasoning process. *Medical Education* 19: 86-91.

Baumann, A.O. 1987. Rapid Decision Making in Critical Care. Doctoral thesis, University of Toronto.

Champagne, F.,; Contandriopoulos, A.P.; Eeckhoudt, L.; Kalina, M.; Farand, L.; Leprohon, J., and Preker, A. 1988. L'Evaluation du tri des appels telephoniques de la population aux services de santé. Projet de recherche soumis au FRSQ, Mars 1988.

Elstein, A.S.; Shulman, L.S., and Sprafka, S.A. (1978). *Medical Problem Solving: An Analysis of Clinical Reasoning*. Cambridge MA: Harvard University Press.

Evans, D.A., and Gadd, C.S. (1989). Managing coherence and context in medical problem-solving discourse. In D.A. Evans and V.L. Patel eds. *Cognitive Science in Medicine: Biomedical Modeling*. Cambridge, MA: MIT Press, pp. 211-256.

Feltovich, P.J.; Johnson, P.E.; Moller, J.H., and Swanson, D.B. 1984. LCS: The role and develoopment of medical knowledge in diagnostic expertise. In W.J. Clancey & E.H. Shortliffe eds., *Readings in Medical Artificial Intelligence*. Reading, MA: Addison-Wesley.

Joseph, G.M., and Patel, V.L. 1986. Specificity of expertise in clinical reasoning. In Proceedings of the Eight Annual Conference of the Cognitive Science Society. Hillsdale, N.J: Lawrence Erlbaum Associates.

Leprohon, J. 1991. Nursing Clinical Decision-Making in the Context of Clinical Interactions. Doctoral dissertation, Dept. of Educational Psychology, McGill University.

Patel, V.L. 1988. The Nature of Understanding and Problem Solving in Medical Expertise. Technical Report # CME8-CS4, McGill University, Montreal.

Patel, V.L.; Evans, D.A., and Kaufman, D.R. 1989. Cognitive framework for doctor-patient communication. In D.A. Evans and V.L. Patel eds., *Cognitive Science in Medicine: Biomedical Modeling*. Cambridge, MA: MIT Press, pp. 257-312.

Patel, V.L., and Groen, G.J.(1986. Knowledge Based Solution Strategies in Medical Reasoning. *Cognitive Science* 10:91-116.

Patel, V.L. & Groen, G.J. 1988 Toward a unified theory of problem solving: Views from the content domains. A view from medicine. Paper presented at the Annual Conference of American Educational Research Association, April 4-9,1988, New Orleans, Louisiana.

Suchman, L.A. 1987. *Plans and Situated Actions: The Problem of Human-Machine Communication*. New York: Cambridge University Press.