

Task Complexity and Nursing Expertise as Factors In Decision Making

SHEILA A. CORCORAN

This study used an information-processing approach and verbal protocol methodology to describe the initial and overall approaches to planning used by six expert and five novice nurses for three patient cases of varying complexity. Subjects did not change their initial approaches significantly across the cases. Most experts consistently used broad initial approaches, but no clear pattern was evident in novices' use of initial approaches. Experts varied their overall approaches as a function of case complexity; novices did not. Most experts used opportunistic overall approaches in the more complex cases; that is, they jumped about, pursuing whatever was opportune at a given point in the planning process. However, they used systematic overall approaches in the least complex case. In contrast, most novices used opportunistic overall approaches in all cases. No relationship was found between overall approaches used and quality of plans developed. The findings support the cognitive model of planning proposed by Hayes-Roth and Hayes-Roth (1979) and the conclusion found in information-processing literature that the task itself is a major determinant of decision-making behavior.

Little is known about the cognitive processes used by nurses to plan patient care. This study was undertaken as an important step in describing such processes.

Review of the Literature

Information-processing theory describes problem-solving behavior as an interaction between a problem solver and a problem task (Newell & Simon, 1972; Simon, 1979). Humans are viewed as information-processing systems operating in complex environments. A major assumption of this

theory is that there are limits to human capacity for rational thought. Despite the almost infinite capacity of long-term memory, short-term memory is limited. There is evidence that the capacity of short-term memory is seven, plus or minus two, "chunks" of any organization of information that has previously become familiar (Miller, 1956; Newell & Simon, 1972).

One concern of investigators in this field is how humans adapt this limited capacity to the complex demands of their environment. Another concern is the extent to which decision-making processes used by individuals are invariant across tasks. Findings indicate that the task itself is a major determinant of behavior; that is, information processing in decision making is highly contingent on the demands of particular tasks (Newell & Simon, 1972; Payne, 1976, 1982; Simon, 1979). Payne (1976), in particular, found task complexity to be one of the variables that influence information processing.

Recent research has been extended from the study of naive subjects to that of experts, and from the study of simple tasks to task domains that require specific knowledge as well as general problem-solving skills (Simon, 1979). Planning nursing care is an example of such a domain.

In a cognitive model of planning, Hayes-Roth and Hayes-Roth (1979) proposed that planners use opportunistic approaches to complex plan-

ning tasks by pursuing whatever seems opportune or promising at the time. They compared their model of planning to earlier models in which planning was viewed as a process that proceeded in an orderly, top-down sequence. In these models one could use a broad initial approach to gain an overview of a situation or a narrow initial approach to immediately focus on one aspect of the situation for decision making. Whether breadth-first or depth-first initial approaches were used, the overall approaches in the earlier models of planning were systematic and orderly. In contrast, opportunistic planning is described as multidirectional, with a plan developing by increments. The planning may appear chaotic and disorderly as the subject searches to develop promising aspects of the plan in progress.

Hayes-Roth and Hayes-Roth (1979) recognized that opportunistic planning creates a greater memory load than does the systematic nature of the top-down process. However, they suggested that for planning in tasks fraught with complexity and uncertainty, opportunistic planning may free the planner of the burden of maintaining a systematic approach and, more importantly, may produce better and more varied plans. Both opportunistic and systematic models have merit and, in fact, the systematic model may be a special case of the opportunistic model. The question remains: Under what conditions do

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SHEILA A. CORCORAN, PhD, RN, is an associate professor in the School of Nursing, University of Minnesota, Minneapolis, MN.

planners use each model? Suggested variables that influence planners' approaches to particular planning tasks are problem characteristics, individual differences, and expertise.

The purpose of this study was to describe the approaches to planning used by nurses. The variables of problem complexity and expertise were investigated in relation to initial and overall approaches to planning used by hospice nurses. The planning task was to develop a drug administration plan with a goal of controlling patients' pain. Three major questions were investigated:

1. How do the initial approaches used by experts in three planning tasks of varying complexity compare with those used by novices?
2. How do the overall approaches used by experts in three planning tasks of varying complexity compare with those used by novices?
3. Is there a relationship between the overall approaches used in each case and the quality of the plans developed?

Method

Subjects: Two groups of subjects were formed, experts and novices in hospice nursing. An expert was a registered nurse currently employed in a leadership position who had had at least 18 months experience in hospice nursing. In addition, an expert met at least one of the following criteria: had published articles on hospice nursing and/or pain control, had made presentations on hospice nursing and/or pain control to professional groups, had offered continuing education programs on hospice nursing and/or pain control, or was labeled as an expert in hospice nursing and/or pain control by at least five hospice nurses when they were asked to identify an expert.

A novice was a registered nurse currently employed as a staff nurse who had had less than 6 months' experience in a hospice program.

Subjects were paid volunteers from three hospice programs within one metropolitan area. All hospice nurses in the three programs who met the criteria for either an expert or a novice participated in the study. Of 11 subjects, 6 were experts and 5 were novices. There was at least one expert and one novice from each hospice program.

The experts were slightly older than the novices. Four of the six experts had master's degrees and two had baccalaureate degrees. In contrast, two novices had baccalaureate degrees and the other three had associate degrees or hospital diplomas. Four of the experts had more than 10 years of experience in nursing and none had less than 4 years. Two novices had 7 to 10 years of experience in nursing and the other three had 1 to 3 years.

Materials: CASES. Three written cases were developed for this study. They represented three types of severe chronic pain and three levels of complexity for decision making. The level of complexity of a planning task was determined by: the number of pain-related problems presented by the patient in the case, the interrelation of the pain-related problems, and the extent to which hospice protocols for pain control could be applied to the case.

The case descriptions were developed by the investigator and a consultant, who was an expert in hospice nursing. A list of 20 information categories was developed to describe each patient. The categories included patient characteristics that could influence the choice of drugs for pain control (Gotz, 1980). Actual patient histories were used to represent the three types of severe pain and to develop case descriptions.

CRITERION MEASURES. In complex situations, such as the three cases in this study, no one drug administration plan can be identified as the right one for controlling a patient's pain. However, the consultant developed a recommended drug administration plan for each case that served as one standard of comparison. The final written plans developed by each subject were compared with the consultant's plans and judged to be in one of four quality categories:

1. *Consistent with the consultant's plan for the case.* The plan addresses all major pain-related problems, and treatments chosen for each problem either match or are comparable to those of the consultant.

2. *Appropriate for the case, but not consistent with the consultant's plan.* The plan addresses all major pain-related problems, and appropriate treatments are chosen for each according to the literature on pain

control and/or hospice standing orders. However, the subject's choice of treatments does not match those of the consultant.

3. *Incomplete.* The plan does not address all of the major pain-related problems presented by the patient.

4. *Erroneous.* The plan includes a choice of treatment inappropriate for the patient, according to the literature on pain control or as evaluated by two expert judges.

Procedure: DATA COLLECTION. Data were collected from each subject in two 2-hour sessions. Initially, each subject was given consent and demographic forms to complete, and a copy of general instructions describing the study. The subject was then given a written case description and asked to: read the case description aloud, develop a drug administration plan, and write the plan. The subject was instructed to think aloud while performing these three tasks. Verbalizations were tape-recorded and later transcribed into verbal protocols.

The task of writing the plan was included in this study to separate the planning process from the final plan in subjects' thinking and in the analysis of data. Subjects could change their minds about drugs to recommend as long as they were developing their plan; but the written plan indicated their final choices.

No time constraints were placed on the tasks. Subjects were told that they could use the case descriptions as worksheets and were given an opportunity to practice the procedure using a sample case of low complexity before moving on to the three study cases.

In the first session, all subjects were given the sample case and Case B. In the second session, all subjects were given Case A, followed by Case C. Therefore, each session included a less complex and a more complex case.

DATA ANALYSIS. Rules were developed for coding and scoring initial approaches, overall approaches, and quality of the final plans. An example of a rule for coding an initial approach was: If a subject comments on two or more of the patient's pain-related problems immediately after reading the case description, but before making any decisions, code the initial approach as broad.

After each verbal protocol and the final plan were coded and scored, comparisons were made between experts' and novices' approaches to planning and their final plans across the three cases.

INTERJUDGE AGREEMENT. To test the reliability of the coding and scoring of data, two judges independently applied the coding and scoring rules to 10 of the 33 verbal protocols and written plans. Cohen's (1960) coefficient of agreement for nominal data, k , was used to determine the proportion of joint judgments in which there was agreement after chance agreement was excluded. The mean Cohen's coefficients on the sample of 10 were: initial approaches, 0.78; overall approaches, 1.00; and quality of plans, 0.86.

Results

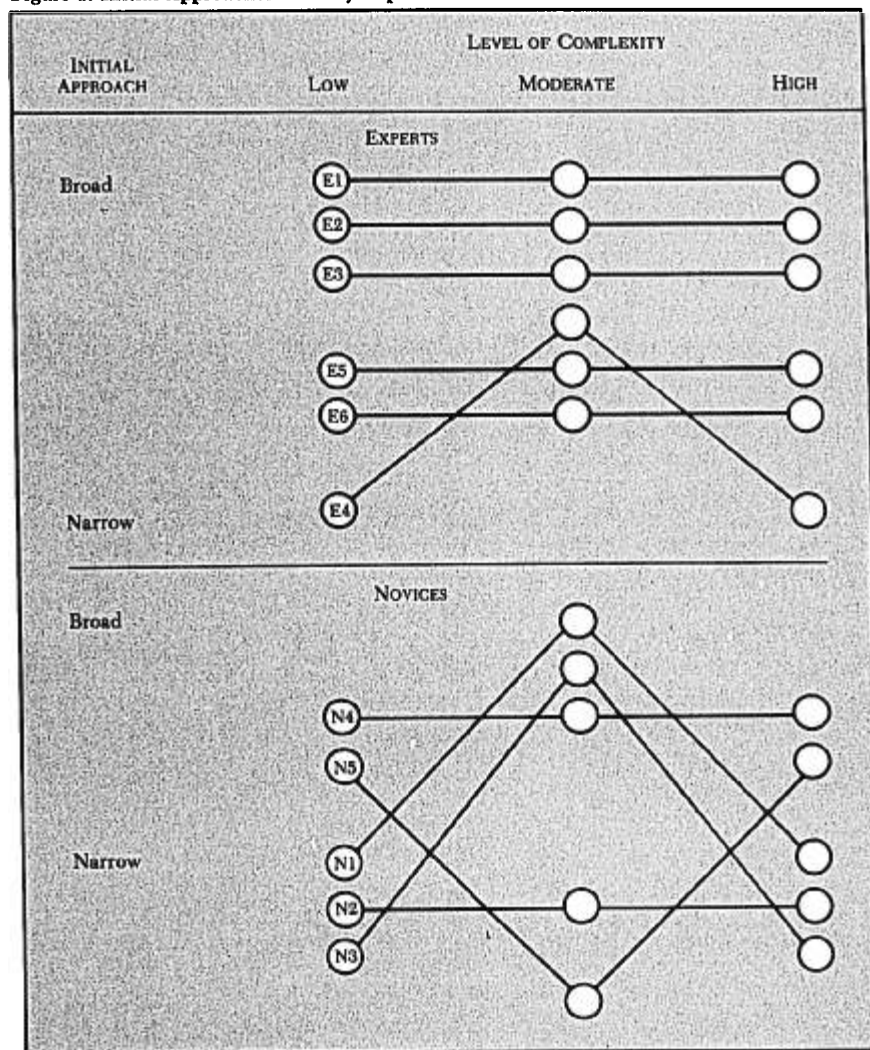
Initial Approaches: The Cochran Q test showed that neither experts nor novices varied their initial approaches significantly across cases, $Q(2) = 2.0, p < .5$ for experts, and $Q(2) = .66, p < .8$ for novices (see Figure 1). Consequently, there was no relationship between initial approaches and complexity of cases. However, experts used broad initial approaches significantly more often than did novices, Fisher's exact $p = .011$.

The following portion of an expert's verbal protocol illustrates a broad initial approach in which the subject gained an overview of the patient's situation before making decisions concerning drugs:

Let's see now. Her first, early history says that she had osteoarthritis. And hip replacement, bilateral. So arthritis could be part of her pain now, too. Uh, adenocarcinoma of the lung. Liver function tests were normal. But we don't know what they are now because we didn't do any tests. We don't know whether she's... this confusion she's having is because she is piling up the oxycodone from the Percocet®, or what. Uh, so her reactions have changed because she is angry and miserable, because she has pain. She hasn't taken care of herself. She is not well groomed any more. So she has had quite a switch in everything. Because of the pain, probably. Also, her disease may be progressing and she is just generally... Her disease is progressing and she may be approaching death also. So, it seems like her pain was uncontrollable now by Percocet® every 6 hours, which doesn't surprise me.

In contrast, the following portion of a novice's verbal protocol illustrates a narrow initial approach in

Figure 1. Initial Approaches Used by Experts and Novices Across Cases



which the subject immediately focused on decision making regarding the drug administration plan.

OK. I would probably continue with the Tylenol No. 3®, every 3 to 4 hours, for about 24 hours. Just to see if the way he describes the pain, I mean, if excruciating is really something that can be managed with Tylenol No.3®.

Overall Approaches: Experts varied their overall approaches significantly across cases, $Q(2) = 6.5, p < .05$ (see Figure 2). Most experts used opportunistic overall approaches in Cases B and C, the more complex cases, and systematic overall approaches in the least complex case, Case A. In contrast, most novices used opportunistic overall approaches across all cases $Q(2) = 3, p < .3$ (see Figure 2).

The following portion of an ex-

pert's verbal protocol illustrates an opportunistic overall approach.

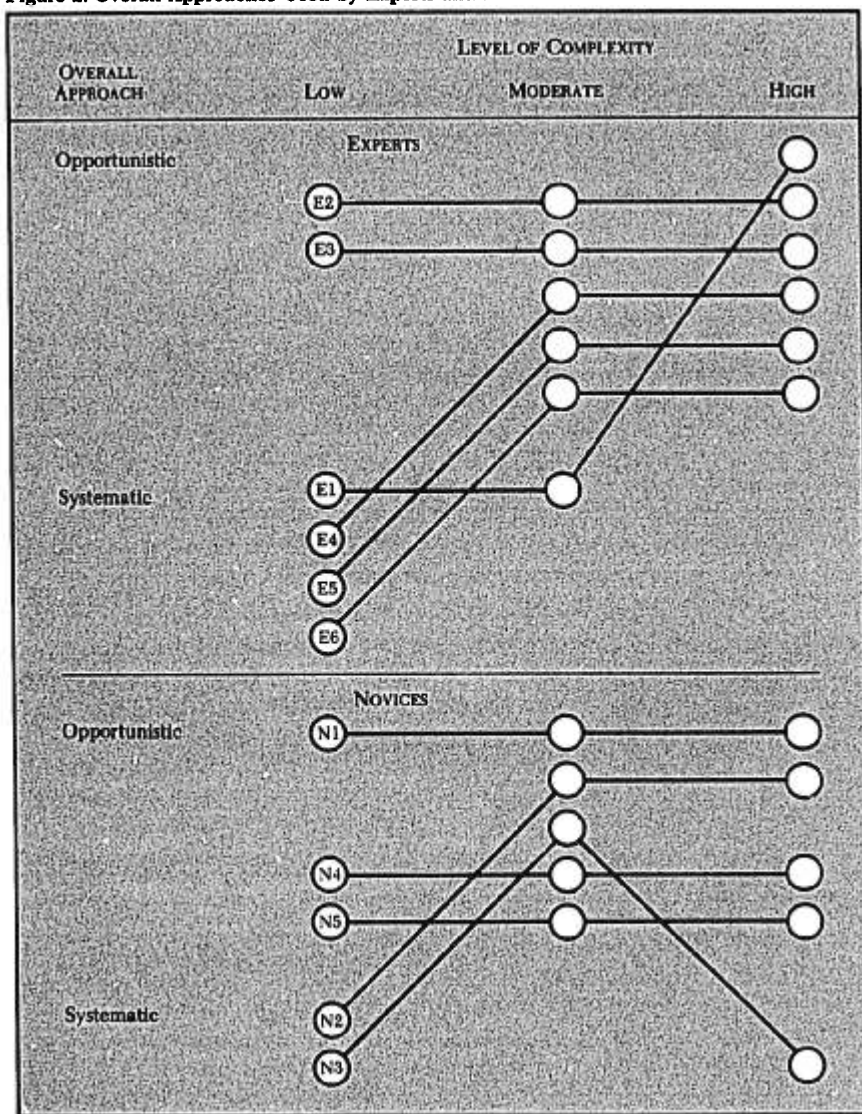
Her pain seems to be beyond Percocet®. But I might try doubling the dose, increase it to every 4, since she had good results from that at one point. Again it might be wise, especially with her history of arthritis, to maybe just stop the Ascriptin® and start Indocin® just for the heck of it, and see if that would work. (sigh) And then I'd consider stopping the Vistaril®, 50 of Vistaril® every 4 hours is a pretty high dose for someone that frail, and it doesn't seem to be doing that much for her anxiety...

Uh, one might consider... and I need the doctor's advice about considering some Decadron®, both for her arthritis and possible brain metastasis. I'd have to work on her bowels again. Our bowel regimen is to use Senokot® and Milk of Magnesia with Cascara® for severe problems...

Methadone is sometimes a consideration for people who have problems with morphine. But with someone like this who is older already having problems with mental clarity, methadone tends to pile up...

It is incredible how all these issues are inter-

Figure 2. Overall Approaches Used by Experts and Novices Across Cases



mixed. I mean, you can't just talk about oral morphine without talking about unfinished business, without talking about lack of sleep and constipation. It's just incredible.

Initially, the expert addressed generalized pain and then moved to the more specific problem of arthritis. Next, the problem of anxiety was noted, but then the expert returned to arthritis along with possible metastasis. A seemingly divergent concern regarding constipation was addressed prior to returning to generalized pain. Finally, the interrelatedness of problems was described which explained the jumping about.

In contrast, the following portion of an expert's verbal protocol illustrates a systematic overall approach.

But we need to start with some really super particular care to that mouth. Warm rinses of

saline and hydrogen peroxide followed up with Mycostatin® . . .

Now, he's been getting—obviously we're going to have to step up the analgesic ladder from Tylenol No.3®. And I don't think we could monkey around with it. And because he's only been on that little bit of codeine (Tylenol No.3®). I don't really know how he's going to react. We could go up the ladder and use Dilaudid® or something.

I think for him, because I know what the progression of this kind of adenocarcinoma is, that is metastasized to the liver, I think that I would get him on a low dose of oral morphine. I have seen OMS work good for liver pain. I would start out with 5 mg and see how it went. We don't know how he's going to metabolize that. We would continue to give him oral morphine and go up in 5 mg increments until we got a comfortable dose. If he is nauseated, then I would give him Compazine® and continue to give it to him a half hour before the morphine, just to see how it goes. . . .

We haven't taken a look at his bowels at all. It doesn't say anything here about his bowels. They may be severely impacted at this time.

First, the expert addressed the problem of mouth pain. Next generalized pain was addressed, followed by possible nausea, often a side effect of narcotic analgesic drugs. Finally, the expert addressed the possible problem of constipation, another frequent side effect of narcotic analgesics. The subject addressed single pain-related problems at adjacent points in the process, in a systematic approach. The subject did not jump about addressing single problems at different points.

Quality of Plans: There was a trend for experts to develop better final plans than did novices, Fisher's exact $p = .147$. Novices developed better quality plans in Case A, the least complex case, than they did in the two more complex cases. However, experts developed better quality plans in Case C, the most complex case. All experts developed appropriate plans for Case C, while at least two of them developed incomplete or erroneous plans in the two less complex cases.

There was no significant relationship between the overall approaches used and the quality of the plans developed by all subjects, Fisher's exact $p = .182, .636$, and $.273$ for Cases A, B, and C, respectively. Further examination of the relationship between overall approaches and quality of plans developed by each group in each case revealed one significant relationship. In Case C, the most difficult case, all experts used opportunistic overall approaches and all developed appropriate plans, Fisher's exact $p = .0002$.

When incomplete or erroneous plans were developed, the verbal protocols were examined to identify sources of difficulty in the planning processes. The sources of difficulty leading to incomplete plans were: (a) failure to overtly recognize a pain-related problem (two experts and two novices); (b) forgetting a pain-related problem that was overtly recognized earlier in the planning process (three experts); (c) overtly dismissing a recognized pain-related problem as not relevant to the task (one expert); and (d) lack of knowledge about alternatives (one novice). Two experts had two incomplete plans each, and one novice had three incomplete plans.

The sources of difficulty leading to erroneous plans were: (a) failure to

combine information about an alternative with information about the patient (one expert and one novice); (b) lack of knowledge about alternatives (three novices); and (c) oversimplification of the planning problem by dismissing all but one major pain-related problem (one novice). Of the five erroneous plans developed by novices, two novices developed two each. In addition, one expert and two novices each developed a plan that was both incomplete and erroneous.

Dismissing a pain-related problem and recognizing, but then forgetting, a pain-related problem were sources of difficulty leading to incomplete plans unique to experts. Lack of knowledge and oversimplification of the planning problem were sources of difficulty leading to incomplete or erroneous plans unique to novices.

Discussion

Despite the varying complexity of the three planning tasks, expert and novice nurses did not vary their initial approaches to planning. Most experts consistently used broad initial

approaches to planning, but no pattern was evident for novices. Overall, novices used narrow initial approaches more often than broad ones. Experts seemed to interrelate data concerning primary sources of pain, possible treatments, and side effects of treatments. Consequently, they could develop a broad picture of the patient when initially addressing the planning task prior to decision making. In contrast, novices usually focused on a single pain-related problem for decision making immediately after reading a case description. Each pain-related problem seemed to be a separate chunk of information from the case description.

The finding that experts varied their overall approaches across cases of varying complexity supported the findings of Payne (1976, 1982) and others that information processing in decision making is highly contingent on the demands of the task.

Experts' use of opportunistic overall approaches in the more complex cases, Cases B and C, was consistent with the model of planning proposed

by Hayes-Roth and Hayes-Roth (1979). A possible explanation for experts' use of a systematic approach in the least complex case is the fact that experts were experienced planners working with a familiar, constrained problem. Case A in this study represented a rather typical hospice patient, one more familiar to experts than the other cases; the appropriate treatments in Case A were common treatments used in hospice programs. It was not surprising that most novices used an opportunistic overall approach across all cases, as all cases were complex for them.

Although it was expected that experts would develop better final plans than did novices, only a trend was found. A possible explanation for this was based on examination of the transcripts associated with incomplete plans. One expert developed an incomplete plan after a major pain-related problem was overtly recognized, but then explicitly dismissed, because it represented acute pain, not chronic pain. The general instruction to subjects indicated the cases would

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involve persons experiencing severe, chronic pain. Therefore, the instructions may have misled that expert. Another possible explanation for only a trend is that the three experts who developed incomplete plans forgot a major pain-related problem because they had generated alternative courses of action beyond the limits of their short-term memories. They had generated 13, 21, and 35 alternatives, respectively, which were among the highest number of alternatives generated in the particular cases. Those numbers are beyond the limits of short-term memory (Miller, 1956). In these instances, the experts overtly recognized all of the patient's major pain-related problems, but then forgot one of them in the process of generating and evaluating many alternatives. Also, five erroneous plans were developed by three novices, but only one expert developed an erroneous plan.

The possible explanations for only a trend in experts' developing better plans than did novices may also explain the finding of no significant relationship between overall approaches and quality of plans. While

Hayes-Roth and Hayes-Roth (1979) proposed that opportunistic planning leads to better plans in complex tasks, they acknowledged that opportunistic planning creates a greater memory load than does systematic planning. Subjects may be more likely to forget parts of a plan when using opportunistic planning, unless memory aids are used.

Recommendations: Several directions for further research are suggested by the present study. Similar studies using other planning tasks are needed to examine the circumstances under which nurses use various approaches. In particular, studies are needed to investigate planning tasks unique to nursing. Studies are also needed to contrast decision-making processes used in emergency and nonemergency situations and to contrast situations familiar to subjects with those that are unfamiliar.

The findings of this study, that decision-making processes used by a particular individual are neither invariant across tasks nor necessarily systematic, have implications for teaching nursing process. Much more needs to be known about decision-

making during planning before specific procedures or strategies can be prescribed. However, the findings of this study do suggest that decision aids might be useful in overcoming the limited capacity of short-term memory, decision aids as simple as note-taking or as complex as decision analysis diagrams. **NR**

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Abstracts are requested for the 6th Annual Research Conference of the Southern Council on Collegiate Education for Nursing, to be held in Shreveport, LA, December 4-5, 1986. Deadline for submission of abstracts is **April 1, 1986**. For information contact: Patricia A. Moxley, EdD, RN, Northwestern State University, College of Nursing, 1800 Line Ave., Shreveport, LA 71101.

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