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UNIVERSITY OF SOUTHAMPTON

FACULTY OF MEDICINE

NURSING STUDIES

CLINICAL DIAGNOSIS IN NURSING - AN ANALYSIS OF KNOWLEDGE STRUCTURES AND DECISION MAKING STRATEGIES

Thesis submitted in partial fulfilment of the requirements for Doctor of Philosophy in the Faculty of Medicine 1991.

by Jennifer Andree Jones

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

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DOCTOR OF PHILOSOPHY

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The verbal protocol technique forms the basis of this research on clinical diagnosis in nursing. In this technique, a nurse subject, by asking specific questions about a patient, obtains the information required to diagnose patient problems. The knowledge area for the study was the assessment of pressure sore risk.

Two sample groups were chosen for comparison. An 'Expert' group was made up of ward sisters while a 'Novice' group consisted of third year student nurses. Each subject undertook 3 verbal protocols. These progressed from, firstly, having no special instructions or interruptions given to, finally, being highly structured as the researcher questioned in depth about the problem solving strategy being used.

On average, the 'Experts' (E group) gave longer protocols than the 'Novices' (N Group), mainly due to the difference in the number of COLLECT (ie. Data collecting) operations. The experts often failed to make use of the extra data they had collected and also tended to make more inferences from outside the data. Problem Behaviour Graphs were built up from the results. These demonstrated that experts tend to use a model of simultaneous data gathering and interpretation of data whereas novice subjects collect all the necessary data first. Vocabulary analysis showed approximately 50% of the language devoted to technical terms in both groups.

The data gleaned from the expert group protocols was incorporated into a small knowledge based system which was then tested. It correlated well with the estimated risk of pressure sores given by subjects in clinical areas and was well received by the nurses using it.

Recommendations were put forward for a professional education which encourages the techniques of clinical nursing diagnosis shown by the expert group in this research and for the nursing profession to take control of the introduction of computer technology into clinical practice.

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I am deeply indebted to Dr C J Colbourn who acted as a supervisor throughout the research process and has been invaluable as a resource person and commentator on the progress of the work. My thanks also go to my other joint supervisor from the Faculty of Medicine, Professor W E Waters, who guided me throughout on the administration details of the project.

Finally, I am grateful to my children for their patience, understanding and generosity of heart which allowed me to work on this project.

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Sections of this work have been published as :-

(a) Clinical reasoning in Nursing

Journal of Advanced Nursing
Volume 13 pp. 185 - 192

(b) The Verbal Protocol - A research technique for nursing

Journal of Advanced Nursing
Volume 14 pp 1062 - 1070

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PART ONE

INTRODUCTION TO THE STUDY

CHAPTER ONE

THE NURSING PROCESS AS A PROBLEM SOLVING TASK

The provision of health care in our society is constantly adapting in order to meet the demands made of it. As part of this overall pattern, nursing has undergone many changes during its history each leading to a need for individual practitioners to develop new knowledge and skills in order to fulfill their professional role.

Nursing as a profession began with Florence Nightingale who instilled the idea of nursing as a skilled vocation requiring education and training on the part of its members in order to reach realization of professional status. Previous to that time, nurses had received no specific training, gaining their skills and knowledge by on the job trial and error experience (McGilloway 1981).

As a result of the drive to educate and train people as nurses it became necessary to attempt definitions of the nurses' role and how it was distinct from other health care professionals. Nightingale (1859) stated the goal of nursing to be " to put the patient in the best condition for nature to act upon him". Regrettably, as nursing became more technical and hospital based, this goal was lost as nurses endeavoured to fill a role which was reactive to the medically dominated environment in which they found themselves. Nursing became subservient to the goals of medicine, that is to say concerned with the investigation, diagnosis and treatment of disease. The nurse herself became the 'hand maiden' of the doctor carrying out his orders to bring about curing of the patient's illness. The patient was seen as the passive receiver of care and at the lowest level of the hierarchical structure thus formed.

Over recent decades, however, there has been a resurgence of the concept of nursing as having an autonomous and unique role of its own, separate from the demands of the medical model of curing illness. These ideas have rekindled the Nightingale ethic of the nurse intervening directly on the patient's behalf irrespective of the medical aspects of care. Nursing actions can thus be distinguished from medical intervention and will include such activities as therapeutic communication, caring behaviours, reduction of

stress and anxiety, rehabilitation skills and educational skills. They encompass beliefs such as assisting the patient during periods of illness to continue with essential daily activities (Henderson 1969), to seek to be independent of care (Orem 1980), to cope or adapt successfully with all the bio-psycho-social changes wrought by being ill (Roy 1984) and to deal with stress reactions (Neuman 1982). These approaches all emphasise the person as being an individual client with a set of needs arising out of health/illness problems for whom nursing has a unique service to offer. The patient is seen as an active participant in the care given. The role of the nurse today does not arise from the association with medicine but directly from the patient's expressed health/illness needs.

In most situations, however, the nurse is acting as a member of a multi-disciplinary health care team and her service must integrate with that of other health disciplines including medicine. Her role within the team in hospital situations is particularly unique by virtue of it being continuous and thus the central coordinating element in total care of the patient.

In many contexts nurses work alongside doctors in the delivery of medical care, still acting as the assistant in the delivery of medically based interventions. The nurse now has a dual role. She retains her own unique function of dealing with patient problems which arise from the fact of being ill as well as also acting to help the doctor in the curing of illness. Care in such cases is delivered on a collaborative basis with the patient being more central to the whole activity than previously while medicine too has evolved to encompass more of a caring cooperative role with the patient (Figure One).

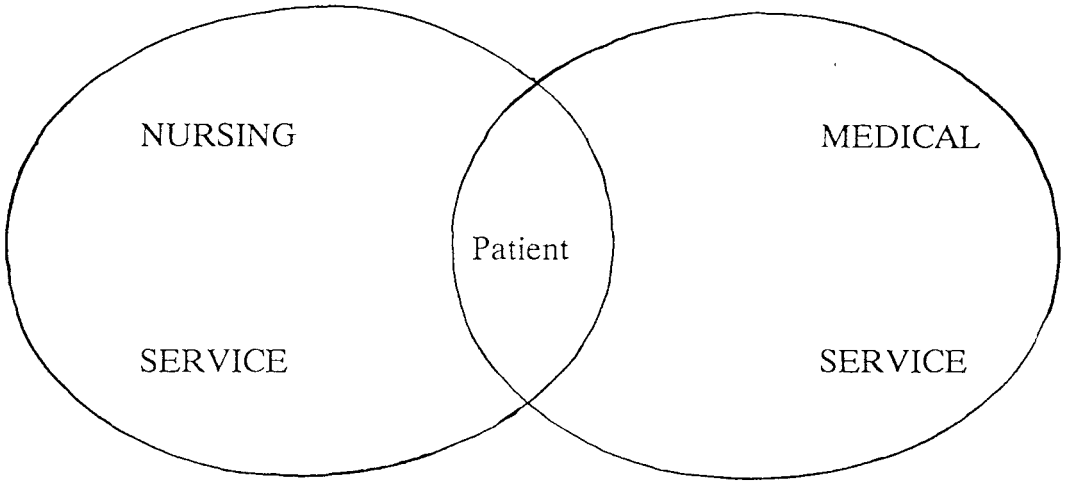


FIGURE ONE - THE COLLABORATIVE ROLE OF NURSING AND MEDICINE

Since medicine and nursing often exist together in a collaborative way and in many circumstances, particularly in emergency situations, their intervention foci overlap, medical and nursing problems will have certain similarities. In the specification of these problems in the form of a 'diagnosis', however, each clinician will always retain the orientation to his or her own professional goals.

> "The doctor's main thrust is in the diagnosis of the disease and the treatment of the same. The nurse concerns herself with the facilitation of meeting the needs of the person afflicted (or in danger of being afflicted) by a disease process. The doctor will be solving problems to arrive at a diagnosis and appropriate treatment. The nurse will be solving problems to assist the patient to achieve his maximum health potential."
>
> (McCarthy 1981)

The development of nursing as a professional activity no longer reliant on medicine for its definition of areas of concern, methods of practice or final accountability to the client, demands that nurses are able independently to define and solve those patient problems which fall within their newly defined unique area of expertise.

This research project investigates the significant role now played in clinical nursing by problem solving processes. In doing so, it draws heavily on the Information Processing paradigm within cognitive psychology to give a theoretical basis for the recent innovation known as the Nursing Process which is now becoming widely established.

The Nursing Process is the application of problem solving to patient care (Marriner 1983). It was first alluded to by Orlando (1961) as "a process which ascertains the patient's immediate need and helps to meet that need either directly or indirectly." For Yura and Walsh (1988) it has developed into 'the core and essence of nursing'. They describe it as :-

> "an orderly, systematic manner of determining the client's health status, specifying problems defined as alterations in human need fulfilment, making plans to solve them, initiating and implementing the plan and evaluating the extent to which the plan was effective."
>
> (Yura and Walsh 1988)

The introduction of the Nursing Process into Britain was supported by the work of McFarlane (1977) who argued that it was a necessary innovation so that nurses could identify how they arrived at the decisions they made and how the relationship between nursing actions and outcomes could be indicated.

The Nursing Process is similar to the basic scientific framework of problem solving used in other disciplines (McCarthy 1981) and is not unlike the diagnosis and treatment based approach found in medicine.

Although the exact labelling of the various stages involved in the Nursing Process may vary from one setting to another, the overall step-by-step problem solving approach remains the same. In British nursing contexts, the process is seen to have four stages. These are :-

(a) **'Assessment'**, which allows problem identification and diagnosis.

(b) **'Care Planning'** including goal setting.

(c) **'Implementation of Care'**

(d) **'Evaluation'** of the effects of care.

These stages operate in a circular manner since re-assessment is an essential outcome of the evaluation of care.

Reilly and Oerman (1985) have expanded the basic four stage model into a much more complex set of operations :-

Assessment	Problem recognition
	Data gathering
	Data Analysis
	Nursing Diagnosis
Planning	Desired Goal Setting
	Priority setting
	Selection of Intervention measures
Implementation	Carrying out nursing actions
	Formative evaluation of actions
	Change as indicated
Evaluation	Relationship of outcome to defined goals
	Consistency for actions in step with pre-determined criteria for standards of care.

Although now in widespread use both in hospital and community based nursing contexts, there has been little questioning of the Nursing Process method as a model for practice and, like many of the practices taught and carried out in nursing today, there is a lack of scientifically acquired knowledge to substantiate its validity for practice, (Hockey 1978). The Nursing Process has been introduced into care with little

understanding of the knowledge and skills necessary for effective clinical problem solving in nursing. The cognitive processes which take place during the four stages of the Nursing Process are far more complex than is often stated.

> "There is evidence that there is far more to the processes of clinical judgement than has been characterised by the Nursing Process."
>
> (Tanner 1986)

Claims that nurses in clinical practice act according to the cognitive model underlying the Nursing Process have not been substantiated. Investigation of the application of Nursing Process to clinical settings has tended to take the form of evaluation of the documentation of care (Brooking 1988) rather than concern for the thinking processes involved in its use. In a previous minor study (Jones 1986), the author investigated how nurses make use of data during the assessment of pressure sore risk for a patient. The main hypothesis was that the wider and more logically based data base used by the nurse, then the greater the specificity and individualisation of the care plans written by the nurse. Although this hypothesis was upheld in a majority of responses (60%) from the subjects (n=18), many nurses failed to make distinctions between the amount or type of care necessary even when presented with more detailed and more extensive information of the patient state. The overall conclusion to be drawn from the results was that nurses were misusing the Nursing Process and formulating highly routinized and habituated care plans with little cognitive problem solving behaviour taking place at the bedside.

The assessment stage, in particular, is seen as the critical element in the use of the Nursing Process :-

> "The effectiveness of any action will be, in many cases, dependent on the validity of the inferences which she (the nurse) has made"
>
> (Kelly 1966)

The aim of the present research is to investigate the clinical reasoning involved in the assessment stage of the Nursing Process. This involves ascertaining the clinical decisions are made by the nurse about which data to collect about a patient's state, the cognitive operations performed on this data and the ultimate judgement made about the nature of the patient's problem which is made in the form of a nursing diagnostic statement. As the results will show, nurses concurrent verbal reports during the process of reaching a clinical diagnostic decision demonstrate the presence of similar cognitive operations cited in the literature of problem solving in other disciplines. The sequence in which these operations were applied however, differed between novice and expert nurses and gives rise to speculation concerning the education of nurses in clinical problem solving.

PART TWO

REVIEW OF THE LITERATURE

CHAPTER TWO
THE COMPLEXITY OF CLINICAL REASONING IN HEALTH CARE - A NURSING EXAMPLE

Eddy (1984) sees the clinical reasoning process as fraught with uncertainties, biases and errors which result in 'alarming variations' in clinical practices. He examines the factors involved in decision making in medicine and the role which uncertainty plays in the process. There is uncertainty for instance even in determining whether or not the patient has a medical problem in the first place. By this he means the dividing line between normal and abnormal is not always clear. Crucial clues may be difficult to find or, on the contrary, like occasional headaches or tiredness be extremely common in the general population without illness being present. In addition some pathological disorder such as mild hypertension may be present but be symptomless at present perhaps merely predisposing the person to illness in the future. Eddy also points out that the number and complexity of clinical clues is increasing as medical technology advances again making the task of diagnosis fraught with uncertainty. There is a high degree of observer variation of patient states even with the interpretation of hard data such as X-rays and ECGs.

Within nursing, the assessment of pressure sore risk is an area of almost infinite complexity which had long presented difficulties of accurate diagnosis for the clinical nurse in spite of much research and the introduction of a number of decision scales to improve speed and accuracy (Gosnell 1973, Norton 1975, Waterlow 1985). The difficulties arise from the insidious nature in which tissue damage occurs, the multitude of different factors determining the individual response to skin trauma and the inherrent problems of validation and reliability of current methods used to assess risk of sore development.

2.1 AETIOLOGY OF PRESSURE SORES

A pressure sore is an area of dead tissue resulting from uni-axial pressure produced between an internal bony prominence and an external resistant surface. If prolonged, the pressure on the capillary bed in the compressed tissues results in localized ischaemia and necrosis. Such compression forces come into play whenever a person's normal activity of body movement is reduced.

Normally the occurrence of sustained or excessive pressure acts as a stimulus for a change of posture to a more comfortable position. This response continues even during deep sleep. Exton-Smith and Sherwin (1961) show a direct correlation between pressure sore occurrence and the number of spontaneous body movements during sleep. Any condition leading to a lowering of the depth of consciousness, such as sedation, general anaesthetic, concussion and coma, increases the risk to the patient as will any condition causing impairment of movement such as paralysis, pain, general weakness and debility and the presence of restricting tubing or splintage. The response to felt pressure is also dependent upon the type of surface on which the body part is resting. Redfern et al. (1973) show that trolleys, X-ray tables and operating tables can exert extremely high pressures on a patient's skin.

Despite the dramatic advances in medical science made this century, the prevention of pressure sore development in the inactive person remains a grave concern. It is now recognised that not everyone whose mobility is reduced will necessarily develop a sore and that some people are more susceptible than others. Recognition of other factors present which may predispose a person to pressure sore development is therefore a crucial initial step in their prevention.

2.2 FACTORS INVOLVED IN PRESSURE SORE DEVELOPMENT

Devitalisation of the skin tissue itself can arise from a number of disturbances involving the supply of oxygen and nutrients to the local area (Gosnell 1973). Compression and distension of the capillary bed in the area under pressure is much increased in the thin person while in the very obese or oedematous patient, not only does body weight increase the pressure which is exerted, but also the distance between the surface tissues and the main arteriole blood supply is greatly extended. Lack of essential nutrients such as protein (Moolten 1972), ascorbic acid (Taylor et al 1974) and zinc (Cohen 1968), or in the carriage of oxygen in the blood as occurs in anaemia (Vasile & Chaitin 1972) can also lead to tissue devitalisation. Other causes include alterations of body chemistry such as diabetes mellitus and uraemia (Barton and Barton 1973).

Vitality of the skin tissue is also directly related to age. In a study by Barbenel (1977), 70% of pressure sores observed were in the 70+ year age group. Loss of elasticity and generalised atrophy of the skin appear to be involved as well as loss of general energy reserves and consequent mobility reduction.

Damage to the upper layers of the skin in an area under pressure can also lead to pressure sores. Shearing forces and friction from rough or crinkled bedding are both exacerbated by poor lifting of the patient by the nurse during position changing. Excoriation of the skin by faeces and urine occur in the incontinent patient in whom frequent washing reduces the normal pH and removes the protective lipid covering necessary to healthy skin.

2.3 RISK ASSESSMENT METHODS

The goal of nursing for the problem of pressure sores is one of prevention. It begins with accurate assessment of the risk to the individual patient of developing a pressure sore based upon an understanding and comprehensive knowledge of the numerous factors involved in pressure sore aetiology.

Until recently, assessment of risk has been performed by nurses operating at an intuitive level and been based upon a non-scientific 'wisdom of old' model. Such a model engendered many erroneous, if not actual harmful, care practices such as massaging the skin and, when prevention failed, weird treatment regimes for the sore which developed such as the application of egg white.

A major development in the nursing of the pressure sore problem was instigated by the work of Norton et al (1975) which made two major contributions to care practices. Firstly, the study gives convincing evidence of the role which prolonged pressure has in the development of a pressure sore and how a simple routine intervention of a two-hourly change of position for all patients with reduced mobility can significantly reduce the occurrence of pressure sore development. Secondly, Norton developed an assessment tool which assists the nurse to make a logical and objective assessment of the risk to an individual patient (See Appendix One). It comprises a numerical rating system on five

sub-scales each of which are seen as implicated in the aetiology of pressure sores. These are namely, physical condition, mental condition, mobility, activity and incontinence. A score of 1-4 is given for each sub-scale such that the higher the score the lower the risk of sore development. The total 'Norton Score' thus ranges from 5 to 20 and a patient with a score of 14 or less is considered to be 'At Risk'. In her survey of 250 geriatric patients, Norton found 48% of patients scoring <12 developed sores, while only 8% of those with a score of >18 did so. All five sub-scales correlated highly with the incidence, with incontinence being the single most useful indicator of sore development.

The predictive value of the Norton Score was examined by Goldstone and Goldstone (1982) who found physical condition and incontinence to be the most discriminating factors but that the scale as a whole did tend to over-predict occurrence of sores. Lincoln et al (1985) found that low inter-relater reliability using the Norton Score, measures averaging 39.7% for absolute agreement and 84.75% for determining patients at risk, ie. a score of 14 or below. Predictive validity was also low. In 50 patients with a mean age of 72.2 years in hospital for the first 8 days, none with a score of <14 developed a sore whereas 2 with a score of >14 did so. The Norton Score was developed for use in care of the elderly but has been commonly used in other areas such as acute care settings where it was no longer valid or reliable. In particular, the Norton Score can lead to a failure to take into consideration medical condition, nutrition and pain. These failures have led to modifications of the original scale such as produced by Gosnell (1973), the Knoll Pharmaceutical Company (1977) and Pritchard (1986). More complicated assessment scales have since been produced which take into account a greater number of risk factors. The Braden Scale (Bergstrom et al. 1987) has six sub-scales. The Waterlow (1985) scale has seven scales and a higher score indicates a higher risk to a possible total of 20. In a survey of 650 general hospital patients, a score of >12 was found in all patients with an established sore.

Stotts (1985), looking at nutritional variables in patients, found that neither the Norton Score nor its derivatives were clinically predictive. Pajk et al. (1986) in a survey of 208 hospital patients found Gosnell's risk factors, if taken in conjunction with age and ideal body weight to be strongly associated with both the incidence and severity of skin

breakdown. Rank order of factors from greatest risk was altered nutritional status, impaired activity, impaired mobility, incontinence and altered mental status.

Other forms of assessment of risk using new technology are now beginning to be used and may in time supercede the scaling methods which at best still rely upon a relatively subjective judgement on the part of the nurse. Thermography which measures the infrared energy emission from the skin gives an accurate indication of the quality of the blood supply to superficial body areas. Simple thermograph equipment is now available for ward use (Davis and Newman 1981). Instruments such as the Denne gauge are also available to measure quantitatively the actual pressure being exerted on an area of skin when the patient is immobile either in a chair or in bed (McClement 1984).

Therefore, besides being a complex area of inquiry, the assessment of pressure sore risk is an everyday area of concern for the practising nurse and one which exists almost entirely in a nursing knowledge base rarely causing the clinical nurse to resort to medical diagnostic and intervention techniques. Since the aim of the present research was specifically to look at clinical diagnosistic behaviours within nursing, it was the area of clinical knowledge chosen as the focus of the investigation.

CHAPTER THREE

APPROACHES TO CLINICAL REASONING

Most of the research currently available in investigating the process of diagnosis and clinical judgement has arisen out of work involving clinical reasoning in medicine. There is evidence to show that the cognitive operations during medical diagnosis share certain critical features with the process of nursing diagnosis. For instance, Elstein et al (1978) demonstrated that the diagnostic process in medicine is based on the early generation of diagnostic hypotheses followed by evaluation of these. In nursing, Carnevali et al. (1984) state that nursing diagnosis follows a similar pattern.

On the basis of these similarities it is assumed that work in clinical reasoning in medicine may be applicable in nursing contexts and is a relevant area of knowledge to serve as background to this research.

Studies of clinical reasoning appear under a wide variety of terminologies in the medical and nursing literatures. Amongst these are 'medical reasoning' (Patel and Groen 1986), 'clinical judgement' (Schwartz et al 1973), 'clinical problem solving' (Kassirer and Gorry 1978) 'medical problem solving' (Elstein et al 1978 , Groen and Patel 1985), 'diagnostic inference' (Fox et al 1980), 'decision making' (Albert 1978), 'medical decision making' (Shortliffe et al 1979) and 'diagnostic reasoning' (Carnevali et al. 1984).

This variety in nomenclature may lead to confusion especially as, at times, different meanings have been applied to the same term. The diversity in the use of terms, however, reflects not only the variety in the methodologies used in this field of inquiry but also the confusing complexity of the cognitive processes involved in the clinical diagnostic task.

> "Whether a physician is defining a disease, making a diagnosis, selecting a procedure, observing outcomes, assessing probabilities, assigning preferences, or putting it all together, he is walking on very slippery terrain. It is difficult for non-physicians, and for many physicians, to appreciate how complex these tasks are, and how easy it is for honest people to come to different conclusions."
>
> (Eddy 1984)

In the field of clinical reasoning, there are basically two major approaches to describing how clinicians make judgements and decisions in the diagnostic process. These approaches vary considerably in the extent to which they seek to demonstrate the cognitive behaviours taking place in the diagnostic task. This entails considerable differences in the purposes of the research, in what aspects of the behaviour are examined, in the research methods used and in the type of conclusions which are derived from the results.

The **decision analysis approach** attempts to set up beforehand, in a logical formalised manner the various diagnostic options open to the practitioner in a particular situation. It specifies probability and utility estimates to each option and thence prescribes the optimal path to be taken to reach the correct diagnosis. The approach does not profess to demonstrate that clinicians necessarily use decision analysis in practice but rather it advocates what clinicians should do to reach the correct diagnosis as efficiently as possible. That is to say, the approach is prescriptive in its aim.

Process tracing approaches on the other hand seek to model how the clinician goes about the process of making a diagnosis rather than how it should be done. They are, therefore, descriptive in strategy. The methodology used here relies mainly upon introspective techniques yielding data which are descriptions of the complex sequences of cognitive behaviour taking place in a clinical task.

3.1 CLINICAL DECISION ANALYSIS

The central aims in the decision analysis paradigm are to demonstrate how clinicians use and weigh information cues in order to make a clinical judgement about a diagnosis or a choice of treatments. It also looks for evidence of consistency of judgement across subjects and similar tasks. Finally it seeks to establish the accuracy of judgements made by clinicians in comparison to a criterion based on a mathematically derived model of the judgement process.

Several approaches have been employed in the mathematical modelling of clinical judgement.

3.1.1 THE LENS MODEL

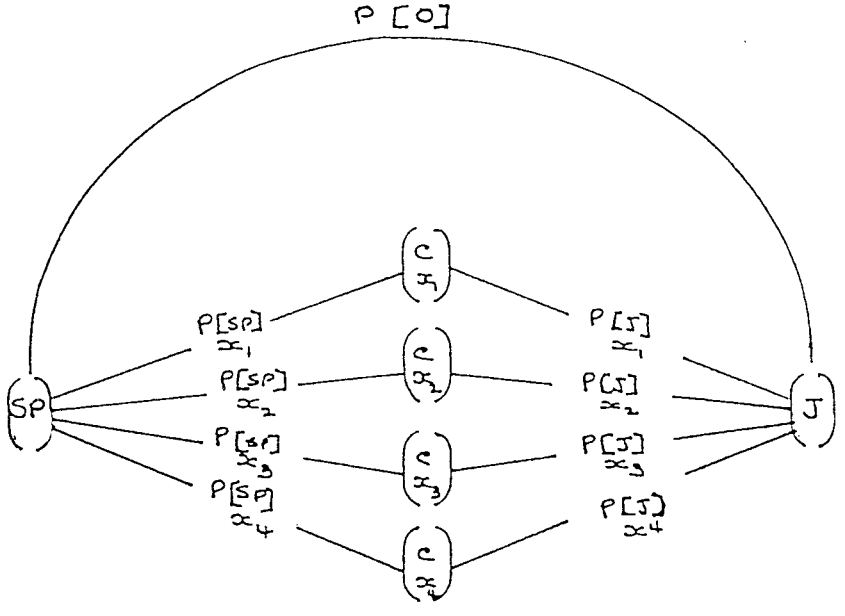
In the first of these, the dichotomy between the person making the judgement and the presenting information environment components of the judgement process is explored. Hammond (1964) developed a conceptual framework based upon the lens model (Brunswick 1955). This model uses the analogy of a convex lens to illustrate the relationship between the clinician's perception or judgement (J) of a set of clues (C) which in turn relate to the state of the object being judged, in this case the state of the patient (SP). (See Figure Two.)

There is a probabilistic relationship between each cue and the state of the patient (P[SP]). If a particular patient problem (SP) exists, then the probability of cue (x) being present is (P[xSP]). Similarly probability relationships exist between the cues and the clinicians perception and judgement of them (P[J]). This will be dependent on a number of factors such as knowledge, experience, familiarity with type of case etc. Thus if cue (x) is present the probability that the clinician judges it to be significant is (P[xJ]). Given a set of cues about a patient, the overall probability (P[O]) represents the degree to which the clinician is able to make a correct judgement of the state of the patient. In studies using the lens model, subjects are asked to state their opinions of what (P[SP]) and/or the (P[J]) and/or the (P[O]) are in a given situation. These can then be compared with and evaluated against predetermined optimal prescribed estimates.

The most comprehensive studies of clinical inference in nursing were undertaken by Hammond and his associates in the 1960's and were based upon the lens model. The first study (1966a) attempted to define the most frequently occurring tasks and cue characteristics occurring in nursing. A sample of 47 hospital nurses were asked to record any task occurring in their shift that involved a clinical judgement. 381 situations were reported but they could not be analyzed in terms of cue clusters. A second study reported in the same publication looked at 212 replies to a questionnaire focusing on abdominal pain in a post operative patient. Again a wide variation was found, 165 different cues being identified as relevant resulting in 17 different final diagnoses of the cause of the pain. No one cue acting on its own provided the basis for a diagnosis. A second set of studies (Hammond et al 1966b) looked in detail at the inference behaviour of 6 nurses. They were asked to infer the state of the patient from cues given in 100 cases selected from the previous studies. Again analysis was inconclusive. The nurses did not discriminate between usefulness of cues and their confidence levels varied little between cases of differing complexity. These early studies were fraught with methodological flaws recognised by the authors. These included doubtful representativeness of the example cases, crude representation of patient data, inadequate statistical analysis and arbitrary assigned cue groupings. Nevertheless the studies remain important as being, for many years, the only explicit effort to analyze the structural characteristics of the diagnostic task in nursing. It is only recently that efforts to explore this area of investigation has been revived, eg. Carnevali et al (1984).

The lens model has also been used in medicine. Moore et al (1974) asked endocrinologists to decide on treatment of hyperthyroidism on the basis of 5 given cues. The clinicians' relative use of information was then analyzed. They typically used less than all the available cues to make their judgement, tending to ignore the laboratory data and assigning greater value to findings from medical history. Goldberg (1970) used a similar model to generate a set of predictors that was superior to clinicians' own judgements in a study in which 29 psychologists were asked to distinguish between psychotic and neurotic patients on the basis of personality scale scores. The model showed itself to be more accurate than individual psychologists.

FIGURE TWO - THE LENS MODEL OF CLINICAL JUDGEMENT (after BRUNSWICK 1955)



3.1.2 BAYES THEORY

Bayes Theory based upon the probability of an event occurring given prior set conditions was originated by Reverend Thomas Bayes in 1763 and was first used in the study of clinical judgement in medicine by Ledley and Lusted (1959). The analysis of a clinical decision is based upon the notion that the clinician considers the probability of a diagnostic hypothesis based upon a cue or set of cues presented by the patient (P disease/findings). This probability is arrived at by considering three other probabilities :-

(a) The probability of occurrence of the finding given the disease is present (P finding/disease)

(b) The probability or underlying frequency of the disease (P disease)

(c) The probability that the signs and symptoms present could have been caused by some other potential disease (P findings)

Simply stated Bayes Theory then declares :-

$$(\text{P disease/findings}) = \frac{(\text{P findings/disease}) \times (\text{P disease})}{(\text{P findings})}$$

In the early years of the studies on clinical judgement Bayes Theory was heralded as a valid statistical model of clinical decision making.

It was used in a further study by Hammond et al (1967). Six nurses were given brief descriptions of 12 cases judged typical of nurses' inferential tasks and were asked to state whether or not a particular condition was present. They were asked to state prior probabilities (P disease), select one datum at a time and state the conditional probability (P findings/disease) and finally revise if necessary the probability of the disease being present (P disease/findings). Results show that the subjects' performance tended to revise probabilities in the direction dictated by the theory although the amount of revision was less than prescribed by the formula.

In a study on medical diagnosis, Kozielecki (1970) found that subjects tended to overestimate the (P disease/findings) if the number of possible diagnostic hypotheses is large, ie. they indulged in 'radicalism', and vice-versa, demonstrated 'conservatism' if the size of the hypothesis pool is small. It may be, however, that there is confusion between cause and effect in this conclusion. Subjects who overestimate the probability of a disease being present will be willing to entertain a larger number of possible hypotheses than those who are more conservative in their estimates.

Later studies led to doubts about the validity of Bayes Theory as a model of the clinical judgement. Elstein et al (1986) found that clinicians frequently depart from the decisions set by a normative model especially when these involve issues of avoiding potentially harmful treatment regimes for the patient. Balla, Iansek and Elstein (1985) found that base rates (P disease/findings) are often neglected in favour of individual information from the patient, perhaps because this is the more vivid and memorable.

Fischhoff and Beyth-Marom (1983) suggest a taxonomy of ways in which a clinician may stray from a pure Bayesian approach to diagnosis. This taxonomy consists of :-

1) Failure to retrieve the correct hypothesis from memory.

2) Pursuit of exotic categories at the expense of more probable diseases.

3) Misinterpretation of data.

4) Errors in the revision of probabilities.

From their studies in both medicine and other fields, Kahneman and Tversky concluded :-

"The usefulness of the normative Bayesian approach to the analysis and the modelling of subjective probability lies not on the accuracy of the subjective estimates, but rather on whether the model captures the essential determinates of the judgement process..... In his evaluation of evidence man is apparently not a conservative Bayesian: he is not Bayesian at all "

Kahneman and Tversky (1972 p 353)

3.1.3 UTILITY THEORY

A third model used in decision analysis studies is Utility Theory. This describes the selection of actions based on the clinician's subjective assignment of the value to probable outcomes of those actions. Whenever a clinician is faced with a patient problem there are a number of possible actions which could be taken. Each has a probable outcome, the value or utility of which can be assessed subjectively. Thus the clinician may opt for one particular course of action, such as a diagnosis, not merely on the basis of probability alone but on consideration of the outcome value. This value may relate to patient preferences or the limitation of time or facilities in the situation. For example, Moore et al (1974) asked 6 experienced endocrinologists to choose the most appropriate of the three standard forms of treatment for thyrotoxicosis (surgery, radio-active iodine, anti-thyroid drugs) for 40 patients and to rate each of the treatments in each case on a twenty point scale. Results show that 4 of the physicians were taking into account the value to the patient of the treatment when making their choice. Although relatively consistent with real decision making, this approach was poor in separating out utility values between treatments.

An alternative technique is the 'lottery' approach (Raiffa 1968) in which a forced choice between two alternatives is offered. One of these has absolute certainty of success while the other has a stated, but less than 100%, probability of success. The probability of this second alternative is altered until the subject can no longer choose between the alternatives. This point marks the utility value of that alternative. Used in several studies, this approach yields good utility estimates but is felt by subjects to be remote from real

decision making (Taylor 1976). According to Taylor (1976) clinicians act on the principle of rationality, ie. they act as if they are able to measure the advantages and disadvantages of a decision in units so that the net advantage to the patient is as great as possible. That is to say, they act to maximise the utility value of the outcome.

Problems with utility theory for clinical practice are discussed by Albert (1978). The first of these is that clinical decisions about patients are of a different order than, for instance, that of monetary decisions on which the basic logic of utility theory is founded. Secondly, utility estimates are highly individualistic, the choice between a surgical scar and a prolonged period dependent on daily drug intake, as in the thyroid example, will vary enormously from one person to another. Thirdly, the choice in medicine is often between unknowns, eg. the experience of dying or the pain of surgery. Accurate utility estimates are very difficult to calculate in advance in such situations.

3.1.4 DECISION THEORY

Decision Theory is a group of concepts which endeavour to describe or prescribe how individuals or groups of people choose a particular course of action from the alternatives presented to them and about which they have varying amounts of knowledge concerning the resulting outcomes (Albert 1978).

Studies using decision theory in clinical medicine and nursing usually relate to individual cases and are prescriptive in approach in that they attempt to define how the clinician should make a choice rather than how that choice is made in reality.

Decision theories can be classified according to how much information is available to the decision maker about the various outcomes for a given action. 'Decisions under certainty', where each alternative has a known outcome, are rare in clinical contexts. More likely, the clinician is faced with 'decisions of risk or uncertainty' where each alternative has a known set of possible outcomes each with a less than 100% probability of occurrence. 'Decisions of ignorance' occur where no knowledge of the probabilities of occurrence are available.

Clinical Decision Analysis is defined by Taylor (1976) as :-

"Any attempt to analyze or explicate the processes by which decisions are made which takes as its basis, either explicitly or implicitly, the conceptual frame-work of decision theory."

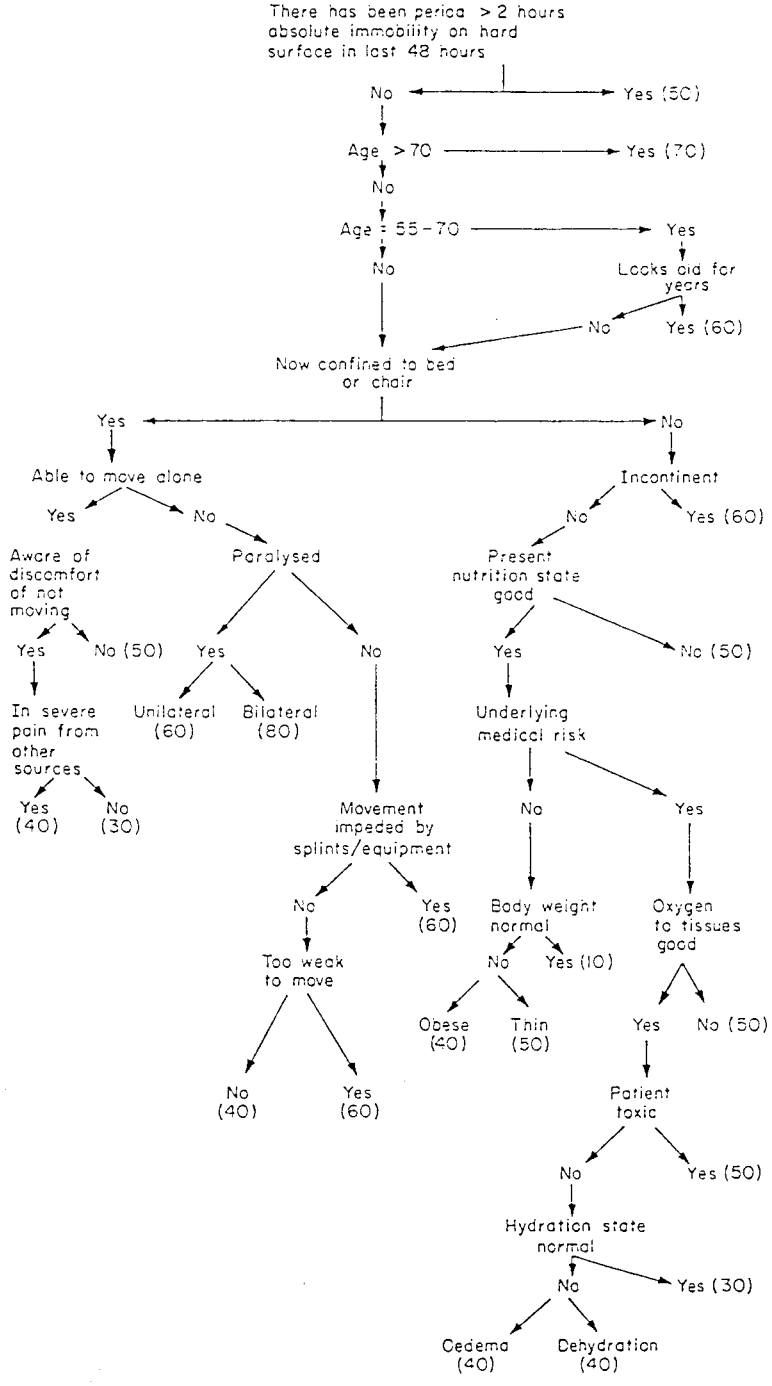
(Taylor 1976)

In this approach to diagnosis the process is seen as a step by step sequence of decision points at which the clinician has to select which way he will proceed next. The decision points are called 'nodes' and are connected by action lines or 'branches'. At each node information about the probabilities of outcome and/ or their utility values are available to the decision maker in terms of 'expected values'. An expected value is the probability of occurrence multiplied by its utility. The expected values of all possible outcomes can be summed and stated at the node which allows estimation of the correct way to proceed using the principle of rationality. Since all the nodes have specifications of their contents, often including probability and utility estimates, already made out, the problem-solver can look ahead and view the outcomes of a possible decision before he actually proceeds. The whole sequence of decision points can be set out diagrammatically as a decision tree. (See Figure Three)

A major advantage of this type of representation is that the knowledge component and decision points are made very explicit from the outset. It combines well with quantitative methods which can determine objectively the effectiveness of decision making. Bayes' theorem is a well established mathematical procedure for this purpose (see Schwartz et al. 1973).

Clinical decision analysis has received wide coverage in the literature. An early outline of the technique is given by Schwartz et al (1973) who details the method using the diagnosis and treatment of hypertension as an example. Studies have also been made of the treatment of individual patients (Doubilet and McNeil 1982), investigating alternatives in management of certain disease states (Elstein et al 1986, Moore et al 1974) and in assessing the value of diagnostic tests (McNeil and Adelstein 1976). It has

FIGURE THREE - DECISION TREE REPRESENTATION OF PRESSURE SORE RISK (From Jones 1988)



Numbers in brackets refer to percentage probability of pressure sore development in patients whose presenting data have led to this node in the tree. For example, a patient who is aged less than 56 years, is not confined to bed or incontinent, but whose nutritional state is poor, is estimated to have a 50% chance of developing a pressure sore.

also been used to investigate the decision making behaviour of nurses. Aspinall (1979) used 30 triads of nurses matched for experience and education. She assigned the nurses in each triad to one of three groups. Group A were given a case study of a patient; Group B had a care study and a list of 18 possible diagnoses indicated by the patient state; Group C were presented with a decision tree in which the 18 possible diagnoses could be systematically trimmed to 6. Each of these was then considered to be a possible correct diagnosis. Subjects in Group A gave the least number of correct diagnoses and those in Group C gave the most. The improvement in accuracy was negatively correlated with the educational level of the nurses. Inexperienced nurses and those with more than 10 years experience showed greater improvement with the decision tree than the middle experienced nurses. The author concludes that the use of decision trees should be encouraged in nursing as a means of improving accuracy of diagnosis of patient problems.

Decision analysis has received criticism in recent years (Tverksy and Kahneman 1981,Lopes 1981). Elstein et al (1986) studied the judgement of physicians in the prescribing of oestrogen replacement therapy in menopausal women with osteoporosis and compared the subjects responses with decisions derived from a decision analysis model. They conclude that " the practice habits of the clinicians studied, as mirrored in their responses to a series of 12 written cases, are inconsistent with a decision analytic model". The reasons cited for the inconsistencies found are that new knowledge about a case does not immediately change established patterns of practice. There is also cognitive overload in trying to synthesize multiple competing factors. Finally physicians' perceptions are swayed by feelings of responsibility, blame and anticipation of regret which may not be accounted for in the model. The researchers point out that departures from the principles of normative decision making theory are a regular feature of human decision making.

Other criticisms of the approach are also noted. A major disadvantage is that decision analysis may not match the sort of human thinking which is taking place in real situations such as medical diagnosis, where consideration of all possible alternative courses of action may not be feasible (Fox et al. 1980). In addition, the techniques depend heavily on being able to establish the prior probabilities and this is frequently not possible in assessment of human problems where many data are difficult to

operationalize (Elstein et al. 1978). The approach therefore is not a good reflection of how decisions are made in practice but only of how they should be made. Decision Theory is contra-intuitive and fails to replicate the reality of clinical practice (Elstein et al 1986).

Schoen (1983) rejects the model of what he terms 'Technical Rationality' underlying the approach to understanding clinical reasoning put forward by Eddy (1984) for its failure to account for the practical competence of the clinician operating in an ever changing clinical context in particular, when dealing with a unique or divergent case. Schoen believes that the most important part of clinical expertise comes from 'knowledge in action', that is to say experience of doing the task without necessarily being able to articulate exactly the thinking processes involved. For Schoen, clinical practice is artistic, intuitive and craft-like. The cognitive activities of the practitioner he calls 'reflection in action' and advocates the development and acceptance by the medical profession of this process.

> "The study of reflection in action is critically important. The dilemma of rigor or relevance may be dissolved if we can develop an epistemology of practice which places technical problem solving within the broader context of reflective inquiry, shows how reflection in action may be rigorous in its own right, and links the art of practice in uncertainty and uniqueness to the scientist's art of research. "
>
> Schoen (1983)

The dichotomy between the two views of clinical practice epitomized by Eddy (1984) and Schoen (1983) is resolved somewhat by the concept of Cognitive Continuum Theory put forward by Hammond (1980). This continuum has intuitive judgement at one pole and scientific experiments at the other. Intermediate modes are 'peer aided judgement', 'system aided judgement', 'quasi-experiment' and 'controlled trial'. Movement along the continuum reflects the increasing manipulation of the clinical situation by the clinician/researcher. Hammond maintains that with less well structured clinical tasks, eg. the unique case, the clinician is more inclined to adopt an intuitive approach while, in the more structured situation, a more analytical way of proceeding will be employed.

Thus the nature of the task is seen as the main factor in determining what cognitive strategy the clinician will adopt. Interesting though Continuous Cognitive Theory may be, it is merely descriptive and not yet substantiated by empirical testing. Research is needed to ascertain whether the clinician's behaviour arises from the nature of the task situation itself or whether other factors are involved. For instance, Schoen (1983) argues that the task situation is not externally defined but is construed by the clinician himself and will thus vary from clinician to clinician. Dreyfus and Dreyfus (1980) maintain that it is the level of expertise which determines the approach to a clinical task. They consider that novices tend to rely on formal methods of proceeding whereas expertise is defined in terms of the 'inclination' of the practitioner to approach the task in a more intuitive manner. Again, Dreyfus and Dreyfus' work is not backed up by empirical evidence. A major problem with such investigations is to define what 'intuition' actually involves. The fact that problem solvers cannot explain all that happens in a task often acquires the label of 'intuition' when it might be the case that information processing is taking place but at an automatic level.

3.2 PROCESS TRACING APPROACH

Process tracing asks subjects to explain their state of awareness of their cognitions as they go about solving a given problem.

The approach is based on the work of Newell and Simon (1972) who postulate that human thinking operates as an information processing system such as a thermostat or a computer program. This analogy with engineering allows explanation of how information is drawn into the human cognitive system and used there for the purposes of problem solving, perception, memory storage and so on. Research paradigms based on this theory seek to give empirical demonstration of the use of information at different stages of progress through the system.

3.2.1 INFORMATION PROCESSING THEORY

Whatever their specific function, all information processing systems have certain features in common.

Information enters the system through one of two separate sources, either from the environment via input channels which in humans would be the various sense organs, or from a Long Term Memory store (LTM). On entry, it is held in a Short Term Memory store (STM) or Working Memory. This is a holding facility until the information is needed by the Central Processor.

The Central Processor is the main functioning unit of the system. It holds in an organised map form the present state of knowledge of the problem being solved, the 'Problem Space'. It has a set of information processes with which it can manipulate incoming data in order to update the problem space. This set of processes are called 'Operators'. The central processor also contains a decision unit, the 'Interpreter' which determines what information is next required from the working memory and which operator is to be employed to use that information to change the problem space. Once data has been used by the processor it is exited again to the working memory from where it is either passed to the LTM as information for action or as a stored

FIGURE FOUR - AN INFORMATION PROCESSING SYSTEM

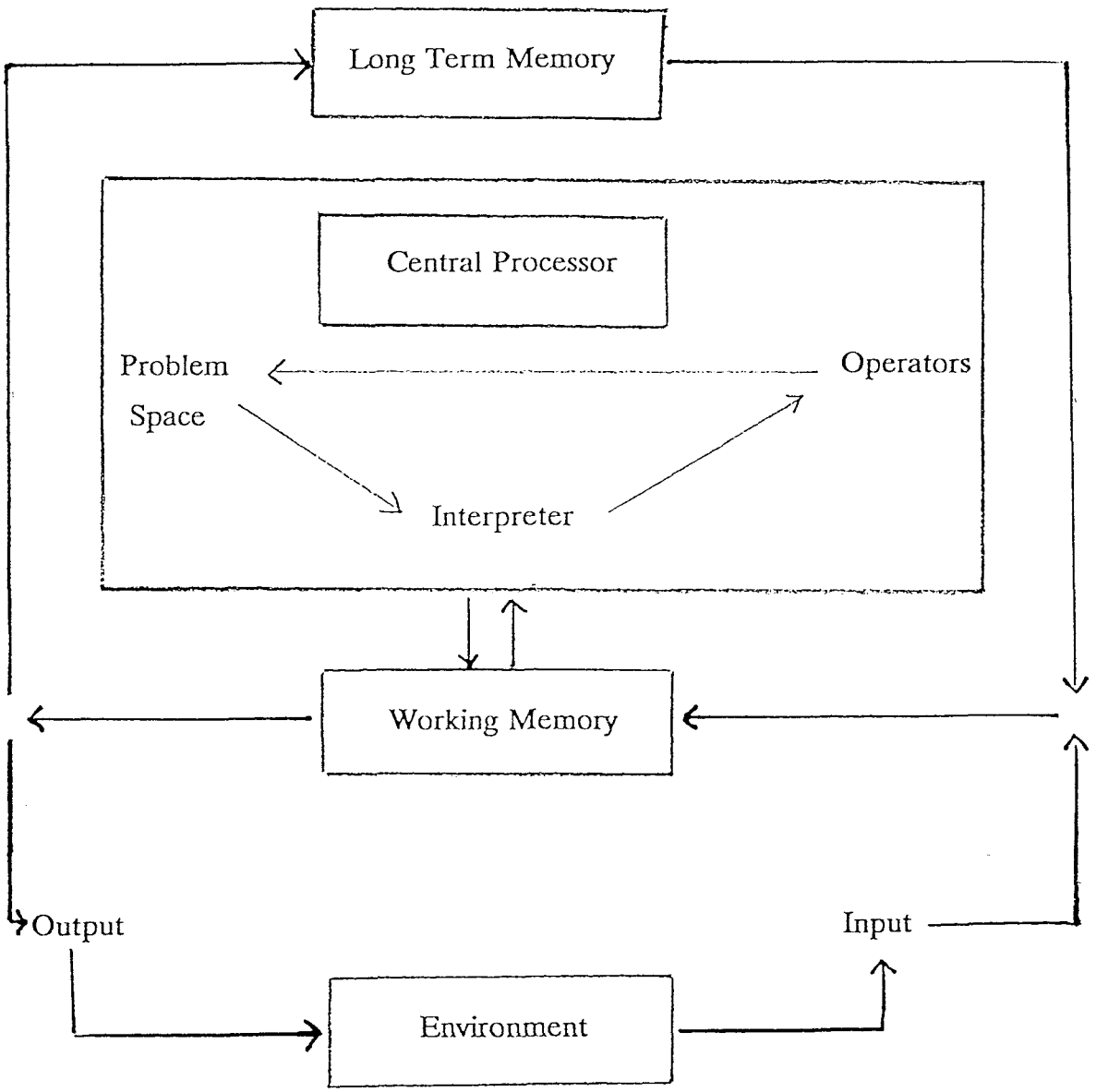
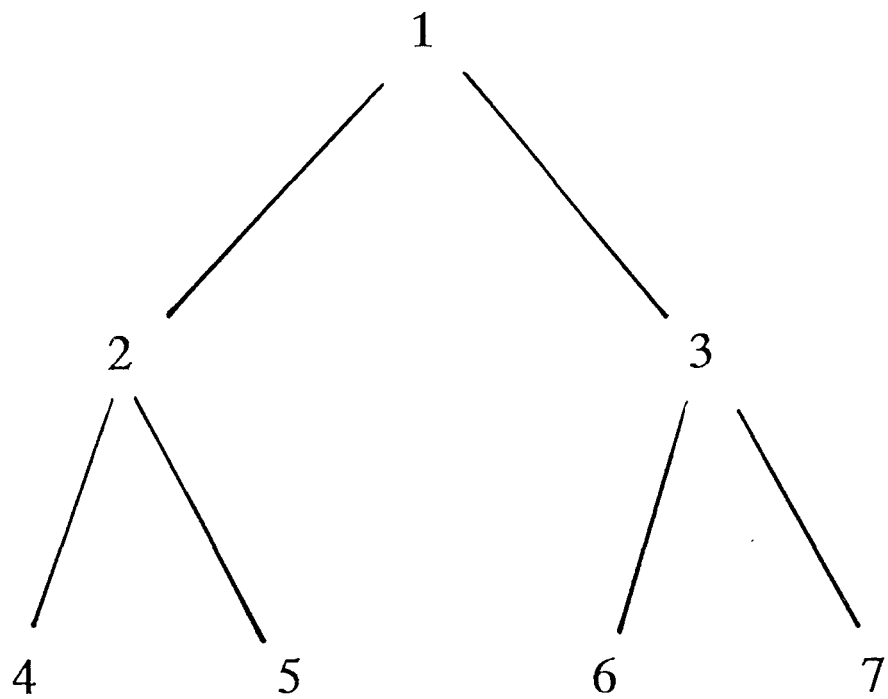


FIGURE FIVE - AN INVERTED TREE REPRESENTATION OF A PROBLEM SPACE



understanding of the problem state. Information not passed to the LTM is lost to the environment.

The problem is represented in the problem space in an inverted tree structure with a root and branches (Figure Five).

Each box is called a 'node' and represents a possible state of the problem. Each line between nodes is a 'link' or 'relation'. Problem solving involves searching from the initial state (Node 1) to the node at the bottom of the tree which indicates that the problem is solved. Rational problem solving demands that the whole tree is exposed and worked upon during the solution but, unlike a computer which can do this, the human cognitive system has severe limitations on the amount of information it can process at any one time. From experimental work, the ultimate limiting factor in the human processing system is the capacity of the working memory. The capacity of the working memory store was shown in a study by Miller (1956). He had subjects repeating back a series of binary digits and found that people had an immediate recall of approximately nine single digits. He then taught subjects to re-code the digits in groups which he called 'chunks'. Now the subjects' immediate recall was seven plus or minus two chunks and that with practice they could remember up to forty binary digits by using chunks of four to five digits each. Thus, by organisation of material, the capacity of the store can be enlarged but is still bounded by the limited amount of chunks of information.

Because of this capacity limitation, rational problem solving is not always an option open to us especially when faced by complex and difficult problems such as clinical diagnosis. To overcome this difficulty, Simon (1957) introduced the notion of 'bounded' or limited rationality, in which the problem solver reduces the overall problem space to a much simpler form. He works with a part of the tree at a time without being aware of the whole, working serially from one stage to the next. The search of the problem space is therefore not exhaustive with every node being evaluated. Rather a 'heuristic' approach is used (Newell and Simon 1972 page 101). In this, as each new node is encountered it is evaluated as to how far from the ultimate solution node it is. If it appears closer to the solution than the present node, it is chosen as the next state of the problem to go to. If there is more than one node that is seen as a possible route as the

result of the last input of information, the node appearing to lead most quickly to the solution is chosen.

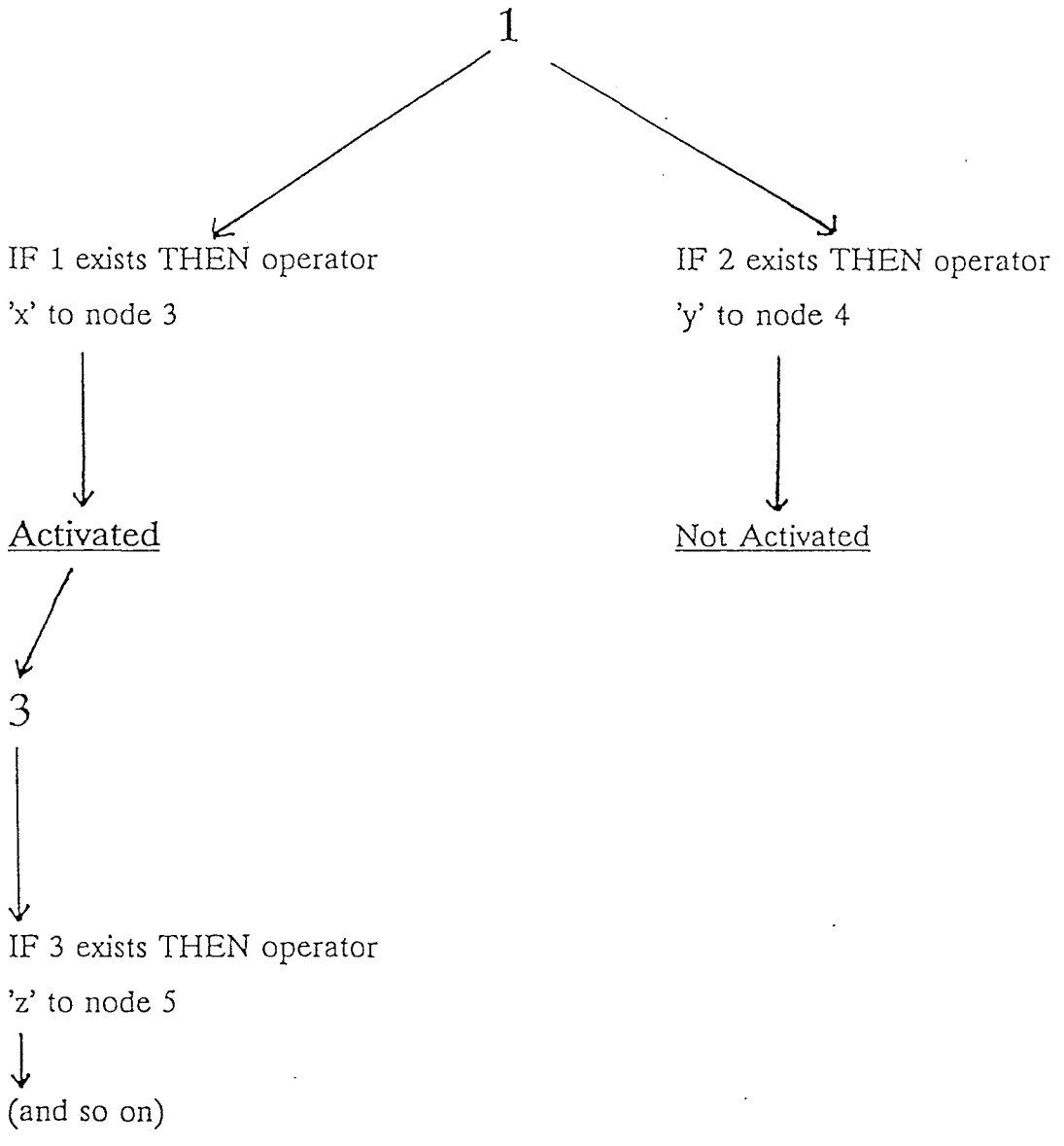
This simple rule of thumb strategy helps to simplify the search of a large problem space but is unable to guarantee a correct solution is actually reached (Barr and Feigenbaum 1981 page 28-31). The other problem is that good evaluations of the usefulness of the next node are not always possible especially in the early stages of the problem. However, heuristic search does have relevance to human problem solving as it appears to capture much of the flavour of what clinicians do when they use rule of thumb, or apparently intuitive hunches, to help them find the solution to a problem.

Newell and Simon (1972 page 803) argue that the functions of the interpreter in choosing which operator to use next operate in what they call 'productions'. A production is a conditional (IF - THEN) statement. That is to say, IF a particular condition 'x' exists, THEN action 'y' is to be taken. Production rules are arranged in sets called 'production systems' (See Figure Six).

Newell and Simon's theory, by proposing the idea of multiple repetitions of very simple individual processing operations taking place within a structured sequence, is able to describe explicitly how very complex cognitive problems can be solved by simple means. It is able to overcome the problem of bounded rationality in complicated situations such as clinical diagnosis. In experiments of solving of cryptarithmetic and logic problems and of chess playing, the authors give substantial evidence to support the validity of the information processing theory for explaining problem solving behaviour in humans.

The experiments undertaken by Newell and Simon (1972) all use the method of process tracing through the means of verbal protocols. These are transcripts of subjects' verbalisation of their thoughts of a problem solving activity.

FIGURE SIX - PRODUCTIONS SYSTEMS IN OPERATION



3.2.2. PROCESS TRACING STUDIES

Studies using this paradigm are numerous and have had a number of aims. The most extensive set of studies was carried out by Elstein et al. (1978) who sought to develop and test a general model of diagnostic reasoning in medicine. Elstein's initial study used trained actors in three simulated diagnostic work-ups with two groups of physicians, seventeen of whom were recommended by their peers (the criterial group) and seven who were non-criterial. A videotape of the work-up was shown afterwards to the subject who was asked to recall his thoughts during the session. The investigation found that the groups could not be distinguished from one another and that the physicians employed a reasoning strategy involving the early generation of diagnostic hypotheses. Elstein concluded that there appears to be four major components to the process:-

(a) Cue Acquisition - initial gaining of information from the patient using a number of methods, eg. history taking, clinical examination. At this stage the potential problem field is enormous and some strategy is needed to limit the regions of that space to those most likely to yield a solution. This is achieved by :-

(b) Hypothesis Generation - This begins at about 10% of the way through a work-up. Approximately 4-5 possible alternative problem formulations are retrieved from the long term memory.

(c) Cue Interpretation - Data so far gathered are interpreted in the light of the possible hypotheses. Data are considered to determine whether they match with a hypothesis already generated.

(d) Hypothesis Evaluation - If a match is found further data may be collected for verification purposes. Now that the problem goal has been defined, the problem solving process can proceed more like the Newell and Simon's (1972) Model of means-end analysis. Specific clinical findings serve as possible conditional triggers to select an operator.

> This operator then drives the production on to reduce the cognitive distance from where the problem solver is at present to the confirmation of the hypothesis. If no match is found, the problem search begins again and a new set of hypotheses is set up and the search for verification re-instituted.

This method is called the Hypothetico-Deductive Model of Diagnosis. It is an example of backward chaining problem solving since from very early on in the process there is a jump forward to the end point, the diagnostic hypothesis, followed by a search back through the empirical data for verification purposes. Forward chaining search of the problem field is a gradual building up of significant data to eventually reach a final confirmed diagnosis such as advocated by the use of decision trees. Elstein et al's model has been corroborated by evidence from later studies. Kassirer and Gorry (1978) using concurrent verbal protocols from six physicians found that early hypothesis formation was the most striking aspect of the early part of the history taking process and found that the physicians maintained from 4 to 11 hypotheses at any one time. In the diagnostic process, hypothesis evaluation or 'case building' was the dominant mode of behaviour. Barrows and Bennett (1972) studied neurologists using both simulated patients with written work-ups and videotapes followed by simulated recall methods. They noted that the hypotheses appeared in the neurologists mind almost before the interview begins suggesting that possible hypotheses in the memory are strongly linked to salient cues in the patient appearing in features such as age, dress, mannerisms and response to the first one or two questions.

Early hypothesis generation has also been demonstrated amongst medical students. Ekwo (1977) tested 20 junior students on two problems. Early hypothesis generation was a more predominant feature in familiar problems than in non-familiar problems. Neufeld et al (1981) used simulated patients with a sample of 57 students and investigated their simulated recall data. Again, early hypothesis generation was present within 30 seconds of eliciting the chief complaint in students of all educational levels, junior students having less specific hypotheses than senior students.

In nursing, Tanner (1977) examined 57 baccalaureate students using five videotaped vignettes of hospital patients. Subjects were asked to think aloud as they asked for information from the researcher. The students generated 5-6 hypotheses immediately on seeing the tape. The final accuracy of the diagnosis was positively correlated with the number of hypotheses put forward, especially if the correct diagnosis was among the original set generated.

Studies have also looked at data acquisition strategies. Allal's study in Elstein et al (1978) concluded that initial data collection is not strategy-driven but generalised primarily seeking associative retrieval of problem formulations either from cues or sets of cues or from previous formulations. She found no consistency in cue acquisition or efficiency of data gathering between subjects. Differences appear to depend more on the nature of the task than upon idiosyncratic factors in the physicians. After hypothesis formulation, the Elstein group found that accuracy of diagnosis tended to be dependent upon accuracy of cue interpretation rather than thoroughness of cue acquisition. Similar conclusions were made by Gill et al (1983) who reported that diagnostic error was due less to faulty data acquisition than to failure to manipulate large volumes of data correctly. Thus it appears that, although thoroughness of data acquisition is necessary for accurate diagnosis, it does not guarantee it. Careful interpretation and integration of the information must also be present. Kassirer and Gorry (1978) describe cue interpretation as 'case building'. Four strategies appear to be involved :-

(a) Seeking data to confirm a hypothesis.

(b) Seeking data to eliminate a hypothesis.

(c) A discriminatory strategy to distinguish one hypothesis from another.

(d) Data to refine an accepted hypothesis to make it more specific.

Barrows and Bennett (1972) describe two types of approaches, either 'hypothesis-testing' lines of enquiry which may switch to a 'pre-set routine' of questioning if an enquiry path is no longer productive. If, during the routine approach, a positive match with a possible

hypothesis is found, the hypothesis testing approach will recommence. They found routine questions may also be used to rank hypotheses or prevent too early closure onto an apparently obvious conclusion. Tanner (1977) found senior nursing students had a similar choice between either a hypothesis-driven approach or a set of routine type questions depending on whether or not a hypothesis was available. She found in one situation that accuracy of diagnosis was more positively associated with general routine questioning than with hypothesis testing. Gordon (1980) based her study on the information seeking strategies of Bruner, Austin and Goodnow (1956). She found that early in the diagnostic task, her sample of 60 graduate nurses held multiple hypotheses which they sought to test using a simultaneous scanning technique. In this, information is used to test several hypotheses simultaneously. In all but two cases, this switched later in the task to successive scanning of the data in order to test single hypotheses one at once. In general, single hypothesis testing, which involves less cognitive strain, predominated among her research subjects. She found also that prolonged hypothesis testing and simultaneous scanning were associated with less accurate diagnosis. From these studies, it can be concluded that clinical decision making follows an early hypothesis activation approach. Cue acquisition then follows a generalised pattern until a positive match with some hypothesis is found when a more directed hypothesis-testing strategy is adopted.

Later work on clinical problem solving has illustrated some difficulties with the original hypothesis activation and testing model. As Elstein (1978 page 263) and Kassirer and Gorry (1978) point out, although physicians may use the same basic process, there is marked variation between individuals on any one task and differences in diagnostic style are apparent. Some physicians direct all their attention to uncover the core of the problem while others are more systematic and explore a variety of aspects of the patients condition. Other clinicians jump from one investigating hypothesis to another or use a pure chronological history taking format to solve the diagnostic problem. A study by Norman et al (1985) in which 3 groups of subjects, one group of medical specialists, another of second year residents and a final group of medical students were asked to give specific diagnoses of patients with either a respiratory or a rheumatology condition from protocols built up by a group of experts. Results showed little evidence of case specificity between subjects with considerable variation within subjects across cases. The investigators concluded that clinical problem solving is a highly variable activity rather

than a general skill. Deber (1986) suggests three sets of factors which explain these variations amongst clinicians. These are :-

(a) Disease-, treatment-, and patient-specific factors

(b) Institution specific factors

(c) Practitioner specific factors.

Other researchers have questioned whether a single general process is sufficient to explain the diagnostic task in the vast variety of forms it may take in clinical situations. They base these doubts on the accumulating evidence, even present in Elstein et al's (1978) own findings, that successful problem solving shows marked case specificity and is often not transferable across clinical situations. Berner (1984), Politser (1981) and McGuire (1985) suggest that the earlier findings were artifacts of inadequate measurement, lack of control in data collection settings, limitation of the problems dealt with to acute illnesses, and the small sample sizes used.

Attention has moved away from searching for a hypothesis activation model to focus upon the role of knowledge in diagnostic problem solving, how knowledge is organised and represented in the LTM, and what processes are involved in accessing it during diagnostic work-ups. Researchers have long been aware that a large amount of clinical knowledge, highly organised for the task in hand, is essential to accurate and efficient diagnosis of patient problems (Barrows and Feltovich 1987, Kassirer and Gorry 1978) and that inferior performance may be the result of an inadequate knowledge base (McGuire 1985).

Several different suggestions have been put forward regarding the structure of the knowledge base representation in the LTM accessed during the clinical diagnostic task. Grant and Marsden (1987) found that when presented with clinical information both students and clinicians interpret it by identifying for themselves certain important pieces of information which they call 'forceful features'. These features act as a key to access memory structures which in turn give rise to clinical diagnosis.

Patel and Groen (1986) in a study using 7 cardiologists examining a written case description of a patient with bacterial endocarditis asked their subjects to write down as much as they could recall of the text together with explanations of the histopathology involved. Accurate diagnosis was associated with pure forward reasoning through the use of a network of 'causal rules' similar to production rules. The overall framework used was comparable to a frame representation first proposed by Minsky (1975). This is a recent development in cognitive psychology yet is already showing itself to have much relevance to medical diagnosis (Ramsey et al. 1986).

A frame is a data structure made up of nodes or 'slots' into which various values can be placed. It thus represents a stereotype of a type of a situation or concept already encountered by the problem solver. Once formatted, this frame resides in the LTM until a similar condition again arises. It is then retrieved and activated to assist in the specification of the exact nature of the present difficulty. The problem solvers' task is to find, from the LTM, that frame showing the closest match between the lowest nodes in the structure and their present empirical equivalents, ie. data drawn from the environment. Once the frame has been found, then the nodes or slots can be filled with new values arising from that environmental data. Slot values may be 'compulsory',ie. they must have a matching to the empirical data, 'default' where they will be filled by preset data if no match is found,or 'optional' which need not necessarily be filled in order for the frame to achieve an overall match. See Figure Seven for an example of a hypothetical frame representation of nursing data.

Recent work has suggested that clinical diagnosis is less of a reasoning process but more a matter of pattern matching (Waldrop 1984, Norman et al 1985, Cantor et al 1980). Norman et al (1985) suggests that patterning within the LTM might serve as an explanation for the case specificity found in so many empirical studies. Individuals consistently group the objects they perceive into meaningful or coherent classes or concepts. This is done by taking note of the various characteristics of an object and comparing them to those characteristics which determine class or concept membership. Concepts in which all members have at least one characteristic in common are called 'Monothetic' concepts. Concepts which do not possess such invariant attributes are called 'Polythetic' (Beckner 1959). In these, groups of objects have a large proportion of their

attributes in common but do not necessarily agree in any one property. They are also often referred to as 'Fuzzy ' concepts (Halloway 1978) or 'prototypes' (Rosch 1976). Many concepts in medical diagnosis appear to be 'fuzzy' in nature (Wigertz 1986)

The idea of prototype learning in the classification of disease entities in medicine is taken up by Bordage and Zacks (1984). They found fourteen broad categories of medical disorders stored in the long term memory of both experienced doctors and medical students. These categories were characterized by marked overlapping of the category boundaries giving a 'fuzziness' to the categorization. Concepts were seen in terms of 'prototypes' or approximate representations of class membership rather than having absolute criteria for an inclusion in a disease category.Thus some disease entities were seen as more typical of a disease class membership than others. Bordage and Zacks believe that the greater the overlap the greater the associative strength between particular disorders and quicker access to knowledge. They conclude that expertise is due not only to large amounts of knowledge but to a "superior organization" of that information in the form of prototypes within the long term memory.

Benner and Tanner (1987) in their study on intuition argue that nursing knowledge is stored in the memory as patterns and that some form of pattern recognition or template matching process goes on in clinical practice. This is in line with the 'frame' theory of problem solving (Minsky 1975). Benner and Tanner state that, because experts have a greater sense of saliency and an ability to see some aspects as more important than others, they are able to make such recognitions quickly if not instantly. Learning is seen in terms of being able to deal with ambiguous 'fuzzy data' when making such matching by using past experience to expect certain events and to selectively attend to certain aspects of the situation. Such skills are seen as being developed 'on the job', ie. only available through repeated exposure to situations which have features in common with past experiences.

This switch in emphasis from explanations of underlying strategies of diagnosis to investigations into the LTM structuring of the knowledge base for practice and the accessing of knowledge patterns stored there has led to an enquiry into the nature of expertise in clinical problem solving.

FIGURE SEVEN - A FRAME REPRESENTATION FOR ACTIVITY OF DAILY LIVING

NODE or 'SLOT'	VALUES
GENERIC CONCEPT	Activity of Living (ADL)
SPECIFIC TYPE	Mobilizing
NATURE	Characteristic of all animals Central to conduct of all ADL's
PURPOSE	Transit. Exploration. Emotional Expression. Physical Fitness
INFLUENCING FACTORS	Stage of Development Physical or Mental Impairment. Temperament. Personal Habit
BODY STRUCTURES	Musculoskeletal system
NORMAL ROUTINES	Individual habit. Mode of transport to work etc. Aids used.
KNOWLEDGE AND ATTITUDES	Need for exercise Attitude to disability
CHANGE IN ENVIRONMENT AND ROUTINE	Illness. Holidays
DEPENDENCE/ INDEPENDENCE	Upper limb defects Lower limb defects
ASSOCIATED DISCOMFORTS	Pain. Immobilizing procedures. Social/Economic/Emotional Difficultes
RELATED NURSING ACTIVITIES	Alleviating discomfort. Help with ADL's Lifting / moving patients. Passive Exercises. Teaching/Supervising active exercises, esp. walking

CHAPTER FOUR

EXPERT VERSUS NOVICE CLINICAL PROBLEM SOLVING

In the nursing literature many argue that expert clinical judgement is an intuitive activity or "understanding without a rationale" and therefore cannot be demonstrated overtly. (Benner and Tanner 1987). They affirm that expertise can only be acquired by the welding of experience with knowledge in trial and error learning. Field (1987) states :-

> "The expert no longer relies on an analytical principle (the nursing process, guidelines, maxims, models of nursing) to connect her understanding to an appropriate action. The process has become internalized and her actions appear to the observer to be intuitive."

A possible explanation for this view is given by Kassirer et al (1982) who, in medicine, note :-

> "The intellectual abilities that form the basis of clinical expertise seem to many to be mysterious, collectively constituting the cognitive skills or wisdom of which physicians are most proud but about which they have little explicit understanding."

Certainly the ward learning environment studies give credence to the view that the expert nurse rarely interacts with novices to explain her various conclusions and that expert reasoning in nursing clinical areas remains hidden (Ogier 1981).

Benner (1984) studied the differences between novice and expert nurses in a study based upon the Dreyfus model of the acquisition and development of skills (Dreyfus and

Dreyfus 1980). According to this model, the practitioner passes through 5 levels of proficiency. These are :-

(a) The Novice

Novices have no experience of the situation in which they are expected to perform. They are taught about concrete elements in the situation and given context free rules to guide their actions. Such rule governed behaviour is limited and inflexible and often legislates against successful performance particularly if the situation is very fluid.

(b) The Advanced Beginner

The advanced beginners have coped with enough real experiences to note recurrent meaningful aspects present in the situation to recognise elements for which they have developed guidelines of behaviour. They are still not able to differentiate priorities however.

(c) The Competent Practitioner

They now begin to see actions in terms of long range goals or plans based on considerable conscious abstract analytical thinking through of problems presented to them. The have a feel of mastery and ability to cope with the many changing contingencies of the situation.

(d) The Proficient Practitioner

Proficient practitioners are able to take on a wholeness in their perception of the presenting situation, they have learnt from experience what to expect and to plan modifications for plans of actions. They are still guided by the conscious use of pre-set plans.

(e) The Expert

Experts no longer rely on an analytical assessment of the situation to connect their understanding of its attributes to appropriate actions. They have an intuitive grasp of the situation almost immediately without wasting time in consideration of a wide range of variables. The experts are guided by feelings of being part of the situation in which they are operating.

Dreyfus explains this development from novice to expert as changes in 3 aspects of behaviour. The first is movement away from reliance on abstract principles to the use of concrete past experiences to guide action. The second is a change in perception of the demands present from separate events to completeness, wholeness,'gestalt' experiences. The third is from being a detached observer and manipulator of events to being an involved performer within the situation itself.

Benner (1984) studied this model in relation to the acquisition of expertise in nursing. A sample of 21 pairs of nurses, one an expert and the other a beginner was chosen from 3 hospitals. Each nurse in a pair was interviewed separately about a patient care situation which they had experienced together. They were asked about the clinical knowledge they had used and for a description of the situation. In a second study, participant observation was conducted on the behaviour of a further 26 nurses to ascertain the characteristics of nurses at different stages of skill acquisition. Later these nurses were interviewed about their experiences during the observation period. Data from both studies were analyzed by a team of researchers using a variation by Heidegger (1962) of the constant comparative technique advocated by Glaser and Strauss (1967). Through the use of examples from the interviews, Benner concludes that the Dreyfus belief, that expertise is learnt through repeated encounters with similar situations, was upheld in nursing contexts. Benner's research is based on subjects' recall of situations and therefore are subject to bias arising from interference since the event (Ericsson and Simon 1984). Few checks on the reliability of the data are in evidence. The notion that expert behaviour is based upon 'intuition' which the practitioner finds difficult to elucidate has limited power of explanation either for understanding the exact nature of

the cognitive processes involved or for adapting this behaviour pattern to assist in training novices for expert performance.

The information processing approach, however, has been successful in explaining the differences between the clinical problem solving behaviour of experts and novices There is much evidence that differences in the strategies used by the two groups can be recognized and demonstrated.

De Groot (1965) considers that the problem space configuration for the expert is a vastly different perception at the outset from that of the novice and Tanner (1984) distinguishes the expert nurse diagnostician from the novice in terms of the diagnostic strategy adopted and the ability to use probabilistic data in reaching a conclusion. Broderick and Ammentorp (1979) compared differences between experts and novice performance while identifying simulated patient problems. They found that experts seek more information about the patient and certain data are given greater prominence by experts than by novices.

According to Kolodner (1984), two factors appear to differentiate experts from novice. These she explains in terms of the different types of knowledge stored in the Long Term Memory. Semantic memory contains the bare facts about our world that we have learned to date, but which are divorced from any memory of the learning experience itself. As would be expected, the expert has a greater and more complex domain of semantic knowledge than the novice.

Episodic memory, on the other hand, is a store of our past experience. Ideas here are linked together by virtue of either their occurring simultaneously in the past or by there being commonalities among repeated episodes of an occurrence. In this memory, factual knowledge is thus augmented by experience. For the expert, facts have become tied to episodes which, although differing in detail, are nevertheless similar overall and are linked both with each other and with the factual knowledge now encountered. Episodic memory, therefore, gives the expert greater understanding of the inter-relationships between facts and higher levels of integration of knowledge. This results in an enhanced readiness to traverse barriers between knowledge areas when problem

solving, to allow greater uncertainty by keeping options open longer and to consider possibilities which are deviations from the accepted norms. Kolodner (1984) supports the viewpoint that the expert is not merely more knowledgeable but better at applying and using acquired knowledge to effect in the working situation. That is to say, it is practical or procedural knowledge which is also required in the clinical field rather than theoretical knowledge alone. She gives three reasons for how this comes about :-

(a) The experience of dealing with previous problems of a similar sort.

(b) The method by which experts come to deal with problems which beset them.

(c) Continuous everyday contact with current problems.

She claims it is experience which turns newly learnt but as yet unrelated facts into expert knowledge. Her quote from professionals like doctors and lawyers about their education might just as well apply to nurses :-

> "in school they taught us everything we needed to know about ..., but it wasn't until I got actual experience that I was really able to appreciate that knowledge and figure out how to apply it."
>
> (Kolodner 1984)

More recently, research has indicated that it may be levels of knowledge per se which is responsible for expert performance rather than the differences in problem solving strategies (Glaser 1984). Groen and Patel (1985) question whether experts do actually use the hypothetico-deductive method during routine diagnostic procedures and that this behaviour is more characteristic of novice performance. They differentiate between 'strong methods' which rely on a highly developed knowledge base specific to the expert's domain and always yield the correct answer and 'weak methods' which consist of various heuristics and specific strategies, are more generalised, more time

consuming and may often lead to error. They claim experts make use of strong methods whereas novices are taught and rely to a great extent on weak methods. The study by Grant and Marsden (1987) demonstrates that, while there was no difference between groups of differing clinical experience in the breadth of thought as measured by the number of interpretations made about given clinical information, but that there were significant differences in the actual pieces of information which were seen as the key features for diagnosis as used by experts compared to novices. That is to say that although the breadth of thought did not differ with level of experience, the content of thought did.

Thus it would appear that the cognitive behaviour of experts and novices in a clinical diagnostic task differs considerably and that an investigation of this task would necessarily entail a comparison between the two groups.

CHAPTER FIVE

AIMS OF THE STUDY

The study arose out of concern about the introduction of the Nursing Process model of care into clinical nursing practice without an adequate understanding of the cognitive processes involved in its application to real patient problems. In particular, there were reservations about the apparent assumption that if the products of Nursing Process are demonstrated in the form of written care plans then a cognitive problem solving process has been accomplished by the nurse.

The focus of the research on the initial assessment of the patient was chosen since decisions made at this point have widespread implications for the planning and implementation stages which follow. The aim of the study was seen to be exploratory in nature. It seeks to make explicit the cognitive processes by which nurses are able to arrive at a diagnostic statement concerning a patient problem if the Nursing Process is being used. It does not seek to demonstrate that this is necessarily the method by which nursing care is implemented in the real world, but rather to investigate the data field and the cognitive strategies being used. In order to achieve this aim of demonstrating exactly what cognitions are taking place during the assessment of the patient, it is necessary to alter the normal situation in which the nurse is operating for in the real world the process often takes place very quickly, without conscious awareness of the complexities involved and without overt demonstration of the thought processes taking place.

In order to ensure that the investigation remained focused on its original aim, a number of working hypotheses were set up :-

(1) In performing the assessment stage of the Nursing Process, nurses use a combination of cognitive activities. These include strategies for search of the data field, data collection, data analysis and synthesis. The end point of this process is the making of a definitive statement of the nature of the presenting problem, the nursing diagnosis.

(2) These cognitive activities normally take place without formal overt expression by the nurse but they can be verbalized if considered necessary.

(3) The strategies and data used in the diagnostic process by expert nurses will be different to those used by novice nurses. These differences will be apparent both in the nature of the data field itself as well as in the search strategies employed to explore that field.

From the literature on the studies of clinical diagnosis in both medicine and nursing, a number of research options appeared to be available. Firstly, the study seeks to investigate what nurses are doing in making a clinical diagnosis rather than demonstrating what they ought to do in order to achieve efficiency and accuracy. For this reason, the decision analysis approach to understand the cognitive processes involved in diagnosis was rejected in favour of the process tracing paradigm based on information processing theory.

Secondly, within this paradigm, the verbal protocol technique was considered appropriate for the purposes of the study. Research has established that it is capable of demonstrating the cognitive activities such as those under investigation even though the verbalisation of their thoughts is not usually undertaken by nurses during their normal performance in the clinical situation.

PART THREE

RESEARCH DESIGN AND METHOD

CHAPTER SIX

THE VERBAL PROTOCOL TECHNIQUE

Introspection, verbalization of one's thoughts, was the earliest methodology used in the science of psychology (Wundt 1902). It fell into disrepute with the rise of Behaviourism which held that scientific knowledge should rely on empirical observable events and not subjective statements on the part of the research subject.

Moves to restore verbal reports of cognitions as data for explaining and supporting psychological theories has been strongly resisted. Zimbardo et al (1969) gave subjects electric shocks while they were involved in a learning task. Those given sufficient justification for the shocks on a second run of the task performed less well than those given insufficient justification. The latter subjects reported that the shocks were less painful the second time around. This was explained by the researchers in terms of attribution theory, that the insufficiently informed group sought to justify taking the shocks a second time by deciding they were less painful. Nisbett and Wilson in reviewing this and other studies claim that correlation between verbal reports and observable behaviours are too low to justify the conclusions reached by the researchers. They argue that :-

> " we may have no direct access to higher order mental processes such as those involved in evaluation, judgement, problem solving and the initiation of behaviour"
>
> (Nisbett and Wilson 1977)

They are supported in this view by a number of other cognitive psychologists:-

> " The constructive processes [of encoding perceptual sensations] themselves never appear in consciousness, their products do."
>
> (Neisser 1967)

> "There are many systems that cannot be brought into consciousness, and probably most systems that analyze the environment in the first place have that characteristic. In most of these cases, only the products of cognitive and mental activities are available to consciousness"
>
> (Mandler 1975)

From their review of the experimental evidence against admitting verbalizations as evidence of mental processes (eg. Nisbett and Schacter 1966, Storms and Nisbett 1970), Nisbett and Wilson (1977) conclude:-

> "People often cannot report accurately on the effects of particular stimuli on high order, inference based responses. Indeed, sometimes they cannot report on the existence of critical stimuli, sometimes cannot report on the existence of their responses, and sometimes cannot even report that an inferential process of any kind has occurred"
>
> (Nisbett and Wilson 1977 p233)

Most of the experiments examined involved retrospective reporting of cognitive processes. Supporters of verbal protocols argue that the time lag between the event and the probe was sufficient for material to be lost from the STM and that elements of LTM processes become involved with the report. This latter problem gives opportunity for contamination of the data.

> " Retrospective accounts leave much more opportunity for the subject to mix current knowledge with past knowledge, making reliable inference from the protocol difficult. "
>
> (Newell and Simon 1972 p184)

Ericsson and Simon (1984) object to Nisbett and Wilson's failure to differentiate between the types or sources of verbal reports in their criticism of the studies reviewed and that

in explicating that subjects are unaware of their higher mental processes, they condemn all reported cognitions as unacceptable data.

The supporters of verbal reports claim that verbalizations can be treated as any other observable behaviour such as button pressing, eye movements etc. Indeed, many so-called acceptable data are verbalizations. For example, subjects report verbally of letters seen on a screen, of changes in colour, etc.. Ericsson and Simon (1984) argue that if psychologists accept that when a subject reports a green ball on a screen that they are in fact seeing a green ball, then they should also accept that a subject's report that he is thinking of a rose then this also is in fact the case.

The verbal protocol technique is based upon the information processing model already discussed and the rationale for it is strongly established by Ericsson and Simon (1984 Chapter 1.2-1.3). The verbalizations uttered by the subject are seen to be a reflection of his cognitive processes as they come to the level of consciousness while he is problem solving. From the theory, it is assumed that only while information is flowing through the STM can it be heeded in this manner. The verbal protocol therefore is essentially a 'thinking aloud' technique; that is to say , subjects are asked to vocalize what is in their consciousness at a particular moment in time during the performance of some task or other.

> "The protocol is a record of the subject's ongoing behaviour, and an utterance at time 't' is taken to indicate knowledge or operation at time 't'"
>
> (Newell and Simon 1972 p184)

To ask the subject to think aloud in this way is not an activity unfamiliar to everyday life. Many subjects engrossed in a task will vocalize what they are thinking spontaneously. This was noticed by Sperling (1967) during a task involving presentation of verbal stimuli. Subjects spoke both during the presentation and during the waiting period until delayed recall was allowed. This spontaneous verbalization feature was more marked when external noise was present in the experimental situation. It was also noted

by Hintzman (1965) on a similar task. He also found that subjects were unaware afterwards that they had been speaking. Unwitting vocalizations have also been a feature of studies involving reading difficult passages (Gibson and Levine 1975) and in memorizing (Bartlett 1932).

Ericsson and Simon (1984), with reference to the information processing model of cognition, describe three levels at which subjects can verbalize their thoughts.

A) FIRST LEVEL VERBALIZATION

The subject merely vocalizes what is already present in his consciousness as verbally encoded material. No intermediate processing is required and, therefore, there is no time difference taken to complete a task between the vocalizing and silent conditions.

B) SECOND LEVEL VERBALIZATIONS

This occurs when material in the STM is not verbally encoded but in some other form such as in visual code. Some processing is necessary to convert it to verbal code before it can be spoken. Thus some time difference in task completion between the silent and verbalized conditions will be present but this will be minuscule.

C) THIRD LEVEL VERBALIZATIONS

Third level verbalizations require subjects to explain their thought processes, to integrate data in the STM with material attended to previously.

Thinking aloud as in the verbal protocol technique is concerned with conditions which conform to Level One or Level Two Verbalizations. Only information arising from the immediate task in hand is attended to and that its vocalisation should not alter the performance of the task itself. Thus, the concurrent verbalizations are reflections of the current contents of the STM.

Ericsson and Simon (1984 Chapter 2.3-2.4) cover in detail the experimental evidence available to support this claim. It relies heavily upon studies which show there to be no significant differences in problem solving performance between subjects asked

to verbalise their thinking and those who are allowed to work silently, that is to say that orally encoded STM contents can be spoken aloud without interfering with the ongoing problem solving process. They quote studies which use a variety of performance measures to show that such interference does not occur. Karpf (1972) had two matched groups of subjects solving a concept attainment problem, one group were asked to verbalise and the other to work in silence. He found no difference in accuracy although the verbalising group took 50% longer to complete the task. Similar studies by Roth (1966) had also shown no differences in accuracy but had also demonstrated no time differences between the groups. Carroll and Payne (1977) had subjects making decisions about the granting of parole and found no differences in the time element. They also failed to demonstrate significant differences in the type of decision made and information requested during the task. Other studies failed to reveal differences in perceived difficulty (Smead, Wilcox and Wilkes 1981) and solution path (Ericsson 1975). Having reviewed evidence such as this Ericsson and Simon state :-

> "We conclude that the processes subjects use to verbalize while thinking are neither illusory nor elusive, but can be understood and modeled. The processes associated with verbalization should be treated as an integral part of any model of the cognitive processes for a given task whenever articulation takes the form of direct verbalization (ie. vocalization of heeded information)."
>
> (Ericsson and Simon 1984 p106-7)

The major problems arising out of the use of verbal protocols relate to veridicality and incompleteness of the report.

The strongest argument that verbal protocols are not veridical, ie. that verbalizations when present may not reflect accurately the underlying thought processes, is that of epiphenomenality. Epiphenomenality is the objection, raised mainly by the Behaviourist school, that the processes involved in the generating of a verbal response are totally independent of the process generating the actual task behaviour. According to Bainbridge (1979), to use the verbal report data as an indicator of what task-related

cognitive behaviour is taking place, is not a valid assumption to make for a correlation between the two may not exist. The access to task related mental activities will always be indirect. A verbal report will contain that which the subject is consciously aware of and this consciousness may contain items of the subject constructing his own ideas about the causal nature of the task. That is to say, a verbal report will always contain some data relating to the subject's own individualized mental picture of what is involved in the task he/she is pursuing (Nisbett and Wilson 1977). Bainbridge (1979) maintains that verbal reports should be used only to suggest hypotheses concerning the task related mental activities rather than confirmatory evidence. They are especially useful,however, if what is reported can be correlated with observable and measurable external behaviours concerning the task.

When a subject does not verbalize information which appears crucial to task performance, the researcher should rightly suspect that the protocol is an incomplete record of the cognitive events taking place. Such incompleteness can be explained from the model. The first problem may be that the information is not heeded because it has not appeared in the STM and hence is not available for verbalization. Some cognitive information, for example perceptual encoding, motor processes and recognition processes, appear not to use the STM. For instance, we recognize familiar faces, words, etc., with no apparent heeding of the process of doing so. When the recognition becomes complex, as in embedded figures, the intermediate stages are not noted directly (Claperede 1934, Henry 1934). Over-learning, such as the repetition of a task over and over again, leads to automation of the activity. This is thought to be due to failure of the intermediate cognitive processes passing through the STM (Sargent 1940). The second reason for incompleteness of the verbal protocol may be because not all of the information present in the STM is reported. In conditions of high cognitive load, subjects tend to stop verbalizing or to give incomplete reports. Also, information in the STM is easily obliterated by, for instance, asking the subject to perform intervening tasks concurrently with their verbal reporting.

Thus, it must be accepted that incompleteness may be a limitation of the verbal protocol technique. However, this does not invalidate the information that is forthcoming.

The researcher can work with the data that is available without the necessity to speculate on what is not.

The information processing approach using verbal protocols is described by Kuipers and Kassirer (1984) as being essentially 'a methodology of discovery'. They justify the approach by pointing out that individual variation in human cognition is so marked that averaging data across populations is fallacious. Newell and Simon (1972) maintain that the full complexity of cognitive behaviour in problem solving, as captured in a verbatim transcript, can alone do justice to the intricacies of the process. For this reason they recommend in depth analysis from a small set of subjects. Elstein et al (1978) maintain that the initial prime objective of their research was that of content validity of their findings rather than generalizability. Therefore, they opted initially for the time consuming methods which gave high fidelity. Generalizability as a secondary aim could be achieved later using low fidelity materials in experimental designs.

The strength of the method is that it relies on direct observation of the clinical diagnostic task even in less than optimal fidelity situations (Elstein and Bordage 1988). It does not seek to exercise control over the data yield thereby having low researcher bias effects. The settings for obtaining the protocols use such methods as actors trained as simulated patients (Elstein et al 1978), predigested case description (Kassirer and Gorry 1978) and so on. The materials used in these settings closely resemble those used in real situations. For instance, medical consultants are often asked for initial diagnostic judgements using written patient data alone. For these reasons, the rationale of the studies and methods as well as the research results are often easy to communicate to clinicians (Elstein and Bordage 1988). Kassirer and Gorry (1978) argue that the benefits of the deep and explicit understanding of the clinical diagnostic processes achieved in these studies are 'undeniable'. They cite three reasons for this. Accurate delineation of the process could be used firstly to help novice clinicians to acquire the skills of diagnosis. It would also lead to better measures of quality of medical reasoning and finally assist in the introduction of computer aided decision making. Computer programs can thus become working models of the human diagnostic task.

The studies cited by Ericsson and Simon (1984) are convincing evidence that concurrent verbal reports are a valid and reliable source of the internal cognitive processes taking place during a problem solving task. It was decided to use this form of verbalization as the data base of the present research study. Research subjects would be asked to talk about what they were thinking as they were actually performing the problem solving task of discovering and defining a patient problem, ie. making a nursing assessment. Their responses would be recorded on audio tape for later transcription and analysis.

CHAPTER SEVEN

MAIN RESEARCH STUDY - RESEARCH METHOD

7.1 METHODOLOGY

Decisions about how to present to subjects the information they would require during the assessment task needed to be carefully considered.

Since, for the purposes of the research, the data yield had to include what information was being collected, when, and in what sequence, it was considered necessary to force subjects to specify in some way what information they were operating with or wished to operate with.

Normally, this information would be available to them in a number of forms. For example, on the ward, they will have access to visual and auditory stimuli presented by the patient. In addition, there would be documented clinical findings and patient history from other clinicians, results of clinical tests and examinations, interview data collected both from the patient and his family and so on. They would also have recourse to their own long term memory structures for previously acquired clinical knowledge.

It was felt that any attempt to obtain verbal protocols in real clinical situations, where such a wealth of information might be put to use, could be deemed unethical. This is because patients might have access to the nurses' cognitions some of which might well be undesirable for patients to be aware of. The surroundings might also cause difficulty in obtaining data in view of the time pressure and recurrent interruptions that frequently accompany the performance of assessment of patients on the wards. The ability of the nurse subjects, under these conditions, to provide a suitable verbal protocol at the level of specification described above was predicted to be extremely limited. This was especially so because verbalising their reasoning processes is not considered to be among nurses' normal repertoire of clinical skills (Baumann & Bourbonnais 1982), a conclusion which had previously also been drawn in the investigation of medical problem solving (Kagan et al. 1967 , quoted in Elstein et al 1978). The notion, then, of collecting verbal

protocols in the real world situation of the hospital ward was rejected even though it was held to be the method which had greatest content and face validity.

A number of alternative scenarios for generating verbal protocols in the investigation into the diagnostic processes were found in the medical literature. These include having actors role play the part of patients while being interviewed and examined by doctor subjects (Elstein et al 1978); providing the research subject with full or extracts of written case notes of a real patient (Patel and Groen 1986) or a group of patients with similar diagnostic labels (Fox et al 1985) ; and allowing subjects to question another clinician on their own or their interpretations of documented findings about a particular patient (Kassirer and Gorry 1978).

The first of these was not considered feasible in view of the often far reaching range of information which nurses often seek from their patients as compared with the more disease focused approach of the doctor. Unlike the documentation in medicine, the nursing care plan unfortunately often lacks precision and comprehensiveness (Tanner 1986) thus rendering the second of the above approaches to data generation problematic. This technique also has the added disadvantages that while searching for a particular piece of information, the subject has the opportunity to scan other facts which may then inadvertently, and therefore not verbalized, influence her later thinking.

Audio and video recording of the research subjects undertaking patient assessments on the ward was also considered. The main advantage of this is a permanent, detailed record of the actual social interactions taking place. This could then act as a stimulus to direct the nurses' recall of their thoughts during the assessment. Smith (1975 p 221) recommends the use of recordings to aid recollection of events taking place during a research session. Supporters of these methods point to the advantage of having the tape played back at slow speeds or be interrupted as necessary to allow detailed analysis of its contents. For the purposes of the present research, however, such data would be analogous to retrospective protocols and be contaminated with material from the LTM. Thus they could not be accepted as evidence of the cognitive processes which took place at the time of the assessment. A second consideration involves the problem of subject reactivity to the presence of the equipment affecting the validity of the data (Kazdin

1982), although some researchers have sought ways in which to try and reduce this effect (Faulkner 1979). Finally, the cognitive activities on which the present research is focused frequently take place without overt verbalisation and thus would not be demonstrated on video or audio tape unless the subject was specifically instructed to express them. The problem of asking the nurses to expose their thoughts in the presence of the patient would still have to be overcome. Thus it was decided to employ a technique similar to that described by Kassirer and Gorry (1978). The nurse subject would be provided with minimal information about a patient and, by asking specific questions of the researcher who had a complete dossier on that patient, would obtain the information required to carry out the task of assessing the extent of the patient problem.

7.2 DESIGN

The design tool for this research is the concurrent verbal protocol based upon the information processing model already discussed and the rationale for its use in research has been strongly established by Ericsson and Simon (1984 Chapter 1.2-1.3).

The initial aim of the pilot study was to establish that clinical nurses were able to verbalize their problem solving behaviours during the task of assessing patient problems and that they could do this sufficiently well enough to provide adequate and meaningful data for the purposes of the research.

Subsidiary aims were then to find and test the optimal conditions under which such verbal protocols might be generated. From the data collected, it was hoped to gain sufficient information to be able to make a definitive judgement concerning the area of the nursing knowledge on which to focus the main investigation.

Finally, it was intended to use the data collected from the subjects in the pilot study to devise a framework for the scheme of analysis to be used in the main project.

After initial pilotting, it was concluded that the basic verbal protocol technique seemed to be appropriate only in part. During analysis of the results it was felt that not enough data had been generated so far to allow for either comparisons across subject

groups or for an explanation of the cognitive processes involved in the nursing assessment to be made.

The structure of the task was therefore expanded in an attempt to overcome these deficiencies. This involved each subject providing THREE separate concurrent verbal protocols during the research task. In each protocol, the subject is given basic details of a patient on a medical ward, ie. the patient's name, age and medical diagnosis. The subject's task is to diagnose the given patient's risk of pressure sore development by asking the researcher for data about the patient. A different patient example was used for each protocol and each of the three protocols given to subjects varied in the instructions :-

Protocol One - (See Appendix Four [a])

Subjects are asked only to make the diagnosis and their performance is not interrupted by the researcher except to give the information asked for. This is the true verbal protocol of a problem solving activity as advocated by Ericsson and Simon (1984).

Protocol Two - (See Appendix Four [a])

This is the same as in Protocol One but with the additional instruction to the subject to verbalise if possible any thoughts they may have on :-

(a) the importance which a particular piece of information may have in helping towards the diagnosis.

(b) their estimate of the patient's risk at each stage in the diagnostic task.

(c) their degree of confidence in that estimate.

It was the hope of the researcher that in the second task the nurse subject might verbalise their thoughts on the process of diagnosing itself, something which they

rarely do in the normal working environment.Thus although this protocol might prove useful to the research aims of discovering how nurses go about the diagnostic task, it should not be seen as replicating their everyday behaviour as Protocol One might be considered to do.

Protocol Three - (See Appendix Four [b])

In this protocol, each time the subject asks for a piece of information, they are interrupted by the researcher with a series of probes about that information. Again this was an attempt to arrive at a closer understanding of the use of information during nursing assessment even to the point where the practitioner herself might not be fully aware of it during the actual task.

7.3 MATERIALS

Each subject was to have a triad of patient histories to work on in the research task.

7.3.1) THE PATIENT HISTORIES

Obtaining the group of patients from whom to collect a history was done by using a purposive sampling procedure in that the same District General Hospital as used for part of the ward sister/ student nurse samples was chosen as the access point. Then, of the seven medical wards within the hospital, a particular ward was chosen by random selection. Finally, systematic sampling of bed space (by a scheme of Bed 1 in Room 1, Bed 2 in Room 2 to Bed 6 in Room 6 and omitting single rooms) was undertaken to find the actual patient required. This procedure appeared to produce a representative cross section of the patients on the ward as good as if random sampling had been used (Kish 1965) and did not seem to be associated with any particular cycle. That is to say there did not appear to be particular properties being associated with certain bed numbers such as the very ill patients being nearer the room doors in all rooms. The type of case history data collected is shown in Appendix Three . The basic details of the six patients

are shown in Table One. In order to provide a data base close to that being used by the research subjects in their present clinical practice, the case histories were derived from the nursing records being used on their wards. These records use the Activity of Living model of nursing care (Henderson 1969) which reflected the underlying philosophy of care on the wards. In this approach, the patient is seen as lacking either the strength, will or knowledge to effectively undertake one or more of the essential activities considered necessary to normal everyday living. Henderson lists 14 of these Activities of Daily Living. They are :-

1) Breathe normally
2) Eat and Drink adequately
3) Eliminate body waste
4) Move and maintain desirable postures
5) Sleep and Rest
6) Select suitable clothing - dress and undress
7) Maintain body temperature
8) Keep body clean and well groomed
9) Avoid dangers of the environment
10) Communicate with others - express emotions and needs
11) Worship according to one's faith
12) Work in such a way that there is a sense of accomplishment
13) Play and participate in various forms of recreation
14) Learn, discover or satisfy the curiosity

The role of the nurse using this model of care is seen as assisting the patient in the maintenance of these essential activities and to encourage and support a return to some degree of independence.

TABLE ONE : PATIENT HISTORIES USED IN VERBAL PROTOCOLS

CODE LETTER	NAME	AGE	MEDICAL DIAGNOSIS
A	John	66	R. Lower Lobe Pneumonia. Chronic Obstructive Air-ways Disease. ? Liver Metastases
B	Bill	79	Right Cerebro-Vascular accident Dysphasia. Dysphagia.
C	Alice	72	Left Ventricular Failure. Pulmonary Oedema.
D	Eric	72	Myocardial Infarction
E	Janice	30	Septacaemia. Cellulitis Right Lower Leg
F	Beatrice	77	Left cerebro-Vascular Accident. Diabetes Mellitus.

TABLE TWO: PATIENT HISTORY TRIADS USED IN VERBAL PROTOCOLS

NOVICE SUBJECT	TRIAD	EXPERT SUBJECT	TRIAD
1	ABD	1	ABC
2	FED	2	FCA
3	BDA	3	ACE
4	ABF	4	DEA
5	FBC	5	DFB
6	DAF	6	BCD
7	CEB	7	CDA
8	CBF	8	CFD
9	BFE	9	EAB
10	EDB	10	EDC

The total of six patient histories were randomized into 20 triads in such a way that no triad appeared twice. Each patient history appeared a total of 10 times and the order of the patient history within the triads was equally spread. The triads were then randomly allocated to research subjects as shown in Table Two.

7.4 PROCEDURE

Each subject was approached in person by the researcher and arrangements made for data collection on an individual basis usually 2-3 days beforehand. Data collection took place during July and early August 1987.

For convenience, the interviews to collect the verbal protocols from the ward sisters took place mainly in the ward areas sometimes in the ward office but more often in some other room on the unit where the chances of being disturbed were lessened. For the majority of students, the researcher's own office within the hospital but outside the medical unit was used. Again steps were taken to avoid interruptions and with the exception of one interview this was achieved.

The subject was put at ease and introduced to the presence of the cassette recorder and reminded again about the nature of the task. In order to minimise the problem of interviewer bias (Boyd and Westfall 1970) a written schedule of 'Instructions to the Subject' was read out by the researcher (See Appendix Four). Any initial questions were answered. Following data collection the subject was debriefed and further information about research aims given. This latter part of the procedure was informal depending upon the perceived needs of the subject at the end of the interview. Some subjects were inquisitive about the technique and how the data would be analyzed. Others expressed amazement at the amount of data they had been able to generate during the protocols. Most had not found the technique intimidating in any way but had become fatigued towards the end.

Subjects were asked to complete a questionnaire at their own convenience after the interview and to return it by post to the researcher. The questionnaire asked for demographic details about the subject and for her opinions about the implementation of

Nursing Process on the wards (See Appendix Five). Data from the tapes was then transcribed prior to analysis.

7.5 FORM OF ANALYSIS OF THE VERBAL PROTOCOLS

From the results of the pilot studies, a scheme of analysis of the verbal protocols based on that given by Ericsson and Simon (1984 pages 263-274 for methods and pages 274-287 for issues) was drawn up as follows.

7.5.1 TRANSCRIBING AND SEGMENTATION

The taped protocol is initially transcribed as a whole,ie. it includes the researchers answers and comments during the data collecting session. During transcription, the protocol is segmented according to meaning. Each segment represents a single statement being made by the subject as he explores the problem. The segments may vary in length. A preliminary analysis of this segmented transcript is then undertaken :-

(a) The verbal protocol is seen as a step-by-step progression towards a solution of the problem and each segment will bring the problem solver to a higher state of knowledge than he had previously (Newell and Simon 1972). Thus following each segment the subject can be seen as being in a new knowledge state. In the transcript then, each new knowledge state is given a number code, (S1.....Sn).

(b) Each step from one knowledge state to the next involves the application of an 'operator' (a mental process generating or transforming knowledge). Task analysis during the pilot stage suggested a small group of such operators which seemed appropriate to the nurse diagnosis task (See Table Three). These operators and the rationale underlying their application to the contents of the segments are described in Appendix Six. The operator which has brought the subject to each new state of knowledge is now identified and stated in the transcript alongside the S code (See Figure Eight).

TABLE THREE - LIST OF OPERATORS USED IN ANALYSIS OF VERBAL PROTOCOLS

LIST OF OPERATORS

COLLECT DATA	-	ASK
	-	MEASURE
	-	CONSULT RECORDS
	-	OBSERVE
	-	OTHER
REVIEW DATA	-	REVIEW
	-	CLARIFY
INTERPRET DATA	-	RELATE DATA
	-	JUDGE
	-	INFERENCE
	-	* = Professional knowledge
	-	** = Other knowledge
ACT	-	PRESCRIBE - Intervene
		- Explain
		- Encourage
		- Reassure
		- Rationale
DIAGNOSE	-	RISK
	-	OTHER
CONTROL	-	CLARIFY ROLE
	-	EXPLAIN PROCESS

FIGURE EIGHT - EXAMPLE OF PROTOCOL ANALYSIS

(Highlighted text indicates speech from the researcher)

TRANSCRIPT	SEGMENT	OPERATOR
Can I know about her prior to admission, please? **(I haven't got a lot of details about her before she was admitted. She has been in hospital before with Left Ventricular Failure... is quite limited ..)**	S1	**COLLECT DATA - ASK** Condition before admission
When you say before.. **(Oh. Wait a minute. Yes I have. She lives alone at home .. she has a daughter and a son who come in to see her most days.)** Right. **(I think she was confined.. more or less confined to the house..)** Right. **(.. because of her ...)**	S2	**REVIEW DATA - CLARIFY**
.. because of her cardiac problems ? **(Because of her cardiac problems, yes.)**	S3	**INTERPRET DATA - INFERENCE** Confined because of cardiac problems
Right. Confined to the house, could she.. did she have any home help ? **Yes, she did. She had a home help who came, I think, twice a week.)**	S4	**COLLECT DATA - ASK** Help at home
Could she wash and dress herself ? **(Yes.)**	S5	**COLLECT DATA - ASK** Hygiene care
Yes. Did she ever go out unaided ? **(No.. No, into the garden, yes, but not 'out ' out.)**	S6	**COLLECT DATA - ASK** Mobility at home
She didn't go out shopping ? **(No.)**	S7	**COLLECT DATA - ASK** Ability to go shopping
Did she ever go out shopping at all ? **(She does occasionally go out with her daughter, shopping.)**	S8	**COLLECT DATA - ASK** Ability to go shopping
Right. Right. But she didn't go out of her own volition ? **(No.)**	S9	**COLLECT DATA - ASK** Go out on own volition

7.5.2 ENCODING THE VOCABULARY

The pilot studies had shown that content analysis could be applied to the content of the verbal protocols and would supply data concerning the relative amounts of lay and professional language being used during the clinical diagnosis task by subjects in each of the research groups. Final specification of this analysis is discussed in the Results Section.

7.5.3 CATEGORIZATION OF THE SEGMENTS

a) The step by step progression of the subject through the problem can been shown diagrammatically in the form of a PROBLEM BEHAVIOUR GRAPH (See Figure Nine)

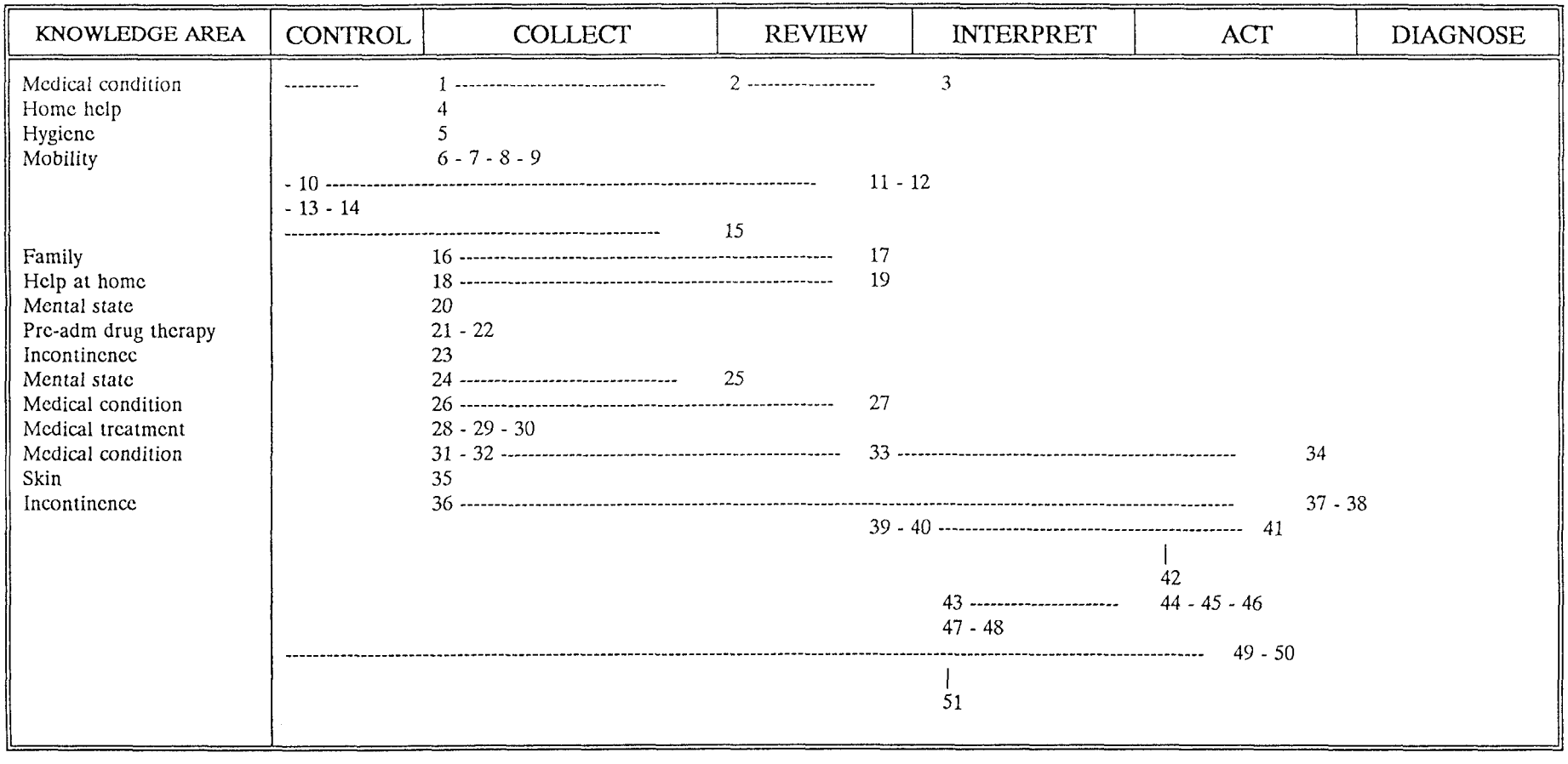
Each state of knowledge is plotted in sequence with time scale running both along and down the page.The vertical axis shows how the subject moves from subject area to subject area within the problem, in the nurse diagnosis task this usually involves movement between the various Activities of Living for the patient. The horizontal axis shows the various moves made within the subject area and is spaced according to the operator being used.

b) Using the problem behaviour graph, therefore, two ways of categorizing the segments (ie. the states of knowledge) can be entertained, according to :-

(i) The **operator being used.** Counting takes place in columns passing down the graph.

(ii) The **ADL domain being explored.** Counting now takes place within blocks defined by lines across the page separating the ADL areas.

FIGURE NINE - EXAMPLE OF A PROBLEM SOLVING GRAPH (Subject: E2 Task : 2)



CHAPTER EIGHT

MAIN RESEARCH STUDY - RESEARCH SAMPLES

Sampling is defined by Smith (1975) as :-

> "a procedure by which we infer the characteristics of some group of objects (a population) through experience with less than all possible elements of that group of objects (a sample)."

Sampling has the advantages of producing a reduction in research costs and savings in time and manpower requirements thus allowing the researcher to extend his field of study to a greater depth and width than would be possible if the whole research population were to be enumerated, ie. a census, were to be carried out. A more important advantage of sampling lies in the greater accuracy of the results which can be achieved when working with a sample. In any data collection, non-sampling errors such as faulty measurement, systematic errors in the population listings, interviewer bias and so forth are all greatly reduced when smaller numbers are being investigated. Thus higher precision of measurement is possible in samples than can be achieved in a census.

Often, the researcher is seeking to demonstrate the incidence or prevalence of phenomena in the population and thus may wish to make generalizations about his/her experiences with the sample. In such a case, steps must be taken to ensure that the characteristics, both in terms of quality and relative quantity of those variables known to be relevant to the research purpose present in the working population, are accurately represented in the sample or samples drawn from that population. Without such precautions, serious bias in the sampling may unknowingly occur. The methods by which the working population have been drawn up need to be carefully specified and qualified in the research report to allow readesr to judge for themselves the accuracy of the relation between the working and general populations and thus the external validity of the research findings. In addition, any predictions that are made about the population

from sample findings will rely on the concept of probability which requires samples of a size that are statistically viable.

In research which seeks instead to discover and describe phenomena and their observed relationships, external validity is less crucial than accurate and precise detailing of the nature of the phenomena.

> "Although the dominant paradigm in many sciences became the large random sample controlled experiment, some social sciences, particularly in psychology, contended that valid experiments could be performed with single subjects..... Limiting ourselves to the dominant paradigm for inquiry limits science and thus limits the ways in which we can know and understand our world.
>
> (Mitchell 1988)

The main aim of the present research project was exploratory in nature, seeking to make explicit the cognitive processes by which nurses are able to arrive at a diagnostic statement concerning a patient problem. That is to say, the purpose is one of description of a set of behaviours which may be used by nurses rather than proclaiming the presence of these in all assessment situations. A small sample design, therefore, was seen to be the most suitable for the project.

8.1 SAMPLES USED IN THE RESEARCH

The initial problem in deciding on the samples used in this research was the typicality of the hospital units from which they were to be drawn. For the purposes of this research, the general population for the sample could be said to be the staff in general wards (ie. medical, surgical and acute geriatric units) within National Health Service hospitals in Great Britain. The working population derived from this definition were taken to be staff who were working or had recently worked in acute general medical

wards in those hospitals and patients present in the ward on a single day when the patient sample was drawn.

The wards chosen for the research were in the Medical Units of two hospitals both in the same District Health Authority in the south of England. The first hospital was a large modern teaching hospital where there were 7 general wards in the medical unit, all of which were used in the research. The second hospital was smaller and still housed in an old Victorian building in the city centre. Here there were 2 general medical wards, both of which were used by the researcher.

The wards in both hospitals operated on the same 'on take' rota for admitting emergency cases from the city. These patients made up the majority of the patient population thus giving an overall homogeneity to the nursing work on the wards. Some degree of specialization between wards is achieved by the small number of 'arranged' admissions to the units where patients have been referred to particular consultants because of the nature of their condition.

The research samples used each consisted of 10 subjects :-

Sample A = experienced medical ward sisters.

Sample B = third year RGN students who had completed their senior allocation to medical wards.

This was to allow comparisons to be made later between expert versus novice problem solving behaviour.

In order that the verbal protocols used as the research method were as realistic as possible, it was decided to use data from real patients present on the medical unit. A group of 6 patients drawn at random from the ward population of patients was derived for this purpose.

For each of the samples necessary to this research project, there were a number of theoretical problems and methodological issues to be considered.

8.1.1 SAMPLE (A) - THE WARD SISTERS

The first sample consisted of 10 ward sisters from the units. Each ward in the unit has a complement of two sisters in general, one being the more experienced and, therefore, senior to the other.

The sample was a non-probability or purposive sample (Smith 1975 page 114) in that, although no sister was guaranteed inclusion or exclusion, the chance of being a member of the sample was not known in advance. This type of sample was necessary because of the small numbers involved and because of the need to seek their cooperation. The job of a ward sister is a very exacting one leaving little time to devote an hour or so interview time to a researcher. Thus, the sample had to be a volunteer sample (Hedges 1979). Letters explaining the research and the subjects role (See Appendix 5 (a)) were sent out to all the 18 possible sister subjects and the first 10 to agree were included in the sample. Four replies were sent back directly and the remaining six agreed to help after a personal visit by the researcher to further explain the research.

The main theoretical difficulty with this sample lies in substantiating the claim made by the researcher that the ward sister is a clinical expert in her field. There appears to be little firm evidence on which to make this assertion. There are, however, certain key factors mentioned in the literature which can be cited to back up the claim, for example :-

> "the role of the ward sister is a complex and senior nursing role, one that is unique in nursing and of vital importance to the proper nursing of patients;"
>
> (Pembrey 1980 page 87)

The ward sister is the most experienced nurse on the ward (Pembrey 1980) who sees her clinical expertise role as more important than that of ward manager (Williams 1969). However, most research on the ward sister shows that, usually because of pressure of work in completing other tasks, her ability to put her clinical expertise into action is

severely limited (Redfern 1981, Hockey 1976). On the other hand, she is the nursing consultant on the ward to whom not only other trained nurses (Douglas 1977) and students (Ogier 1986) defer but also to whom other health care workers such as the doctors and therapists refer for ongoing information about the patients (Mauksch 1966) and about services for care on the ward (Exchaquet 1967).

A second problem lies in the ward sister's role as a teacher of student nurses in the clinical area. This may mitigate against her working in her own individual way in an activity, such as the assessment of risk of pressure sores, for the sake of conformity to the dictates of the student's curriculum. Thus many ward sisters may use a scheme of assessment (eg. the Norton Score) or a theoretical model of care (eg. the Henderson model) simply because they are on a teaching ward and feel required to show an example application of these ideas to nursing care which may in fact be alien to their own natural way of going about the task.

8.1.2 THE STUDENT NURSE SAMPLE

The student nurse sample was also a volunteer sample. Letters were sent to all the 25 members of the student nurse set who had most recently completed their third year ward allocation on the medical unit, requesting their cooperation to act as research subjects. The response rate was extremely poor (16%) in spite of a follow up visit by the researcher to explain the aims of the research. A second group of students who had completed the ward allocation immediately before the first group was therefore canvassed in the same way. This time the response rate was slightly better (32% = 8 students of which the first six to reply were included in the sample) This rate is still well below that which could be deemed desirable for ensuring that sampling bias was not occurring and that the responders were in some way atypical of the group as a whole. In view of the findings of Scott (1961) who raised his postal questionnaire rate from 74.8% to 95.6% by making three approaches to subjects, further personal contact with the students was made but with no result.

Although Sudman and Bradburn (1974) believe that a variety of factors might be involved in non-response by subjects, precise explanation of the poor response rate from

this particular population is difficult to explain. The students were approached at a time in their training programme that was particularly stressful with final examinations looming (Birch 1983). Having been continually assessed on their nursing performance for three years may also have left them unwilling to volunteer for what they may consider a further assessment procedure. There is also thought to be a great deal of disillusionment among students at this stage in their training (Lamond 1974) particularly with the theoretical aspects of care such as the Nursing Process (Bowman, Thompson and Sutton 1986) and therefore, presumably, with the aims of the present research.

Theoretically, these student nurses can be defined as novices in that they are still in training . On the other hand, the nature of the nurse training syllabus incorporates a high proportion of 'on the job' practical ward experience, which might be argued as having taken them beyond the novice practitioner stage. Certainly the third year students nurses in this research tended to see themselves as experienced in the particular type of ward task they were asked to perform. Nevertheless, they were not yet eligible to enter the profession as independent practitioners and take on personal accountability for the diagnostic decisions they might make. For this reason, it was considered acceptable to classify them as 'novice practitioners' still.

There are a number of difficulties in sampling specific groups, such as particular sets of student nurses, which exist within a greater social organization. It might be argued, for instance, that individuality of response from these subjects cannot be guaranteed. Over the previous three years all of them had been exposed to powerful persuasive influences concerning their professional actions arising both as part of the climate of their training course as well as that involved in being working members of the hospital team. Thus a great deal of homogeneity in the way they approach a clinical problem task could be expected. On the other hand as Lipset, Trow and Coleman (1956) point out in their study on the socializing effects of union membership on the individual printers, this may not necessarily be the case :-

" to say that a certain political climate characterizes the union does not mean that this climate is felt by all printers alike. The climate makes itself felt more strongly by some men than others, depending on their social and political locations."

(Lipset, Trow and Coleman 1956)

8.2 ACCESS TO SAMPLE SUBJECTS

Access to research subjects was negotiated and organised during June 1987. This was achieved by writing to and then being interviewed by the Nursing Officers for the wards being used in the research and by the Director of Nurse Education for the District Nurse Training School (Appendix Two [b] and [c]).

PART FOUR

MAIN RESEARCH STUDY - RESULTS

CHAPTER NINE

RESULTS

A questionnaire given to subjects following the verbal protocol interview yielded both demographic details about the subjects and their opinions concerning the implementation of nursing process on the medical wards. The 87.5% response rate achieved was, perhaps, indicative of a high positive feeling towards the research interview. The results of the questionnaire will be described first before a discussion of the verbal protocols.

A scheme of analysis for Protocols One and Two is provided prior to the findings being described in four stages. Firstly, the results of the segmentation of the protocol text are outlined together with the kind of cognitive operations being used. The sequence of operations is then shown by means of Problem Behaviour Graphs. The vocabulary used in these protocols is also examined. Finally the findings from Protocol Three, the interrupted protocol are outlined.

One subject (N6) from the novice group (ie. the third year student nurses) and two subjects (E5 and E7) from the expert group (ie.the ward sisters) had to be rejected from the data analysis because of a recording fault during data collection. A further novice subject was rejected because the nature of the data given was inconsistent with protocol analysis in that she persistently held a conversation with the researcher as if the latter were the patient being investigated and failed to show in her expressions evidence of cognitive problem solving. Thus the results given below relate to data collected from eight novice and eight expert subjects.

9.1 DESCRIPTION OF SAMPLES

The mean age of the student nurses was 24.75 years while that of the ward sisters was 34.4 years. The ward sisters had been in their present positions, on average, for 48.75 months.

For all the students, this was their first employment post in nursing. The professional experience of the ward sisters varied considerably. Half of the group (ie. 4 subjects) had trained at the hospital where they were now employed and had not worked at any other hospital. The others had all trained in London hospitals. None of the ward sisters had any other professional qualification other than SRN although three of them had completed the ENB Course 100 in Intensive Care Nursing. One sister (E2) had completed short internal courses on care of the elderly, counselling, ward management, ward teaching and research appreciation and another (E4) had attended a similar course on teaching.

Four of the group were in their first ward sisters post, one had previously been a night sister and one had been a relief sister in neurology. Of the two remaining with previous ward sister experience, one had worked in a Coronary Care Unit and the other had held two ward sisters posts in England as well as a number of similar appointments in overseas hospitals.

Educational achievement also differed between the two groups. The students had, on average, gained 7.75 GCE 'O' Levels and 1.75 'A' Levels. The sisters had an average of 6.625 'O' Levels and 0.875 'A' Levels. No one in either group was a graduate.

9.2 SUBJECT'S OPINIONS OF THE NURSING PROCESS APPROACH TO CARE

As would be expected, there were differences between the groups about their experiences with the Nursing Process approach to care.

All the students had learnt the method during their Introductory Study Block three years previously. The ward sisters had, on average, first heard of this approach eight years previously. Three had gained their knowledge from the hospital based Nursing Process Coordinator employed specifically to educate staff in the method prior to its introduction into the wards. Three of the newer sisters had first encountered it by joining wards where the nursing process was already in practice, one had been taught the

method in her RGN course and, finally, one sister had learnt about the nursing process from her own reading.

First impressions of the worth of the nursing process were surprisingly alike between the novice and the expert subject groups. In both groups all but one subject considered it a logical and sensible means of delivering care. However, four of the students and five of the sisters were sceptical about being able to put it into practice in the wards. One sister also had initially found the variability of its application from ward to ward confusing.

Only one student considered she was specifically instructed in the implementation of the nursing process on the ward whereas four of the sisters felt that this had been covered by discussions with the Nursing Process Coordinator.

Present views among the students about the process show that some wards are better at its implementation than others. It should be noted that they have much greater knowledge of current practice on various wards outside the medical unit than will the ward sister group who do not move from ward to ward. All the ward sisters continue to show enthusiasm for the method but five of them specifically mentioned the difficulty of maintaining this attitude because of the time pressure, particularly when the ward is very busy.

Asked how much they are actually involved with the nursing process documentation on the ward, subject replies are shown in Table Four.

Students see themselves as both applying nursing process documentation themselves and demonstrating its use to junior staff more than do the ward sisters.

TABLE FOUR - SAMPLE DATA - USE OF NURSING PROCESS

	OFTEN	SOME-TIMES	RARELY	NEVER
EXPERT GROUP				
Do you have opportunity to:				
Complete patient assessment forms	2	5	1	0
Write patient care plans	0	6	2	0
Record evaluation of care on patient care plans	1	4	3	0
Do you yourself manage to demonstrate to junior nurses how to :				
Complete assessment forms	1	6	1	0
Write patient care plans	0	5	3	0
Record evaluation of care on care plans	0	5	3	0
NOVICE GROUP				
Do you have opportunity to:				
Complete patient assessment forms	4	3	1	0
Write patient care plans	4	3	1	0
Record evaluation of care on patient care plans	7	1	0	0
Do you yourself manage to demonstrate to junior nurses how to :				
Complete assessment forms	2	4	1	1
Write patient care plans	3	4	1	1
Record evaluation of care on care plans	3	4	1	0

9.3 ANALYSIS OF THE VERBAL PROTOCOL RESULTS

The scheme of analysis of the verbal protocols based on that given by Ericsson and Simon (1984. See pages 263-274 for methods and pages 274-287 for issues) as described earlier was used.

9.3.1 TRANSCRIBING AND INITIAL SEGMENTATION

A measure of inter-researcher reliability was sought for deciding how the transcripts were segmented. A fellow researcher not involved in the project was given transcripts of four protocols (ie. 25% of the total) to work on. The purpose of the research together with the method of segmenting the protocols was explained and examples of the pilot study protocols were used as examples to show how the task should be accomplished. When she was able to segment these protocols and reach high correlations with the researcher, ie. greater than 80%, she was asked to segment the sample of protocols from the main study alone. The results of this procedure showed an overall agreement of 66.6% with the segmentation performed by the researcher. The main disagreements arose in how to classify vocal but non-verbal utterances such as " Er", "Uhmm.. ", etc. and similar non-meaningful expressions like "Well..", "So...,".

9.3.2 ANALYSIS OF THE SEGMENTS OF THE PROTOCOLS

Again a measure of inter-researcher reliability was sought in a similar way as for the segmentation procedure. The inter-researcher reliability for the application of operators to the segments was 86.25%.

9.4 OPERATORS USED

9.4.1 TOTAL NUMBER OF SEGMENTS

The number of segments identified from the verbal protocol and the operators being used in these segments are shown in Table Five (i) and (ii).

The expert group produce overall longer protocols (Mean number (E Group) = 78, (N Group) = 61 segments). This difference was significant (Mann-Whitney Test U = 4.5; p = < 0.05 level).

9.4.2 THE 'COLLECT' OPERATOR SEGMENTS

The main factor involved in the greater length of the protocols in the expert group is the number of 'Collect' operator segments present, that is to say, in the amount of patient data which is collected from the researcher.

The mean number of 'Collect' segments for (E Group) was 40.1 making up 51.4% of all the segments in the protocol. The (N Group) mean was 21.6 segments or 35.5% of the total. Again this result was found to be significant, (Mann-Whitney Test U = 9.5 p = < 0.05).

Analysis of these 'Collect' segments is given in Table Six. The categories used for this analysis are derived from an examination of the vocabulary content of the protocols (See Table Ten).

The differences in Table Six were subjected to a Chi-squared Test. The use of this test assumes that the answers given by the subjects for each category was independent of the answers which they gave for all other categories. This assumption is questionable here to some extent since, for instance, an orientation towards medical condition and signs might well correlate with a tendency to consider medical treatment more. In spite of this, the Chi-squared Test was still thought to be the most appropriate method to use. The results were found to be significant (= 85.8294; df = 19; p = < 0.001). An

analysis of the residuals, using the Binomial Test, revealed a significant difference over a one tailed test and in the predicted direction, ie. that the experts would give a greater number of 'Collect' operators than the novices in the following categories :-

Patient and Family characteristics	(p = 0.001)
Admission and Hospital stay	(p = 0.02)
Drinking	(p = 0.04)
Medical condition and signs	(p = 0.002)
Medical Treatment	(p = 0.001)

There was a significant difference (p = 0.033) also in the 'Communication and Emotional State' category but in the opposite direction, ie. the students used this category more than the experts.

9.4.3 THE 'CONTROL' OPERATOR SEGMENTS

The experts used less 'Control' statements in their protocols than the novices (E Group Mean = 6.1 [7.9%], N Group Mean = 9.4 [15.3%]). This result was not significant (Mann-Whitney Test U = 24; p > 0.05).

On examination of the classifications for this operator, the difference appears to lie in the number of times the subject explains to the researcher what she is doing (E Group Mean for 'Explain' = 3.9, N Group Mean = 7.5)

9.4.4 THE 'INTERPRET' OPERATOR SEGMENTS

Although the novice group give a slightly increased questioning rate for the 'Diagnose' operator, there appears little differences between the two groups on the rate of using the 'Review', 'Interpret' and 'Act' operators. However, because of its importance in understanding the cognitive processing of information which is going on during the process of diagnosing , a closer examination of the use of the 'Interpret' operator by the two groups was undertaken in a similar manner to that used for the 'Collect' Operator.

TABLE FIVE - NUMBER OF SEGMENTS PER OPERATOR USED IN VERBAL PROTOCOLS

(i) Expert Group

OPERATOR	NUMBER OF SEGMENTS	MEAN NUMBER OF SEGMENTS	% OF TOTAL SEGMENTS
CONTROL	49	6.1	7.9
COLLECT	321	40.1	51.4
REVIEW	43	5.4	6.9
INTERPRET	100	12.5	16.0
ACT	53	6.6	8.5
DIAGNOSE	58	7.25	9.3
TOTAL	624	78	-----

(ii) Novice Group

OPERATOR	NUMBER OF SEGMENTS	MEAN NUMBER OF SEGMENTS	% OF TOTAL SEGMENTS
CONTROL	75	9.4	15.3
COLLECT	175	21.9	35.9
REVIEW	37	4.6	7.6
INTERPRET	84	10.5	17.2
ACT	53	6.6	10.8
DIAGNOSE	64	8	13.1
TOTAL	488	61	-----

TABLE SIX - ANALYSIS OF COLLECT OPERATORS

CATEGORY	E GROUP Total	%	N GROUP Total	%
Patient and Family Characteristics/				
Pre-admission features	59	18.4	7	4
Admission and Hospital stay terms	8	2.5	1	0.6
Skin Condition	17	5.3	11	6.3
Diagnosis of Pressure Sore Risk	0	0	0	0
Nursing Care to Prevent Pressure Sores	4	1.3	5	3
Body Parts	0	0	0	0
Body Position	6	1.9	1	0.6
ACTIVITIES OF DAILY LIVING AND THEIR CARE				
Weight	5	1.6	9	5.1
Eating Diet	27	8.4	17	9.7
Drinking	15	4.7	6	3.6
Mobilising	36	11.3	35	20
Elimination	26	8.1	16	9
Breathing	11	3.4	15	3
Mental State	8	2.5	14	8
Communication & Emotional State	2	0.6	9	5.1
Care of ADL's	1	0.3	1	0.6
Other ADL's	5	1.6	3	1.8
ADL Total		**42.5**		**66**
Medical condition and Signs	51	15.9	24	13.7
Medical Treatment	30	9.4	4	2.3
Aids to Relieve Pressure	9	2.8	6	3.6
Other Equipment	0	0	0	0
Explanation of Diagnostic Process	0	0	0	0
Unclassifiable	1	0	1	0
TOTAL	321		175	

This analysis would show in what areas the subject most used or manipulated the information which they had collected. Results of this analysis are given in Table Seven. The overall differences found in this table were found to be not significant (= 29.7868; df = 19; p = >0.05). Three individual categories, however, did show significant differences using the Binomial Test. These were 'Nursing care to prevent sore' (p = 0.055) and 'Body position' (p = 0.033) in the predicted direction but in the category 'Diagnosis of Pressure Sore' the novices gave more 'Interpret' operations than the experts (p = 0.05). Again the assumption that the responses of the subject are independent of each other has to be considered when interpreting this result.

In spite of all the information gathered concerning the home environment of the patient, very little of it appears to be used by the expert group in the task of diagnosing the risk of pressure sores (2 segments). The novice group did appear to use what little information they had gathered in this area (5 Segments). Similarly, with the incontinence (elimination) information, very little of the extra data gathered by the experts was actually manipulated for use in the diagnostic task.

On the other hand, in a number of areas the experts were making judgments, relating facts, and making inferences about data which they had not actually obtained about the particular patient in question. That is to say, they were going beyond the information given. This occurred in areas such as nursing care, body position, and the patient's communication and emotional state. The phenomena of reaching out beyond the information obtained is not seen in the results of the novice group.

Since the INTERPRET operator as a whole subsumes a number of cognitive processes which occur in the protocols, a breakdown of the operator into its various components was undertaken (See Table Eight).

TABLE EIGHT - ANALYSIS OF INTERPRET OPERATOR SEGMENTS BY PROBLEM AREA

CATEGORY	Total E Group	N Group
Patient and Family characteristics /Pre-admission features	2	5
Admission and Hospital stay terms	2	0
Skin condition	9	3
Diagnosis of Pressure Sore Risk	0	4
Nursing Care to Prevent Pressure Sores	8	2
Body Parts	2	3
Body Position	9	2
ACTIVITIES OF DAILY LIVING AND THEIR CARE		
Weight	2	3
Eating and Diet	13	8
Drinking	4	3
Mobilising	9	12
Elimination	3	2
Breathing	3	0
Mental State	8	4
Communication & Emotional State	6	10
Care of ADL's	1	0
Other ADL's	1	0
Medical condition and signs	12	19
Medical Treatment	3	1
Aids to Relieve Pressure	1	0
Other Equipment	0	0
Explanation of Diagnostic Process	0	0
Unclassifiable	2	3
TOTAL	100	84

TABLE EIGHT - ANALYSIS OF INTERPRET OPERATOR SEGMENTS BY COGNITIVE PROCESS UNDERTAKEN

COGNITIVE PROCESS	E GROUP		N GROUP	
	Total	%	Total	%
Relate	12	11.8	22	26
Judge	41	39	30	35.7
Inference from data	36	35.3	23	27.4
Inference from outside data	13	12.7	9	10.7
TOTAL	102	-	84	-

9.5 THE PROBLEM BEHAVIOUR GRAPHS

9.5.1 MODELS OF DIAGNOSTIC STRATEGY

The step-by-step nature of the subjects progress during the problem solution can then be shown diagrammatically as a Problem Behaviour Graph (See Figure Nine). Each state of knowledge, having been numerically labelled, is plotted in sequence with the time scale running both along and down the graph. The vertical axis is used to show how the subject moves from one line of enquiry to another within the problem. For instance, in a nursing diagnostic task, this might involve the movement of the enquiry from one Activity of Living to another. The horizontal axis shows the progressive steps within each line of enquiry, ie. within each Activity of Living.

Two distinct patterns of problem solving emerged in this research project from representing the verbal protocols in this form. These have been labelled :-

a) **The Lateral Model of Diagnostic Strategy**

b) **The Descending Model of Diagnostic Strategy**

In the Lateral Model of Diagnostic Strategy, data collection and data manipulation can be seen to be going simultaneously and thus appear side by side on the graph. (See Figure Ten). In the Descending Model of Diagnostic Strategy, data collection is an initial activity which is completed a most in its entirety before any data manipulation appears to occur. (See Figure Eleven).

Figure Ten shows a pattern in some of the problem behaviour graphs where there is some overlap between the collection and interpretation of data yet the two activities are not truly integrated. This pattern was subsequently called **The Mixed Model of Diagnostic Strategy**. (See Figure Twelve)

A clear example of the Lateral Model of Diagnostic Strategy is shown in the following protocol analysis from one of the ward sisters, Subject E2.

FIGURE TEN - THE LATERAL MODEL OF DIAGNOSTIC STRATEGY

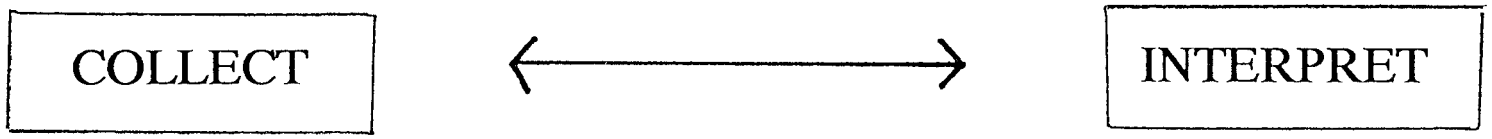


FIGURE ELEVEN - THE DESCENDING MODEL OF DIAGNOSTIC STRATEGY

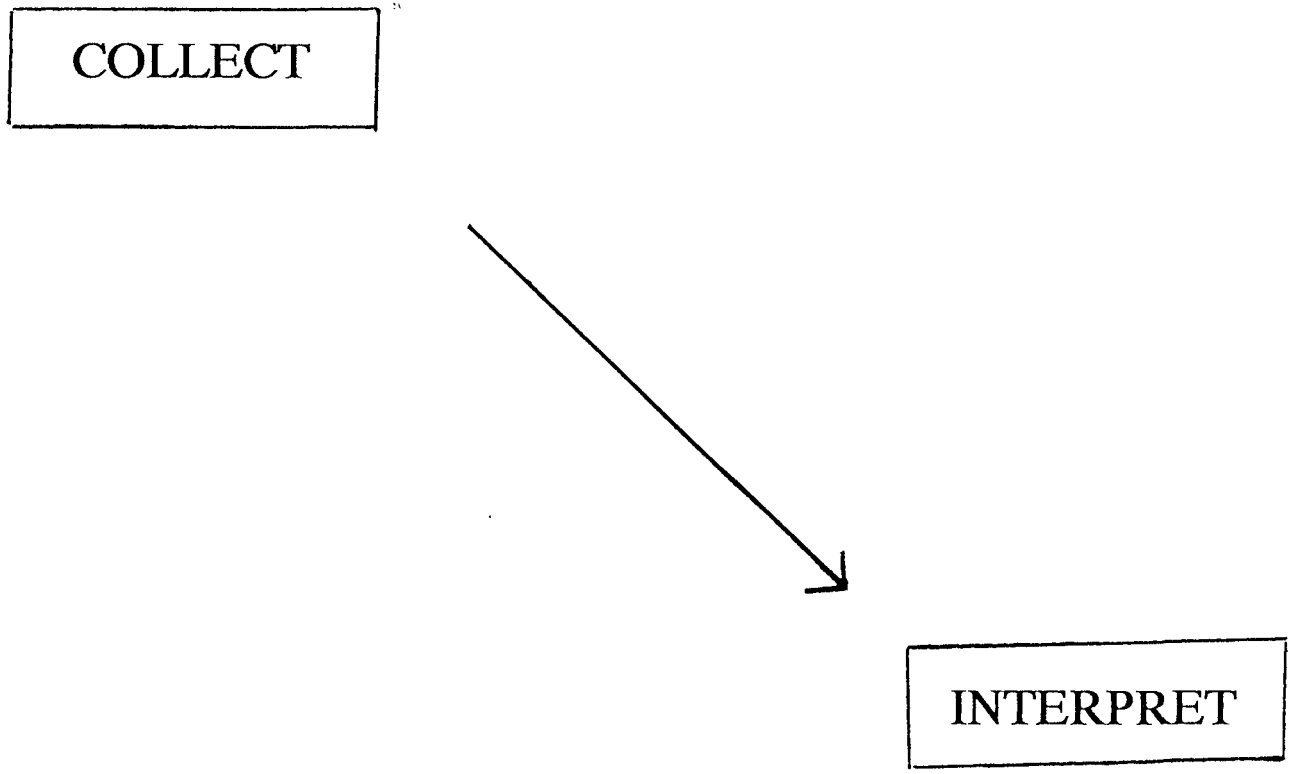
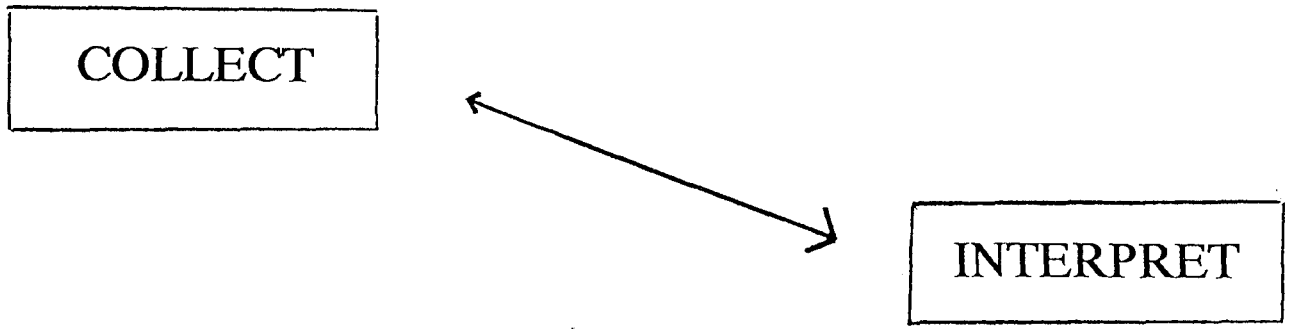


FIGURE TWELVE - THE MIXED MODEL OF DIAGNOSTIC STRATEGY



9.6 *PROTOCOL ANALYSIS EXAMPLE*
SUBJECT E2 - THE CLASSIC HORIZONTAL MODEL

Subject E2 was a senior and experienced nurse having been a staff nurse for 2 years and then night sister for over 3 years in the medical unit where now she had now spent a further 3 years as a ward sister. During these years, she had attended several short professional educational courses in a variety of subjects.

In her first research task, she was asked to investigate the pressure sore risk of Beatrice, a diabetic lady aged 77 who had had a stroke. This patient was typical of many that the subject would have cared for over the years working on the medical unit.

Examining the protocol which results from this first task, it appears that in Segments 1 the subject sets up an initial hypothesis that there is an association between present pressure sore risk and the patient's ability to cope with independent living prior to admission to hospital. From there to Segments 23 she is seeking out examining information to test this hypothesis.

During this sequence, it can be seen that data, as it is being collected (Segments 3-9, 16, 18, 20 - 23), is being constantly reviewed (Segments 2, 15, 25) and interpreted (Segments 11, 12, 17, 19). This is the essential feature of the horizontal model of clinical diagnosis in nursing. In Segments 6, the subject sets up a sub-hypothesis in which she uses ability to go shopping as an indicator of mental functioning (Segments6 - 9). This line of thinking is made explicit in Segments 11 - 13.

She breaks from the searching of the problem space at Segments 14 to deal with the second part of this research task and seeks to clarify with the researcher that her performance was what was required. Reassured, she continues in such a way that the link between data collection and data interpretation is further emphasised (Segments 15 - 24).

Segment 25 is a break in this intense data collection and interpretation to stand back as it were to evaluate progress made. It would appear that a decision about the earlier hypothesis has been made at this point although this is not explicitly verbalized. From here

on though, the path of investigation can be seen to change to the patients hospital based care.

The next section of the protocol is indicative of further hypothesis formation and testing, this time that the degree of cardiac failure is seen as being positively related to risk of pressure sores (Segments 26 - 36). Segments 27 - 36 involve a further series of data gathering (Segments 26, 28 - 32, 35, 36) and interpretation (Segments 27 and 33) leading to a diagnostic statement in Segments 37 and 38.

From Segments 37 the diagnostic task now enters it closing phase as the data acquired is assimilated into the current state of knowledge of the patient to allow provisional diagnosis of pressure sore risk (Segments 37 - 38 and Segment 41). The collected data is also combined at this stage with information from the subject's wider professional knowledge base stored in the long term memory (Segments 39, 40, 43, 47 and 48). This now opens the path to the final diagnosis. Segments 44 - 46 are an example, typical of many of these protocols from essentially practice orientated nurses, of the subject moving immediately from awareness of a patient difficulty to its clinical management,ie. ACT operations, and by-passing for the present the formal definition of the extent of the problem (DIAGNOSE operations). The diagnosis task, however, is resumed resulting in the final diagnostic statements in Segments 49 and 50. The final segment given as justification of her decision, gives clear indication of the critical criteria which the subject the subject perceived herself as using in reaching the diagnosis of pressure sore risk.

PROTOCOL ANALYSIS

SUBJECT - E2 TASK - 2

PATIENT - BEATRICE

(Highlighted text indicates speech from the researcher)

TRANSCRIPT	SEGMENT	OPERATOR
Can I know about her prior to admission, please? **(I haven't got a lot of details about her before she was admitted. She has been in hospital before with Left Ventricular Failure... is quite limited ..)**	S1	COLLECT DATA - ASK Condition before admission
When you say before.. **(Oh. Wait a minute. Yes I have. She lives alone at home .. she has a daughter and a son who come in to see her most days.)** Right. **(I think she was confined.. more or less confined to the house..)** Right. **(.. because of her ...)**	S2	REVIEW DATA - CLARIFY
.. because of her cardiac problems ? **(Because of her cardiac problems, yes.)**	S3	INTERPRET DATA - INFERENCE Confined because of cardiac problems
Right. Confined to the house, could she.. did she have any home help ? **Yes, she did. She had a home help who came, I think, twice a week.)**	S4	COLLECT DATA - ASK Help at home
Could she wash and dress herself ? **(Yes.)**	S5	COLLECT DATA - ASK Hygiene care
Yes. Did she ever go out unaided ? **(No.. No, into the garden, yes, but not 'out ' out.)**	S6	COLLECT DATA - ASK Mobility at home
She didn't go out shopping ? **(No.)**	S7	COLLECT DATA - ASK Ability to go shopping
Did she ever go out shopping at all ? **(She does occasionally go out with her daughter, shopping.)**	S8	COLLECT DATA - ASK Ability to go shopping
Right. Right. But she didn't go out of her own volition ? **(No.)**	S9	COLLECT DATA - ASK Go out on own volition

PROTOCOL ANALYSIS

SUBJECT - E2 TASK - 2 PATIENT - ALICE

TRANSCRIPT	SEGMENT	OPERATOR
Why I ask about people going out.. shopping, it is always a very good yardstick.	S10	CONTROL - EXPLAIN PROCESS
If old people go out, in my mind, you know very well if they are able to go out doing their own shopping, they are able to get dressed, they are able to cross roads, they are able to cope with money, they are able to behave in a..in a pretty good pattern.	S11	INTERPRET DATA - INFERENCE* Shopping capability = other capabilities
I always think if a person is able to go out and do their own shopping, they're pretty 'compus mentus', they have 'got all their buttons on' as it were	S12	INTERPRET DATA - INFERENCE* Ability to shop = 'compus mentus'
and I always use that as a yardstick about how well they were prior to coming into hospital	S13	CONTROL - EXPLAIN PROCESS
Is that the sort of thing you are asking for.. my reasoning behind it ? **(Yes. That's right. That's right.)** Yes. Right.	S14	CONTROL - CLARIFY ROLE
She has got a son and a daughter that come in most days, so I assume they are very devoted..	S15	INTERPRET DATA - INFERENCE** Relatives visiting = devotion
Are they coming in because they are devoted, do you know, or are they coming in because they feel she requires help or she requires an eye keeping on them. **(I think it is.. I think it is a mixture of both .. I think they see it as their duty, they live close by.. Yes, they are close to their mother, yes.)**	S16	COLLECT DATA - ASK Reason for family visiting
Yes.Yes. So in fact, they would see to her dietary.. make sure that her diet was a correct diet and that she was properly eating it and cooking and coping with herself. **(Yes. Her diet before..)**	S17	INTERPRET DATA - INFERENCE** Family visits = diet OK

PROTOCOL ANALYSIS

SUBJECT - E2 TASK - 2 PATIENT - ALICE

TRANSCRIPT	SEGMENT	OPERATOR
She didn't have meals on wheels or something ? **(She didn't,no. She normally had one cooked meal a day..)** Yes. **(.. otherwise she was, you know,her other meals were made up of things like tea and toast or biscuits or something like that..)**	S18	COLLECT DATA - ASK Meals on wheels
Yes, which is typical, I suppose. **(She had one cooked meal a day..)** Yes, right. **(..which was usually a proper,you know, meal.)**Yes.	S19	INTERPRET DATA - JUDGE
She's totally 'compus mentus' this lady, is she ? **(Yes, she is.)** Right. **(By 'compus mentus' I mean she is aware of her situation..)**	S20	COLLECT DATA - OBSERVE Mental state
I was thinking about drug compliance. If she was on any drugs prior to coming into hospital **(Yes. She was 'compus mentus' in that way.)**	S21	CONTROL - EXPLAIN PROCESS Drug therapy prior to admission
So she would be able to comply with drug taking ? **(Yes.)**	S22	COLLECT DATA - CONSULT RECORDS Drug compliance prior to admission
She wasn't incontinent prior to coming in ? **(No,no.)**No.	S23	COLLECT DATA - ASK/CONSULT RECORDS Incontinence prior to admission
And she is sound in her mind ? **(Yes.)**	S24	COLLECT DATA - OBSERVE Mental state
So we have got a pretty average seventy-two year old who is really... with cardiac problems...	S25	REVIEW DATA - REVIEW Review
How long standing are the cardiac problems ? **(She has had hypertension for twenty years. She was admitted last year in.. with gross Left Ventricular Failure .. was in hospital for four weeks ..)**	S26	COLLECT DATA - ASK/CONSULT RECORDS Length of illness
Right.. So she was given medication, I presume, for that.. **(Yes.)**	S27	INTERPRET DATA - INFERENCE Cardiac condition -> drug therapy

PROTOCOL ANALYSIS

SUBJECT - E2 TASK - 2 PATIENT - ALICE

TRANSCRIPT	SEGMENT	OPERATOR
What medication was she given ? **(I don't know what she was on before, I do know what she is on this time.)**	S28	COLLECT DATA - ASK/CONSULT RECORDS Drugs given
Can I have that, please ? **(She is on Propanalol now, Digoxin and she is on Lasix 80 milligrams orally each day.)**	S29	COLLECT DATA - ASK/CONSULT RECORDS Present drug therapy
Is she? No potassium supplement ? **(I think she must be.)** Right.**(I haven't got it down here but I must find out.. I don't know. I think she must be, yes.)**	S30	COLLECT DATA - ASK/CONSULT RECORDS Potassium supplement
Yes. Can you just tell me about why she was admitted ? I mean you say she was in gross ventricular failure a year ago, was it gross ventricular failure or was she just out of breath or..**(This time.. I haven't many details about last time,but this time, yes, she was .. she was very breathless.. and had a very 'bubbly' cough and, you know... Yes, she was in gross ventricular failure this time with pulmonary oedema.)**	S31	COLLECT DATA - OBSERVE/CONSULT RECORDS Condition on admission
On admission, did she have pitting oedema of her legs and sacrum ?**(Yes. Marked.. yes..)** So she's.. **(..and she still has.)**	S32	COLLECT DATA - OBSERVE/CONSULT RECORDS Oedema of legs and sacrum
Very overloaded with water then, isn't she ? **(Yes, yes.)**	S33	INTERPRET JUDGE - INFERENCE Water overload
Well right away, she is a very high risk	S34	DIAGNOSE RISK
.. the condition of her skin was intact was it when she was admitted ? **(It was intact when she was admitted, yes. Again, she has aging skin which isn't... which is fairly thin and fragile.)**	S35	COLLECT DATA - OBSERVE Skin on admission

PROTOCOL ANALYSIS

SUBJECT - E2 TASK - 2 PATIENT - ALICE

TRANSCRIPT	SEGMENT	OPERATOR
Does she have any problems with incontinence ? **(No, she has not been incontinent since admission.)**	S36	COLLECT DATA - OBSERVE/ CONSULT RECORDS Incontinence
Well, she is still .. this lady would be very high risk, right from the word go because of her oedema.	S37	DIAGNOSE RISK
If she has got oedema at her sacrum she really is a very high risk at that point in time.	S38	DIAGNOSE RISK
She is going to be bed-bound for a start.. **(Yes, she is.)**	S39	INTERPRET DATA - INFERENCE* Cardiac problem -> Bed rest
You know,she is not going to want to get out apart from not being able to get out of bed ..	S40	INTERPRET DATA - INFERENCE* Cardiac problem -> Bed rest
and she is a very high risk candidate unless intervention is taken and that was right... from the minute she gets onto the ward really.	S41	DIAGNOSE RISK
She should be looked over obviously from head to foot. I'm sure she was, because even the point of being on a trolley in Casualty could have given that lady quite... you know, serious problems.	S42	ACT - PRESCRIBE Full skin inspection
You know, we get a lot of problems with Casualty..people who have been in casualty departments and have been left on the trolley for an hour or two, which is quite easy, as I am sure you realise.	S43	INTERPRET DATA - INFERENCE** Casualty trolley -> sores
So she should have been looked at immediately , as I say,	S44	ACT - PRESCRIBE Skin inspection on admission

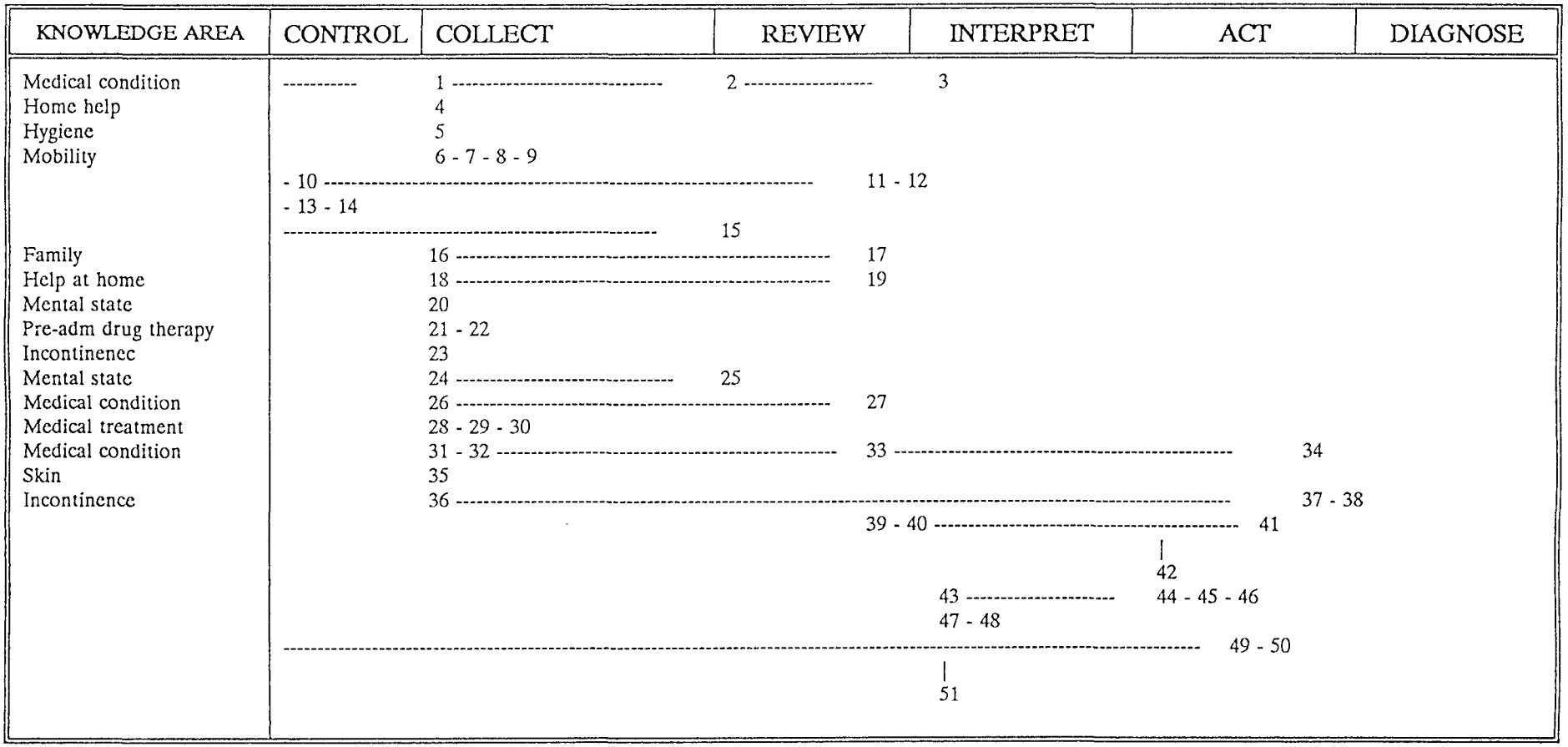
PROTOCOL ANALYSIS

SUBJECT - E2 TASK - 2 PATIENT - ALICE

TRANSCRIPT	SEGMENT	OPERATOR
and I would personally have given her a sheepskin and something for her heels and ankles because of the oedema present..	S45	ACT - INTERVENE Use of pressure relieving aids
and she would have had to have had a strict two-hourly turn.	S46	ACT - PRESCRIBE Two hourly turning
Obviously, diuretics hopefully would have improved the situation	S47	INTERPRET DATA - INFERENCE* Speed of recovery
but that would not have happened within five days,	S48	INTERPRET DATA - INFERENCE* Speed of recovery
so all this time, this lady is at very, very high risk. **(OK. Again, if you use the scale, could you tell me where on there you would put her.)**	S49	DIAGNOSE RISK
I think initially, I would put her on nine.	S50	DIAGNOSE RISK
Because, even the fact that she is very 'compus mentus' etc., etc., she is a 'with it' lady, I would still think that with oedema to that height of your body, when it gets to sacral oedema, you've got a very serious problem. **(Right. OK.) [Tape stopped.]**	S51	INTERPRET DATA - JUDGE Oedema -> high risk

PROBLEM SOLVING GRAPH

SUBJECT : E2 TASK NUMBER : 2



In Task One, where the subject had been given no instruction about how to proceed with the diagnostic task, most of the novice group produced the descending type of problem solving model while only 2 of the expert subjects did. (See Table Nine). In Task Two where subjects had been asked to consider how important was the information being collected and why it was required, all but one of the novices now produced the lateral model. This switch of diagnostic strategy from the descending type to the lateral type is shown in Protocols 1 and 2 from one of the student nurses, Subject N4 which follows in Section 9.7.

It is interesting to note that such instructions did not lead to a similar change of tactics in the expert group as shown in the example protocols from Subject E9 who used the Descending Model of Diagnostic Strategy throughout (See Section 9.8).

In fact, two of the Expert Group subjects (E4 and E8) reversed the trend, producing descending models for the second task where they had produced lateral models for the first. This can be seen in the protocols from Subject E4 (See Section 9.9). Most experts, by making no change in model style between tasks, show a consistency in their own individual style of diagnosing risk of pressure sores regardless of outside instruction.

TABLE NINE - TYPE OF DIAGNOSTIC STRATEGY MODEL PRODUCED BY THE PROBLEM BEHAVIOUR GRAPHS

(i) EXPERT GROUP

Subject	E1		E2		E3		E4		E6		E8		E9		E10
Protocol	1	2	1	2	1	2	1	2	1	2	1	2	1	2	
Lateral Model			/	/	/	/			/	/			/	/	
Descending Model	/	/					/				/	/	/		
Mixed Model					/				/						

(ii) Novice Group

Subject	N1		N2		N4		N5		N7		N8		N9		N10
Protocol	1	2	1	2	1	2	1	2	1	2	1	2	1	2	
Lateral Model		/		/		/		/		/		/		/	
Descending Model			/		/		/	/		/		/		/	
Mixed Model	/						/								

9.7 *PROTOCOL ANALYSIS COMMENTS*
SUBJECT N4 - DESCENDING TO LATERAL MODEL SWITCH

TASK ONE

Subject N4 was 23 years old and in her third year of nurse training when the verbal protocol studies were undertaken. She had gained 7 'O' Levels at school and had achieved diploma level in hairdressing before entering nursing. Throughout her training she had used the Nursing Process as the model for implementing patient care, never having worked in a clinical area where the process was not used.

In Task One, she was asked to consider the patient John, the 66 year old man with pneumonia. Even for the novice group her protocol was very brief. It consisted of 27 segments (Mean number of segments for novice group = 61). The deficits are particularly noticeable in the DATA COLLECTION operators (11 segments. Mean = 21.9) and INTERPRET operators (2 segments. Mean 10.5). In spite of the brevity of the protocol for Task One the Problem Behaviour Graph is a clear demonstration of the Descending Model of Diagnostic Strategy.

Subject N4 starts off her task by checking with the researcher the task expected of her (Segment 1) and verbalizing as if to herself how she is going to go about it (Segment 2). There then begins a long series of data collecting segments passing quickly from one problem area to the next. There is little exploration of each problem area except for respiration (Segment 7 - 9) a mobilization (Segment 10 - 12). It can also be seen that the problem areas relate strongly to the ADL model of nursing rather than a Norton Score framework. She brings this activity to an abrupt halt at segment 13, but, on prompting by the researcher, seeks one further additional datum (Segment 15) before halting data collection finally in Segment 16.

There is hiatus in Segments 17 - 18 when it appears that the subject is unsure what to do with the information she has collected. She is having difficulty in finding a methodology for reviewing and interpreting the data. Unlike the ward sisters, e.g. E9, she has not internalized the Norton Score framework and has to rely on external rules of procedure (Segment 18).

She recovers well however and from Segments 19 - 24 makes a relatively detailed review of the data using REVIEW and INTERPRET operations to arrive at her diagnostic decisions in Segment 25 and Segment 26. Segment 27 ends the task in a state of catharsis.

TASK TWO

In the second task, Subject N4 is given the additional instructions about reflecting on her cognitions and then introduced to her second patient. This was Bill who was 79 years old and had had a stroke resulting in not only limb paralysis, but also difficulty in speaking and in swallowing food and fluids.

It is evident very early on that subject E4 is approaching the nursing diagnosis task in a very different way than before. The protocol, although showing brevity typical of novice performance, nevertheless displays the horizontal strategy normally associated with expert performance. Segment 1 is a quick settling in to the new problem. She then seeks two pieces of information only (Segments 2 - 3) which are sufficiently critical to the assessment of pressure sore risk to allow her to move to a very early diagnostic hypothesis (Segment 4). There follows a fairly detailed explanation for that hypothesis formulation (Segments 5 - 7). Segments 8 - 12 is a series of data collection -> data interpretion sequences showing the continuous interplay of the COLLECT DATA and INTERPRET operations. This is less apparent in (Segments 13 - 19) but nevertheless still definable. The sequence is broken at Segment 18 to synthesise the newly collected information into an overall judgement of the patients fluid state.

In Segment 21 it would appear that the subject is less aware herself of her change of strategy since the first task. She apparently still considers that she has been merely collecting data and that this substage is now at an end and she can move directly on to the substage of making a formal diagnosis of risk (Segment 22 - Segment 23). Segment 24 is a lengthy justifaction of her decision and explanation of her difficulty accepting that the patient factors leading pressure sores are unusually negatively orientated.

PROTOCOL ANALYSIS

SUBJECT - N4 TASK - 1 PATIENT - JOHN

TRANSCRIPT	SEGMENT	OPERATOR
Right. And I'm dealing with his pressure sores ? **(Yes, I want you to assess his risk of pressure sores)**	S1	CONTROL - CLARIFY ROLE
Right. Well, first of all I want to really see him but I know I can't, so to look at the..what he is skin is like first so that we have got somewhere to start from.	S2	CONTROL - EXPLAIN PROCESS
So I want really to know if he has got any sort of ... boney, very boney areas,	S3	COLLECT DATA - OBSERVE Boney areas
How thin he is ? **(OK. Fine. Well I can give you that information. He is quite thin with very little underlying fat and very little muscle.He has got marked boney prominences for most, most areas.)**	S4	COLLECT DATA - OBSERVE Body weight
... Is he managing to drink very much, what is his fluids input like ? **(His fluid intake for the last 24 hours has been 1200 ml's. He has got a positive fluid balance. He doesn't look dehydrated.)**	S5	COLLECT DATA - CONSULT RECORDS Fluid Intake
.... Is he eating very much ? **(He's, he's still quite anorexic, he hasn't been eating very much while he has been in hospital but normally he doesn't have any dietry insufficiency, you know, he normally eats well. It's just that while he has been ill this time he hasn't really eaten very much. He has begun to eat now, he's still, you know, not.. still not really got his appetite back.)**	S6	COLLECT DATA - CONSULT RECORDS Dietry Intake
What about his um... Is he on oxygen all the time ?	S7	COLLECT DATA - ASK/CONSULT RECORDS Duration of oxygen therapy

PROTOCOL ANALYSIS

SUBJECT - N4 TASK - 1

PATIENT - JOHN

TRANSCRIPT	SEGMENT	OPERATOR
What is his lung capacity like ?	S8	COLLECT DATA - MEASURE/ CONSULT RECORDS Lung Capacity
Is he.. is the circulation good or is he very cyanosed ? **(He's not cyanosed now.. his respiratory function is improving. His peak flows are coming up, he has got no peripheral cyanosis. He was on oxygen therapy..for two or three days continuously. It is now p.r.n.. It is not usually necessary although he does get dyspnoeic on exertion sometimes still.)**	S9	COLLECT DATA - OBSERVE Peripheral circulation
Is he on bedrest or is he being able to.. how mobile is he ? **(..He's getting and walking about, walking backwards and forwards to the loo occasionally during the day.)**	S10	COLLECT DATA - ASK Mobility tolerance
So that would be two or three times in the day ? **(Usually more often than that, ..)** Yeah.**(...four to six times.)**	S11	COLLECT DATA - ASK Mobility pattern
So he is sitting out as.. **(Yes, he is sitting out in the chair...during the day as well... twice a day..)**	S12	COLLECT DATA - ASK Sitting out
I can't think of anymore to ask... **Do you feel you know enough now to say what his risk of pressure sores is ?)**	S13	CONTROL - EXPLAIN PROCESS Explain Process
Um....can I just ask one more question ? **(Yes.)**	S14	CONTROL - CLARIFY ROLE

PROTOCOL ANALYSIS

SUBJECT - N4 TASK - 1 PATIENT - JOHN

TRANSCRIPT	SEGMENT	OPERATOR
Is he on a sitting on a sheepskin or anything like that ? (He's got a sheepskin, he has a full length sheepskin on his bed .. he is not using it while he is in the chair, sitting on a pillow while in the chair.)	S15	COLLECT DATA - OBSERVE Aids used
I think I.. yeah, I have enough there.(OK. What would you say his risk is then ?)	S16	CONTROL - EXPLAIN PROCESS
Um... well... (If you can describe it or... in any way you find appropriate.)	S17	REVIEW DATA - REVIEW
I should really evaluate it from the Norton Scale but I must admit that unless I have got it in front of me, I wouldn't.(Umm.)	S18	CONTROL - EXPLAIN PROCESS
So what I would say is that he is very thin which even though ... fair enough, he is walking out to the toilet and he is up and about,	S19	REVIEW DATA - REVIEW
he is still quite at risk because he has got quite a lot of boney prominences (Uh huh.)	S20	DIAGNOSE RISK
And he's in a positive fluid balance although.. he's drinking well so I think that makes ...	S21	REVIEW DATA - CLARIFY
He's more prone to oedema really which would make him more prone to pressure sores	S22	INTERPRET DATA - INFERENCE* Oedema -> pressure sores
and also he hasn't really started eating very much so he's.. his skin's not going to be in terrific condition	S23	INTERPRET DATA - JUDGE Low food intake -> Poor skin
although his respiratory function is better..	S24	REVIEW DATA - REVIEW

PROTOCOL ANALYSIS

SUBJECT - N4 TASK - 1

PATIENT - JOHN

TRANSCRIPT	SEGMENT	OPERATOR
so really he is ... um, high risk. **(At a high risk ?)** Yes. **(Yeah. OK. Fine. If I gave you a scale that I have made up from one to ten about pressure sore risks, where on the scale would place him [Card One] ?)**	S25	DIAGNOSE RISK
..... **(You can go in between if you want to.)** .....I would say number six. **(Number 6 ?)** Umm. **(OK. Fine. I'll leave that in front of you because you will be using it again. OK ,fine. That's smashing. Was that Ok ?)**	S26	DIAGNOSE RISK
Yes (laugh). It ,was difficult ! **(Yes, it is a thinking exercise. It does make you think..) .....straight on to Task 2...**	S27	CONTROL - EXPLAIN PROCESS

PROBLEM SOLVING GRAPH

SUBJECT : N4 TASK NUMBER : 1

KNOWLEDGE AREA	CONTROL	COLLECT	REVIEW	INTERPRET	ACT	DIAGNOSE
Weight Fluid intake Eating Breathing Mobilization Aids used	-- 1 -- 2 ----- 3 - 4 5 6 7 - 8 - 9 10 - 11 - 12 -- 13 - 14 ---- 15 -- 16 ---------- -- 18 ---------- --27		17 19 ---------- 21 ---------- 22 -- 23 24 ----------			20 25 --26

PROTOCOL ANALYSIS

SUBJECT - N4 TASK - 2

PATIENT - BILL

TRANSCRIPT	SEGMENT	OPERATOR
Right. Number One...	S1	CONTROL - EXPLAIN PROCESS
What's..What's his skin area like ?	S2	COLLECT DATA - OBSERVE Skin condition
Is he..Is he overweight and obese or is he underweight ? **(.. He's, he's quite thin now. He's lost weight significantly over the last three weeks. There is very little underlying fat and not much underlying muscle.)**	S3	COLLECT DATA - OBSERVE Body Weght
Right. So then I would say that's quite.. .. at a high risk then.	S4	DIAGNOSE RISK
Also seeing that he's a hemiplegia makes me feel think straight away that he is at a high risk of pressure sores, especially down that side.	S5	INTERPRET DATA - INFERENCE* Hemiplegia -> high risk
That would be something that would spark off in my mind **(Yes.)**	S6	CONTROL - EXPLAIN PROCESS
And also that, because he was having difficulty speaking, he won't be able to tell you if he wants to move, you know, to be able to say very well what he wanted, if he wanted to turn he might, you know, be uncomfortable **(Yeah..)**	S7	INTERPRET DATA - INFERENCE* Dysphasia -> Inability to relieve discomfort
Is he ... getting in a chair, how mobile is he, is he on bed rest or.. ? **(.. He is getting up, they are getting him out to the chair and he is sitting out for approximately four hours twice a day. So he is spending most of the day in the chair... They're having to.. to get him out in the chair, he can't get out by himself, he needs..he needs help to get out.)**	S8	COLLECT DATA - ASK/CONSULT RECORDS Present mobility
Right. there again, I would say that if he is sitting out in the chair for four hours, he's not.. not going to be moving himself so there again he is going to be at high risk.	S9	INTERPRET DATA - INFERENCE* Immobile in chair -> High risk

PROTOCOL ANALYSIS

SUBJECT - N4 TASK - 2 PATIENT - BILL

TRANSCRIPT	SEGMENT	OPERATOR
What's his fluid balance like ? **(His fluid intake has been quite low. It can often get down to as low as 300 ml's in 24 hours. He has had negative fluid balance for the last three days, something like less than five hundred in and six to seven hundred out each day)**	S10	COLLECT DATA - CONSULT RECORDS Fluid balance
OK. The more I'm asking the worse it seems to be getting.**(laugh)**	S11	CONTROL - EXPLAIN PROCESS
So he's again I would say very..at very high risk especially if he is dehydrated like that and not drinking and just sitting out in a chair.**(Ummm)**...(undecipherable aside)..	S12	INTERPRET DATA - INFERENCE* Dehdration -> High risk
Is he able to move his arm and his leg on the..you know, the right side at all ?	S13	COLLECT DATA - ASK/OBSERVE Movement on affected side
.... himself, you know, without any help or ... ? **(Not really,no.... no... er, it is quite a deep..quite a dense loss there.)**	S14	COLLECT DATA - ASK/OBSERVE Movement on affected side
What's his diet like, is he taking much diet ? **(He is having great difficulty swallowing.. before admission he was, you know, his diet was alright but he's now got a dietry insufficiency from the last three weeks because of his inability to swallow.. he seems to have particular problems with fluid, he can get semi-solid food down slowlly... but it does take him a long time.. and to try and help him with fluids they are mixing it with a cellulose crystals to make it a bit, you know, a bit more solid for him to get it down.)**	S15	COLLECT DATA - ASK/CONSULT RECORDS Dietry intake
Yeah. Is he having anything like 'Build Up' or anything like that or is he .. ? **(They are, yes, they are giving him 'Build Up' in ..in those drinks to and then trying to get him to eat as much of a ..of a soft hospital diet as they can.)**	S16	COLLECT DATA - CONSULT RECORDS Supplementary feeding

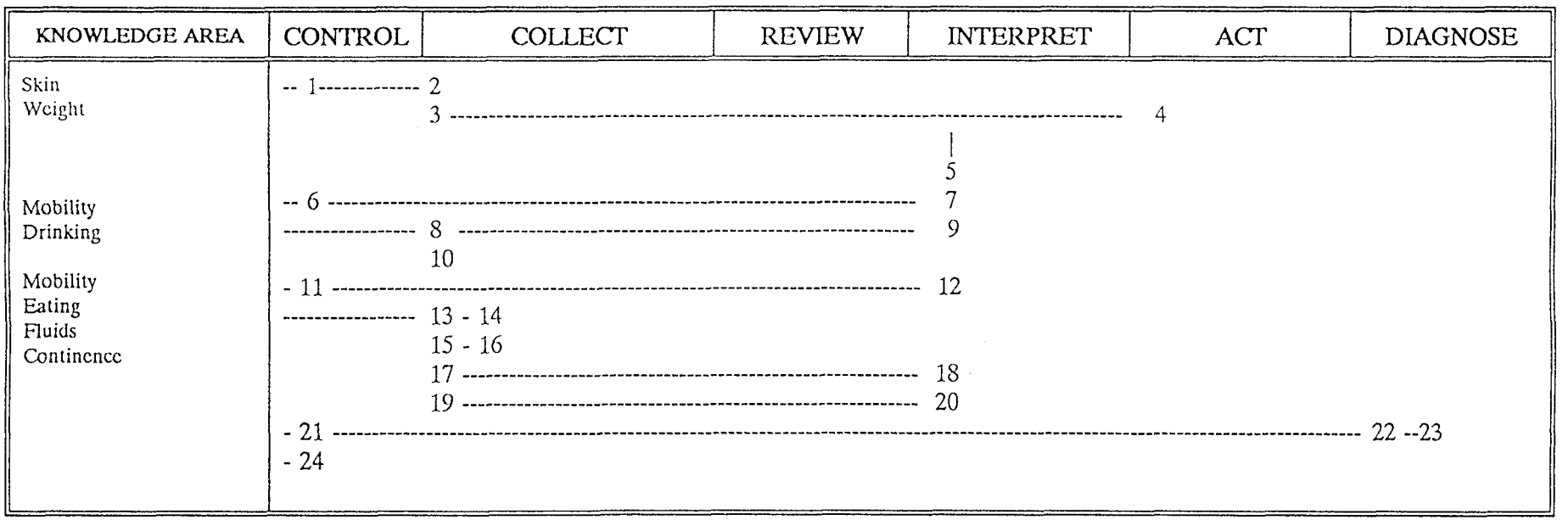
PROTOCOL ANALYSIS

SUBJECT - N4 TASK - 2 PATIENT - BILL

TRANSCRIPT	SEGMENT	OPERATOR
Going back to the fluid balance. Is he having additional intravenous fluids or is.. ?**(No, he isn't.)**	S17	COLLECT DATA - OBSERVE CONSULT RECORDS Additional IV Fluid
He isn't, so it is a low intake then. So.. **(The history was taken a few weeks ago and ... I don't know what is actually happening to him at the moment in this very hot weather, whether in fact they would be very worried about him now, you know, they were considering that he was just coping at that time and his dysphagia was, is getting better so I suppose they didn't want to interfere.)**	S18	INTERPRET DATA - JUDGE Low fluid intake
What's his ... his.. is he continent ? **(...Continence..)** of urine or faeces, is he having problems there ? **(..No, he's not. he is continent. He has two-hourly toiletting and usually when he is in bed he has a urinal left in situ, so they are managing to keep him dry.)**Yes. **(He has had.. only one episode of being wet while he has been in hospital.)**	S19	COLLECT DATA - CONSULT RECORDS Urinary continence
That's ..that's one good thing, yes.	S20	INTERPRET DATA - JUDGE Continence beneficial
..In that case, I won't need anymore information	S21	CONTROL - EXPLAIN PROCESS
because I think he is definitely at high risk. **(He is at high risk ?)** Definitely. **(Yes. OK.,fine. Right, on the scale again [Card One] where would you put him ?)**	S22	DIAGNOSE RISK
I would put him between eight and nine. **(Uh huh. Yeah, OK. Fine. That's smashing. Right, thanks.)**	S23	DIAGNOSE RISK
I'd ...saying about being definite, I think I'd be more definite if someone who had had all these ... sort of everything you asked was um... **(Was coming out bad ?)**.. bad, than if it ..sort of.. they were doing more for themselves and there are more things that are right. I find that more difficult to evaluate than when.. you can see it, everything you ask is coming out bad, you can be more definite. **(Yes. OK, fine.)**	S24	CONTROL - EXPLAIN PROCESS

PROBLEM SOLVING GRAPH

SUBJECT : N4 TASK NUMBER : 2



9.8 *PROTOCOL ANALYSIS COMMENTS*
E9 - DESCENDING MODEL

Compared to the other expert subjects whose protocols are examined in this research, Subject E9 was relatively inexperienced. She was aged 37 years (Mean of expert sample = 34.4 years) and had only two years post-registration experience before taking up her present post, all spent as a staff nurse in the same unit where she now worked. She had been a ward sister for 28 months (Mean 48.75 months) at the time when the protocol interviews were made. She had no significant post-registration professional education. In her training, undertaken at the same hospital, she had been introduced to the Nursing Process and had learnt her patient assessment skills advocated by the early protagonists of this approach. Her protocols reflect the discrete stage by stage technique which was seen necessary to the application of the nursing process, not only in the major stages themselves, ie. Assessment, Planning, Implementation and Evaluation, but also within each of these stages, eg. the sub-stages of Assessment described by Reilly and Oerman (1985). Diagnostic behaviour reflecting this type of approach results in the Descending Model of Nursing Diagnosis.

TASK ONE

The first diagnostic task which subject E9 was asked to undertake concerned the patient Janice who was 30 years old and acutely ill with septacaemia and cellulitis of the right lower leg. The resulting protocol is short, consisting of only 37 segments (Mean of Expert sample = 78 segments), concentrates almost entirely on data collection. The are only three points before Segment 32 at which she pauses from her questioning. Firstly in Segments 13 and 14 she turns aside to briefly consider the significance of the pyrexia and dehydration data. At Segment 25 information gained so far is used to judge the limitation of mobility resulting from the swollen painful leg. Finally Segment 27 is an overt declaration that she is following the strategy described in the Descending Model while Segment 28 signals the return to data collection.

Although in this research the Descending Model of Nursing Diagnosis is predominant in the problem solving behaviours of students, the data collection activity of Subject E9 is highly complex and does not reflect the simple patterns of the novice. This ward sister is using the full range of data sources, as seen in the various types of data collection operators which

can be defined. She is also following through her various lines of inquiry as shown in the horizontal pathways shown in the Problem Behaviour Graph.

The statement in Segment 32 marks the division point between the data gathering sub-stage and the clearly different cognitive activity in Segments 33-36. These segments reveal that E9 is making a very close linkage between the cognitive activities of data analysis, ie. the use of INTERPRET and REVIEW operators, (Segments 34 and 36) and of making diagnostic decisions (Segments 33, 35 and 37).

In the second verbal protocol task, the research subjects were asked to explain why sought information was necessary to diagnosing pressure sore risk and to give their evolving estimation of that risk as they progressed through the task. Unlike many of the novice group, these instruction did not appear in Subject E9 to act as a stimulus for a major change of diagnostic strategy from the Descending Model used in Task One to a Horizontal Model in Task 2.

TASK TWO

For this second task, the patient in question is John, a 66 year old man with a chronic chest problem who has now developed pneumonia. After a short review of this presenting data, Subject E9 again launches into a prolonged sequence of data gathering (4 - 14) with no pause to consider the significance of and relationship between the data which is being gleaned. As in her first diagnosis task, she makes a clear break (Segment 16) with this activity. The division of data collecting and diagnosis into separate sub-stages is broken up somewhat in this second protocol by the more explicit use of the Norton Score methodology. In spite of this however, the basic principle of collect all of the data then use it altogether to make a diagnosis and finally justify the decision by a review of the data can be seen to persist within each Norton category. Segments 4 - 19 covers Physical Condition, Segments 20 - 24 Mental State, Segments 25 -26 Activity and Segments 27 -28 Incontinence.

From this second protocol, it appears that Subject E9 has internalized a fairly rigid framework for patient assessment based on the formal models of the Nursing Process and

the Norton Scale. Throughout this second protocol there appears to be little use of her personal experiences as, for instance was seen with Subject E2. Indeed, from Segments 30 and 31 it is possible to draw the conclusion that there is a strong reluctance to use such informal methods.

PROTOCOL ANALYSIS

SUBJECT - E9 TASK - 1

PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
How long had she been ill at home ? **(She has been ill for 3 days at home.)**	S1	COLLECT DATA - CONSULT RECORDS Length of illness
Had she been in bed at home ? Who had been looking after her ? **(...She had tried to stay in bed at home but she has 3 young children and her husband goes out to work so she had to keep getting up to see to them.)**	S2	COLLECT DATA - ASK Home conditions
Has she been able to walk about at all with her bad leg ? **(Well, she says she could manage to hobble around hanging on to the furniture sort of.. Not really weight bearing though.)**	S3	COLLECT DATA - ASK Walking
Is she pyrexial ? **(Yes she is.)**	S4	COLLECT DATA - MEASURE CONSULT RECORDS Pyrexia
How much and for how long? **(She has had a high temp now for about 4 days. Her temp this morning was.... well, it's been between 38 and 40 since she came in yesterday.)**	S5	COLLECT DATA - CONSULT RECORDS Pyrexia
Has she been sweating much ? Is her skin frequently damp from sweating ? **(Yes. She is sweating a lot and needs frequent sponging etc. to remain comfortable.)**	S6	COLLECT DATA - ASK/CONSULT RECORDS Perspiration
What is her fluid intake like since she came into hospital ? **(Her oral intake has been 500ml. so far. She has an infusion in as well and is having 3 litres in 24 hours through that. That went up last evening.)**	S7	COLLECT DATA - CONSULT RECORDS Fluid Balance

PROTOCOL ANALYSIS

SUBJECT - E9 TASK - 1 PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
And her output ? **(... I'm sorry I haven't got that. She is going about every 4 to 6 hours so I doubt if it is excessive.**	S8	COLLECT DATA - CONSULT RECORDS Fluid Output
Does she seem dehydrated at all ? **(Yes, she does seem to still be a bit dry. Her mouth tastes nasty and so on.)**	S9	COLLECT DATA - OBSERVE Dehydration
Is she having IV antibiotics now for her infection ? **(Yes she is.)**	S10	COLLECT DATA - CONSULT RECORDS Medical Treatment
How long has she been on them ? **(Again, since last evening. She was on oral antibiotics at home as well.)**	S11	COLLECT DATA - CONSULT RECORDS Medical Treatment
Is she having an antipyretic as well like Aspirin or Paracetamol ? **(No. She is having DF 118's thought for pain every 6 hours. I don't think they have very much of an antipyretic action, do they ?)** No, not really....	S12	COLLECT DATA - CONSULT RECORDS Medical Treatment
So she is still slightly dehydrated and remains pyrexial...	S13	REVIEW DATA - REVIEW
It looks as if her general condition is still quite poorly today even though she has commenced treatment.	S14	INTERPRET DATA - JUDGE General condition poorly
What is her mental state like? Is she very 'knocked off' and drowsy or not ? **(She's fully conscious but you could say she was 'knocked off' from the analgesia and the pyrexia though.)**	S15	COLLECT DATA - OBSERVE Mental state
She's not confused, is she ? **(Oh no. She is fully aware of her surroundings and situation when she is awake...)**	S16	COLLECT DATA - OBSERVE CONSULT RECORDS Confusion
Is she worrying about home very much ? **(A little. Although she knows the children are being cared for by her mother and by her husband.)**	S17	COLLECT DATA - ASK Anxiety

PROTOCOL ANALYSIS

SUBJECT - E9 TASK - 1

PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
How much can she move with her leg today Can she turn herself over from side tide by herself ? **(Yes.)**	S18	COLLECT DATA - ASK/OBSERVE Mobility in bed
Does she turn over in bed anyway without being instructed to ? **(Yes, she will do when she is awake. She has been told to sleep on alternate sides if she can... and seems to be mobile in bed by herself.)**	S19	COLLECT DATA - OBSERVE Mobility in bed
Can she move her leg unaided or does she have to lift it around when she moves ? **(She has to lift it up to turn over.)**	S20	COLLECT DATA - ASK/OBSERVE Mobility of leg
She has a bed cradle in, hasn't she ? **(Yes, she has.)**	S21	COLLECT DATA - OBSERVE Bed cradle
Is the end of the bed elevated ? **(Yes)**	S22	COLLECT DATA - OBSERVE Bed Elevated
Is she on bedrest or can she get up to the commode ? **(She can manage to get out onto the commode although it is painful to do so.)**	S23	COLLECT DATA - CONSULT RECORDS Getting out of bed
She's not been incontinent at all has she ? **(No, she hasn't.)**	S24	COLLECT DATA - CONSULT RECORDS Incontinence
OK. So her activity is quite restricted by that leg really.	S25	INTERPRET DATA - JUDGE Movement impeded
At home, when she is well, is she normally an active person ? I should think with those young children she hasn't got much choice not to be! **(Yes, she is normally active. She walks a lot because her husband uses the car for work.)**	S26	COLLECT DATA - ASK Mobility at home

PROTOCOL ANALYSIS

SUBJECT - E9 TASK - 1

PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
OK...That is about all I want to know really ,I think.	S27	CONTROL - EXPLAIN PROCESS
Oh, no. I forgot to ask earlier about nutritional state.	S28	CONTROL - EXPLAIN PROCESS
Has she been eating since she has been ill ? **(No, she stills feels very anorexic.)**	S29	COLLECT DATA - ASK/CONSULT RECORDS Eating while ill
What is her weight like ? Does she normally eat well at home ? **(She says she does but she doesn't look very well nourished at all. In fact she looks quite thin and emaciated as if she has been neglecting her diet for some time.**	S30	COLLECT DATA - ASK Normal weight and diet
Is there financial difficulties at home that has lead to poor nutrition or is it that she just doesn't bother for herself ? **(It's the latter I think, her husband is in work. I don't know really though, things could be a bit tight. I don't think anyone has talked to her about it yet though.)**	S31	COLLECT DATA - CONSULT RECORDS Reasons for poor diet
OK. I see. Now I think I have enough to assess her risk. **(OK. That's fine.)**	S32	CONTROL - EXPLAIN PROCESS
In spite of her age, her Norton Score would be quite low, about 12,	S33	DIAGNOSE RISK
because she is very poorly still and her leg is limiting her mobility quite a bit.	S34	REVIEW DATA - REVIEW

PROTOCOL ANALYSIS

SUBJECT - E9 TASK - 1

PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
Therefore she is in the 'at risk' category at the moment. It is unlikely to stay that way for long though,	S35	DIAGNOSE RISK
I would think her score will rise quickly and the risk diminish as the antibiotics take hold and her toxic state gets better. **(That's great. Just one last thing. Could you give me a risk score using this scale too. [Card One explained].)**	S36	INTERPRET DATA - INFERENCE** Speedy recovery
Yes. Using this scale, I would say that, at the moment, her risk is medium, that is Number 4. **(That's fine. Thankyou. Taped switched off.)**	S37	DIAGNOSE RISK

PROBLEM SOLVING GRAPH

SUBJECT : E9 TASK NUMBER : 1

KNOWLEDGE AREA	CONTROL	COLLECT	REVIEW	INTERPRET	ACT	DIAGNOSE
Condition at home Mobility Medical signs Drinking Medical treatment Mental state Emotional state Mobility Continence Mobility at home Eating	---------- 1 -- 2 3 4 - 5 - 6 7 - 8 - 9 10 - 11 - 12 ---------- 13 ---------- 14 ---------- 15 - 16 ---------- 17 18 - 19 - 20 - 21 - 22 - 23 ---------- 24 ---------- 25 ---------- 26 -- 27 - 28 ----- 29 - 30 - 31 -- 32 ---------- 33 | 34 ---------- 35 ---------- 36 ---------- 37					

PROTOCOL ANALYSIS

SUBJECT - E9 TASK - 2 PATIENT - JOHN

TRANSCRIPT	SEGMENT	OPERATOR
Well the first thing I want to do is to assess his physical condition.	S1	CONTROL - EXPLAIN PROCESS
With a patient with a respiratory problem this is particularly important because it tells me a lot about how healthy the circulation to the pressure areas is.	S2	CONTROL - EXPLAIN PROCESS
John came in nine days ago with pneumonia on top of COAD...	S3	REVIEW DATA - CLARIFY
Does he get cyanosed at all ?Does he still require oxygen ? **(No he isn't using it now.)**	S4	COLLECT DATA - OBSERVE Cyanosis
Can he carry out his activities of living alright or does it make him breathless to wash and go to the loo etc.? **(....He does get dyspnoeic still on exertion but if he takes things slowly and isn't rushed he can manage alright by himself... except for getting into the bath. He has a hoist bath still. He potters down to the loo and back several times a day. He may have to stop for a breather now and again but he can make it alright.)**	S5	COLLECT DATA - ASK CONSULT RECORDS ADL capability
How poorly was he on admission ? How long did he require oxygen therapy for ? **(He was quite poorly on admission with a low Po2 for over 24 hours after admission. He had o2 for several days intermittently.)**	S6	COLLECT DATA - CONSULT RECORDS Condition on admission
What about normally at home? How incapacitated by his chest is he at home ? **He usually potters around the house alright and can manage the stairs once or twice a day. He doesn't walk far from the house at all.)**	S7	COLLECT DATA - ASK Mobility at home
You say he has ?Liver Metastases ? What makes them think that ? **(The doctors found he had slight ascites on examination and now his LFT's have come back abnormal. I don't quite know what though....)**	S8	COLLECT DATA - CONSULT RECORDS Reasons for ? Liver metastases

PROTOCOL ANALYSIS

SUBJECT - E9 TASK - 2

PATIENT - JOHN

TRANSCRIPT	SEGMENT	OPERATOR
OK. ...Is he jaundiced ? **(No.I don't think so.)**	S9	. . . COLLECT DATA - OBSERVE Jaundice
Has he any oedema elsewhere, in his sacrum and ankles for instance ? **(He has got slight peripheral oedema there, yes.)**	S10	COLLECT DATA - OBSERVE Oedema
What is his skin like? Is it intact still after his illness ? **(He's got a dusky coloured dry skin, rather thin. It is intact, yes, and has been all along.)**	S11	COLLECT DATA - OBSERVE Skin Condition
Is John a big man or not? **(No he isn't.In fact he is really quite thin.)**	S12	COLLECT DATA - OBSERVE Body Weight
Is he very bony then ? **(Yes.)**	S13	COLLECT DATA - OBSERVE 'Bony-ness'
Has he got a sheepskin or a Spenco mattress on his bed ? **(....He has a full length sheepskin on his bed, yes.)**	S14	COLLECT DATA - OBSERVE Aids used
He has, good. It sounds as if he needs it.	S15	INTERPRET DATA - JUDGE Needs for aids
Right. Having assessed his physical condition then, I would give him a score of 2 on that Norton factor because of his weight and his breathing problem.	S16	DIAGNOSE RISK Physical condition category
You want to now what I think his overall risk is going to be, don't you? ... **(Yes, please...)**	S17	CONTROL - CLARIFY ROLE
Well he is definitely in a high risk category even now his illness isgetting better.... about 7 on your scale	S18	DIAGNOSE RISK

PROTOCOL ANALYSIS

SUBJECT - E9 TASK - 2 PATIENT - JOHN

TRANSCRIPT	SEGMENT	OPERATOR
because as I said I see the sheepskin to be essential to him. **(OK....)**	S19	REVIEW DATA - CLARIFY
Norton then asks you to score him on 'mental state'.	S20	CONTROL - EXPLAIN PROCESS
How is he on that factor ? **(He's alert but quiet.... not the sort of man that says very much. He appears anxious at times but usually denies it when asked.)**	S21	COLLECT DATA - OBSERVE Mental state
So he really has to be asked if there is anything he wants and so on ? **(Yes.)**	S22	COLLECT DATA - OBSERVE Verbal behaviour
OK. That really makes him a 3 there then.	S23	DIAGNOSE RISK Mental state category
Mental state is an important thing to think of in pressure sores because an alert patient won't allow himself to stay in one position too long. If they get numb they either move anyway or ask to be moved.	S24	INTERPRET DATA - INFERENCE** Mental state = movement
Activity comes next on the scale. I've already asked about that and about mobility at home.	S25	CONTROL - EXPLAIN PROCESS
He would score 2 for each of those or perhaps a 3 for activity.	S26	DIAGNOSE RISK Activity/mobility categories
That leaves incontinence. Is John incontinent at all ? **(No and hasn't been since admission.)**	S27	COLLECT DATA - CONSULT RECORDS Incontinence
Fine ,so that's a 4 there.	S28	DIAGNOSE RISK Incontinence category

PROTOCOL ANALYSIS

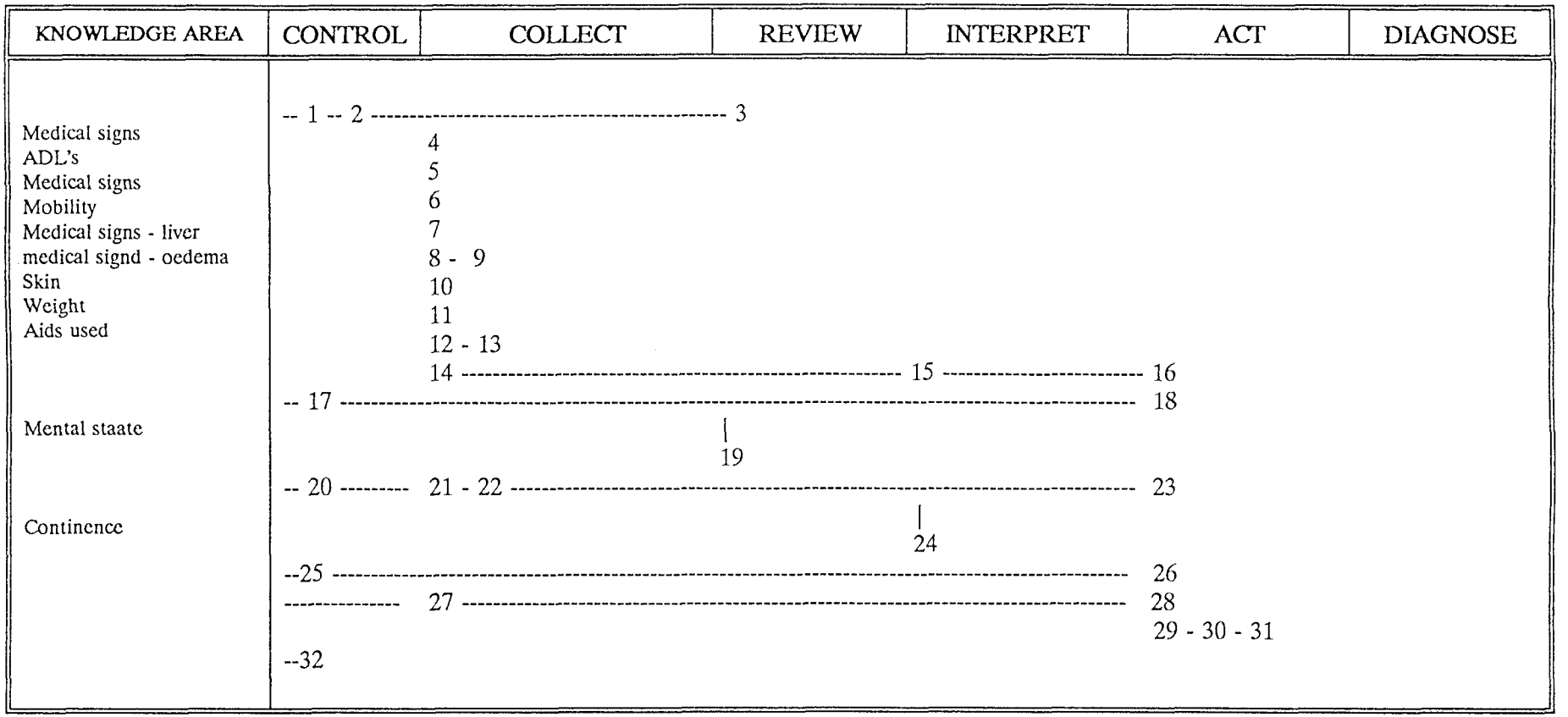
SUBJECT - E9 TASK - 2

PATIENT - JOHN

TRANSCRIPT	SEGMENT	OPERATOR
So it looks like he has a score of 14 on the Norton Scale. That's just in to the at risk category.	S29	DIAGNOSE RISK
My intuitive feeling would put him lower than that....	S30	DIAGNOSE RISK
On your scale I would put him at 7 still.	S31	DIAGNOSE RISK
Is that OK for you ? **(Yes, thankyou . That was super.)[Tape stopped]**	S32	CONTROL - CLARIFY ROLE

PROBLEM SOLVING GRAPH

SUBJECT : E9 TASK NUMBER : 2



9.9 *PROTOCOL ANALYSIS COMMENTS*
SUBJECT E4 - MIXED TO DESCENDING MODEL SWITCH

Subject E4 was 33 years old and had been a qualified nurse for 11 years at the time of taking part in this research. She had served 6 years as a staff nurse mainly in intensive and coronary care units. She had then been a ward sister for 2 years in the latter type of unit before taking her present sister's post on the medical unit 3 years ago. Although close to the mean in terms of age and ward sister experience, the nature of her previous clinical work indicated that she was a highly skilled and knowledgeable clinical nurse practitioner. She had been using the Nursing Process approach to care for 7 years.

TASK 1

The first patient E4 was asked to assess was Eric, a 72 year old gentleman who had been admitted to the ward the day before following a Myocardial Infarct (heart attack). The verbal protocol which results from this assessment is a clear demonstration of the Mixed Model of Nursing Diagnosis with an early predominance of data collection (Segments 1 - 14) with a brief interlude of working back and forth from COLLECT DATA to REVIEW and INTERPRET (Segments 15 - 25) before returning again to data collection on its own with INTERPRET and DIAGNOSIS only coming at the final stages of the task (Segments 43 - 50). Again the data collection sequences are quite complex as can be seen by the intense investigation of Eric's chest pain (Segments 5-10) and breathing problems (Segments 11 - 14). The main sequence of data collection essentially comes to an end at Segment 26. At this point Subject E4 comes almost to a sudden halt as if she has lost her way somewhat and seeks the aid of the researcher to clarify the task (Segment 27 - 28). Although at this point she feels the first stage of her task is complete (Segment 29) there are four more COLLECT DATA segments in which she appears to be seeking confirmation from the patient himself of the information she already has access to. This little sequence of segments posed problems for the researcher in terms of categorizing into the type of operator being used. It was initially difficult to decide whether E4 is collecting data here or is giving an account of proposed actions, ie. using ACT operators. The conclusion is that her main purpose at this point is gaining information from the patient. Thus Segments 31 - 33 are classified as COLLECT DATA operations. From Segments 34 - 42 the subject is more obviously recounting actions

she would undertake and thus are classified as ACT operations. Segments 43 - 45 are explorations of care since admission which E4 infers has been given which allows her to reach the point in Segment 47 to give an overall estimate of his risk of pressure sores. This diagnosis is then made more specific in the final Segments 48 - 50.

TASK TWO

Subject E4 has now been asked to explain if possible her awareness of the reasons for collecting particular information. In novice subjects who had similarly shown a Mixed Model of Nursing Diagnosis in Task One (Subjects N1 and N7), this instruction had led them to switch to the Lateral Model of Nursing Diagnosis in Task Two. For the expert subjects (E4 and E8) however, the switch that was made was not to the lateral model but to the descending model characteristic of the novice practitioner. This switch is shown in this second protocol from Subject E4.

The patient involved is Janice, aged 30 years, who had cellulitis of the lower leg. The protocol is dominated by COLLECT DATA operations which make up 31 of the total 47 segments. Segments 2 - 37 is almost entirely data collection with only two brief episodes of REVIEW (Segments 21 - 29) and one segment (Segment 24) of INTERPRET data. Only during the last nine segments is all of the data that has been previously collected clearly used by REVIEW (Segments 39 -41) to reach the final diagnostic decision in Segments 42 - 46.

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 1

PATIENT - ERIC

TRANSCRIPT	SEGMENT	OPERATOR
Right, so I've got to concentrate on his pressure sores. **(Yes.)** Right.	S1	CONTROL - CLARIFY ROLE
Since he came into hospital, has he been well. By that I mean has he had any complications ? **(Since he came into hospital... No. No, he's had no complications.)**	S2	COLLECT DATA - CONSULT RECORDS General progress
So, although he has been on bedrest, he has been able to move freely in bed ? **(He is able, but he isn't moving a lot in bed. He seems.. afraid to move because of ...)**	S3	COLLECT DATA - CONSULT RECORDS Movement in bed
Because of the monitor or because of what ? **(Yes, because of the monitor and because of chest pain.**	S4	COLLECT DATA - ASK Monitor impeding movement
So he is still having chest pain ? **(Yes. He is frightened of aggravating it.That is why he is not moving very much.)**	S5	COLLECT DATA - ASK Chest Pain
So he is pain free twenty hours after admittance ? **(... more or less, yes. He has had analgesics. He has had some today. He had Diamorphine early this morning.)**	S6	COLLECT DATA - ASK Pain
Early this morning. So, what, how many hours interval am I talking about now ? **(... He was admitted, er, I've got twenty hours here, so that is sort of seven o'clock last night. He had a dose of Diamorphine then last early this morning...early this morning.)**	S7	COLLECT DATA - CONSULT RECORDS Drugs given
And we are talking about now being three o'clock in the afternoon ? **(Yes. About this time.)**	S8	CONTROL - CLARIFY ROLE

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 1

PATIENT - ERIC

TRANSCRIPT	SEGMENT	OPERATOR
Right. And do we know that he is pain-free now ? **(He is pain free, yes.)**	S9	COLLECT DATA - ASK/OBSERVE Degree of pain
Completely pain free ? **(He's completely pain-free.)**	S10	COLLECT DATA - ASK/OBSERVE Degree of pain
And that he is able to breathe comfortably ? **(...er.)**	S11	COLLECT DATA - ASK Pain on breathing
That he is able to take deep breaths comfortably ? **(.. Yes, he gets.. he knows, he gets dyspnoeic on exertion, gets short of breath, you know, if he moves onto his side.)**	S12	COLLECT DATA - ASK Pain on breathing
Is that new, related to this admission ? **(No. No, he's got a history of angina for four or five years..**	S13	COLLECT DATA - ASK Dyspnoea
On minimal exertion ? **(..It is now, on minimal exertion. But not normally, at home, it is only when walking hills and so on.)**	S14	COLLECT DATA - ASK Dyspnoea on exertion
So normally he's quite active at home ? **(Yes.)**	S15	COLLECT DATA - ASK Dyspnoea on exertion
He's not restricted in is mobility at all ? **(Not really. He's able to walk one to two miles a day and he usually does go out most days with the dog. .. But if he goes too fast or has to go uphill then he gets, you know, he may get angina. Normally he doesn't, yes.)**	S16	COLLECT DATA - ASK Dyspnoea restricting mobility
Right, but he is obviously really quite active really.	S17	INTERPRET DATA - JUDGE Activity level

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 1

PATIENT - ERIC

TRANSCRIPT	SEGMENT	OPERATOR
So he is obviously able to meet, meet all his own hygiene needs at home ? He's been able to look after himself ? **(Yes. Yes, that's true.)**	S18	COLLECT DATA - ASK Self care at home
Right... I'm just thinking about now that he's been in bed for twenty hours and you said that he has not been moving too well..	S19	CONTROL - EXPLAIN PROCESS
I wonder if the nurses are actually, you know, probably going to him and change his position	S20	ACT - PRESCRIBE Change position
or whether you think he is able to fidget and able to turn from side to side or..	S21	COLLECT DATA - OBSERVE Movement in bed
you know, sounding out really... actually **(Yes. He has been moved two hourly.)**	S22	CONTROL - EXPLAIN PROCESS
Two hourly. **(Yes... You know, he can move with help or I suppose he would move if he was prompted.)**	S23	REVIEW DATA - CLARIFY
I would have thought, having been so active previously and now pain-free, that he would probably have been able to turn more freely **(Yes.)**.. than having to be turned by the nurses two -hourly...	S24	INTERPRET DATA - JUDGE Level of activity in bed
Presumably, the fact that they have turned him two-hourly, they are noting his pressure areas **(Yes.)**..and will see ...	S25	INTERPRET DATA - INFERENCE* Nurses assess pressure areas on turning
There has been no mention of any reddened areas ? **(No. His skin is in good condition and it is intact...)**	S26	COLLECT DATA - OBSERVE/ CONSULT RECORDS Reddened areas

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 1

PATIENT - ERIC

TRANSCRIPT	SEGMENT	OPERATOR
.. I'm not quite sure what I'm meant to ask, what.. I mean what do I do now ? **(You just keep going until, you just keep going until you can sort of say what his risk of pressure sores is.)**	S27	CONTROL - CLARIFY ROLE
Oh, what his risk of pressure sores are. **(Yes.)**	S28	CONTROL - CLARIFY ROLE
... I think that is everything really.	S29	CONTROL - EXPLAIN PROCESS
The fact that if he is completely pain free, I would probably ... ask him, you know, if he's pain free, myself assess his pain,	S30	COLLECT DATA - ASK Degree of pain
and ask him if he can breathe comf..comfortably	S31	COLLECT DATA - ASK Breathing comfort
and see that he can take a deep breathe, ask him to take a deep breathe so that you can see that he can fully take a deep breathe easily	S32	COLLECT DATA - ASK/OBSERVE Breathing capacity
and to ask him if anyone has explained how.. what movements he is allowed to, to carry out in bed, and..	S33	COLLECT DATA - ASK Been instructed about movement in bed
the fact that although he has got a monitor he is still to fidget and to turn on his side if he wants to.	S34	ACT - PRESCRIBE Explain movement allowed
If he wants to lie flat, he could and if he wants to sit up, he could	S35	ACT - PRESCRIBE Explain movement allowed

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 1 PATIENT - ERIC

TRANSCRIPT	SEGMENT	OPERATOR
and that he is not restricted because of the monitor.	S36	**ACT** Instruct nurses
And make sure someone had pointed out to him about that.	S37	**ACT - PRESCRIBE** Explain movement allowed
And where everything is on the locker and the call buzzer, you know, so that he can freely move either way...	S38	**ACT - PRESCRIBE** Explain movement allowed for toiletting
And that getting out to use the bottle, if he is having difficulty in using the bottle in bed that if he asks for the curtains to be drawn round he could stand out	S39	**ACT - PRESCRIBE** Explain movement allowed for toiletting
and if he was a bit worried about it someone could stand with him.	S40	**ACT - PRESCRIBE** Explain movement allowed for toiletting
But.. otherwise to use the commode.	S41	**ACT - PRESCRIBE** Explain movement allowed for toiletting
So that he knew he could be a bit more active and that he wasn't expected to lie still and straight waiting for.. you know, in case anything changed on the monitor..	S42	**ACT** Rationale
It's just to make sure that when he was admitted, although perhaps if he wasn't well on admittance,	S43	**INTERPRET DATA - INFERENCE*** Possible poor condition on admission
or if, you know, perhaps there was a lot of information would have been given at the time depending on how much pain he was in.	S44	**INTERPRET DATA - INFERENCE*** Amount of information given on admission

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 1

PATIENT - ERIC

TRANSCRIPT	SEGMENT	OPERATOR
But perhaps within the first six hours someone has explained to him, you know, what his restrictions are and what, what he is able to do and what he is not able to do.	S45	INTERPRET DATA - INFERENCE* Amount of information given later
And..you know, once he has got all this information, he appears quite well.. I wouldn't, I don't see of any reason why he shouldn't be standing.. on the edge, out, and standing up to use the bottle	S46	ACT - PRESCRIBE Able to stand out of bed
and I feel his pressure areas, there shouldn't be any problems with them	S47	DIAGNOSE RISK
except.. pressure area marking, if he is aware that he can, you know, be ... freely active. **(OK. That's fine. You said that you don't think his pressure areas, you know, that there's, there is going to be much problem with his pressure areas.)**	S48	DIAGNOSE RISK
I wouldn't have thought so. No. **(Could you on this scale [Card one], you will be using this scale several times this afternoon, could you on that scale give me a number, a numerical score for, for his risk of pressure sores then.)**	S49	DIAGNOSE RISK
Three. **(Three. Yes. Ok. Fine.) [Tape stopped]**	S50	DIAGNOSE RISK

PROBLEM SOLVING GRAPH

SUBJECT : E4 TASK NUMBER : 1

KNOWLEDGE AREA	CONTROL	COLLECT	REVIEW	INTERPRET	ACT	DIAGNOSE
Medical condition Mobility Medical condition Pain Breathing Activity at home Other ADL at home Mobility in bed Skin Pain Breathing Instruction to move	-- 1 ---------- 2 3 -- 4 5 -- 6 -- 7 -- 8 ---------- 9 - 10 11 - 12 - 13 - 14 15 - 16 ---------- 17 18 - 19 ---------- 21 - 22 ---------- 26 - 27 - 28 - 29 -- 30 31 - 32 33 ----------	---------- 20 ---------- 23 ---------- 24 - 25 ---------- 34 - 35 - 36 - 37 - 38 39 - 40 - 41 - 42	---------- 43 - 44 - 45 ---------	46 ---------- 47 48 - 49 - 50		

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 2 PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
She was admitted twenty four hours ago ? **(Approximately, twenty four hours ago, yes.)**	S1	REVIEW DATA - CLARIFY
Fine. And she has been confined to bed, has she ?**(She has been confined to bed,yes.)**	S2	COLLECT DATA - CONSULT RECORDS Bed Rest
Is her leg very oedematous, to, a lot of inflammation ? **(Yes, it is. It is quite... it is very... Yes. It is very oedematous.)**	S3	COLLECT DATA - OBSERVE Leg oedema
Is she able to move her leg ? **(..She can move it but it is very painful to do so.)**	S4	COLLECT DATA - OBSERVE Leg Movement
And how long.. how much history had she had before her admittance ? Is it very .. **(She's been, she's been, she's had a high temperature ... The bee sting was five days ago, she's had a high temperature for three to four days now.)**	S5	COLLECT DATA - CONSULT RECORDS Length of illness
And she has been unwell for five days ? **(More like three or four.)**	S6	COLLECT DATA - ASK/CONSULT RECORDS Length of illness
At home in bed for that length of time ? **(.. Well she couldn't stay in bed at home. She's ... she couldn't stay in bed, no.)**	S7	COLLECT DATA - ASK Bedrest at home
Why couldn't she stay in bed ? **(She's got three young children to look after.)**	S8	COLLECT DATA - ASK Home conditions
So she was actually able to move around at home even though.. **(Yes. Yes. Very limited, you know, with .. you know. Gradually she became more and more limited and unable to cope, but she felt she had to, you know, ...)**	S9	COLLECT DATA - ASK Movement at home

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 2 PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
And she has had a fever for three days ? **(Yes.)**	S10	COLLECT DATA - ASK/CONSULT RECORDS length of fever
Has she been eating and drinking ? (..) at home ? to do what her.. **(... She.. not very much, she.. What, you mean in the short period..)**	S11	COLLECT DATA - ASK Fluids/diet at home
It was prior to admission and ...I was wondering if she hadn't actually been having a dietary intake or whether she had been drinking as well. **(Yes... She has been anorexic for two or three days and not really caring much for food. She has been drinking at home.. but she looks slightly dehydrated on admission.)**	S12	CONTROL - EXPLAIN PROCESS
Fine. Has her husband taken time off work now to look after the family ? **(Yes. He has gone to work today but her mother is looking after the children for the day and then he's off..)**	S13	COLLECT DATA - ASK Husband available to care for children
And the age of the children, they are small enough to be looked after by .. her mother. She's not..? **(Yes.)**	S14	COLLECT DATA - ASK Age and needs of children
They are not infants ? **(They are not infants, no. I think the youngest is three or four.. but they are very close together, I think the oldest is about seven.)**	S15	COLLECT DATA - ASK Age and needs of children
Right. Since she came into hospital... can I ask you about what treatment she is having ? **(Yes.)**	S16	CONTROL - CLARIFY ROLE
What is her treatment ? What treatment has she had since she came in ? **(What particularly are you..?)**	S17	COLLECT DATA - CONSULT RECORDS Medical treatment

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 2 PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
Is she .. commenced intravenous therapy ?	S18	COLLECT DATA - OBSERVE/CONSULT RECORDS Medical Treatment
I would have thought she would be having intravenous fluids and antibiotics or .. just fluids ? **(Yes. She is having intravenous antibiotics and an intravenous infusion of ..)**	S19	INTERPRET DATA - INFERENCE* Medical care required
Is she.. **(..Sorry)** I was going to say , is the infusion because she is dehydrated ? **(I think so, yes. She's on a regime of three litres in twenty four hours plus she has had five hundred orally since admission. And she seems to be in positive fluid balance.)**	S20	COLLECT DATA - CONSULT RECORDS Dehydration requiring IV therapy
Positive fluid balance....	S21	REVIEW DATA - REVIEW
Is she .. drinking, in that she feels able to drink or is it that ..the anorexia continues with reluctance to take fluids ? **(She can take , she can take fluids alright.)**	S22	COLLECT DATA - ASK Oral fluid intake
Right. Is that all fluids ? **(.. She's sticking mainly to cold fluids. She will have tea but she can't drink milk.)**	S23	COLLECT DATA - ASK Oral fluid intake
No milk.. I was just wondering about .. her.. nutritionally ..state in the last.. you know, few days especially since she has been anorexic at home **(It has not been very good for the last few days.)**	S24	INTERPRET DATA - INFERENCE* Anorexia -> Low nutritional state
Right... Is she being.. is she able to turn in bed at all ? **(..She can. She can turn but she can't turn right over on her side. But if she is prompted she can turn, you know, sort of half on her side.)**	S25	COLLECT DATA - OBSERVE Turning in bed

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 2 PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
Is she having any sort of measures to relieve .. pressure ? Is she sitting on a.. sheepskin or.. a ring or has she got a bed cradle in the bed ? **(She's got a bed cradle in the bed but she hasn't got any pressure relieving aids at the moment.)**	S26	COLLECT DATA - OBSERVE Pressure relieving aids used
Right..... And she is being bodily.. she can turn part way ? **(She can turn part way.)**	S27	COLLECT DATA - OBSERVE Turning
Part way... I've come to a blank, I'm afraid .. **(Do you feel you know enough about her or is there anything else you want to know ?)**	S28	CONTROL - EXPLAIN PROCESS
Has she any past history... Oh, this is from a bee sting, sorry. **(Uh huh.)** From a bee sting.	S29	REVIEW DATA - REVIEW
Is she on any other treatment apart from her IV. antibiotics ? **(She is having analgesics, DF118's ..four hourly for pain ... they are making her quite drowsy.)**	S30	COLLECT DATA - CONSULT RECORDS Medical Treatment
Right. She is not on any anti-histamine of any sort ? **(No.)**	S31	COLLECT DATA - CONSULT RECORDS Medical treatment
So she is quite sedate ? **(Yes.)**	S32	COLLECT DATA - OBSERVE Mental state
By that, do you mean that she is sleeping on and off throughout the day ? **(Yes, yes. She can wake if.. if disturbed she will wake up and she is quite conscious and aware of her surroundings but left to herself she drops off, you know, she's drowsy)**	S33	COLLECT DATA - OBSERVE Mental state

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 2

PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
Has her fever settled at all since she came in ? **(No. She still, she still has a high temperature... I can tell you what it is... it is till quite high...)**	S34	COLLECT DATA - CONSULT RECORDS Fever
Is she perspiring very much ? **(She is perspiring, yes. Her skin is quite moist.)**	S35	COLLECT DATA - OBSERVE Perspiration
Right. Would she be able to wash herself at all if she had a bowl on the bed table, is her drip .. sited in that she would actually need a nurse to help her ? **(She will actually need, she will actually need someone to help her wash.. ay, because of her drip and bee, she..)**	S36	COLLECT DATA - ASK/OBSERVE Self care ability
Because she is not well enough ? **(Because she is not well enough.)**	S37	COLLECT DATA - OBSERVE General condition
Right. I think .. I think I've got enough information. **(Uh huh. I've found her temperature on it. Between 38 and 40 since admission.)**	S38	CONTROL - EXPLAIN PROCESS
Between 38 and 40.. **(OK. What do you think her risk is then ?)**	S39	REVIEW DATA - REVIEW
..... What do you mean by routine preventative interventions ? **(By routine, I mean sort of two hourly turning..)**	S40	REVIEW DATA - CLARIFY
And washing the skin.. **(Yes, and keeping the bed clean and dry. Extra ones really are putting in ..)** Right. **(..pressure aids. Intensive ones really are when we have to sort of think about extra beds and mattresses.)**	S41	REVIEW DATA - CLARIFY
Yes. So I would say four then. **(Four, yes. Could you say why ?)**	S42	DIAGNOSE RISK

PROTOCOL ANALYSIS

SUBJECT - E4 TASK - 2 PATIENT - JANICE

TRANSCRIPT	SEGMENT	OPERATOR
The fact that she isn't moving freely	S43	INTERPRET DATA - RELATE Poor movement -> risk of sores
and she is obviously unwell	S44	INTERPRET DATA - RELATE Poor general condition -> risk of sores
and, unless disturbed, is not going to be changing her position	S45	INTERPRET DATA - RELATE Poor movement -> risk of sores
and that she is perspiring, sort of sweaty skin .. which she is not able to .. you know, freshen herself...	S46	INTERPRET DATA - RELATE Perspiring -> risk of sores
and... that's it really. **(OK. Fine. [Tape stopped.])**	S47	CONTROL - EXPLAIN PROCESS

PROBLEM SOLVING GRAPH

SUBJECT : E4 TASK NUMBER : 2

KNOWLEDGE AREA	CONTROL	COLLECT	REVIEW	INTERPRET	ACT	DIAGNOSE
	---------- 1					
Mobility allowed	---------- 2					
Medical condition		3				
Movement		4				
Medical condition		5 - 6				
Condition at home		7 - 8 - 9				
Medical condition		10				
Drinking		11				
Diet		12				
Home/Family		13 - 14 - 15				
Medical treatment	-- 16 ----------	17 - 18 - 19 - 20 ----------	21			
Drinking		22 - 23 ----------	24			
Mobility		25 - 26 - 27				
Medical treatment	-- 28 ----------	29				
Mental state		30 - 31				
Medical condition		32 - 33				
Other ADL		34 - 35				
		36 - 37				
	-- 38 ----------	39 - 40 - 41 ----------	42			
	----------					43 - 44 - 45 - 46
	-- 47					

9.10 VOCABULARY ANALYSIS

9.10.1 TECHNIQUE

i) Each protocol was re-written taking out the researchers spoken contribution.

11) The total number of words spoken by the subject was then calculated.

iii) The text of the protocol was marked using a high-lighter pen indicating those phrases considered by the researcher to be 'Technical Nursing Language'. These were either those phrases containing either specialized technical language of the nurse, for example, 'signs of dehydration', 'incontinence', or phrases in common English which were being used in a special way for the purposes of nursing such as 'transfer with one nurse', when she came in'.

iv) The total number of the technical phrases was then calculated for each protocol as was the total number of words which it contained. The former figure was expressed as a percentage of the total number of words in the protocol itself. The percentage tended to be around the 50% mark for the two groups (Mean for E Group = 52%, Mean for N Group = 50%)

v) Each phrase in the protocol was written onto a slip of paper and these then sorted into categories relating to the subject area of the pressure sore risk enquiry which they related to. For the first 10 protocols sorted in this way the categories were kept fairly flexible, new ones being added as necessary and generally being adapted to accommodate the incoming phrases. Gradually a set of categories was derived into which the phrases could sorted without difficulty (See Table Ten).

Once this standard set of categories had been formulated, all previously sorted protocols were re-sorted to comply with the new format.

TABLE TEN - ANALYSIS OF VOCABULARY PHRASES

CATEGORY	Total E Group Phrases	%	Total N Group Phrases	%
Patient and Family characteristics/ Pre-admission features	109	9.3	46	5.3
Admission and Hospital stay terms	54	4.8	11	1.3
Skin condition	66	5.9	21	2.4
Diagnosis of Pressure Sore Risk	108	9.8	139	16
Nursing Care to Prevent Pressure Sores	56	5.0	35	4
Body Parts	23	2.1	14	1.6
Body Position	27	2.4	36	4.1
ACTIVITIES OF DAILY LIVING AND THEIR CARE				
Eating	90	8.1	66	7.8
Drinking	26	2.3	20	2.2
Mobilising	101	9.0	99	11.4
Elimination	50	4.5	36	4.1
Breathing	20	1.8	8	0.9
Mental State	34	3.0	40	4.6
Communication & Emotional State	27	2.4	42	4.8
Care of ADL's	39	3.5	34	3.9
Other ADL's	18	1.6	12	1.4
Medical condition and signs	159	14.2	91	10.4
Medical Treatment	42	3.8	26	2.3
Aids to Relieve Pressure	28	2.5	18	2.1
Other Equipment	20	1.8	6	0.7
Explanation of Diagnostic Process	24	2.2	58	6.7
Unclassifiable	8	0.7	13	1.5
TOTAL	1116		871	

vi) Finally, the total number of phrases in each category was calculated and recorded (See Table Ten).

9.10.2 RESULTS

The differences between the groups which are evident from the vocabulary analysis are shown in Table Eleven.

The differences found between the expert and novice vocabulary appear to reflect the differences already found in looking at the operators and segments. In spite of these similarities with previous analyses, vocabulary analysis was nevertheless considered to be a necessary part of the research as it might assist in the classification of a knowledge base for nursing.

The overall differences in the vocabulary of both subject groups were highly significant (Chi squared Test; = 115.41; df = 19; $p < 0.001$). The experts gave significantly more vocabulary phrases for :-

Patient and Family Characteristics	(p = 0.001)
Admission and Hospital stay	(p = 0.001)
Skin Condition	(p = 0.001)
Medical Condition	(p = 0.001)
Nursing care to prevent sore	(p = 0.02)
Eating	(p = 0.02)
Medical Treatment	(p = 0.04)

Novices gave significantly more vocabulary phrases for:-

Explanation of the Diagnostic Process'	(p = 0.001).
Diagnosis of Pressure Sore Risk'	(p = 0.03)
Communication, Emotional State'	(p = 0.05)

There were more phrases per protocol in the E Group than in the N Group. This is to be expected from the already found greater length of the protocol.

Both groups are using 'technical nursing language' to more or less the same degree. The Experts appear to talk more about the patient and his family circumstances prior to admission. They also tend to use more medical terminology showing a more disease orientated approach to the pressure sore risk problem than do the novices. On the other hand, the Novice group are more likely to use language to explain their own reasoning of the diagnostic process than are the Experts and also explain the diagnosis itself more. These students also were able to talk more about the patients emotional state and general communication ability.

9.11 RESULTS OF TASK THREE

9.11.1 IMPORTANCE OF RISK FACTORS

The first part of Task Three was to determine which factors the subjects considered were most important in the diagnosis of pressure sores.

For each new piece of information asked for, the subject had to give an importance score where a score of '1' was rated 'Critical' and a score of '5' was 'Not Important' (See Appendix Four [b]). The risk factors seen as relatively important, ie.given a rating of '1' to '3' on this scale, are shown in Table Eleven (i) and (ii).

There is a slight increase in the diversity of factors given by the experts over that of the novices (Experts = 22 factors, Novices = 20 factors).

The most important factors to arise from this analysis are shown in Table Twelve.

9.11.2 PROBABILITY OF A PRESSURE SORE GIVEN THE PRESENCE OF THE FACTOR

The subjects were then asked to subjectively estimate, for each factor, the probability of a pressure sore developing under normal to busy ward conditions given the presence of the factor in its most severe form.

Mean values of their replies for the group of dominant factors given above are shown in Table Thirteen. Differences in mean probabilities between the two groups are not significant at the 0.05 level (Mann-Whitney Test; $U = 21.5$; $n1 = n2 = 8$; $p > 0.05$).

TABLE ELEVEN - FACTORS RATED '1' TO '3' IN IMPORTANCE IN DIAGNOSIS OF PRESSURE SORE RISK

(i) EXPERT GROUP

FACTOR	FREQUENCY OF RESPONSE			
	RATING '1'	RATING '2'	RATING '3'	TOTAL
Incontinence	3	2	0	5
Skin Condition	1	2	1	4
Medical Condition	1	1	2	4
Diet	0	4	0	4
Weight	1	1	1	3
Previous History	1	0	1	2
Severity/Length of Illness	1	1	0	2
Pre-admission mobility	2	0	0	2
Present Mobility	2	0	0	2
Pain	0	1	1	2
Mental State	0	1	1	2
Hydration	1	0	0	1
Condition on admission	1	0	0	1
Presence of Heart Failure	0	1	0	1
ADL Ability	0	1	0	1
Jaundice	0	0	1	1
Length of Stay	0	0	1	1
Social Situation	0	0	1	1
Oxygen Therapy	0	0	1	1
Aids used	0	0	1	1
Oedema	0	0	1	1
Drugs	0	0	1	1

TABLE ELEVEN - FACTORS RATED '1' TO '3' IN IMPORTANCE IN DIAGNOSIS OF PRESSURE SORE RISK

(ii) NOVICE GROUP

FACTOR	FREQUENCY OF RESPONSE			
	RATING '1'	RATING '2'	RATING '3'	TOTAL
Incontinence	3	2	1	6
Weight	2	2	1	5
Mental State	1	4	0	5
Movement/Walking	2	0	2	4
Diet (Nutrition)	1	3	0	4
Skin	1	2	0	3
Depth of Hemiplegia	2	0	0	2
Previous Mobility	0	2	0	2
Communication	0	0	2	2
Past History	0	1	0	1
Condition on Admission	0	1	0	1
Standard of care	0	1	0	1
Blood Pressure	0	1	0	1
Medication	0	1	0	1
Fluid Balance	0	1	0	1
Use of Sheepskin	0	0	1	1
Smoking	0	0	1	1
Pain	0	0	1	1
Presence of Cardiac Monitor	0	0	1	1

TABLE TWELVE - MOST IMPORTANT FACTORS GIVEN IN TASK THREE AS INCREASING THE RISK OF PRESSURE SORES

(i) EXPERT GROUP

FACTOR	FREQUENCY
Incontinence	5
Skin Condition	4
Diet	4
Medical Condition	4
Weight	3

(ii) NOVICE GROUP

FACTOR	FREQUENCY
Incontinence	6
Mental State	5
Weight	5
Movement/Walking	4
Diet/Nutrition	4
Skin	3

TABLE THIRTEEN - MEAN PROBABILITIES OF PRESSURE SORE DEVELOPMENT GIVEN THE PRESENCE OF A RISK FACTOR

FACTOR	MEAN PROBABILITY	
	EXPERT GROUP	**NOVICE GROUP**
Incontinence	.72	.48
Movement/Walking	.65	.49
Skin Condition	.60	.56
Mental State	.50	.51
Weight - Thin	.50	.37
Diet	.46	.35
Medical Condition	.40	N/A
Weight-Fat	.37	.57

9.11.3 DECISION MAKING STRATEGIES

The next part of Task Three was to test whether these nurses, when diagnosing the risk of pressure sores, used strategies of decision making described in the literature on nursing diagnosis (Gordon 1982, Carnevali 1984). These models imply that there should be a unidirectional change in the estimated degree of risk present and that there is an increased level of confidence in that estimate at each new assimilation of incoming data.

The results for this part of Task Three are shown in Table Fourteen .

The greatest range of scores for the Expert Group was four with a mean change of score = 1.6. For the Novice Group these were 3 and 1.25 respectively. Only one of the eight student nurses demonstrated a unidirectional change in score while 3 of the 8 ward sister showed the same trend.

In addition, six students have an increased level of confidence as they approach a final diagnosis but two of these continued to ask for data even once they had reached Level 1 , ie.absolutely sure of now being correct. Among the ward sisters, three show the same level of confidence throughout the procedure with only one feeling more confident as she progressed to the final diagnosis.

TABLE FOURTEEN - CHANGING PRESSURE SORE RISK SCORE AND LEVEL OF CONFIDENCE IN DIAGNOSIS DURING TASK THREE

SUBJECT	RISK SCORES OF RISK FACTORS IN ORDER OF CHOICE (Level of confidence given in brackets) 1rst	2nd	3rd	4th	5th	6th	7th	8th
EXPERT GROUP	('?' indicates a 'don't know' answer)							
1	4(2)	6(2)	5(2)	5(2)				
2	6(2)	6(2)	5(2)	6(2)	7(2)			
3	3(1)	4(1)	3(1)					
4	3(1)	3(1)	3(2)	3(?)	3	3(?)	3(1)	
6	3(3)	3(3)	5(2)	3(2)	2(2)	2(2)	3(2)	3(2)
8	4(2)	3(3)	3(3)	4(2)	6(1)	3(2)	3(1)	
9	6(4)	7(3)	7(3)	6(2)	6(1)			
10	6(3)	7(3)	7(2)	7(2	7(2)	7(2)	7(1)	
NOVICE GROUP								
1	8(3)	7(2)	6(3)	4(2)	4(5)	4(2)		
2	3(2)	3(2)	4(3)	?	4(2)	4(3)	4(2)	
4	?	?	7(2)	7(2)	7(2)	8(1)	8(1)	8(1)
5	9(3)	8(3)	8(2)	8(2)	8(2)			
7	6(2)	6(2)	7(2)	7(2)	8(2)	7(2)		
8	7(4)	8(2)	9(1)	7(1)	7(1)	7(1)	7(1)	
9	4(4)	4(3)	4(3)	6(2)				
10	7(3)	5(3)	5(3)	4(3)	4(3)	4(3)	4(3)	5(2)

9.12 CONCLUSION

The main research study involved an exploration of the knowledge base and cognitive strategies used by nurses in diagnosing a patient problem. The verbal protocol technique used gave rise to a vast amount of data about the problem solving behaviour amongst clinical nurses. In particular, there was now available highly detailed information concerning the use of the Norton Score method of assessing risk of pressure sores. This information was seen as being appropriate as a basis for constructing a computer program which could be used to enhance the accuracy and efficiency of pressure sore risk assessment in real clinical situations.

PART FIVE

A KNOWLEDGE BASED SYSTEM FOR NURSING

CHAPTER TEN

THE DEVELOPMENT OF COMPUTERIZED DIAGNOSIS IN HEALTH CARE

10.1 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Artificial Intelligence (AI) is a relatively new branch of computer science which tries to study intelligent human behaviour by developing computer models which display the same information processing characteristics as a human counterpart (Barr and Feigenbaum 1981). Researchers in AI attempt to develop computer programs which could in some sense 'think' and solve problems in a way that could be thought of as intelligent if done by a human. They do not claim that machine and human reasoning processes necessarily take place by the same mechanisms, but rather, that the computer analogy generates further understanding of how human cognition could operate.

Originally, in the 1960's, AI tried to simulate human problem solving by using programs which would solve broad classes of problems, eg. the General Problem Solver (Newell and Simon 1972). Although fruitful in many ways, this line of research was gradually abandoned. This was because it was found that the more types of problem a particular program was able to deal with, the less well it performed on any individual problem. The next decade saw a change of strategy when research concentrated on structuring of a problem and looking at new ways of representing the knowledge base contained in it. Methods of search through the problem structure were also investigated (See Barr and Feigenbaum 1981).

Late in the 1970's, it became clear that the power of a problem solver, be it human or machine based, arose from not merely the inferences and reasoning used in the solution. Rather, it was determined by the amount of specific high level knowledge which was brought into operation to bring about a solution. This realization led to computer programs which dealt with narrowly defined problem areas. The problem specific knowledge component was derived directly from a human who was an expert in solving that particular type of problem. Thus the programs became known as expert systems. An expert system is defined as :-

"a computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution."

(Feigenbaum quoted in Townsend 1986 page 4)

Although 'expert system' was the original term used for this type of computer program, it was later found that the knowledge base needed could be derived from sources other than directly from an expert person so that, now, the preferred term is 'knowledge based system'.

10.2 HEALTH CARE APPLICATIONS OF KNOWLEDGE BASED SYSTEMS

The advent of AI techniques is having considerable impact by providing new insights in health care research. This is most noticeable in generating programs to aid the speed and accuracy of diagnosis and in specifying both the knowledge component and the cognitive processes underlying expert judgement in clinical care.

Wortman (1972) is one of the early advocates of the current moves to the use of computers in medical diagnosis. He maintains that such moves provide a more formal language for dealing with complex problems and thus demands a precise formulation of the theory of clinical problem solving. Computer programs allow for a direct unquestionable test of that theory by comparing the performance of the program against that of the human problem solver performing the same task.

In spite of the problems associated with the "fuzzy" nature of the data which arises from medical investigation (Komaroff 1979, Wigertz 1986), there has been, in recent years, many examples of knowledge based systems for medical diagnosis have been developed (Shortliffe 1976). Reviews of this field show that these programs are rapidly gaining ground in medical diagnosis research (Barr and Feigenbaum 1982, Duda and Shortliffe 1983, de Vries and de Vries Robbe' 1985). Their acceptability in clinical

practice, however, has been slow and difficult (Fox et al 1980). Many well established programs such as INTERNIST-I (Miller et al. 1982) using a tree representation, EMYCIN (van Melle 1980) based on production rules, CASNET (Weiss et al. 1978) having a semantic network and PIP (Pauker et al 1976) which is frame-based are now available. These have been used to assist the would-be knowledge based system builder in knowledge acquisition and system construction (Masarie et al. 1985, Mulsant and Servan-Schreiber 1984). The general role played by knowledge-based systems in health care and the issues arising out of their application is discussed by Basden (1984).

Computer decision aids have been developed in nursing (Goodwin and Edwards 1975) and specification of nursing knowledge for computer programs is shown by Goodwin and Edwards (1975). More recently there have been tentative steps made to apply knowledge-based system research to nursing contexts (Hyslop et al. 1987).

A major advantage to practice disciplines, such as nursing and medicine, of building an knowledge-based system arises from the need to specify the structure of the knowledge base being used by the expert clinicians themselves. It is often only when a knowledge domain has been identified and specified in such detail as is required for an intelligent problem solving program, that any omissions, discrepancies and faulty logic can be recognised and dealt with (Duda and Shortliffe 1983).

10.3 KNOWLEDGE ACQUISITION

In the building of an knowledge-based system, the problem solving behaviour of one or more domain experts, such as a medical specialist, must be captured by some means or other and be presented to the machine in an acceptable codified form.

Knowledge acquisition, ie. the actual tapping by the knowledge engineer of the domain knowledge reservoir of the clinical expert, is a stage crucial to the eventual success of the system. It is, however, often the most problematic stage and is seen by many researchers as the major barrier to the future progress of knowledge-based systems (Waterman and Hayes-Roth 1978).

In many knowledge domains, input data for the system is obtained using a knowledge engineering procedure. In this, there is a face to face interaction between a 'knowledge engineer', ie. a person who has a background in cognitive psychology and computer programming, and a 'domain expert' who is articulate in providing the knowledge component for solving the problem. This component will include both the knowledge base itself and the heuristics involved in producing a solution. The knowledge engineer's task is to interview the domain expert, restructure the knowledge obtained into a form which is programmable into the computer and the to produce a prototype program. This is then tested by the expert and modifications made as necessary until the program satisfactorily simulates the problem solving behaviour of the human expert.

The advantages and limitations of the different approaches to knowledge acquisition in medicine are discussed by Fox et al (1985). They accept that informal methods are lengthy and unreliable. They also point out that interaction methods might suffer from interviewer bias on the part of the knowledge engineer, especially that arising from a desire to comply with the machine processes. As a consequence of these criticisms, they advocate the technique of collecting on tape the concurrent verbal protocol of domain experts as they 'think aloud' during actual problem solving, ie. diagnostic, tasks. This approach to capturing the medical experts diagnostic behaviour is also discussed at length by Kassirer et al (1982) who, while accepting the problems and limitations of the technique, nevertheless consider it the most appropriate knowledge acquisition method in medical diagnosis knowledge-based system development.

The difficulty of translating human expert knowledge into a program format has been overcome to some extent by the development of specific programming languages for knowledge-based systems such as LISP and PROLOG. Recent advances in knowledge engineering technique have been to automate the process and produce 'expert system shells'. These are essentially programs which hold the rules and procedures for solving problems, ie. what is known as the inference engine component of the system, but which have no knowledge component added. They are built to be very user friendly with the intention that the human expert can interact directly with the machine to build an knowledge-based system to solve a particular problem and so by-pass the use of a knowledge engineer. An example of an expert system shell is CRYSTAL (Intelligent

Environments 1986) which was chosen as the medium through which to construct a pressure sore risk assessment program.

CHAPTER ELEVEN

THE VALUE OF USING KNOWLEDGE-BASED SYSTEMS IN NURSING

The object of the current research project is directed towards demonstrating how the development of knowledge-based systems for nursing can harness the vast potential of computer technology to the improvement of the quality of care delivered to the patients. A number of advantages are possible.

Firstly, the actual development of the directory of rules which will form the knowledge base of the computer system forces the highly experienced expert nurses to explain their cognitions. These will include the individual stages of inferential thinking, as well as the probabilities and interconnections between particular pieces of information which are being used to make the diagnoses. This is an activity which in the normal course of events, they may not do. Thus, while the actual information content of the problem area itself may be available to the less experienced practitioner in the form of textbooks, etc., its actual manipulation into the form required for use in clinical diagnosis may be lacking.

Knowledge-based systems are able to reproduce for the novice user, at any time, the pattern of expert inferences which has led up to a particular state of knowledge or conclusion. Their potential in educating novices in clinical decision making and the ease with which they can be converted to computer assisted learning tools are self evident.

An advantage which the machine expert can have over its human counterpart is consistency, since it will be unaffected by environmental stressors so prevalent in many care settings. The system also frees the human expert in the care setting to concentrate on more urgent things such as the special needs of patients. Furthermore, the computer program can be reproduced and disseminated to other users in the care facility so that tapping of its expertise can go on in many areas, an attribute often coveted by expert and novice alike.

Within nursing research, knowledge-based system development has the potential for helping in the clarification and structuring of the knowledge domain necessary to effective practice and for formalising the logic of many areas of care which at present rely on tradition and routine as their 'raison d'etre '.

Knowledge-based systems in clinical nursing can serve to enhance the quality of care by providing accuracy, speed and comprehensiveness of nursing assessment irrespective of the stresses under which care is being given. Their use can be extended, also, to enhance care planning itself by providing suggestions for appropriate care interventions based on the information obtained. Thus cognitive strain on the nurse would be reduced still further. With the addition of print-out facilities, individualised care plans can then be produced at the touch of a button. Nursing manpower is made more efficient, greatly reducing costs. A knowledge-based program for nursing assessment also provides opportunity for practitioners, either on an individual or on a group basis to evaluate their care. They could do this by comparing their own performance as diagnosticians against the logic, efficiency and accuracy of the machine program. This has great value not only in enhancing the quality of care to be given but also as an educational incentive for nurses to improve their own performance where necessary.

Computer decision aids have been developed in nursing (Goodwin and Edwards 1975) and specification of nursing knowledge for computer programs is shown by Goodwin and Edwards (1975). More recently there have been tentative steps made to apply knowledge-based system research to nursing contexts (Hyslop et al. 1987).

CHAPTER TWELVE

BUILDING AN KNOWLEDGE-BASED SYSTEM FOR NURSING

The second stage of the research involved taking the data obtained from the Stage One Verbal Protocols as the knowledge base from which to build an Expert System which would diagnose the risk of pressure sores. This program was entitled CRYSTINE and the procedure for its construction will now be described.

12.1 DEVELOPMENT OF THE PROGRAM

12.1.1 THE KNOWLEDGE BASE

The core component of any knowledge-based system program is the knowledge base itself. In the CRYSTINE program described below, the knowledge base consists of rules and conditions by which the logic part of the program is able to make judgments and calculations and finally arrive at a conclusion concerning the Norton Score (Norton et al. 1975) of a patient whose data has been fed into the computer. As with any other knowledge-based system, the knowledge base was derived from human clinical experts, in this case, the group of eight ward sisters working on acute medical wards of a large district general hospital used as research subjects in first stage of this study.

Six of the sisters used the Norton Score format as the base on which to proceed with the assessment and two others referred to it in their replies as the 'correct' way of making such assessments, ie. the method by which students were taught to assess risk of pressure sores. The Norton Score was therefore considered a valid framework for the CRYSTINE program in view of the main aim for which it was devised, that is to demonstrate the potential benefits of knowledge-based systems to the clinical practice of nursing.

12.1.2 THE 'CRYSTAL' SOFTWARE PACKAGE

Knowledge-based system building has now become greatly simplified by the development of programs called 'Expert System Shells'. These are sets of logic structures

necessary to build a full system but as yet do not contain any specific knowledge base. Using a 'shell' the knowledge can easily be entered by a person, such as the domain expert, who may have very limited experience with computers (Harman and King 1985). Expert system shells are now being used in a great number of application areas such as finance, sales and marketing, law, engineering and science as well as in medicine.

12.2 A PROGRAM TO ASSESS RISK OF SORE - CRYSTINE

The CRYSTINE program was constructed using the CRYSTAL software package which acts as an expert system shell. The CRYSTAL software package runs by a system of rules devised by the programmer using the package's **BUILD** mode. These are statements followed by a series of condition necessary to be tested before that rule can be confirmed. For instance, in CRYSTINE the rule states that :-

"The patient is at risk of pressure sores"

and a condition to be tested is :-

"IF Norton Score is less than 14".

Each condition itself can be converted into a 'sub' rule and carry with it its own condition. For instance the condition :-

"The patient's Norton Score is less then 14"

can be made into a rule with its own series of conditions such as :-

"IF Physical Condition score is 2"

"AND Mental condition score is 2"

"AND ...so on."

These subsequent conditions in turn can also be made into rules and the process repeated thus allowing for a highly complex branching program to be built up. Thus CRYSTAL is a backward chaining system because it starts with the final hypothesis and then seeks the evidence which it needs to establish that fact and so on backwards through the knowledge base. Forward chaining systems start with the empirical data to build up a hypothesis then gathers more data to prove that hypothesis and so forward to the final conclusion.

These rules and conditions on which the program function depends are not usually seen by the user unless a special request to do so is made. Instead, they form the logic basis of the program. What the user does see is the part of the program appearing on the screen when the package is used in **RUN** mode. There will be direct questions presented in a variety of formats to test the conditions and also 'user friendliness' frames built in by the programmer in special displays. Other facilities offered by the package is the ability to do assign variables and to make calculations on the values of these variables. There is also a print out facility to talk to the user via the printed word.

12.2.1 KNOWLEDGE ACQUISITION FOR THE 'CRYSTINE' EXPERT SYSTEM

The basic framework of the CRYSTINE program was to be the calculation of the Norton Score for the patient plus the production of a care plan to fit the particular patient needs as demonstrated from the input data.

The CRYSTINE program is thus divided into two main parts, the diagnosis of pressure sore risk and the prescription for nursing care. This division is achieved by use of by the first **MASTER RULE** which states :-

The patient's risk of pressure sores can be calculated

OR Patient's care plan can be drawn up

The first of these statements is then made into a separate **MASTER RULE** and given

a number of conditions to coincide with the five categories with the Norton Score calculation. These are :-

The patient's risk of pressure sores can be calculated

IF Physical condition is known

AND Mental state is known

AND Activity level is estimated

AND Mobility level can be determined

AND Patient's continence state is defined

CRYSTINE then takes each one of these conditions in order and begins to ask the user for details about the patient so that it can make the assessment of Norton Score.

To ensure the validity of the final program, it was necessary at this point to return to the original data from the Main Research study to decide which aspects of the patient's condition are of importance for assessing each of these categories. The results of this analysis are shown in Figure Thirteen.

CRYSTINE then takes each one of these areas in turn and begins to ask the user for details about the patient so that it can make the assessment of Norton Score. It then calculates the risk score for each of the categories and once, inputing of patient data is completed, the program calculates the overall score. An interpretation of this score in terms of the risk of pressure sore development in this patient is displayed to the user.

12.2.3 CARE PLANNING WITH CRYSTINE

Having calculated, tested and interpreted the risk of pressure sores, the original **MASTER RULE** switches to its second part which stated :-

Patient's care plan can be drawn up

The user is given on request a basic care plan for the severity of risk found plus plans for only certain crucial problems from those identified. If the obtained Norton Score is less than or equal to 14 then the interventions recommended are seen as essential. If the score is 14 to 17, the problems are seen as potential and the interventions recommended as preventative measures. A score of 17+ is not given a care plan at all.

Part of a care plan for a patient with a Norton Score of 10 is given below (See Figure Thirteen)

PRESSURE SORE RISK CARE PLAN FOR

.....

DATE .....

PROBLEM - Norton score shows patient at risk of pressure sores.
AIM - Prevention of sores/Increase Norton Score/Early detection of decrease in score
Action - Assist pt. to move/position correctly
Correct lifting techniques to avoid drag on skin
Early mobilisation out of bed
Encourage full diet
Bed/chair surface to be dry and crinkle free
RE-assess Norton Score twice weekly

PROBLEM - Patient is incontinent of urine
AIM - Prevention of pressure sores and incontinence.
ACTION _ Liase with doctor to investigate and treat cause of incontinence.
Continual asessment of condition using incontinence chart.

PROBLEM - Low activity score
AIM - Early mobilisation out of bed.
ACTION - Begin getting patient up as soon as possible.
Encourage and train patient in transferring and walking exercises
Liase with physiotherapist about activity needs.

PROBLEM - Movement may be impaired by presence of cardiac monitor
AIM - Patient to move in bed sufficiently enough to prevent pressure sores
ACTION - Teach pt approved movements and their importance.
Reassure patient that approved movement will not harm cardiac function.

PROBLEM - Broken skin area present
AIM - Promote healing of skin
Prevent further breakdown in skin
ACTION - Re-assess risk and earlier failed preventative measures.
Aseptic re-dressing of broken area prn.
Prevent soiling of dressing by use of watertight covering

FIGURE 13 - EXAMPLE OF A CHRISTINE CARE PLAN

PART SIX

DISCUSSION OF THE RESEARCH

CHAPTER THIRTEEN

DISCUSSION OF THE RESULTS

13.1 INTRODUCTION

The original aim of the research project was to investigate the process of nursing diagnosis to determine the nature of the knowledge base required and the cognitive problem solving process being undertaken. A subsidiary aim was to make comparisons between expert and novice diagnosticians in nursing. The second stage of the research involved using the results of the first stage to develop a computer based program to aid nurses in assessing patient problems.

From the individualized patterns which emerged from analysis of the verbal protocols it has been possible to draw out certain salient features of the diagnostic process in nursing and the relevance of these in acquiring the appropriate data from which to develop knowledge based systems for clinical practice and education. It has also been possible to demonstrate differences in the cognitive problem solving activities of the novice and the expert during the patient assessment stage of the nursing process.

13.2 SUBJECTS OPINIONS OF THE IMPLEMENTATION OF NURSING PROCESS IN THE HOSPITAL WARDS

The nursing process is now learnt as part of the basic introduction courses for nursing practice and the skills involved, therefore, are learnt early in the nurses career. Older nurses, such as most of the ward sisters taking part in this research, acquired nursing process knowledge after learning skills needed for alternative approaches to implementing care. For these nurses, some degree of unlearning of these earlier skills was necessary in order to use the nursing process. This may involve having to overcome the problem of resistance to change both on a personal basis and on the part of the contemporary and senior colleagues.

Generally the nursing process is well accepted by both the expert and the novice nurses in the research samples However, they all consider, to some extent, that time constraints mitigate against its proper implementation on the wards. Students are aware of a wide variety of implementation policies and practices from ward to ward, a situation which leads them to feel confused and disheartened.

When it came to views on the actual implementation of the nursing process, the student nurses appeared more involved in its use in patient management than did the ward sisters. This is evidence of differences between the groups in the level of orientation to practical-based patient problems and in authority patterns within the ward. The differences are particularly evident in the evaluation of care stage of the nursing process where, it could be argued, the greater understanding and knowledge of the ward sister is required to make pertinent judgments. This may lead to a deterioration in standards and a delegation of responsibility for education and maintaining standards of practice. Nursing should learn from the medical profession where the diagnosis of patient problems is performed only by the trained practitioner. The work of medical students is a supplementary activity for learning purposes only and in no way determines the implementation of care.

In addition, the results of the questionnaire show that the third year students are doing as much, if not more, of the teaching of nursing process skills as the ward sisters. Thus it would appear that these key skills are being taught to junior students by unskilled nurses.

13.3 ANALYSIS OF THE VERBAL PROTOCOLS

13.3.1 OPERATORS AS INDICATORS OF COGNITIVE PROCESSES

In the analysis of the verbal protocols, the basic set of operators were derived from the pilot protocols without great difficulty. That is to say, the manner in which the subject verbalised their cognitions gave clear indications of the nature of the task being undertaken at the time. The operators themselves bear close resemblance to the cognitive activities cited in the literature as taking place during the diagnostic process in nursing (Gordon 1982, Carnevali et al. 1984).

The verbal protocols from the subjects in this research demonstrate how initial data are sought (COLLECT OPERATOR) and reviewed so that they can be used as cues to guide a further round of data collection or to clarify a presenting situation (REVIEW OPERATOR). The initial cues activate long term memory structures, such as the background understanding of patient problems developed from previous acquaintance with them. This LTM information is used either to relate cues to one another (INTERPRET - RELATE OPERATOR), or to make a subjective emotional reaction to the cue (JUDGE OPERATOR).

Data which has been collected, clarified and related to knowledge already in the subjects possession is then interpreted and an inference made in order to apply some form of early labelling (INTERPRET - INFERENCE OPERATOR). This is seen by the Gordon (1982) and Carnevali et al (1984) as hypothesis activation. According to the diagnostic process which they describe, further data is then sought to confirm or negate each hypothesis in turn, so arriving at a final confirmed statement of the patients problem (DIAGNOSE OPERATOR).

The literature confines itself to the diagnostic process itself but, in general, the subjects in the present research frequently made excursions into the next stage of the problem solving process, ie. the proposal of activities necessary to solve the difficulty (ACT OPERATOR). This was information not asked for in the instruction to the subjects and its presence in the data is indicative of a strong orientation to begin interventions at a stage in the nursing process where cognitive activity alone is required. This was particularly noticeable among the novice group where 56% of the students included action in their protocols while only 38% of ward sisters did so. Indeed, one student devoted 35% of her protocol segments to actions.

13.3.2 THE PROCESS OF DIAGNOSIS IN NURSING

Although the nature of the cognitive operators used by subjects in their diagnosis reflect the nature of those cognitive activities described in the literature, the sequence in which they were used does not, as a general rule, do so. The sequence of operator use is shown up in the Problem Behaviour Graphs.

The 'lateral model' corresponding to the hypothesis activation/testing strategy described in both the medical literature (Barrows and Bennett 1972, Elstein et al 1978, Kassirer and Gorry 1978) and in nursing texts (Carnevali et al. 1984, Gordon 198). This model illustrates how the subject, after a little initial data collection, begins interpretation and inference making almost straight away. There is the a return to collecting more data before making more interpretations and so on. Thus a pattern of constant flowing back and forth between the collection of data and its interpretation emerges.

During Task One, ie. where the subject is free to decide her own problem solving strategy, this model was predominant among the expert subject group. This is consistent with Kolodner's (1984) view of the superiority of episodic memory, gained as a result of experience, over the purely factual basis of semantic memory. It is at odds, however, with the work of Groen and Patel (1985) who consider the hypothetico - deductive approach to be more evident in novices diagnostic behaviour. During Task Two, where subjects were asked to consider their problem solving strategy, the majority (75%) of the novice group did change their behaviour to conform to the 'lateral model'. It is interesting to note that similar instructions to those experts not using this approach did not induce a similar change of strategy. These senior nurses, therefore, appeared to be much less plastic in their approach to problem solving strategy than do student nurses Once they have adopted a particular way of going about nursing diagnosis, they are not amenable to instructions to change that method.

The novices, left to their own choice as they are in Task One, used the second type of model seen in the Problem Behaviour Graphs, the 'descending model'. Here data is collected initially as a total batch and any interpretation left until later. There is very little backward flow between interpretation and further data collection. Such a model

would seem, therefore, to indicate an inexperienced approach to nursing diagnosis and may reflect an educational policy, seen in basic nursing texts such as McFarlane and Castledine (1982), where great emphasis is placed on the data collection phase of the diagnosis process and little on the necessity for data interpretation. Field (1983) found that nurses frequently collected data but failed to use it in examining relationships and arriving at appropriate conclusions. The fact that student nurses in this study were able, with only minimal instruction, to switch to a strategy used by experts indicates that only small educational changes might be necessary to induce even basic learners to adopt a mature problem solving strategy from the beginning. On the other hand, once established as the main strategy of practice, the ability to make a change to this strategy seems less easy. The 25% of expert subjects using the descending model in Task One also did so in Task Two. All expert subjects using the lateral model in Task One did not make any changes during Task Two.

Finally, the Problem Behaviour Graphs revealed a third model which was an amalgamation of the other two and called the 'mixed model'. Most data was collected initially but was followed by a pattern of back and forth flow between interpretation and a small amount of further data collection. This was seen only in Task One in both the expert and novice groups (25% of subjects in each group). Any subject using this third model switched, in Task Two, to the descending model. This may indicate that, for some nurses, the ability to use the lateral model in its pure form is not possible and that, in order to proceed at all towards a final diagnosis, they need a vast amount of information to begin with. Thus, these nurses demonstrate an inability to tolerate the uncertainty that is inherent in using the lateral model. Any change in strategy which the experts using the mixed model made was a 'regression' to the descending model of the inexperienced nurse diagnostician which consists of early complete data collection before data analysis.

These results would appear to be further evidence for the belief that a single general process may be insufficient to explain clinical diagnostic behaviour (Berner 1984, McGuire 1985, Norman et al 1985, Politser 1981). Even in a single specific task with identical instructions, there appears to be individual differences in the diagnostic strategies used which make generalisations about behaviour difficult and tenuous.

There was more consensus among subjects in the analysis of the information content of the verbal protocols than was found in the search for diagnostic strategy. All subjects in the research applied, to some extent, an Activities of Daily Living approach to investigating the patient problem. That is to say, their behaviour indicated that they were using some scheme of procedure which they had previously developed in their mind. Such behaviour gives credence to the concepts of frame representation of professional knowledge (Ramsey et al 1986) and pattern matching processes being used in clinical diagnosis (Cantor et al 1980, Norman et al 1985, Waldrop 1984).

13.3.3 DEMONSTRATING AWARENESS OF COGNITIONS DURING THE DIAGNOSTIC PROCESS

The CONTROL operator arises from the subject's expressed perception of their cognitions during the problem solving process as opposed to cognitive work on the problem itself. This factor is not taken up in the literature but was prevalent in 87.5% of the protocols derived from this research. In two protocols 25% of all the operators analyzed were CONTROL operators. These latter protocols were both from novice subjects and occurred in Task One where no specific instruction to describe the thought process itself was asked for. In Task Two, where subjects were specifically instructed to think about the cognitive processes taking place, it might be expected that the number of CONTROL operators found in Task Two would be greater than in Task One. This, however, was not the case. The mean number of CONTROL segments for the expert group on Task One was 3, while in Task Two it was 3.1. The novice group, although producing more CONTROL operators overall, also failed to show an increase in Task Two (Mean - Task One = 5.4, Mean - Task Two = 4). These findings may be explained by the fact that student nurses are so used to having to explain their thinking processes and conclusions about patients in tutorial sessions, that to do so may have become almost a habitual activity. It may be that, in Task Two, becoming consciously aware of the need to make such explanations inhibits this tendency. The ward sisters are not required to make such explanations so frequently in their normal work. They do not make them spontaneously nor find it easy to do so when requested. The instruction to consider what the thinking processes are occurring while actually performing problem solving, therefore, failed to make these subjects more aware of their thinking processes.

13.3.4 DATA COLLECTED FOR CLINICAL DIAGNOSIS

Overall the expert protocols were longer, ie. contained more segments, than the novice group. This difference can be ascribed to the greater frequency of COLLECT operator segments present. Broderick and Ammentorp (1979) also found that expert nurses tended to collect more information overall than did novices.

The experts in this study asked far more questions about the patient's home conditions and their pre-admission state than did the novices (Expert Group total = 59 [18.4% of all the questions they asked], Novice Group total = 7 [4%]). The experts asked particularly about family make - up (5.6%), ADL abilities prior to admission (5.3%), early medical condition (2.8%) and previous mobility patterns (2.2%). This line of questioning was rarely found in the novices protocols. The novice group were concerned mainly with eating and mobilizing patterns at home. The expert nurses in this study appeared to consider that various features in the patient's life style before admission to hospital were important in assessing their of developing pressure sores in the ward. These home based data, collected by the expert nurses but not by the novices, could be considered an example of the 'forceful features' concept proposed by Grant and Marsden (1987).

Apart from the above single major difference in the area of questioning, it can be seen from Table 7 that the novices questioning followed a similar coverage of subject area as that of the experts. This is in line with the results obtained by Grant and Marsden (1987) in their study of the differences between novice and expert behaviours in medical diagnosis. Generally, it was not that the novices questioning was limited in its scope that brought about the differences in the overall rate of questioning, but rather, that their enquiries lacked the depth which the experts showed. Typically, a novice subject, when receiving a simple 'Yes' or 'No' reply to the question 'Is the patient continent?', would then go on to the next subject area. The expert, on the other hand, would tend to continue to probe the area of incontinence further. This is shown in the following examples from the protocols:-

PROTOCOL E6(2) - Segments 23 - 26

Right. Is she continent ?

She is continent. Doubly continent ?

Right. She doesn't get any stress incontinence or anything like that at all ?

She is perfectly dry ?

What about her mental state, is she quite alert and with it or is she a little bit depressed ?

PROTOCOL N2(1) - Segments 20 - 21

..incontinent. Is she incontinent ?

Umm.. has she talked about her condition at all ?

PROTOCOL E9(1) - Segments 18 - 22

How much can she move with her leg today Can she turn herself over from side to side by herself ?

Does she turn over in bed anyway without being instructed to ?

Can she move her leg unaided or does she have to lift it around when she moves ?

She has a bed cradle in, hasn't she ?

Is the end of the bed elevated ?

Is she on bedrest or can she get up to the commode ?

She has not been incontinent at all, has she ?

PROTOCOL N5(1) - Segments 1 -2

How mobile is Eric usually ?

Does he use any aids for walking at all ?

Does he have any other breathing difficulties at all ?

Another subject area where the experts asked a lot questions was the patient's medical condition and treatment (Experts = 51 [15.9%] questions and 30 [9.4%] questions respectively). This is in marked contrast to the Novice group who showed less interest in this area (24 [13.7%] and 4 [2.3%] respectively). Medical treatment in particular was not seen by the novices as an important area of questioning.

The percentage of questions devoted to investigating the patient's current Activities of Daily Living (ADL) abilities was much greater among the novice group (Expert Group = 42.5%, Novice Group = 66%). They laid particular emphasis upon mobilizing (20%) and eating/ body weight (14.8%). They also asked considerably more questions than the experts about the mental and emotional state of the patient. Both groups showed an interest in the drinking and in elimination ADL's. The latter was almost entirely devoted to incontinence as a problem. Both groups also asked frequently about the patient's skin condition, not only its present state but its condition on admission to hospital.

In spite of the enormous literature on pressure sore prevention, there were surprisingly few questions on the preventative nursing measures being taken for the patients under review, the pressure relieving aids being used or the positioning of the patient's body.

If we take the ward sisters as the experts in clinical nursing problems such as the risk of pressure sores, then it is to be expected that the risk factors supplied by this group would reflect the factors given in the literature. In general, this is the case but some omissions are worthy of note. Many sisters omitted to determine the patient's level of consciousness when it is known that this is crucial to the level of spontaneous body movements present (Exton Smith and Sherwin 1961). No one asked whether the patient was receiving sedation and only two asked about the patient's level of pain. Even though nutrition was asked for (8.4% of COLLECT operators), it was usually as a general deficiency being present rather than a specifically directed investigation of the nutrients necessary for healthy skin, ie. protein (Moolten 1972) and vitamin C (Taylor et al. 1974). Body weight was rarely asked for (1.6%). Although chronological age was a given datum in the introduction of the patient to the research subjects because it was seen as part of the basic information a nurse would have on one of her patients, no sister questioned it further looking for discrepancies between chronological and physiological aging. It might be argued that questioning about the patient's aging status might have been more evident if the subject had to ask for the patient's age for her data base rather than it being a 'given' datum which the subject accepted passively. Very few questions (2.8%) concerned the type of surface on which the patient was resting and these were entirely devoted to the use of only one sort of pressure relieving aid, that of sheepskins. Types of bed or chair were not asked for nor was there any questions about how long the patient had spent lying on hard surfaces such as hospital trolleys and X-ray tables . These periods were not investigated either in terms of the excessive pressures on the patient's skin which are produced (Redfern et al 1973) nor in terms of there being long periods of unrelieved pressure on the same skin area in these situations.

13.3.5 DATA ANALYSIS DURING CLINICAL DIAGNOSIS

The results show little differences in the number of INTERPRET segments between the groups (Expert mean = 12.8, Novice mean = 10.5), but there were some differences worthy of comment in the cognitive processes actually taking place within this group of segments. The novices INTERPRET OPERATOR segments showed a higher proportion of RELATE Operations (26% of all their INTERPRET operations) than the experts (11.8) but they were less likely to make inferences particularly from within the

given data source (Expert Group = 35.3% of the INTERPRET segments, Novice group = 27.4%). It would appear, therefore, that the novices were less likely to use a hypothesis activation and confirmation approach to their diagnosis of patient problems, particularly during Task One. This conclusion is borne out by the data in Table Ten relating to the model of problem solving strategy being used in Task One and Task Two.

Little differences between groups were seen in either the number of REVIEW DATA segments or of DIAGNOSIS segments. Both groups were undertaking these activities more or less to the same extent while working through the diagnosis of the risk problem.

13.3.6 ANALYSIS OF TASK THREE RESULTS

An assumption in the analysis of Task Three results was that subjects would seek information about those factors which they deem critical in the aetiology of pressure first before going on to look at less crucial information about the patient.

Important factors, ie. those items of information the subject looked for initially in Task Three were :-

Incontinence
Nutrition
Skin Condition
Medical Condition
Weight
Mobility.

These findings are in line with the factors given in the literature as important in the aetiology of pressure sores. These dominant factors appear high in all the protocols of Task Three regardless of the medical diagnosis of the patient under consideration. Factors specific to the patient's diagnosis such as oxygen therapy, presence of cardiac monitor, heart failure, oedema etc. are generally assigned a lower level of importance in

the diagnosis of pressure sore risk, with the possible exception of 'depth of paralysis' in patients with a Cerebro - Vascular Accident label.

The second part of Task Three concerned a particular feature of the diagnostic strategy, described by Gordon (1982), Carnevali et al (1984) and Kassirer and Gorry (1978). This is that, as hypotheses are gradually confirmed by further data gathering, there should be a unidirectional change in the estimated degree of risk present. There should be an increasing level of felt confidence in that estimate by the subject as hypothesis confirmation by new data proceeds. In general, the results from this part of the research are inconclusive. No confirming evidence that the estimate of risk was unidirectional was found. Indeed, the results may be more indicative of a multi-directional swinging between closer and closer approximations around the final outcome score. This is particularly noticeable in the protocols of the novice group. On the other hand, there did appear to be some trend indicating increasing confidence in the estimation of risk as new data was sought in the results particularly in the expert group.

The overall lack of clear evidence here for changes in confidence may relate to the research design. The research subjects, particularly the ward sisters, commented afterwards on the difficulty of reaching definite conclusions about a patient based on second hand verbal information only. Real patient problem diagnosis takes place in the presence of the patient where a great number of additional cues are presented often without being consciously sought. It is possible that, in the presence of a real patient, the choice and sequence of the information cues sought by the subjects may be different from that given in a verbal protocol research setting. In this respect, human problem solving may forever remain more effective than even the most complex knowledge based systems program.

> "Man is infinitely more efficient because he can accept a wide range of data and frame it in a communication reference-field. He can accept a variety of cues at one time and these can be from a variety of sources, both verbal and non-verbal, and both short and long term memory are utilized."
>
> McCarthy (1981)

Wortman (1972) argues that the presence of perceptual cues in a real situation is no guarantee that they will be taken up by the human clinician and that programs can be designed to ask for answers to perceptual cues. There would be little opposition to the use of the computer in the presence of the patient which might further ensure that the computer program was provided with the same data as the human problem solver. The differences found in the Physical Condition scores when this procedure was followed in Stage Two of the present research, however, are indicative that such questioning would need to be very specific in order to force the clinician to externalise the patient cues being picked up sub - consciously.

13.4 THE KNOWLEDGE-BASED SYSTEM DEVELOPMENT

The essential feature of an knowledge-based system is that its information base is derived from the expressed beliefs of a human expert dealing with an actual example of the problem for which the program will eventually be used. This approach assumes that the human expert chosen is the most qualified person to supply data for that knowledge base. Herein lies a difficulty for any would-be programmers for they must decide what is the nature of expertise in the particular field under investigation and who, ie. what group of people, best display that expertise.

These questions are particularly relevant to a practice discipline like nursing where experienced clinical practitioners may be so engrossed in solving complex problems of the real and immediate situation that they fail to remain acquainted with new knowledge and research findings from elsewhere in their discipline. In this research project, not only were crucial risk factors, for example the aging process, specific nutritional deficits, pain, not investigated by the chosen 'experts', but also they decided to use a pressure sore risk assessment scheme which research has shown to be very limited in its validity in the clinical area where they were using it. However, since the aim in tuis part of the research project was to show the process by which knowledge-based systems for clinical nursing could be developed, it was felt necessary, for the sake of illustration, to use the data obtained from the verbal protocols of the ward sisters, even though the quality of that data was questionable.

For most contexts where patients are at risk of pressure sores, no other clinical expert is available apart from the ward sister. Because the CRYSTINE program was produced to earch is to show practising nurses how computerised knowledge-based systems can help with the sort of decision making they have to make in their everyday work, it was felt justified in using the ward sisters' data as the knowledge base of the computer program in spite of the known deficiencies inherent in them. Ward staff would identify more closely with a data base that they themselves refer to rather than with a more elaborated base supplied from a highly theoretically based source. It is acknowledged that this design decision would lead to weakness in the resulting program but the emphasis of the research is on illustrating the technique of knowledge-based system building and the applicability of the finished program to the realities of the current ward situation rather than the general applicability of a complex program to a multitude of clinical contexts. In view of this argument, it was decided to design an knowledge-based system using the Norton Score format.

The Norton Scale was used by 75% of the ward sisters and recommended by the remaining 25%. None of the sisters referred to other assessment tools which are known to be more beneficial in the determination of pressure sore risk in acute medical patients (Gosnell 1973). To have sought an alternative group of nurses to form the expert subject group would also have led to problems of justification of the choice. It could prove difficult to justify that possession of greater theoretical knowledge gives a particular group a greater claim to be experts in nursing diagnosis. In the field of knowledge-based system research, early workers concentrated on the belief that an expert is one who knows more about their knowledge domain than does the novice (Feigenbaum 1976, Shortliffe 1976). This assumption does not necessarily follow in present day nursing contexts where many students exiting baccalaureate degree programmes may have a greater knowledge base for nursing than the ward sister under whom they serve. Yet, in no way, can these newly graduated nurses be considered more 'expert' than the ward sister.

Justification for the choice of ward sister was made on the basis that experience in the role itself plays an important part in the development of expertise (Kolodner 1984). Her study shows that the reasoning capability of the expert is dependent on the

memory structures that are built up by long term experience with similar on-the-job type problems. In a hospital ward nursing context, the ward sister is a permanent member of staff, often staying the ward much longer than any other member of the nursing team and, in general, has had earlier experience of the particular type of work as a staff nurse (Wilson 1975). Therefore in Kolodner's terms the ward sister would qualify as an expert in that ward. According to Kolodner, the memory structures involved develop in two stages. First, there is both an incremental building up of practical knowledge together with its integration into an organized structure. Secondly, there is a continual refinement of this structure which encourages flexibility in approaching exceptional or new situations. The role of the ward sisters today is one of perpetually dealing with patient problems on all levels. They are involved in the management of care of all patients on the wards thus having a familiarity with the everyday type problems which they present. In addition, ward sisters are faced repeatedly new and unusual difficulties which require extra ordinary nursing intervention. Thus their role is never static but is a continual dynamic ongoing process of information acquisition and integration. Again this is in line with Kolodner's (1984) concept of the expert practitioner.

13.5 A MODEL OF THE KNOWLEDGE BASE FOR NURSING

The dilemma about the ward sister as a nursing 'expert' leads on to a consideration of what constitutes the nature and make-up of expert knowledge in a practice discipline. Analysis of the verbal protocols from the 'expert' ward sister group in this research demonstrated that knowledge needed for clinical nursing incorporates not merely theoretical data but also the wisdom of experience and the ability to apply these to solving patient problems. Such a knowledge base can usefully be described in terms of three interjecting facets which can be depicted as a three dimensional model (see Figure Fourteen).

The model attempts to show how the different types of knowledge and the level of each which a nurse gains during her career become integrated with each other. Each type of knowledge has a separate dimensional surface on the cube structure with the range of knowledge for each type forming the limiting edge of each surface or facet.

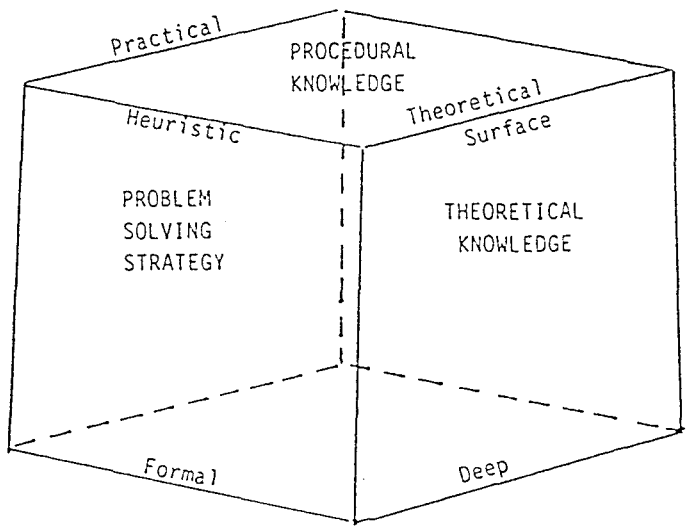


FIGURE FOURTEEN - MODEL SHOWING THE NATURE OF EXPERT KNOWLEDGE IN A PRACTICE DISCIPLINE

The facets are, firstly, theoretical knowledge, the factual basis of the discipline, which is formally learnt often within a distinct educational setting. For example, within nursing this would include knowing the various factors involved in pressure sore aetiology and understanding the concepts within the theoretical care model being used such as the Activities of Daily Living.

Secondly, there is procedural knowledge, which is often informally learnt through the experience of solving everyday problems in the real practice world of the discipline. Many of the ward sisters in this research investigated in depth the home life of the patient before admission as experience had shown them that this is a good indicator of the patient's generally mobility pattern.

Finally, there is the facet belonging to the cognitive strategies adopted by the practitioner to solve the problems presented to her. These may be dependent on a number of factors such as formal instruction, experience and personality features like learning style and general intelligence.

Theoretical knowledge may vary from being superficial in nature, such as that pressure on skin structures leads to tissue damage, to a deeper level of understanding concerning the processes of blood perfusion mechanisms and tissue viability involved in pressure sore development. Procedural knowledge may vary from the direct application of theory to practice to a highly practical knowledge of skilled performance needed for care delivery. Problem solving strategies may range from a highly defined formalised way of proceeding such as demonstrated by the use of mathematically based decision analysis models (Taylor 1976) to a highly intuitive heuristic approach.

The ward sisters in this study were displaying behaviours characteristic of the practical end of the model. They were able to apply experiential knowledge both heuristically and by using the more formal method of the Norton Score. They failed, however, to penetrate the theoretical components of knowledge at the other end. Thus, they were operating on a plane which would run diagonally from bottom left to top right on the cube shaped model depicted.

Choosing a group of 'expert' nurses from among nurse researchers or educationalists, who have a great deal of formal knowledge but are working away from the everyday care setting, might have involved the risk that the practical, heuristic nature of clinically based problem solving would be excluded. In the model, these nurses operate in the bottom half of the cube.

The most desirable expert in a practice discipline is a practitioner who is daily involved to some extent in solving real life problems but also has the opportunity to keep abreast of recent research and innovation from outside her normal area of functioning. Such expertise is now available within the nursing profession in the form of the clinical nurse specialist (Pearson 1983 pages 15-18).

In terms of the 3 dimensional model, such a nurse operates on a plane dissecting the model diagonally from top left to bottom right - see Figure Fifteen. She can operate at a highly practical and intuitive level yet also apply a deep formalised theoretical knowledge to her practice. An alternative approach for the profession to take to enhance the development of this type of clinical expertise in nursing care lies in changes in the education of its practitioners both at basic level but more importantly at the post-basic level of career development. As indicated in this research, many experienced ward sisters lack the theoretical knowledge required for clinical expertise. The study by Kershaw (1978 cited in Allen 1982 page 12) shows that 66% of ward sisters were ignorant of the Norton Scale and the research which led to its production, knowledge which has been part of the basic syllabus for nursing courses for several years. There is little formal education opportunity beyond registration. The findings of Stapleton (1983) show that only 54% of ward sister/nursing officer subjects felt that the course leading to registration was sufficient to prepare them for their role. It would appear, therefore, that greater attention to the continuing education needs of the practising nurse is an imperative for clinical expertise within the profession.

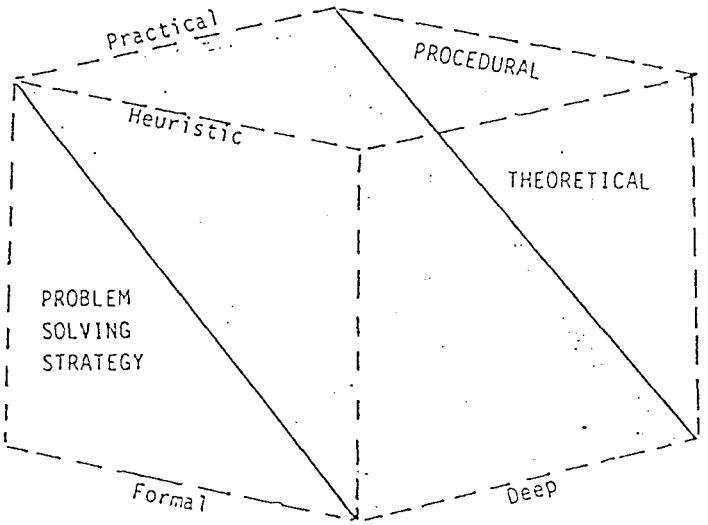


FIGURE FIFTEEN- MODEL OF THE KNOWLEDGE BASE FOR THE CLINICAL NURSE CONSULTANT

CHAPTER FOURTEEN

LIMITATIONS OF THE RESEARCH

The decision to use verbal reports as the knowledge acquisition method for the main study leads to difficulties in establishing the validity of the data as being representative of the subject's mental activity during the diagnostic task. Not only does having to produce a verbal report distort the performance of the task but the nature of the task may distort the accuracy and comprehensiveness of the report produced (Bainbridge 1979). For instance, in the clinical area much of the diagnostic mental activity takes place subconsciously especially among the expert group. Such unconscious activities may, therefore, not be reported. Even if the activity is conscious, the subject's ability to describe it accurately in words may be deficient. Since we tend to think quicker than we can speak much of the mental activity taking place during diagnosis may be missed because of time pressure.

The research design for collecting the verbal protocols involved a dyadic interaction between the research subject and the researcher. This leads to the introduction of interpersonal intervening factors which may have acted to bias the results obtained, with various characteristics of the researcher and the subject influencing the data that is elicited (Allen Williams 1964). These include the felt need to conform to what are seen by the participants as the desired behaviours in the research interview, pressures arising from differences in status between the roles of the ward sister or student nurse and the nurse researcher and the possible presence in the subjects of the sense of being threatened. The subject is always at liberty to decide what information to give and what to withhold. Steps were taken in the introduction of the research task to the subjects to put them at ease but, in order to maintain a standard approach to all subjects, individual needs could not be fully catered for. It is also debatable whether even the most highly trained interviewer can maintain exactly the same approach to each new research subject and that distortions due to the researchers behaviour inevitably occur (Smith 1975).

The use of the Norton Scoring method by the ward sisters produced a disturbing conflict in the results in that staff nurses in the CHRISTINE program testing stage commented that this method of pressure sore assessment in not in current use on the medical wards. This produces doubt that the ward sisters, in giving their verbal protocols, were in fact using the same problem solving strategy that they used in the real ward situation. There are a number of explanations of this result. Firstly, the need to describe the process of diagnosing pressure sore risk may have persuaded the ward sisters to opt for a method of performing the task that is easy to describe verbally. Alternatively, they may have used the Norton Score because it is it is the method they were taught to use or are officially instructed to use. Both learning and official instructions for these would have been crouched in a verbal form which would have been easier to employ in the verbal protocol situation.

Alternative designs would have been to ask subjects to access the information required for the pressure sore assessment task either by presenting the subject a written patient dossier or by having them interact with a computerised patient data base. These were both rejected during the design stage. In the first method, it would have been difficult to trace the sequence of data collection which the subjects were using, since searching for one data cue in the dossier would have meant them having access to a number of other data which could serve as inadvertent cues and altered their chosen method of proceeding with the assessment. The second method was not considered desirable since very few of the research subjects had any experience of using computers and to ask them to do so would lead to many problems of anxiety and embarrassment at their ignorance with using the machine.

Another factor introducing bias into the situation is the motivation of the subjects to perform the research task (Cannell-Kahn 1968). The interviews of the ward sisters took place during the working day and the press of competing activities concerning ward concerns might have been present and disturbed their ability to concentrate on the research task. On the other hand, it was felt that asking them to complete a ward based assessment task within the ward context may have been beneficial to their ability to apply themselves to the demands of the task.

The choice of pressure sore risk diagnosis is a very limited area of the total work of the clinical nurse and whether the problem solving strategies shown up in this research are generalizable to the diagnosis of the many other problem areas demanding nursing decisions in the real world is debatable. Many of these assessments remain subjective in nature not having been the subject of so much research or objective measurement tool development as the field of pressure sore risk. Further research is necessary to determine whether the results of this research project apply also in other assessment areas which are the concern of nursing such as the broader areas of defining Activities of Daily Living capabilities.

It may be argued that the data from the first protocol which subjects produced should not have been used to make inferences about the subjects' normal diagnostic behaviours but rather that this was a learning exercise for the subject and the results should be ignored. Field (1987) states that in a strange context nurses are likely to revert to a reliance on a rules based method of proceeding until the features of the new situation become clear. This is an alternative explanation of the differences in strategy found between subjects' performance in Task One and Task Two.

The complexity involved in having six different patient case studies and subjects assessing different patients may have been unnecessary. It led to difficulties in making comparisons between subjects' conclusions or in determining what constitutes the 'correct' or 'best' decision of risk for each patient. A question which still remains is whether the hypothetico-deductive strategy used many of the experts, and by novices in Task Two, leads to greater accuracy of determination of risk. This research, then, explored only the process of nursing diagnosis and not the appropriateness of the outcome decision. It is the latter which has great implications for the implementation of care practices. Further research to look at outcomes of diagnostic activity as well as the actual process involved is required to confirm the assumption that the expert diagnostic method is always the more accurate. This is particularly necessary in nursing in view of the deficiencies also shown up in this research concerning the knowledge base of the present clinical 'expert', the ward sister.

Inferential statistics were used for testing the results of the verbal protocol analysis even though the size of the samples was small (N = 8). This was felt to be necessary to a better understanding of the meaning of the relative magnitude of the differences found in the data although it is recognized that the reliability of the test results using such a meagre amount of data is very limited. Non- parametric methods were adopted on the whole because they make less assumptions about the data than parametric tests and are more robust when only small amounts of data are available (Haber and Runyon 1973).

CHAPTER FIFTEEN

CONCLUSIONS

The research project began by investigating the process of diagnosis in nursing, taking as its basis the models of diagnosis current in medical research. This section of the research has demonstrated that the Verbal Protocol technique as presently used in psychology and by knowledge engineers in the computing sciences is an appropriate design tool for studying the clinical reasoning behaviour of practitioners in nursing. The main strength of the technique when used for this purpose appears to be the ability to bring into the open those cognitive behaviours frequently hidden by the pressing practical and social demands which make up the majority of the nurse's clinical role.

The results have indicated that there are definable diagnostic strategies being used by the research subjects while solving the problem of pressure sore risk in hospital patients and that differences in strategy are present between expert and novice practitioners. Much of the nursing literature advocated the hypothetico-deductive model and the initial stages of this research project was looking for evidence of this approach among practising nurses using the United Kingdom model of the nursing process. Results using the verbal protocol technique show that this diagnostic strategy is prevalent amongst expert practitioners but not in novices unless specific instruction is given beforehand to take note of the content of thought during the problem solving task.

From the data received from the verbal protocols, a model of the nature of the knowledge base for clinical nursing was derived. Recommendations were put forward for incorporating the various dimensions of this knowledge into clinical management of patient care especially with regard to the continued education of the nurse practitioner in order that practical competence and a high level of up-to-date research based knowledge might be combined to produce a clinical nurse expert.

A subsidiary aim of the research was to use data from the 'expert' diagnosticians to build a knowledge-based system for the diagnosis of pressure sore risk assessment in hospital patients. It was found that the verbal protocols provided by the 'expert' nurse

group provided an adequate knowledge base from which to derive the system although some doubt remains about the validity of the data as an accurate representation of the diagnostic process used in real-life nursing problem solving contexts.

The CRYSTINE program derived from the verbal protocol results is beneficial to the practice and education of nursing in a number of ways. It demonstrates the technique for collecting and analyzing the data necessary for use of the Norton Score assessment tool. It prompts the nurse user to collect all the relevant data needed for risk assessment and helps her to enlarge her original data base thus contributing to an enhancement of the nurse's diagnostic performance. It identifies data indicating specific dysfunctions in the patient which require nursing interventions and suggests appropriate aims of care for these together with the nursing actions needed to bring them about. The print-out care plan facility is a major labour saving innovation for the ward based nurse freeing her for more patient centred activities. The program can also be used to evaluate the quality of nursing diagnosis of pressure sore risk on the ward and, by picking out patients at risk and suggesting a comprehensive set of interventions immediately, it can aid the early application of effective interventions to prevent pressure sores.

Computer technology is advancing rapidly in our society and making vast inroads into the field of health care creating many problems, both technical and professional, that need to be dealt with. For nursing, the advent of computers to aid the implementation of the various stages of the nursing process is a question of 'when and how' rather than 'if'. Some nurses view a future in which the computer is put to such use with distrust and pessimism. They caution that, injudiciously applied, a knowledge-based system has the potential to impair standards of patient care for :-

> "It ignores the nurse's work situation and the negotiated nature of her expertise that is so vital in a people-oriented profession.(sic) It seeks to provide a uniformity of care that denies the individual nurses' and clients' contributions to the caring situation."
>
> (Robinson and Robinson 1990)

This fear is not without foundation if nurses do not take control of the use of computers in patient care and insist that their use retains the ethos of personal care. It is incumbent on the nursing profession to take on the responsibility of identifying where and how the new technology can enhance the quality of care delivered to patients and to develop the knowledge and skills to build the programs which will achieve this aim.

The final component of this project constitutes a simple example of how computers may be used to examine the process of diagnosis of patient problems and to build programs which allow expert clinical diagnosis to be available to all grades of nurse undertaking this activity in the real world of clinical practice. Nurses have a professional duty to employ the computers which are now appearing in clinical areas to meet their own particular professional goals and stake their claim for access to the machinery before their reluctance to do so is interpreted by other health care team members as an inability to align the aims and interventions of nursing care with the advantages offered by computerised processes.

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APPENDICES

APPENDIX ONE

RISK OF PRESSURE SORE SCORING SYSTEM - THE NORTON SCORE

RISK OF PRESSURE SORE SCORING SYSTEM - THE NORTON SCORE

(Norton et al. 1975)

A	B	C	D
PHYSICAL CONDITION	MENTAL CONDITION	ACTIVITY	INCONTINENCE
Good 4	Alert 4	Ambulant 4	Not 4
Fair 3	Apathetic 3	Walk/help 3	Occas- 3
		Chair- 2	ionally
Poor 2	Confused 2	bound	Usually/ 2
			urine
Very bad 1	Stuporous 1	Bedfast 1	Doubly 1

KEY : Total Score of 14 or below = " AT RISK"

APPENDIX TWO

ACCESS TO RESEARCH SETTING -
COPIES OF LETTERS SENT

(a) Research subjects -

(i) Expert Group
(ii) Novice Group

(b) Nursing Officers
(c) Director of Nurse Education

APPENDIX TWO

ACCESS TO RESEARCH SETTING - COPIES OF LETTERS SENT

(a) Research subjects

Department of Nursing Studies
University of Southampton
Level C, West Wing
Southampton General
Hospital
Tremona Road
SOUTHAMPTON SO9 4XY

Dear Sister ,

I am working as a Research Fellow at the University of Southampton being funded by the DHSS Nursing Studentship to undertake research into Clinical Decision Making in Nursing. In particular, I am interested in the ways in which clinical experts like yourself arrive at a nursing diagnosis of a patient's problem.

Assessment of patients is, I feel,an crucial and everyday task for clinical nurses and one whose complexity is often underrated. Significant benefits to patient care could be attained if the task could always be done using the considerable expertise possessed by senior ward nurses. The aims of the research are to enhance understanding of the clinical reasoning process in nursing generally and to use the data collected to build a computer programme for use in clinical practice, such as a busy ward like yours where it would assist senior students and inexperienced staff nurses in accurately defining patient problems or act as a back-up facility for them allowing both self and peer evaluation of diagnosis skills being used on the ward. This sort of programme will also have obvious uses education settings.

In order to try and understand how patients problems are recognised by nurses, I feel it is important to study the thinking of those people who are in close and continuous involvement with this activity such as yourself. I am therefore requesting your assistance in the project by allowing yourself to act as a research subject. This will involve you talking through how you assess a particular problem in patients, of whom you will be given three examples, and having what you say taped so that it can be studied closely later. The study seeks to compare the differences between how experienced and inexperienced nurses find the information they need about the patient's problem and does not intend to evaluate the performance of individual subjects, ie. it is not meant to be a test of how well you do in actually assessing the patient but rather to see how you go about the task.

The interview will take about 45 minutes and I can be available at any time, including evenings and weekends, to see you. The best venues would be either your office or my own but anywhere where we could remain quiet and uninterrupted would do.

If you are willing to cooperate, could you complete the tear off slip below and return it to me as soon as possible as I would like to complete the twenty interviews I have to do by the end of June. I will then contact you within a few days in person or by telephone to confirm a time and venue of your choice which is also convenient to me.

Even if you do not feel able to participate, may I thank you for taking time to read my letter and wish you success in your work.

Yours Sincerely,

Jennifer A Jones

MSc, BA, SRN, RNT, RCNT,

Dip.Nursing

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CLINICAL REASONING IN NURSING RESEARCH PROJECT

I am willing to act as a subject in the above project and to participate in a taped interview concerning assessment of patient problems.

I understand that the tapes and their transcripts will be used only for the purposes of this research and that my personal identity will be not be revealed by the researcher to anyone apart from her research supervisor.

A summary of the completed research thesis **would be appreciated / not be required. (**Delete as necessary)

Dates and Times for the interview which are convenient to me are:-

FIRST CHOICE = Day..... Date..... Time.....
SECOND CHOICE = Day..... Date..... Time.....
THIRD CHOICE = Day..... Date..... Time.....

Signed .....

NAME (Block letters).....

Ward (or other contact address).....

Department of Nursing Studies
University of Southampton
Level C, West Wing
Southampton General
Hospital
Tremona Road
SOUTHAMPTON SO9 4XY

Dear Nurse ,

I am at present working as a Research Fellow at the University of Southampton being funded by the DHSS Nursing Studentship to undertake research into Clinical Decision Making in Nursing. In particular, I am interested in the ways in which clinical nurses, especially senior students, arrive at a nursing diagnosis of a patient's problem and to compare this with the way in which senior nurses, such as ward sisters go about the same task.

Assessment of patients is, I feel,an crucial and everyday task for clinical nurses and one whose complexity is often underrated. Significant benefits to patient care could be attained if the considerable expertise possessed by many senior ward nurses could be used to help and to train juniors in the skills of accurate diagnosis of problems. The aims of the research are to enhance understanding of the clinical reasoning process in nursing generally and to use the data collected to build a computer programme for use in clinical practice, such as a busy ward like the one you are working on, where it would assist senior students and inexperienced staff nurses in reaching accurate definitions of patient problems. This sort of programme will also have obvious uses in schools of nursing too.

In order to try and understand how patients problems are recognised by nurses, I feel it is important to study the thinking of those people who are in close and continuous involvement with this activity such as yourself. I am therefore requesting your assistance in the project by allowing yourself to act as a research subject. This will involve you talking through how you assess a particular problem in patients, of whom you will be given three examples, and having what you say taped so that it can be studied closely later. The study seeks to compare the differences between how experienced and inexperienced nurses find the information they need about the patient's problem and does not intend to evaluate the performance of individual subjects, ie. it is not meant to be a test of how well you do in actually assessing the patient but rather to see how you go about the task.

The interview will take about 45 minutes and I can be available at any time, including evenings and weekends, to see you. The best venue would be in my office on 'C' Level, West Wing but anywhere where we could remain quiet and uninterrupted would do if you would rather.The interview will, I'm afraid have to take place during your off duty time.

If you are willing to cooperate, could you complete the tear off slip below and return it to me as soon as possible as I would like to complete the twenty interviews I

have to do before or during your next study block. I will then contact you within a few days in person or by telephone to confirm a time and venue of your choice which is also convenient to me.

Even if you do not feel able to participate, may I thank you for taking time to read my letter and wish you success in your final examinations and in your future nursing career.

Yours Sincerely,

Jennifer A Jones
MSc, BA, SRN, RNT, RCNT,Dip.Nursing

Cut Here>>> ----------

CLINICAL REASONING IN NURSING RESEARCH PROJECT

I am willing to act as a subject in the above project and to participate in a taped interview concerning assessment of patient problems.

I understand that the tapes and their transcripts will be used only for the purposes of this research and that my personal identity will be not be revealed by the researcher to anyone apart from her research supervisor.

A summary of the completed research thesis **would be appreciated / not be required. (**Delete as necessary)

Dates and Times for the interview which are convenient to me are:-

FIRST CHOICE = Day..... Date..... Time.....
SECOND CHOICE = Day..... Date..... Time.....
THIRD CHOICE = Day..... Date..... Time.....

Signed .....

NAME (Block letters).....

Ward (or other contact address).....

.....

APPENDIX TWO

ACCESS TO RESEARCH SETTING - COPIES OF LETTERS SENT

(b) Nursing Officers

Department of Nursing Studies
University of Southampton
Level C, West Wing
Southampton General
Hospital
Tremona Road
SOUTHAMPTON SO9 4XY

[redacted]

18 May 1987

Dear Sir,

I am a Research Fellow at the Southampton University being funded by a DHSS Nursing Studentship to undertake research into Clinical Decision Making in nursing. In particular, I am interested in the ways in which clinical experts arrive at a nursing diagnosis of a patient's problem.

Since "nursing" as such is a vast field, I have decided to focus my research into the problem of assessment of pressure sore risk in hospital patients as this is one of the few areas where expert decision making remains within the sphere of nursing and where the input to the problem by other disciplines in the health care team is minimal. Assessing pressure sore risk is, I feel,an crucial and everyday task for clinical nurses and one whose complexity is often underrated. Significant benefits to patient care could be attained if the task could always be done using the considerable expertise possessed by senior ward nurses.

The methodology of the study will be an in depth analysis of verbal protocols taken from subjects assessing a patient from data presented to them. The aims of the research are to enhance understanding of the clinical reasoning process in nursing generally and to use the data collected to build a computer based Expert System for use both in clinical practice, eg.hospital wards where it would be used to assist in diagnosis and as a back-up facility for self and peer evaluation of diagnosis skills ,and in education settings as a CAL tool.

The methodology of the study will be an in depth analysis of verbal protocols tape recorded from subjects assessing pressure sore risk of a patient from data presented to them. Each subject will be asked to assess three such patients during a single session which should last about 45 -50 minutes. The analysis will consist of comparing the way in which both expert and novice nurses go about the diagnostic task involved. The research sample therefore will consist of two groups each containing 10 subjects. The first group will be defined as the 'expert' group and be made up of Ward Sisters working in Acute Medical wards. The second group, the 'novice' group, will be student nurses who have completed their third year allocation to the medical unit.

I am writing to you for approval of and assistance in having access to the ward sisters on your unit to request their cooperation as research subjects for the first of the above groups. I would like to undertake the interviews during June if possible and am quite willing to meet both with you alone and with them as a group to explain my research to them before their agreement is necessary.

I am ,Sir
Yours Sincerely,

Jennifer A. Jones
M.Sc, BA(Hons), SRN, RNT, RCNT, DipNursing.

APPENDIX TWO

ACCESS TO RESEARCH SETTING - COPIES OF LETTERS SENT

(c) Director of Nurse Education

Department of Nursing Studies
University of Southampton
Level C, West Wing
Southampton General
Hospital
Tremona Road
SOUTHAMPTON SO9 4XY

[redacted]

18 May 1987

Dear Mrs ,

As you know, I am a Research Fellow at the Southampton University being funded by a DHSS Nursing Studentship to undertake research into Clinical Decision Making in nursing. In particular, I am interested in the ways in which clinical experts arrive at a nursing diagnosis of a patient's problem.

Since "nursing" as such is a vast field, I have decided to focus my research into the problem of assessment of pressure sore risk in hospital patients as this is one of the few areas where expert decision making remains within the sphere of nursing and where the input to the problem by other disciplines in the health care team is minimal. Assessing pressure sore risk is, I feel, a crucial and everyday task for clinical nurses and one whose complexity is often underrated. Significant benefits to patient care could be attained if the task could always be done using the considerable expertise possessed by senior ward nurses.

The methodology of the study will be an in depth analysis of verbal protocols taken from subjects assessing a patient from data presented to them. The aims of the research are to enhance understanding of the clinical reasoning process in nursing generally and to use the data collected to build a computer based Expert System for use both in clinical practice, eg.hospital wards where it would be used to assist in diagnosis and as a back-up facility for self and peer evaluation of diagnosis skills ,and in education settings as a CAL tool.

The methodology of the study will be an in depth analysis of verbal protocols tape recorded from subjects assessing pressure sore risk of a patient from data presented to them. Each subject will be asked to assess three such patients during a single session which should last about 45 -50 minutes. The analysis will consist of comparing the way in which both expert and novice nurses go about the diagnostic task involved. The research sample therefore will consist of two groups each containing 10 subjects. The first group will be defined as the 'expert' group and be made up of Ward Sisters working in Acute Medical wards. The second group, the 'novice' group, will be student nurses who have completed their third year allocation to the medical unit.

I am writing to you for approval of and assistance in having access to a set of student nurses fulfilling the criteria for the second group described above to request their cooperation as research subjects. I would like to undertake the interviews during June if possible and am quite willing to meet both with you alone, your teaching staff and with the student themselves to explain my research to them before their agreement to participate is necessary.

Yours Sincerely,

Jennifer A. Jones
M.Sc, BA(Hons), SRN, RNT, RCNT, DipNursing.

APPENDIX THREE

CASE HISTORY DATA FORM FOR PATIENTS USED IN VERBAL PROTOCOLS

PRESSURE SORE RISK DIAGNOSIS - PATIENT DATA

Pt. Code No._____ Pt.Code Name_____

Age (Chronological)_____ Biological_____

Medical Diagnosis_____

Stated Nursing Problems_____

_____

MOBILITY

1) Body Movement Ability

Muscle Weakness_____ Pain on Moving_____

Joint Mobility_____ Other _____

2)Movements performed

Action	Self Help	Minimal help	Dependent	Frequency	Duration	Aids to Moving
Moving in bed						
Getting out of bed						
Moving in chair						
Getting out of chair						
Walking						

3)External Factors

External restraints on movement _____

Pressure Relieving Aids used _____

4)Periods spent immobile in last 72 hours

Cause _____ Duration _____

Body Position _____Resting Surface_____

5)Neurological Factors

Paralysis _____

Sensory Deficits_____

Level of Awareness (a) L.O.C._____

(b) Mental State _____

(c) Pain _____

(d) Anxiety _____

TOILETTING

a)Present Mode

Mode	Self Care	Minimum help	Dependent	Frequency
Catheter				
BedPan/Urinal				
Commode				
O.T.T.				

b) Last Urinalysis Result_____ Date_____

" MSU\CSU Result_____ Date_____

c)Skin Soiling

Source	Cause	Onset/ Cessation	Past Frequency	Present Frequency	Effect on skin Past|Present
Urine					
Faeces					
Other					

SKIN CONDITION

Self Care Ability_____

Skin Type _____ Turger_____

Hydration_____ Thickness_____

Underlying Fat_____

Underlying Muscle_____

Muscle tone_____

Bony Prominences_____

Body Temp._____ Skin Humidity_____

HYDRATION

Self Drinking Ability_____ Fluid Intake _____

Fluid Balance(Last 72 hrs)_____

Dehydration_____ Oedema _____

NUTRITION

Self Feeding Ability_____

Body Trauma/Infection in last 3 weeks_____

Chronic Infection/Inflammation present_____

Malabsorbtion present_____Diarrhoea_____

Dietry Insufficiency - Past _____

- Present_____

MEDICAL STATUS

General Condition and Progress_____

Prognosis_____

Drug Therapy_____

Previous Medical History _____

Previous P.Sores _____

Medical Risk Factors present

Anaemia _____(Hb)_____ Uraemia _____ (S.Urea)_____

Septacaemia\Toxaemia_____ Jaundice_____(S.Bil)_____

Respiratory Function _____

Circulatory Function _____

APPENDIX FOUR

COPY OF INSTRUCTIONS READ TO SUBJECTS IN STAGE ONE OF THE MAIN STUDY

(a) Protocols One and Two
(b) Protocol Three

APPENDIX FOUR

COPY OF INSTRUCTIONS READ TO SUBJECTS IN STAGE ONE OF THE MAIN STUDY

(a) Protocols One and Two

PROTOCOLS ONE AND TWO - INSTRUCTIONS TO SUBJECT

The research task consists of a series of thinking exercises which I want you to talk yourself through. I will be recording what you say on tape so that I can study it in detail at my leisure!! Each exercise is basically the same and should take about 10 minute to do.

In each exercise, I am going to give you minimal details of what is, I hope, a typical patient on your ward. Your job is, by asking me questions, to find out enough information about the patient to make fairly clear cut definitions of a certain nursing problem.

The situation is,I know, artificial. You cannot actually observe, examine or question the patient directly to get the information you require....Imagine him or her in front of you though and ask yourself aloud what you need to know here. Talk through your ideas about the problems as they occur to you.

Ask your questions as specifically as possible so that I do not give you the wrong information at that time.

The important thing which I wish to stress in all the exercises is to keep talking all the time about what you are thinking about the problem.

Before we start with the first exercise, have you any questions or worries? .....

OK then.

Here is the first exercise.....

The first patient's name is .....

He/She was admitted .....ago with a medical diagnosis

of.....

I want you to decide what his/her risk of pressure sores is today.

[On completion present subject with Card One = "Risk Scale" and ask the following question.....]

Using this scale of measurement, what number would you consider to be this patients risk of pressure sores?

The second exercise is very similar to the first. Again you are given minimal information about a patient and have to talk through finding out enough information about him/her in order to decide what is the risk of pressure sore developement.

This time, however, I want you to think about not only the actual estimation of the pressure sore risk but also about the effect which the information you are collecting has on how you proceed.

In particular, I want you to keep in mind, and therefore talk through THREE QUESTIONS each time you ask me for a piece of information. These questions are :-

[Display Card Two = "Questions about Information sought"]

(a) How important is this piece of information to me in deciding the risk of pressure sores for this patient ?

(b) With the information I have so far, what do I think the actual risk is ? (Using Card One)

(c) How sure am I that this particular estimation of the risk will prove to be correct ?

Don't worry if at times you forget to ask yourself these questions. Just carry on trying to decide what the patients risk of pressure sores is and answer the questions from then on if you can.

Your second patient is .....

He/she was admitted .....ago with a medical diagnosis of .....

I want you to decide what is his/her risk of pressure sores today.

APPENDIX FOUR

COPY OF INSTRUCTIONS READ TO SUBJECTS IN STAGE ONE OF THE MAIN STUDY

(b) Protocol Three

PROTOCOL THREE - INSTRUCTIONS TO SUBJECT

The final exercise is slightly different. This time I will interrupt you as you are trying to find out about the patient and ask you a series of questions whenever you ask me for information. Answer as quickly and precisely as you can each time so that you don't loose track of where your are in the assessment process. Don't worry if you can't answer ...just 'Pass' and carry on with the problem solving.

The final patient is.....
He/she was admitted ..... ago with a medical diagnosis of .....
I want you to decide what is his/her risk of pressure sores today.

CARD ONE - RISK OF PRESSURE SORE DEVELOPEMENT

1	**NIL RISK**	under present circumstances.
2	**LOW RISK**	even if patient is self caring.
3	**FAIRLY LOW RISK**	providing routine preventative interventions are maintained.
4	**MEDIUM RISK**	providing routine preventative interventions are maintained.
5	**MEDIUM TO HIGH RISK**	routine preventative interventions should be a priority in patient's care.
6	**HIGH RISK**	unless routine preventative interventions are strictly adhered to.
7	**FAIRLY HIGH RISK**	requires additional preventative measures to be implemented.
8	**VERY HIGH RISK**	intensive preventative interventions may be necessary.
9	**EXTREMELY HIGH RISK**	patient in grave danger of pressure sores unless intensive preventative measures are strictly adhered to.
10	**PRESSURE SORE DEVELOPEMENT IS INEVITABLE**	in spite of all preventive interventions

CARD TWO - IDEAS TO THINK ABOUT DURING TASK TWO

1. IMPORTANCE OF THIS INFORMATION IN DECIDING PATIENTS RISK OF PRESSURE SORES

2 YOUR BEST ESTIMATE NOW OF THE PATIENTS RISK

3 YOUR LEVEL OF CONFIDENCE THAT (2) IS CORRECT

CARD THREE - IMPORTANCE OF THIS PIECE OF INFORMATION IN DECIDING RISK

1	CRITICAL	I cannot assess the risk unless I know this.
2	CRUCIAL	This is a major factor in the developement of pressure sores and should always be taken into account.
3	IMPORTANT	This is often a factor in pressure sore developement and should be considered.
4	RELATIVELY UNIMPORTANT	This can sometimes be a contributory factor.
5	NOT IMPORTANT	in the actual assessment of pressure sore risk. Just curious really.

CARD FOUR - PROBABILITY OD DEVELOPING PRESSURE SORE IF WORST VALUE OF A CUE IS PRESENT

1 = **100% guaranteed.** Pressure sore would be inevitable.

5 = **50/50 chance** of developing a pressure sore.

10 = **1 in a hundred chance** A pressure sore is extremely unlikely.

CARD FIVE - LEVEL OF CONFIDENCE THAT ESTIMATED RISK IS CORRECT

1 I'm absolutely sure that this is the correct pressure sore risk for this patient .

2 Quite sure I'm right

3 I don't think I'm very far out.

4 I might be wrong, I suppose.

5 A 'Wild Guess' really. I can't really say what the risk is with the information I have so far

APPENDIX FIVE

QUESTIONNAIRE GIVEN TO SUBJECTS IN VERBAL PROTOCOLS

SUBJECT NUMBER..... PATIENT TRIAD.....

DATE..... TIME .....

CLINICAL REASONING IN NURSING - RESEARCH PROJECT

RESEARCH SUBJECT DEMOGRAPHIC QUESTIONNAIRE (E GROUP)

Age.....

Present Post .....

Length of Time (in months) in this post.....

Details of previous Sister posts held (Type of Ward/Dates)
.....

Details of Staff Nurse posts held (Type of Ward/Dates).....
.....
.....

PROFESSIONAL EDUCATION

SRN Training School.....
Year of SRN registration .....

Details of other statutory training undertaken (Establishment/
Qualification/Dates).....
.....
.....

Details of other profession education .....
.....

GENERAL EDUCATION QUALIFICATIONS

	Number of Subjects	Tick here if taken after leaving school
'O' Level GCE	.....	.....
'A' Level GCE	.....	.....

University Degrees/Diplomas(Give details).....

Other Educational Qualifications .....
.....

P.T.O. .....

EXPERIENCE WITH THE NURSING PROCESS

When did you first hear about the Nursing Process and from whom.....

What were your early impressions about it ? .....
.....

Did you receive any specific education in the philosophy of the Nursing Process or in how to implement it ? (Give details and comments about your impressions at the time)
.....
.....
.....

What are your present views about the Nursing Process generally ?
.....
.....
.....

What are your present views about the implementation of the Nursing Process in your particular ward ?
.....
.....
.....

USING THE NURSING PROCESS (Tick appropriate box below)

	OFTEN	SOMETIMES	RARELY	NEVER
Do you have the opportunity to:-				
Complete patient assessment forms				
Write patient care plans				
Record evaluation of care on patient care plans ?				
Do you yourself manage to demonstrate to junior nurses how to :-				
Complete patient assessment forms				
Write patient care plans				
Record evaluation of care on				

patient care plans

ANY OTHER COMMENTS.....
.....
.....

Thank you for your cooperation.

SUBJECT NUMBER..... PATIENT TRIAD.....

DATE..... TIME .....

CLINICAL REASONING IN NURSING - RESEARCH PROJECT

RESEARCH SUBJECT DEMOGRAPHIC QUESTIONNAIRE (N GROUP)

Age.....

Present Ward .....

Last Allocation to Medical Wards Dates..... Ward .....

PROFESSIONAL EDUCATION

Date of entering RGN training .....
Expected date of qualifying for RGN registration.....

Details of other statutory training undertaken (Establishment/ Qualification/Dates).....
.....
.....

Details of other profession education .....
.....

GENERAL EDUCATION QUALIFICATIONS

	Number of Subjects	Tick here if taken after leaving school
'O' Level GCE	.....	.....
'A' Level GCE	.....	.....

University Degrees/Diplomas(Give details).....

Other Educational Qualifications .....
.....

P.T.O. .....

EXPERIENCE WITH THE NURSING PROCESS

When did you first hear about the Nursing Process and from whom.....

What were your early impressions about it ? .....
.....

Did you receive any specific education in the philosophy of the Nursing Process or in how to implement it ? (Give details and comments about your impressions at the time)
.....
.....
.....

What are your present views about the Nursing Process generally ?
.....
.....
.....

What are your present views about the implementation of the Nursing Process in your particular ward ?
.....
.....
.....

USING THE NURSING PROCESS (Tick appropriate box below)

	OFTEN	SOMETIMES	RARELY	NEVER
Do you have the opportunity to:-				
Complete patient assessment forms				
Write patient care plans				
Record evaluation of care on patient care plans ?				
Do you yourself manage to demonstrate to junior nurses how to :-				
Complete patient assessment forms				
Write patient care plans				
Record evaluation of care on patient care plans				

ANY OTHER COMMENTS

.....
.....

Thank you for your cooperation.

APPENDIX SIX

EXPLANATION OF THE OPERATORS USED IN THE VERBAL PROTOCOL ANALYSIS

EXPLANATION OF THE OPERATORS USED IN THE VERBAL PROTOCOL ANALYSIS

COLLECT DATA OPERATORS

In this cognitive operation the subjects are seeking, in the form of direct questioning of the researcher, further information about the patient.

This information sought during the interview would normally be acquired in a number of ways by the nurse subjects when working in the clinical area. The various methods used there are detailed in the operator statement of the Protocol Analysis. The real-life clinical data collection methods shown up in the research data are :-

(a) ASK

This information would normally be obtained by the nurses through questioning, ie. asking, the patient (or the relatives if the patient is unable to respond appropriately). This information is often non-medical in nature and is subjective in nature, ie. it is the patients' perspective of their symptoms etc.

(b) OBSERVE

This is patient data arising from the nurses' perceptions of the patient state. Although often subjective in nature, the interpretation of clinical signs is based on a body of scientific knowledge. The content, structure and accessibility of this knowledge base is variable according to clinical experience of the particular nurse and the context in which it is used.

(c) MEASURE

This operator refers to the relatively objective measurement of a patient variable. These data are usually physiological in nature but can also be psychological variables measured using a specially designed tool, eg pain scale or mental status questionnaire.

(d) CONSULT RECORDS

Nurses frequently seek information about their patients from written documents, either medical such as doctor's notes, laboratory reports etc, and nursing records such as ward reports, care plans and observation charts.

(e) **OTHER**

This category is used for any data collection activities arising from the verbal protocols which do not fit into any of the above categories.

REVIEW DATA OPERATORS

In these verbal responses, subjects are repeating information which has already been obtained from the researcher in earlier parts of the protocol task.

From the initial analysis of the research data, these repetitions appear to serve one of two functions for the subjects :-

(a) **REVIEW**

This is simple re-iteration of material which has already been referred to in the verbal protocol. The verbal responses are not directed to the researcher but appear as a form of externalisation of internal use of this information. This often takes the form of a bringing back to or keeping in the foreground of attention previously acquired information.

EXAMPLES :

E2(1) Seg 34 and 35 " *Her skin is intact* ", " *She is not dehydrated* "

(b) **CLARIFY**

Here the verbal repetition is directed towards the researcher as a means of gaining confirmation of a line of thought or clarification of an interpretation of acquired information.

EXAMPLE

E2(1) Seg 45 " *So she was only incontinent for two days* "

INTERPRET DATA

In these responses, the nurse subjects demonstrate assimilation of the previously given information into the patient data base being built up by COLLECT and

REVIEW DATA This assimilation leads to a subsequent build-up of further linkages and new configurations of knowledge within the knowledge base.

The types of linkages made in this process are :-

(a) **RELATE**

The latest intake of information from the researcher is linked to information previously acquired from that source.

EXAMPLE

N4(2) Seg 5 and 7 " *Also seeing that he's a hemiplegic makes me feel straight away that he is at high risk of pressure sores, especially down that side.*"

(b) **JUDGE**

Here the linkage of information, occurring during the protocol sequence, results in some kind of evaluation statement being made by the subjects. This evaluation might arise from professionally based knowledge and values :-

EXAMPLE

E2(1) Seg 18 " *So she could obviously cope with the diet.*"

Other judgements come from a more personalised lay perspective.

EXAMPLE

E2(2) Seg 19 After an exchange discussing the limitations of the usual dietary intake of the elderly patient, the subject observes
" *Yes, which is typical, I suppose*".

(c) **INFERENCE**

The incoming information is linked to internal information which has not been derived during the investigation of this particular patient, ie. from outside the data base given so far. The content analysis of the protocols showed that the internal information structures thus linked appeared to originate from two main sources :-

(i) * = PROFESSIONAL KNOWLEDGE -
The inference appears to arise from a well established body of common nursing knowledge as defined by the researcher. The

validity of this definition was based on the researcher being widely experienced both in clinical and in theoretical aspects of nursing. These inferences are seen as legitimate for the nurse subjects to make in the context of the present research task which requires their acting out the role of a clinically based nurse practitioner.

(ii) ** = OTHER KNOWLEDGE -

The justification for making the inference within the nursing diagnostic task lies neither in the data so far obtained nor from a body of professional knowledge as defined above. Such inferences are seen as being illegitimate for the subjects to make in the present context.

ACT

The instructions given to the research subjects refer to the task of nursing diagnosis. This task constitutes the first stage of the Nursing Process as defined by Yura and Walsh (1988), ie. Assessment. In using this model of practice, the nurses are asked to complete this stage before attempting the second stage which concerns the prescribing of nursing care actions. Thus, in its pure form, reference to proposed nursing actions would not appear as part of the assessment stage of the nursing process. However, content analysis of the initial verbal protocols demonstrated that nurses did make such references. They are therefore classified in the Protocol Analysis as ACT operators.

Sometimes ACT statements show the research subjects actually taking the role of a clinical nurse and addressing the researcher as if the latter were the patient in question. Usually however, the ACT statements take the format of a definite prescription for care. These are assigned as 'ACT - Prescribe' operators in the analysis. They are further qualified by the nature of the nurse action being prescribed.

EXAMPLES

ACT - Prescribe - Intervene

E2(2) Seg 45 " *And I would personally have given her a sheepskin and something for her heels and ankles because of the oedema present ...*"

ACT - Prescribe - Explain

E4(2) Seg 32 " *And to ask him if anyone has explained how... what movements he is allowed to, to carry out in bed, and ...*"

ACT - Prescribe - Encourage

N1(1) Seg 51 " *But encouraging him to drink plenty of fluids and to take quite a nourishing diet.*"

ACT - Prescribe - Reassure

N1(1) Seg 28 " *So therefore this, I mean, this gentleman needs a lot of reassurance.*"

ACT - Prescribe - Rationale

E4(2) Seg 41 " *So that he knew he could be a bit more active and that he wasn't expected to lie still and straight waiting for ... you know, in case anything changed on the monitor..*"

DIAGNOSE

In this operator category, subjects are making a diagnostic statement about a patient problem. For the purposes of analysis of the Verbal Protocols, two types were identified :-

(a) **RISK**

Here the nursing diagnosis being made refers directly to the research task of identifying the patient's risk of developing pressure sores.

EXAMPLE

E2(2) Seg 37 " *Well.. she is still.. this lady would be a very high risk right from the word go, because of her oedema.*"

(b) **OTHER**

This is a wide category referring to statements concerning other nursing diagnoses that have been identified during the assessment of the patient.

CONTROL

During the verbal protocol, subjects frequently made statements referring to the research task itself rather than being concerned with the acquisition and manipulation of the patient based data itself. These statements are classified as CONTROL operators in the analysis since they are seen as attempts by the subjects to maintain a sense of mastery over their performance of the research task. Two types were identified :-

(a) **CLARIFY ROLE**

In these statements the subjects are checking with the researcher that they are complying with the latter's expectations of their performance.

EXAMPLE

N4(1) Seg 1 "*Right. And I'm dealing with his pressure sores ?*"

(b) **EXPLAIN PROCESS**

Here the subjects are explaining the thinking processes that they are aware of at the present time. These are frequently concerned with why a particular line of questioning is being followed or why and how they have come to the conclusions they now make.

EXAMPLE

N4(2) Seg 18 " *I should really evaluate from the Norton Scale but I must admit that unless I have got it in front of me, I wouldn't.*"

PUBLISHED ARTICLES

The following published papers were included in the bound thesis. These have not been digitised due to copyright restrictions, but the links are provided.

https://doi.org/10.1111/j.1365-2648.1988.tb01407.x

https://doi.org/10.1111/j.1365-2648.1989.tb01518.x