ORIGINAL ARTICLE

Thinking in Clinical Nursing Practice: A Study of Critical Care Nurses' Thinking Applying the Think-Aloud, Protocol Analysis Method

Kyung-Ja Han[1]*, RN, PhD, *Hesook Suzie Kim*[2], RN, PhD, *Mae-Ja Kim*[1], RN, PhD, *Kyung-Ja Hong*[1], RN, PhD, *Sungae Park*[1], RN, PhD, *Soon-Nyoung Yun*[1], RN, PhD, MPH, *Misoon Song*[1], RN, PhD, *Yoenyi Jung*[3], RN, PhD, *Haewon Kim*[4], RN, PhD, *Dong-Oak Debbie Kim*[5], RN, PhD, *Heejung Choi*[6], RN, PhD, *Kyungae Kim*[1], RN, PhD

[1]Professor, College of Nursing, Seoul National University, Seoul, Korea
[2]Professor, College of Nursing, University of Rhode Island, Kingston, RI, USA
[3]Department of Nursing, Samsung Medical Center, Seoul, Korea
[4]Professor, Department of Nursing, College of Medicine, Kwandong University, Gangreung, Gangwon do, Korea
[5]Associate Professor, Department of Nursing, College of Oriental Medicine, Daejeon University, Daejeon, Korea
[6]Associate Professor, Department of Nursing, College of Medicine, Konkuk University, Chungju, Chungbuk, Korea

Purpose The purpose of the paper is to discover the patterns and processes of decision-making in clinical nursing practice.

Methods A set of think-aloud data from five critical care nurses during 40 to 50 minutes of caregiving in intensive care units were obtained and analyzed by applying the procedures recommended by Ericsson and Simon for protocol analysis.

Results Four thinking processes before acting were identified to constitute various sorts of thoughts in which the nurses were engaged during patient care: reviewing, validation, consideration, rationalization, and action. In addition, three patterns of sequential streaming of thinking (short, intermediate, long) were identified to reveal various ways the nurses dealt with clinical situations involving nursing tasks and responsibilities.

Conclusion This study specifies the initial categories of thoughts for each of the processes and various patterns with which these processes are sequentially combined, providing insights into the ways nurses think about problems and address their concerns. The findings suggest that the thinking in clinical practice involves more than focused decision-making and reasoning, and needs to be examined from a broader perspective.
[*Asian Nursing Research* 2007;1(1):68–82]

Key Words clinical practice nursing research, critical care, nurses, thinking

***Correspondence to**: Kyung-Ja Han, RN, PhD, Professor, College of Nursing, Seoul National University, 28 Yongon-dong, Chongro-gu, Seoul, 110-799, Korea.
E-mail: hankj@snu.ac.kr

INTRODUCTION

Clinical practice in nursing involves nurses' engagement in both thinking and doing. Nurses make clinical decisions regarding patients' problems, formulate them into nursing diagnoses, and regard nursing interventions in terms of what to do, when to do them, and how to do them. Kim (1993) calls these two types of clinical decisions *concept* and *action* decisions, and Hamers, Abu-Saad, and Halfens (1994) identify them as two specific types of nursing decisions. Clinical decision-making is a critical aspect of nursing practice as through this process nurses frame patients' needs, decide upon choices for approaches, and meet patient-care needs.

In the current health care situation in this country, nurses require more accountability for patient care. Much technological development has taken place in health care in recent years, especially in the area of critical care. Although technological developments provide the potential for improvements in health care, devices alone will not effect these changes. Effective use of thinking strategies is essential to strengthen nursing practice and improve care outcomes.

Studies of nursing practice have often focused on identifying or examining the process of decision-making in natural settings or through the use of clinical scenarios or simulated cases, and applying various research methods. Such investigations revealed nurses' use of information processing involving hypothesis generation-confirmation (Offredy, 2002; White, Nativio, Kobert, & Engberg, 1992) and the use of heuristics (Cioffi & Markham, 1997; Kremer, Faut-Callahan, & Hicks, 2002; Simmons, Lanuza, Fonteyn, Hicks, & Holm, 2003), the use of intuition (Hicks, Merritt, & Elstein, 2003; Rew, 1990), or combinations of different processes, including pattern recognition (Fowler, 1997; Redden & Wotton, 2001; Ritter, 2003). In addition to the studies focusing on the processes of clinical decision-making, many studies have examined the influence of experience, education, specialty, or context on clinical decision-making in nursing. For example, adoption and use of various clinical decision-making processes and the quality of decision-making are found to be associated with clinical experiences and expertise levels (Azzarello, 2003; Bucknall & Thomas, 1995; Christie, 1996; Watson, 1994), specialty types (Redden & Wotten; White et al.), and the context of the decision-making situation (Bucknall, 2003; de la Cruz, 1994; Greenwood, Sullivan, Spence, & McDonald, 2000; Higuchi & Donald, 2002). Clinical decision-making by nurses in critical care units has received specific attention in many of the studies cited above because of the complexity and urgency associated with decision-making in critical care.

Although the findings from these studies and various theoretical expositions in nursing regarding clinical decision-making (Buckingham & Adams, 2000a, 2000b; Harbison, 2001; Thompson, 1999, 2001) provide insights regarding the processes used in clinical decision-making in nursing representing typical cognitive processes, there is a paucity of findings focusing on various *thinking* processes involved in patient care as a stream of processes. Viewing the cognitive component of nursing practice only in terms of decision-making seems narrow in view of the wide range of possible modes of thinking that are associated with information gathering, information processing, and responding in situations. Hence, in this study, we investigated the patterns of thinking involved in critical care nurses' practice in providing direct patient care. The research question was: What processes of thinking do critical care nurses involved in direct patient care use? In order to answer this question, we applied think-aloud (TA) and protocol analysis to actual clinical incidences engaged in by a sample of experienced critical care nurses.

TA and protocol analysis, proposed by Ericsson and Simon (1980, 1984, 1993), has received a great deal of attention in cognitive science and other fields, including nursing, as an approach to study thinking within various perspectives and contexts either in natural settings or in laboratories. This method has been applied to study everyday thinking (such as in calculating, shopping, or text comprehension) as well as thinking involved in special circumstances (group behaviors and team performances, games, or clinical decision-making). TA as a method to capture sequential thought processes has been accepted not only

by its major proponents (Ericsson & Simon, 1998) but also by others (Crutcher, 1994; Payne, 1994; Wilson, 1994). Thinking represented as a sequence of thoughts, which is a silent process, is viewed as being capturable unchanged by its verbalization in the TA method. Ericsson and Simon state that successful verbalization of thinking occurs when people are instructed to continue an undisrupted focus on completing their ongoing tasks while verbalizing their thinking in this method and that the evidence from studies suggests that the impact of verbalization itself on thinking is none or very minimal (Ericsson & Simon, 1998). In nursing, Henry, LeBreck and Holzemer (1989) also found that verbalization of thinking regarding clinical decision-making does not affect the performance of tasks. This method provides details of the sequences of thoughts and protocols that reveal thought processes in performing specified tasks.

METHODS

Setting and participants

This study focused on discovering the thinking processes and the patterns of serialization among various thinking processes in nursing care by critical care nurses through TA and protocol analysis. Critical care nursing was the focus because it is viewed as involving complex and various sorts of nurses' thinking and decision-making. The focus of this study is a description of the thinking processes in clinical nursing practice as the thinking processes in actual practice settings. The setting of the study was a regional hospital for tertiary care in a metropolitan city in Korea with five critical care units: cardiac–surgical (CVSIU), neurosurgical/pediatric (NR/PICU), general surgical (SICU), medical (MICU), and coronary care (CCU) units. One nurse from each of these units, based on the approval of the study participants, was selected for the study. The study participants thus consisted of five registered nurses working in the hospital's critical care units. All five had a minimum of 2 years of full-time experience in intensive care units (ICUs). We specifically approached the ICU experienced nurses as potential study subjects because the purpose was to discover the usual thinking processes in patient care, rather than examine factors that influence thinking in clinical practice.

Procedures

Prior to the initiation of data collection, the researchers of the study participated in a practice program for the TA method in order to understand the process and the researchers' role in data collection. Each researcher exercised TA of simulated non-nursing situations such as two digit additions, and practiced in the role of verbal prompter in data collection. Practicing in the role of verbal prompter was especially important, as suggested by Ericsson and Simon (1993), in order to control and minimize the external influence on thinking. After the researchers gained confidence in the role of verbal prompter through exercises, the researchers oriented the study participants to the method of TA, instructed them in the method, and engaged them in exercising in non-nursing situations until the participants gained a full understanding of what was required as participants in the study.

Ethical considerations

Since there was no institutional review board at the selected hospital, the purpose of the study was explained to the nurse manager of the study hospital, and all the nurse participants gave written consent once approval had been granted to conduct the study.

Data collection

The study participants were instructed that the data collection of TA would be for their usual nursing care of assigned patients, and were told to verbalize everything that passed through their heads (i.e., what they were thinking) as they were involved in caring for their patients. Each participant was asked to think aloud as she was assessing, managing, and caring for patients, which involved collecting information, determining patients' conditions or problems, arriving at decisions for actions, and carrying out certain activities. TA data collection was done by audiotaping; the study participants carried an audiotape recorder with a lapel microphone during the whole process from

the beginning of a nursing care session to its natural conclusion within a 1-hour limit. A maximum of 1 hour was decided as the limit for data collection based on the belief that various sorts of nursing activities would be completed within this time frame. Each TA data collection session with a participant lasted between 40 and 50 minutes, within which the participants moved from one patient to another or from one nursing care situation to another, as the critical care nurses remained in the open critical care units assigned to two patients at a time. One of the researchers followed each study participant during data collection as a verbal prompter, and reminded the participant to continue to think aloud if she paused for longer than a few seconds. The study participants continued the care of their patients as they would under normal circumstances, interacting with both the patients and other members of the health care teams. The data collection commenced as the nurse-participants began nursing care at patients' bedsides soon after the beginning of a shift upon having received shift reports and reviewed their patients' records.

Data analysis

In following the proposal by Ericsson and Simon (1993), the data analysis involved three phases: a) recording and transcribing of verbalization; b) encoding the transcribed verbalization into codes; and c) analysis of the codes for sequential patterns. The audiotaped data were transcribed verbatim by the researchers and cross-checked for accuracy of representation among the researchers. The transcribed data were loaded into the NUD*IST program for qualitative data management. The second phase for encoding was done first by thorough reading of one set (by one of the participants) of transcripts by the researchers in order to decide upon a coding scheme. Although Ericsson and Simon (1993) suggest that codes should be created prior to an encoding activity based on the task model, the cognitive theory under test, or the nature of the problem space under study, the researchers decided to use a set of data to generate codes in this study because of the open nature of the thinking processes involved in nursing practice. Ericsson and Simon (1993) as well as other researchers (Chi, 1997; Hughes & Parkes, 2003; Lee & Pennington, 1994) admit the necessity of developing data-based or iterative coding schemes when studying special situations.

Five semantic codes developed through this initial process were used to encode the protocols, which applied the segmentation rules determined for each of the codes. The segmentation rules specified key paragraphs, phrases, and words for each code. Each of the researchers carried out encoding separately, and then held group meetings in order to arrive at a consensus of encoding of the data. Interrater agreement was .87 (range, .75–1) in the initial phase for encoding. When a disagreement occurred in encoding, checking the full description of the situation helped the researchers to reach a consensus. The third phase of data analysis involved identification of various patterns of sequential thinking processes in patient care. This involved first segmenting the participants' nursing care into nursing care events, then examining various serial configurations of codes.

RESULTS

Patients and patient care situations

The study participants were involved in caring for 12 patients in five different ICUs during the data collection period. Each nurse participant cared for two patients except for the nurse in the NR/PICU, who cared for four patients. The patients' ages ranged from 33 days to 76 years. The clinical contexts of the patient care were complex, as shown in Table 1, including various respiratory care, tube feeding, consciousness and/or seizure monitoring, multiple medication uses, and dependent care. During the course of data collection for 40 to 50 minutes with each participant, the nurses were in constant movement or engaged in various activities at the patients' bedsides.

General codes of thinking in clinical nursing practice

Five codes that were initially identified in the preliminary analysis were confirmed in the analysis of the

Table 1

Description of the Patients Who Received Care from the Study Participants During Data Collection

Gender/Age/ICU	Medical diagnoses	Clinical nursing contexts
F/76/MICU	R/O chronic obstructive pulmonary disease; tuberculous meningitis	– Poor oral intake; tube-feeding – Weaning ventilator; requiring frequent suctioning – Antibiotics – Drowsiness & unstable mental state – Self-care inability; bed confinement
M/60/MICU	Aspiration pneumonia & pulmonary edema	– NPO – CVP monitoring – Frequent oronasal suctioning; nebulizer treatment – Self-care inability; bed confinement
M/48/SICU	Post kidney transplant due to chronic renal failure; pulmonary edema	– Drainage tube – Use of CVVH – I/O imbalance – NPO – Transfusion – Pain control via patient-controlled analgesia – Self-care inability; bed confinement
M/62/SICU	Alcohol-induced chronic hepatitis; supra op done	– NPO – Drainage tube – Post-op respiratory care – Self-care inability; ABR
M/75/CVSICU	CoA, ASD, VSD, & TI; primary closure of ASD & VSD, coarctoplasty, & tricuspid annuloplasty; pulmonary hypertension	– NPO; use of total parenteral nutrition – Central line kept – Ventilator weaning, PAP line removal planned – Hemodynamic monitoring – Self-care inability; ABR
F/33 days/CVSICU	Hyperplastic left heart syndrome; modified Norwood procedure	– 25 days post-op (sternum closure done at last three times due to cardiomegaly) – Stable sinus rhythm – Extubation & C-tube removal
F/73/CCU	Dilated cardiomyopathy & unstable angina	– On dobutamine, nitroglycerine & heparin – On furosemide for pulmonary edema – Cardiac monitoring – Bed rest
M/51/CCU	Unstable angina; CAG & PTCA done	– On dobutamine, nitroglycerine & heparin – Sheath kept at right groin (removal of sheath after 1 hour according to ACT level) – Cardiac monitoring – Bed rest
F/40/NRPICU	Tuberculous meningitis; gastric cancer	– Brain death state due to respiratory arrest – Observation of EVD drainage – Use of dopamine & dobutamine
F/70/NRPICU	8 years post-op for traumatic EDH; emergence of GTc type	– Admitted via ER – Increasing alteration of seizure

(*Contd.*)

Table 1

(*Continued*)

Gender/Age/ICU	Medical diagnoses	Clinical nursing contexts
	seizures for 6 years	– Medication schedule—seizure controlled – T-cannula in place – An adverse reaction to SIADH—monitoring – Suspected of ICU psychosis
M/4/NRPICU	Spinal muscle atrophy	– Ventilator weaning in place for 2 hours per day—respiratory muscle tone is in weakening state, thus weaning is in trouble – On abdominal breathing training
F/7/NRPICU	Seizure; gastrointestinal bleeding	– ICU admission after CPR on the ward – Antiepileptic medication with seizure controlled – Ventilatory support state – Nasogastric tube in place – Drainage using gravity

entire data. These codes are reviewing, validation, consideration, rationalization, and action. Although the code *action* itself does not refer to thinking, this code was retained because patient care involved sequential movements among these codes, often with *action* being a pivotal part.

Reviewing

This is defined as a process that involves noticing and examination of existing data for their meanings, in which the data may have been obtained by the nurse herself or already existing in the patients' medical records. This thinking involves noticing, registering, reflecting, and contrasting, in which the person brings data to the front (or to the surface) and views their meanings. This involved short-term memory registered by immediate inputs or by extracting pieces of information into the short-term memory from the long-term memory.

Validation

This is defined as a process in which confirmation, interpretation, or evaluation of data occurs. This involves comparing data for their meanings in relation to norms or expectations, questioning data, asking questions, interpreting meanings of data, and seeking specific reasons for data. The nurses involved in this thinking process were oriented to gaining deeper understandings regarding information from their patients and their meanings in the contexts of specific patient care situations.

Consideration

This is defined as a process involving an inquiry into various options in situations including meaning variations, choices of actions, various explanations, and consequences. This process involves eliciting different ideas, notions, and options regarding whatever one is focusing on at a given moment, often coming to a conclusion, or weighing the meaning of an option or approach in a specific context. This includes foreseeing what is expected, anticipating or identifying problems, anticipating actions to be performed, anticipating what to expect, selecting a specific action, and specifying goals.

Rationalization

This is defined as a process by which one uses justifications. The rationalization process is used to justify one's thoughts and actions, and is the basis for problem-solving and decision-making. Rationalization involves making inferences, noting reasons and objectives that should guide actions, setting up one's position, and inferring to general cases.

Action

This involves *doing* in which the nurse engages herself in specific activities. Actions emerge from the stream of thoughts, and lead to another stream of thoughts in patient-care situations, as the nurses were continuously involved in solving problems and attending to routine activities. Actions sometimes involved patients directly as in turning or suctioning, and there were also nurse-independent actions such as reading the monitor values, charting, or seeking out physicians.

Table 2 lists examples of various types of thoughts extracted from the data for these codes. There were a total of 494 instances of different thoughts (this total excluded action instances) in the data from five sets of TA data. The distribution among the four thinking processes was 33.4% for rationalization, 27.1% for consideration, 21.5% for validation, and 18.0% for reviewing. These processes of thinking were embedded in various configurations in deliberating and acting within clinical practice.

Patterns of thinking in clinical nursing practice

The nurses in this study were found to engage in patient care with certain sets of foreknowledge about their responsibilities and what were expected of them for each assigned patient. They knew their patients, their conditions, and their care needs from previous assignments, shift reports, medical records, or just being on the units. This meant that the nurses were immediately engaged in patient-care activities, some in routine activities such as monitoring and instituting specific therapies and others with situation-specific requirements.

Upon the completion of encoding the data for identification of codes, the third step of the protocol analysis for the analysis of codes was carried out to identify serial patterns of thinking in various task environments of nursing care. The data were first separated into different tasks as the nurses moved from one nursing task to another and from one patient to another. These segments were in general naturally separated action contexts as the nurses shifted their attention to patients' problems or needs. Hence, each segment as a task situation was identified with a beginning and an end, constituting specific sequences of action and thinking. Each task-segment is considered to be a problem-solving or decision-making situation involving a series of thinking and acting relative to the task involved in the situation.

The sequential nature of thinking and acting processes in the identified nursing tasks was analyzed for a classification into three patterns. This classification into three patterns was based on the total number of steps involved in the tasks, and includes short, intermediate, and long patterns. This differentiation is an arbitrary one, formulated to show the sequential complexity involved in thinking according to the total number of steps involved in nursing tasks. The short pattern was designated for nursing task segments involving fewer than 10 steps (6–10 steps), while the intermediate pattern was for task segments involving between 11 to 20 steps, and the long pattern for those involving more than 20 steps (23–61 steps) using all five processes, including action. In many of the short and intermediate patterns, not all five processes were found. This way of differentiating the patterns was adopted primarily because the series identified in this study did not reveal any patterns of movements among the five codes.

A total of 39 nursing task situations were identified, among which only seven situations were identified in the short pattern. The intermediate pattern was found most frequently (22 out of 39), followed by the long pattern, of which 10 instances were composed. As shown in Figure 1, the short pattern involved an immediate resolution regarding a problem with a sequence of a few steps of thinking.

On the other hand, the intermediate pattern was found in nursing task situations that require resolution of problems in a progressive fashion, as shown in Figure 2. As shown in this figure, the situation began as the nurse was initiating suctioning in response to excess mucus while feeding was in progress. Suctioning in this situation required a careful monitoring of the patient's responses and changes in her condition as the patient was in the initial period of weaning from a mechanical ventilator and was still in an unstable state. In addition, the suctioning had to be carried out in conjunction with another procedure, which

Table 2

Five Codes of Thinking in Clinical Nursing Care and Examples from the Data

Codes	Descriptors and examples
Reviewing	Comparing what one encounters at present with the data from the past: *Vigorous lung sound was audible before, and crackle in both lungs is still audible.* Noting or registering what the current status is like or what one obtains through monitoring: *She has no fever now.* *There is still arrhythmia, and the heart rate is 120/minute and blip is observed.* Reflecting on secondary data: *There is a space on the chart to record the extremities' peripheral pulsation, and the day duty nurse recorded all 'strong' on that.* Reviewing the patient's overall situation or progress: *She hasn't shown any signs of peripheral cyanosis, edema, or anything like that for 5 days since she has been in the ICU.* Reviewing or noting treatments: *So, ventolin nebulizer treatment is being offered.*
Validation	Comparing data for their meanings in relation to norms or expectations: *The osmol is 288 mm/dl, changing from a low level to borderline now.* Questioning data: *How come this is minus 4?* Asking questions: *Are you OK now?* Interpreting the meaning of data: *Since right modified BT shunt was applied, it's all right if the saturation is around 80.* Seeking specific reasons for data: *The reason why the osmol is so low is probably because of the low BUN level.* Evaluating current status or situation: *And then if we count the total and subtotal amount, we would be able to find out that the intake and output is almost balanced.*
Consideration	Foreseeing what might be expected: *Since this is displayed, an alarm bell would go off, if something is not done.* Anticipating or identifying problems: *This patient is especially at more risk for bed sores than other patients because of his abnormally low body weight.* Anticipating actions to be performed: *Suction is going to be applied first, and then nebulizer is going to be applied.* Anticipating some future actions: *So, it is expected to be administered at 9 AM and 5 PM.* Selecting a specific action: *I am going to change the patient's position to the opposite side.* Specifying goals: *A BP of over 90 is to be maintained in this elderly woman.*
Rationalization	Making an inference: *This patient's DBP fell to around 40, because she is a DCMP patient whose cardiac contraction isn't effective.*

(*Contd.*)

Table 2

(*Continued*)

Codes	Descriptors and examples
Rationalization	Noting reasons and objectives that should guide actions: *While changing the patient's position, I have to check frequently if the IV line is pressed or not. Because this patient needs to have the pressure reduced...* Setting up one's position: *The physician will be here soon, so I will consult with him about getting the F/U ABGA, and then recommend that he check again whether too much CO_2* was eliminated. Inferring about general cases: *All ICU nurses set the alarm ranges according to the vital signs obtained and the patient's condition.*
Action	Performance of various nursing actions

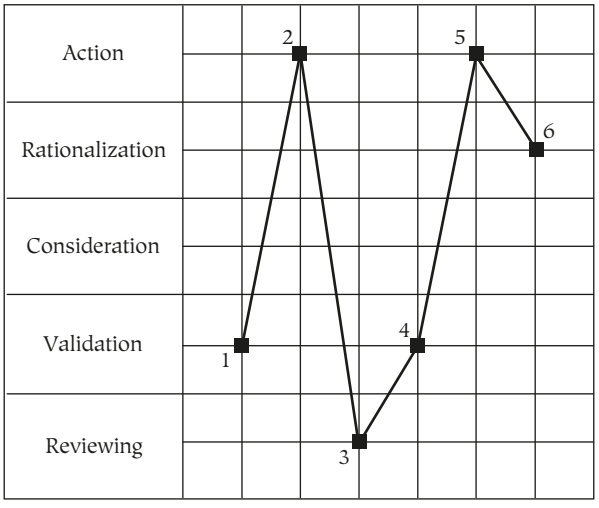

Figure 1. Example of a serial configuration of a short pattern.

could have an impact on the progress and outcomes. This pattern showed a repetition of rationalization and action sequences as the nurse moved to complete this task, which was within a situation of instability requiring careful thinking.

The long pattern shown in Figure 3 was related to a task situation that involved complexity both in action and thinking. The nursing action required in this situation had various components and required the nurse to carry them out in sequences, involving especially various thinking processes such as reviewing, rationalizing, and considering before an action was taken.

In this study, 16 different nursing tasks involving decision-making were found, as shown in Table 3. The 39 instances mentioned above were distributed among these 16 different nursing tasks. While there were nursing tasks carried out in all three patterns (such as respiratory care and hemodynamic monitoring), certain tasks were more often in the short pattern while others were in the intermediate or long patterns. For example, the processes of tube-feeding, recording, and measuring intake/output were either in the short or intermediate pattern, while the processes involved in resetting an alarm range, dressing change, assessing physical status, and providing emotional support were in the intermediate or long pattern. It seems that the sequential complexity of thinking is both the function of the specific task involved and the task environment, in this case, the nature of a specific patient's condition. For example, seemingly simple tasks such as oral care and transfusion were carried out in long patterns, not because of the complexity of the tasks themselves but due to the complexity of the patient situations in which these tasks were carried out. Six instances of respiratory care were also carried out in all three patterns, suggesting that the series of thinking and doing involved in respiratory care depends on the complexity of patients' needs and clinical conditions.

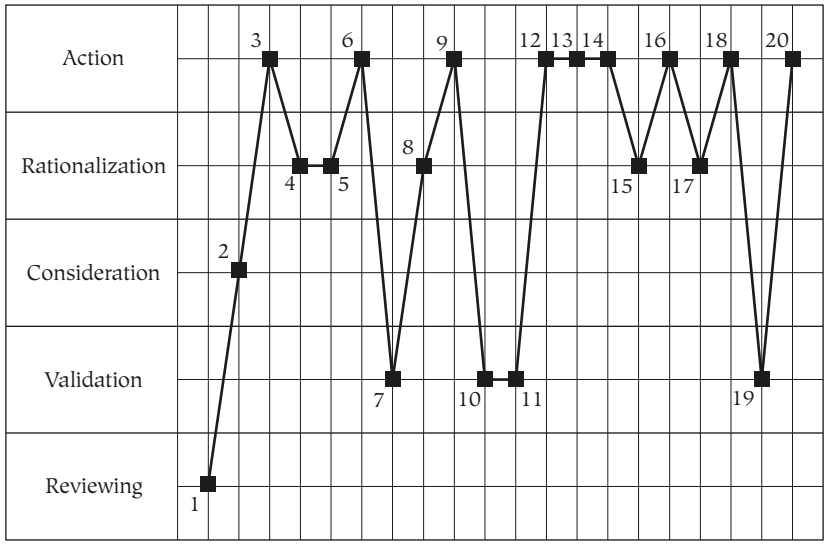

Figure 2. Example of a serial configuration of an intermediate pattern.

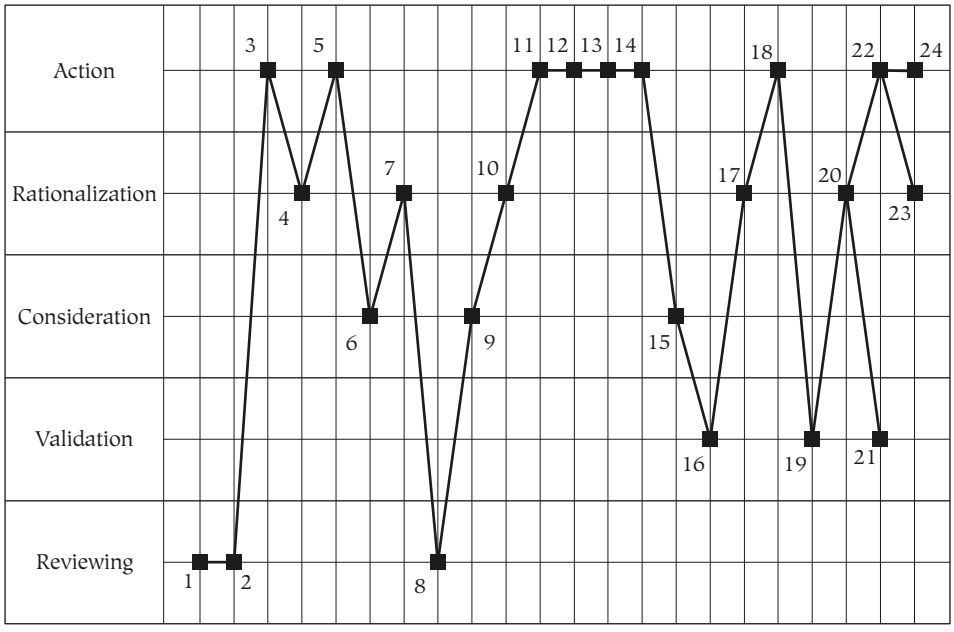

Figure 3. Example of a serial configuration of a long pattern.

DISCUSSION AND CONCLUSION

The results of this study identified three patterns with which the five different processes were sequentially combined to accomplish nursing tasks by ICU nurses. The nurses were involved in moving from one form of thinking to another or from thinking to action in dealing with problem situations or in the process of accomplishing specific nursing tasks.

The four thinking processes identified in this study (reviewing, validation, consideration, and rationalization) are somewhat different from the cognitive

Table 3

Patterns of Thinking in Nursing Practice of Critical Care Nurses

Nursing task	Short pattern					Intermediate pattern					Long pattern				
	Re	V	C	Ra	A	Re	V	C	Ra	A	Re	V	C	Ra	A
Respiratory care	1	2	0	1	2	1	4	1	5	8	3	1	7	6	6
						0	1	1	10	9	3	4	17	15	7
											3	3	3	6	9
Recording	2	4	0	1	3	4	1	2	4	8					
						3	1	1	0	6					
Hemodynamic monitoring	0	2	2	3	3	2	1	2	4	4	9	11	15	11	15
	0	0	1	3	5	0	4	0	4	9					
IV infusion						4	0	3	1	3					
						1	0	5	7	8					
						1	0	1	5	8					
Measuring I/O	2	2	1	2	1	3	2	5	6	4					
	2	3	0	3	2										
Tube feeding	0	0	2	3	2										
Positioning						0	2	6	2	7					
						2	1	1	4	7					
Assessing physical status						1	0	6	6	10	3	7	6	8	8
						6	4	3	1	6					
Neurologic assessment						1	6	2	2	4					
Resetting alarm ranges						3	1	4	2	3	4	6	8	4	5
Emotional support						2	2	4	3	5	1	4	2	2	14
						4	3	3	1	3					
Checking order/lab data						1	2	2	3	4					
Monitoring						2	6	0	3	9					
Vital signs						5	1	1	2	5					
Dressing change						3	3	3	3	3	3	3	4	5	10
Oral care											2	5	5	3	12
Transfusion											2	4	9	1	7

Note. Re = Reviewing; V = Validation; C = Consideration; Ra = Rationalization; A = Action.

strategies found in other studies of clinical decision-making. For example, Fowler (1997) identified six cognitive strategies, including hypothesizing, cue logic, framing, reflexive comparison, prototype case reasoning, and testing as those used in care planning by home health care nurses, while Ritter (2000) found gathering facts, generating a hypothesis, gathering data to confirm the hypothesis, and skilled

know-how as the four cognitive strategies used in diagnostic reasoning by expert nurse practitioners. These cognitive strategies seem to be embedded within the four broad processes identified in this study, suggesting that there may be a hierarchical structure that differentiates processes in thinking into various levels of specificity. On the other hand, these four cognitive processes align well with Marshall's (1995) reference to identification, elaboration, planning, and execution as the basis for schema development and use in problem-solving. These four broad forms of thinking processes identified in this study seem to reflect the nature of thinking in clinical practice more clearly than the cognitive strategies that are more specifically identified within the information processing models. It appears that thinking in nursing practice involves more than just arriving at *diagnosing*, identified as the focus in clinical reasoning studies through hypothesis generation and hypothesis confirmation. Thinking in practice appears to be more involved in dealing with information to make sense of the situation, frame the meanings, justify what has to be done, and convince oneself of one's thoughts and actions.

The nurses in the study were experienced in a specific clinical practice, and moved with ease in accomplishing routine or simple tasks, especially when the patient's condition was stable or the situation was familiar. In such situations, the nurses went through a short or intermediate pattern, using reviewing and rationalization as the most commonly employed thinking processes. This means that the nurses seem to interpret data in a straightforward fashion and arrive at conclusions quickly, involving only a few steps. One example of the typical linear pattern involving a simple task situation went as follows: "There's some dyspnea <reviewing>, this patient has DCMP <validation>, if I were to put him into a semi-Fowler's position <consideration>, it will be helpful to relieve dyspnea <rationalization>, so I'll put you in a little up position <action>." However, the nurses often skipped the *consideration* step embedded within this linear rational processing, and moved into actions rationalizing as the actions were being carried out, as in: "The breathing sound is labored <reviewing>, there is too much mucus <validation>, I do suctioning <action>, because the airway should be kept patent <rationalization>." These experienced nurses tended to make judgments promptly, often coalescing key information and following with immediate actions. Newall and Simon (1972) proposed a backward processing as that enabling quick solutions to given problems. Such processing tends to bring early closure to thinking, producing solutions that are satisfactory but not necessarily optimal. The use of heuristics (Gilovich, Griffin, & Kahneman, 2002; Kahneman, Slovic, & Tversky, 1982) as the method of shortcuts has been found in the studies of nursing assessment by Cioffi and Markham (1997) and Simmons and colleagues (2003) to reason quickly and efficiently. The thinking process identified in this study in uncomplicated, familiar situations seem to follow such an abbreviated processing, as the process tended to be streamlined and simplified, in which various options were not considered and alternative explanations were not sought. This aligns with the notions of *satisfying solutions* and heuristic thinking to be the modes with which familiar situations are dealt with in clinical practice.

However, the thinking in complex situations tended to involve moving back and forth among various thinking processes. When the nurses were involved in dealing simultaneously with multiple problems or actions, their processing tended to be in longer patterns. The nurses were engaged in a series of processes including various actions, not moving from one process to the next in a linear fashion to deal with the situation as a whole, but by moving according to the cues that were brought forward as the thoughts and actions progressed. This means that clinical problem-solving in a complex situation required the nurses to select the focus of attention and pursue their attention until a resolution was achieved before moving to other aspects of problems, suggesting the different roles short-term and long-term memory play in thinking and deliberating. However, when the nurses had to think about several things at the same time, they tended to merge information to the most critical issue being confronted in the situation, for example, keeping the airway open.

This means that the nurses' cognitive processing in clinical practice is influenced by the complexity of the clinical situation, but is streamlined in a stepwise fashion, rather than carried out in a holistic processing. The findings of this study are associated with Ellefsen, Kim, and Han's (2007) conclusion that nurses' gaze is not simple, unilateral or one dimensional, but complex, and take into consideration both the client and practice setting by.

Additionally, the findings in this study, especially the results regarding different series of thinking sequences found in the three patterns of thinking, point out that the nurses were rarely engaged in the process of hypotheses generation and hypothesis-confirmation. In most cases, the nurses tended to think that they knew the nature of the problems in the situation and also the possible solutions. Hence, their thinking was mostly concerned with specific situational requirements. This means that decision-making in clinical practice is mostly concerned with adaptation to situational variations rather than re-thinking routines or creating new approaches. In addition, the findings also indicate that the nurses seldom cited pattern recognition by inciting exemplars as a mode of thinking suggested by Benner (1984). More often, prototypical or general cases were used as reference points, suggesting that there may be a coalescing of patterns into mental representations in experts, which become the basis for comparisons rather than specific patterns etched in memory as exemplars to be the basis of recognition. This is in line with the ideas in Marshall's schema theory (1995). In addition, as Ericsson and Simon (1998) suggest, experts rely greatly on previously learned mental representations in addressing problems. Mental representations in experts as the basis for evaluating, reasoning, and choosing in problem-solving situations require critical attention from the information processing perspective. This is an area that requires further investigation.

The four processes of thinking identified in this study specify the forms of thinking that are involved in clinical practice, as nurses are engaged in dealing with clinical problems. This study specifies the initial categories of thoughts for each of the processes and various patterns with which these processes are sequentially combined, providing insights into the ways nurses think about problems and address their concerns.

The finding is important for the development of nursing practice. The nurses' thinking processes that there is no specific sequential pattern in clinical practice indicates how contextual requirements influence thinking in practice. These are different from the steps in nursing process and the linear models of problem-solving as well as from the cognitive categories found in the general cognitive studies, pointing out the specific nature of thinking that goes on in clinical practice. There is a need to re-think the theoretical implications of the findings in relation to the idea of serialization in problem-solving, and bring in the influence of task environment such as the complexity of clinical situations.

One additional consideration of this category of processes is in relation to problem-oriented teaching. It would be interesting to consider teaching students within a problem-oriented learning environment by identifying an approach to problems modeled by combining reviewing, validation, consideration, rationalization, and action.

References

Azzarello, J. (2003). Knowledge structure and problem representations: How do novice and expert home care nurses compare? *Southern Online Journal of Nursing Research*, *4*, 26.

Benner, P. (1984). *From novice to expert: Excellence and power in clinical nursing practice.* Menlo Park, CA: Addison-Wesley.

Buckingham, C. D., & Adams, A. (2000a). Classifying clinical decision making: A unifying approach. *Journal of Advanced Nursing, 32*, 981–989.

Buckingham, C. D., & Adams, A. (2000b). Classifying clinical decision making: Interpreting nursing intuition, heuristics and medical diagnosis. *Journal of Advanced Nursing, 32*, 990–998.

Bucknall, T., & Thomas, S. (1995). Clinical decision-making in critical care. *Australian Journal of Advanced Nursing, 13*, 10–17.

Bucknall, T. (2003). The clinical landscape of critical care: Nurses' decision-making. *Journal of Advanced Nursing, 43*, 310–319.

Chi, M. T. H. (1997). Quantifying qualitative analyses of verbal data: A practical guide. *The Journal of the Learning Sciences, 6*, 271–315.

Christie, L. A. (1996). Expertise in nurses' clinical judgments: The role of cognitive variables and experience. (Doctoral dissertation, The University of British Columbia). *Dissertation Abstracts International B, 57/12*, 7718.

Cioffi, J., & Markham, R. (1997). Clinical decision-making by midwives: Managing case complexity. *Journal of Advanced Nursing, 25*, 265–272.

Crutcher, R. J. (1994). Telling what we know: The use of verbal report methodologies in psychological research. *Psychological Science, 5*, 241–244.

de la Cruz, F. A. (1994). Clinical decision-making styles of home healthcare nurses. *Journal of Nursing Scholarship, 26*, 222–226.

Ellefsen, B., Kim, H. S., & Han, K. J. (2007). Nursing gaze as framework for nursing practice: A study from acute care settings in Korea, Norway and the USA. *Scandinavian Journal of Caring Sciences, 21*, 98–104.

Elstein, A. S., Shulman, L. S., & Sprafka, S. A. (Eds.). (1978). *Medical problem solving: An analysis of clinical reasoning.* Cambridge, MA: Harvard University Press.

Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. *Psychological Review, 87*, 215–251.

Ericsson, K. A., & Simon, H. A. (1984). *Protocol analysis: Verbal reports as data.* Cambridge, MA: Bradford Books/MIT Press.

Ericsson, K. A., & Simon, H. A. (1993). *Protocol analysis: Verbal reports as data*. Revised edition. Cambridge, MA: Bradford Books/MIT Press.

Ericsson, K. A., & Simon, H. A. (1998). How to study thinking in everyday life: Contrasting think-aloud protocols with descriptions and explanations of thinking. *Mind, Culture, and Activity, 5*, 178–186.

Fowler, L. P. (1997). Clinical reasoning strategies used during care planning. *Clinical Nursing Research, 6*, 349–361.

Gilovich, T., Griffin, D., & Kahneman, D. (Eds.). (2002). *Heuristics and biases: The psychology of intuitive judgment*. Cambridge: Cambridge University Press.

Greenwood, J., Sullivan, J., Spence, K., & McDonald, M. (2000). Nursing scripts and the organizational influences on critical thinking: Report of a study of neonatal nurses' clinical reasoning. *Journal of Advanced Nursing, 31*, 1106–1114.

Hamers, J. P. H., Abu-Saad, H. H., & Halfens, R. J. G. (1994). Diagnostic process and decision making in nursing: A literature review. *Journal of Professional Nursing, 10*, 154–163.

Harbison, J. (2001). Clinical decision making in nursing: Theoretical perspectives and their relevance to practice. *Journal of Advanced Nursing, 35*, 126–133.

Henry, S. B., LeBreck, D. B., & Holzemer, W. L. (1989). The effect of verbalization of cognitive processes on clinical decision making. *Research in Nursing & Health, 12*, 187–193.

Hicks, F. D., Merritt, S. L., & Elstein, A. S. (2003). Critical thinking and clinical decision making in critical care nursing: A pilot study. *Heart & Lung, 32*, 169–180.

Higuchi, K. A. S., & Donald, J. G. (2002). Thinking processes used by nurses in clinical decision making. *Journal of Nursing Education, 41*, 145–153.

Hughes, J., & Parkes, S. (2003). Trends in the use of verbal protocol analysis in software engineering research. *Behavior & Information Technology, 22*, 127–140.

Kahneman, D., Slovic, P., & Tversky, A. (Eds.). (1982). *Judgment under uncertainty: Heuristics and biases.* Cambridge: Cambridge University Press.

Kim, H. S. (1993). Putting theory into practice: Problems and prospects. *Journal of Advanced Nursing, 18*, 1632–1639.

Kremer, M. J., Faut-Callahan, M., & Hicks, F. D. (2002). A study of clinical decision making by certified registered nurse anesthetists. *American Association of Nursing Anesthetists Journal, 70*, 391–397.

Lee, A., & Pennington, N. (1994). The effects of paradigm on cognitive activities in design. *International Journal of Human-Computer Studies, 40*, 577–601.

Marshall, S. P. (1995). *Schemas in problem solving.* Cambridge: Cambridge University Press.

Newall, A., & Simon, H. A. (1972). *Human problem solving.* Englewood Cliffs, NJ: Prentice-Hall.

Offredy, M. (2002). Decision-making in primary care: outcomes from a study using patient scenarios. *Journal of Advanced Nursing, 40*, 532–541.

Payne, J. W. (1994). Thinking aloud: Insights into information processing. *Psychological Science, 5*, 241, 245–248.

Redden, M., & Wotton, K. (2001). Clinical decision making by nurses when faced with third-space fluid shift: How well do they fare? *Gastroenterology Nursing, 24*, 182–191.

Rew, L. (1990). Intuition in critical care nursing practice. *Dimensions of Critical Care Nursing, 9*, 30–37.

Ritter, B. J. (2000). An analysis of expert nurse practitioners' diagnostic reasoning. (Doctoral dissertation, University of San Francisco). *Dissertation Abstracts International-A, 61/04*, 1279.

Ritter, B. J. (2003). An analysis of expert nurse practitioners' diagnostic reasoning. *Journal of American Academy of Nurse Practitioners, 15*, 137–141.

Simmons, B., Lanuza, D., Fonteyn, M., Hicks, F., & Holm, K. (2003). Clinical reasoning in experienced nurses. *Western Journal of Nursing Research, 25*, 701–724.

Thompson, C. (1999). A conceptual treadmill: the need for 'middle ground' in clinical decision making theory in nursing. *Journal of Advanced Nursing, 30*, 1222–1229.

Thompson, C. (2001). Journal of Advanced Nursing Forum: Clinical decision making in nursing: Theoretical perspectives and their relevance to practice—a response to Jean Harbison. *Journal of Advanced Nursing, 35*, 134–137.

Watson, S. (1994). An exploratory study into a methodology for the examination of decision making by nurses in the clinical area. *Journal of Advanced Nursing, 20*, 351–360.

White, J. E., Nativio, D. G., Kobert, S. N., & Engberg, S. J. (1992). Content and process in clinical decision-making by nurse practitioners. *Journal of Nursing Scholarship, 24*, 153–158.

Wilson, T. D. (1994). The proper protocol: Validity and completeness of verbal reports. *Psychological Science, 5*, 249–252.