CONTEXTUAL DESIGN METHODOLOGY: Designing a prototype software system linking the Nursing Interventions Classification with the Nursing Outcomes Classification

By

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A THESIS

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Abstract

Traditional software designers now realize the value of qualitative research in the development and evaluation of information systems. This paper presents the development of a prototype Nursing Information System (NIS) using contextual software design methodology. This design process makes use of qualitative interviewing strategies to extract knowledge from expert nurses in home health nursing. The experts' knowledge is used to formulate the prototype's user requirement specifications. The iterative prototyping method incorporates expert knowledge into the user requirement specifications; resulting in a more usable prototype.

This prototype system will link the Nursing Interventions Classification (NIC) with the Nursing Outcomes Classification (NOC) using pain management as the exemplar. These two taxonomies show promise in furthering evidence-based nursing by providing a standardized means for nurses to report interventions and nursing sensitive outcomes.

After the development of the prototype the nurse experts evaluated the prototype NIS using an open-ended questionnaire. The evaluation addresses issues such as:

- Did the system meet the user requirement specifications?
- Is the system operable?
- What are the system's strengths and weakness?

The incorporation of expert knowledge into the prototype system facilitated the design of a usable nursing information system.

Introduction

Nursing Interventions Linked to Nursing Outcomes

It is imperative for nurses to develop standardized means to communicate the treatments performed on patients as well as the outcomes of these treatments. By standardizing the language used to describe nursing care, nurses can begin to use clinical information systems to identify the benefits of particular nursing interventions within various patient populations. Furthermore, by linking a standardized intervention nomenclature to standardized outcomes, data between different care settings and patient populations can be more readily exchanged. The Nursing Interventions Classification (NIC) developed at the University of Iowa and the Nursing Outcomes Classification (NOC) also developed at the University of Iowa are two proprietary nomenclatures using standardized language to describe nursing interventions and nursing outcomes.

Designing information systems for the healthcare domain is a complicated and difficult task. There are several software design methodologies available to the developer. Traditional software design makes little use of domain experts in the early phases of product development. Often times, the experts are called upon to evaluate the completed product shortly before its release to the user domain. This process can lead to poor user interface (UI) design as well as a product poorly matching the work process of the end user.

Contextual software design methodologies utilize the knowledge of domain experts to create a product closely matching the end user's work process. Furthermore, the expert knowledge helps the developer create a UI found usable by users. The reluctance to utilize contextual software design methodologies in the software industry is driven by the need to produce and release product in the quickest manner. Designers view

the iterative process used in contextual design as slow and unnecessary. However, this hurried pace often times produces products deemed unusable by the end user.

Linking the Nursing Interventions Classification (NIC) and the Nursing Outcomes Classification (NOC) will allow nurses to readily exchange standardized patient care data across information systems and between patient populations and settings. A prototype-computerized system linking the NIC to the NOC could be designed using contextual design methodologies. By incorporating expert knowledge into the prototype's design, a usable product could be developed.

Developing and releasing software products in a timely manner is important both to the producers and the end-user. The targeted user domain often finds many products released today as inferior. This is often due to poor UI design or the system lacking the incorporation of the end users' work process into its design. The use of design methodologies enabling the developer to utilize the specialized knowledge of the end-user will improve the quality and usability of the product produced.

This research exercise will examine contextual design methods and prototyping in the development of software supporting nursing practice.

Review of Literature

The American Nurses Association (ANA) recognizes many standardized nursing nomenclatures. Among these are: the North American Nursing Diagnosis Association's (NANDA) nursing diagnoses, the Nursing Interventions Classification (NIC), the Nursing Outcomes Classification (NOC), the Omaha System, and the Georgetown University Home Health Care Classification (HHCC). Most of these nomenclatures are specific to one particular patient population or care setting.

NANDA, NIC, and NOC are nomenclatures for nurses caring for patients throughout the care continuum. All three can be used in most care settings with varying patient populations, (Gail Keenan PhD & Mary Lober Aquilino PhD, 1998). Using common standardized languages to document patient care allows the smooth transition of patient throughout differing patient care settings. All three nomenclatures were designed for use in both paper-based charting and computerized charting systems. Each diagnosis, intervention, and outcome is identified by a numerical code, (Gail Keenan PhD & Mary Lober Aquilino PhD, 1998). A comprehensive picture of care provided to the patient by nurses is the goal of any charting system. The development of a charting system found usable by the nurses, yet comprehensive enough to provide the overall "care picture" is a formidable task. By selecting comprehensive nursing nomenclatures and using contextual software design techniques the production of a usable prototype computerized system linking the NIC to the NOC is possible.

Nursing Interventions Classification

A nursing intervention is "any treatment, based upon clinical judgment and knowledge, that a nurse performs to enhance patient / client outcomes"(McCloskey & Bulechek, 1996). These interventions can include both direct and indirect patient care.

McCloskey & Bulechek (1996) define direct patient care as those interventions performed on or with the patient. These interventions can include those performed by nurses to improve physiologic and psychosocial patient outcomes. With direct patient care the nurse is with the patient and actively participates and interacts with the patient during the care process.

Indirect patient care includes the interventions the nurse performs away from the patient to improve the patient's outcome. These interventions can include consultations or changes in a care plan to improve the nursing management of the patient's condition (McCloskey & Bulechek, 1996). With indirect treatments the nurse takes on the role as patient advocate or case manager, performing administrative duties to influence a patient's outcome.

Either the nurse or the physician may initiate treatment. A nurse-initiated treatment is an intervention in response to a nurse diagnosis. The nurse-initiated treatment is an autonomous action backed by scientific rationale and carried out on behalf of the patient to improve the patient's outcome. A physician-initiated treatment is based on medical diagnoses and carried out by a physician or a nurse through a physician's order (McCloskey & Bulechek, 1996).

"The Nursing Interventions Classification (NIC) is the first comprehensive standardized classification of treatments that nurses perform", (McCloskey & Bulechek, 1996). The nursing interventions contained in the NIC include both direct and indirect care interventions as well as physician ordered and nurse-initiated treatments. The NIC's comprehensive design allows it to be used by nurses of all specialties. The taxonomy is coded to allow easy computerization to capture the nursing care provided to patients in all setting. An example of the NIC is provided in Appendix A.

Nursing Outcomes Classification

The Nursing Outcomes Classification (NOC) was developed at the University of Iowa. Its primary purpose is to standardize the language and criteria used to report a patient's outcome relative to nursing interventions. NOC is the first comprehensive language for the measurement of nursing-sensitive patient outcomes, (Johnson & Maas, 1997). Its use by nurses allows the ready exchange of data, between health care settings, regarding a patient's outcome to nursing interventions. Like NIC, NOC is coded to allow patient outcomes to be easily computerized. Its inclusion within a computerized nursing documentation system meets the Nursing Information and Data Set Evaluation Center (NIDSEC) requirements for use of standardized languages, (Iowa, 1997).

The American Nurses Association (ANA) has recognized the Nursing Outcomes Classification as being useful for clinical nursing practice. By recognizing the importance of NOC the ANA has opened up the likelihood for its inclusion in the hospital nursing documentation systems. Furthermore, its usefulness is increased by the inclusion of linkages between the North American Nursing Diagnosis Association (NANDA) diagnosis and NOC, (Iowa, 1997).

Most recently NOC was submitted and accepted by the national Library of Medicine for inclusion in the Unified Medical Language System (UMLS) Metathesaurus, (Iowa, 1997). An example of the NOC is provided in Appendix B.

Nursing Interventions Classification linked to Nursing Outcomes Classification

The development of NIC and NOC has happened in parallel. Until recently, no official attempt has been made by researchers to link the two languages together in a meaningful and useful way. A system linking the two languages together would facilitate nursing research, and for the first time allow nurses practicing in various settings a means

to communicate the effectiveness of nursing interventions upon specific patient outcomes.

A monograph published by the University of Iowa provides linkages between the NIC and NOC nomenclatures. These linkages identify NIC interventions as treatment options to achieve a specific NOC outcome. For example: Pain Level is an example of a NOC. Analgesic Administration is an example of a NIC. If Analgesic Administration increases the likelihood of achieving an improved Pain Level than a link, or linkage, between Analgesic Administration and Pain Level exists. The development of the monograph's linkages required experts to review an initial draft of the linkages between NIC and NOC. The reviewers' comments were then submitted to the Principal Investigators of NIC for final decisions regarding the placement of linkages. These linkages will provide a starting point for research of relationships between interventions and outcomes, thus facilitating the development of evidence-based nursing care, (Iowa, 1998).

The potential for improving nursing care provided to patients through an evidence-based approach has great appeal from both administrative and healthcare perspectives. Costs associated with nursing care could be tracked and interventions found to be least beneficial both economically and in effectiveness could be eliminated. Patient care could be greatly improved by the use of research-proven effective nursing treatments.

General Pain Management Strategy

A general nursing pain management strategy can be used to illustrate nursing interventions and nurse-sensitive patient outcomes. "Pain is a stressor; unrelieved, it can cause both physical and psychological strain", (Loeb, 1999). The nurse's view or beliefs of pain management can directly influence the strategies utilized in the management of a

patient's chronic pain, (Ellen E. Bral, 1998). Nurses must understand and be aware of their own bias and understand how these can influence care decisions. Pain management should be approached in a systematic and organized fashion.

A complete pain assessment should be performed to identify the patient's pain, location, duration and intensity. Physician orders should be reviewed by the nurse and primary care provider notification should be made for an adverse changes in the patient's condition.

A treatment plan for pain should be developed. This plan could include the use of narcotic and non-narcotic analgesics, (Ellen E. Bral, 1998). The patient's pain should be assessed prior to the administration of analgesics and monitored following the analgesics administration.

The nurse may try non-pharmaceutical pain management strategies. These strategies can include: simple relaxation, guided imagery, and music therapy. Introduction of non-pharmaceutical techniques should follow personal instruction by the nurse and, when appropriate, involve family members and significant others.

Competent care requires knowledge at its core, (Mary L. Heye PhD & Leslie Goddard PhD, 1999). Nurses should further their education regarding pain management strategies and collaborate with other professionals and patient families while making pain management decisions.

Contextual Software Design

Determining a project's success

Usability should not, as commonly held, be considered a one-dimensional entity limited to the computer interface. Nielsen (1993) notes five attributes associated with usability: 1) Learnability: deals with the ease a user has in learning a program, 2)

Efficiency: can be measured in terms of the productivity of users who have learned the system, 3) Memorability: allows a user to return to a system after a prolonged period and quickly relearn its use, 4) Errors: should be infrequent and allow the user easy recovery, and 5) Satisfaction: of the user can be measured by the user's subjective descriptions.

The Standish Group (1995) discovered three major reasons most software projects succeed. These are: user involvement [with design], executive management support, and a clear statement of the requirements. Other contributing factors for the success of software projects are (in order of significance): proper planning, realistic expectations, small project milestones, competent staff, ownership, clear vision and objectives, and a hard working / focused staff.

The Standish Group (1996) developed a tool to predict the likelihood of a software project's success. This tool assigned weighted scores to questions categorized using the success criteria cited earlier in this paper. This point system, for determining the success / failure potential of any given software project, is key in allowing developers to determine a project's feasibility, see Appendix K.

To automate an integrated nursing intervention and outcome system so that it is usable in nursing practice requires careful attention to design. Holtzblatt & Holtzblatt, (1995) note traditional software design is carried out through the use of a design team. In traditional software design the design team is made up of a group of experts in product design not experts in implementation and usage design (Holtzblatt & Holtzblatt, 1995). Many software products fail due to the design team's lack of understanding for the end users' work patterns. Traditional software design processes start with an understanding of the workers' "problem" (Greenbaum & Kyng, 1991). This problem-oriented approach to software design is ineffective if the problem is not put into the context of the workplace, as the context offers both constraints and affordances for a usable design. Contextual

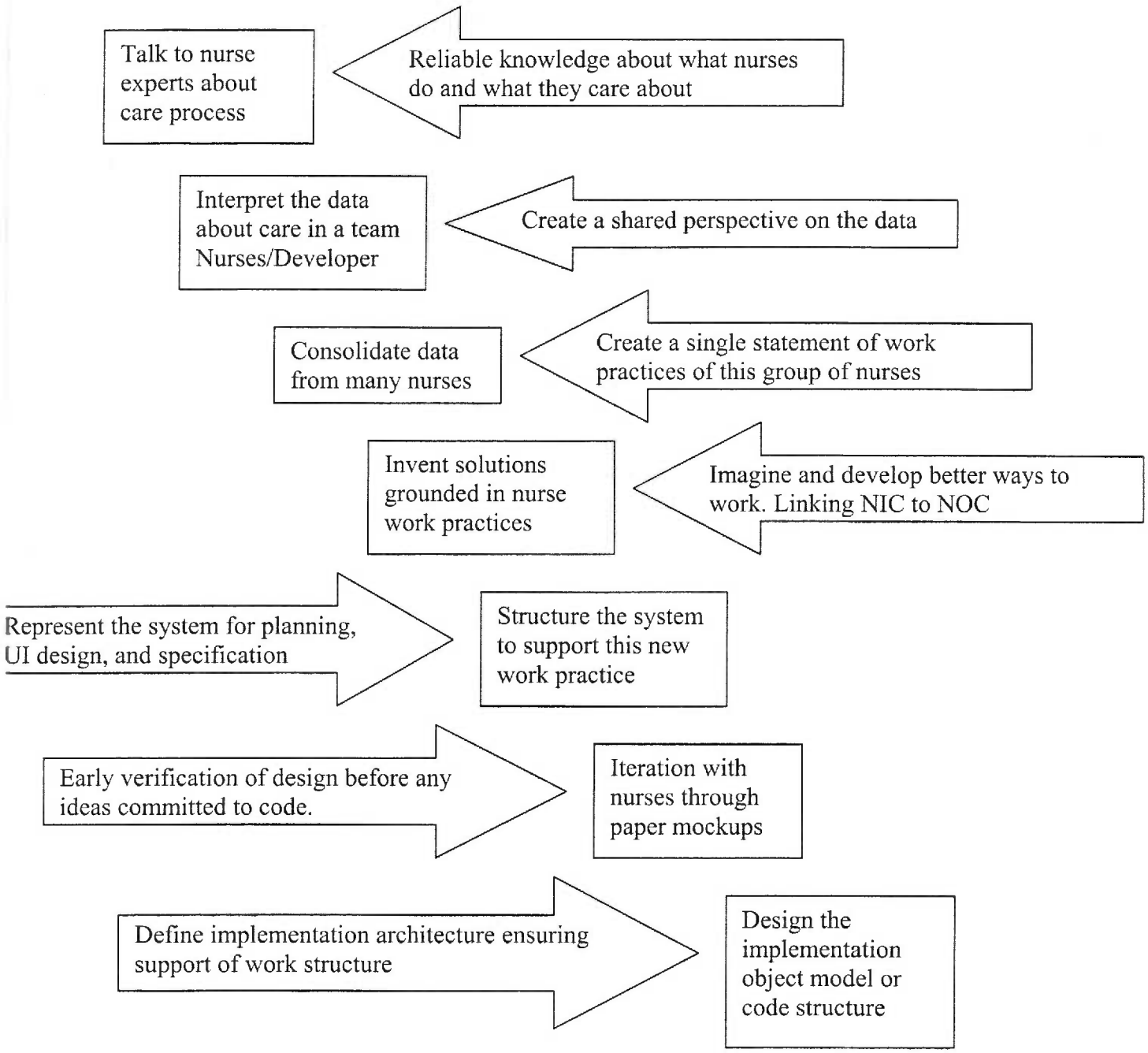
design methodologies make use of the workers' knowledge to bring the context of the problem into focus for the developer.

Software Design

Contextual design, also referred to in the literature as client centered design, uses ethnographic interviewing as a general method for developing a framework for performing systematic observations of work (Holtzblatt & Beyer, 1993; Wixon & Holtzblatt, 1990). With contextual design methods the software designer uses expert knowledge in the design of a product. Experts give the software designers insight into how they work and the designers incorporate this work model into the product design.

Nurse Information Systems (NIS) focus on "clinical data and information as strategic resources for nursing practice" (Grobe, Epping, & Goossen, 1997). A usable NIS should support nurses by providing 1) decision support, 2) contributing to the advancement of nursing knowledge, and 3) providing access to databases of information needed for the delivery of evidence-based care. Contextual design methodology can be used to attain the expert nursing knowledge necessary to design a usable NIS. Figure 1. gives an overview of the contextual design method proposed for the development of a simple Nurse Information System (NIS). It is important to note the involvement of nurse experts throughout the design process. The designer, employing a framework to model the prototype software's design, uses the gathered expert knowledge.

Figure 1. Outline of the Contextual Design Methodology



Adapted from Holtzblatt and Beyer (1998). Contextual Design. http://www.incent.com

Note: Each box indicates a process used by the designer. The arrows indicate the outcome of the process indicated by the box.

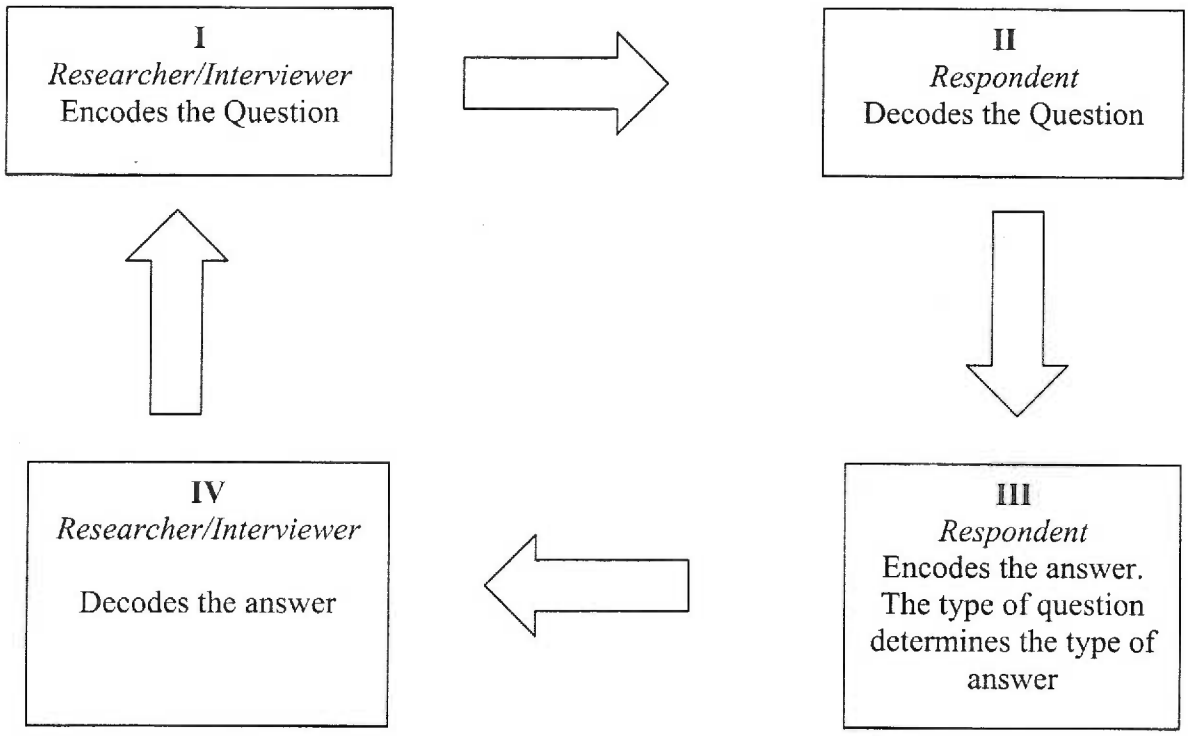
Phases of Qualitative Interviewing Research

Weiss (1994) notes qualitative interviewing research consists of three phases: 1) deciding on the sample to interview, 2) collection of data, and 3) analysis of the data. In quantitative research these phases are discrete entities. In qualitative interviewing, often times these phases are intermeshed and overlap. The researcher benefits from early analysis of data to further focus his or her questioning in future interviews. The new data, obtained from refined interviews, provides information for further analysis creating an iterative and increasingly focused process. The process eventually reaches a point where the discovery of new data is greatly diminished or non-existent. This point of limited discovery is known as saturation.

Zeisel (1981) notes the methodology of semi-structured interviewing requires the researcher to analyze the situation to be studied. This analysis is carried out through the use of theory and observational research methods. This situational analysis will guide the researcher throughout his or her interview. During the interview "the interviewer negotiates with the respondent to find correspondence between the analytic framework and the respondent's mental image of the situation" (Zeisel, 1981). By structuring the information themselves, semi-structured interviewees become participants in the research (Zeisel, 1981).

Based on the situational analysis conducted by the research an interview guide is formed. This guide is used to outline the topics, elements, patterns, and relationships the interviewer plans to cover (Zeisel, 1981). The process of an interview is illustrated in Figure 2.

Figure 2. The framework of an interview.



Foddy (1993)

Interviewing

Scientists in the social sciences (psychologists, anthropologists, sociologists, and historians) routinely use qualitative techniques to gather data for use in research evaluation. Recently, qualitative data analysis has been recognized as an important means for the evaluation of computer systems within health care settings. Questions commonly asked are: "What do users like or dislike about the new system?" and "How does the new system impact the way healthcare providers interact and perform their jobs?" These are difficult questions to answer and are nearly, if not entirely, impossible to answer through quantitative means.

"Interviewing gives us access to the observations of others" (Weiss, 1994). Through the use of interviews the researcher is able to go to places he or she has never

been. Interviews provide the researcher with valuable insight to the nature of cultures and their values. Weiss also notes the researcher can learn about interior experiences, people's perceptions, and how things affect personal thoughts and feelings through the use of a well-conducted interview. Furthermore, interviews give researchers a window to the past. The interviewer can relive past events and experiences through the informants' views and perceptions.

The semi-structured interview is structured in terms of the research problem. This form of interview is not fixed, however, by pre-determined questions and allows the respondent freedom to introduce materials not anticipated by the interviewer (Whyte, 1984). The interviewer uses probes, or follow-up questions, to help the respondent further develop his or her answer. The interviewer is careful not to pass judgment or give advice and listens more than talks.

Qualitative Sample

When determining sample size in qualitative research it is important to distinguish the respondents' knowledge from the respondents. The interview data collected from every respondent makes up the entire data sample and determines the sample size. Knowledgeable respondents, or experts, within a domain reduce the amount of individual respondents necessary to gather a large sample size. This is due to the wealth of rich information a knowledgeable respondent can provide during the interview process. Less knowledgeable respondents are unable to provide the breadth of data given by an expert. Thus, it is possible for the qualitative researcher to provide an adequate sampling of data by focusing his or her research efforts in the identification of highly knowledgeable, expert, respondents and limiting the data collection to those experts.

Indexing

Coding, or indexing, is the segmenting of data into discrete units, (Kaplan & Maxwell, 1994). The researcher usually starts his or her coding scheme guided by previous research and theory along with the information obtained in the situational analysis. As the study progresses, the indexing method becomes grounded in the data. "…It is developed in interaction with, and is tailored to the understanding of, the particular data being analyzed" (Kaplan & Maxwell, 1994).

Evaluation of Interview Data

Whyte (1984) notes interviews are used to 1) determine what has been going on in the experience of the respondent and 2) how the respondent feels about these "events, about other people and organizations important in these events, and him or herself". It is important for the researcher to relate 1 with 2, events with attitudes, else we are left with sentiments and attitudes disconnected from the individuals' personal experiences. This is how the researcher determines as closely as possible "what actually happened".

Contextual Design's Shortcomings

Contextual design's strengths are in its ability to design domain specific software closely matching the users' work processes. This strength is not without trade offs. Developers must learn to value the benefits of user input early in their designs and learn new "social science" skills to be successful in the incorporation of this qualitative data into their project.

The developer must be very cautious in determining the domain experts used throughout the development process. Perspectives of the expert within the domain must be considered when selection of experts takes place. One potential problem in expert selection is the problem of spectators and participants within a work domain. Spectators are those individuals coordinating activities and talking "about" the work. Participants are those doing activities and talking "in" the work (Hlmqvist & Andersen, 1991). Although

both may be domain experts, it is important to distinguish the perspective each views the domain. If the developer excludes one group over the other during the design phase, the potentially biased information could produce a product found unusable by the targeted user.

Incorporation of user input into the development of requirement specifications requires iteration in the project's specification design (Bannon, 1991). Increasing the number of iterations during the design of these specifications increases the time spent on development. If the time spent with users during the specification design is poorly managed, projects will not be completed on time and may be found not usable, despite the extra time spent with domain experts.

A computerized system linking the NIC to the NOC potentially may further evidence-based nursing practice. Contextual software design allows the designer to obtain qualitative data necessary in developing usable computer systems. To successfully exploit the advantages of contextual design, the designer must be an expert at eliciting information from experts within the intended system's domain. Through the use of semi-structured interviews the designer is able to obtain rich data to allow the formulation of a system's user requirements specifications. Using the NIC to NOC links published by the University of Iowa and interview data from nurse experts a prototype-computerized system linking the NIC with the NOC can be developed.

Research Questions

1) Using expert judgments, can a prototype-computerized system be developed which links the Nursing Interventions Classification with the Nursing Outcomes Classification?
2) Is a computerized system developed using contextual design methods and linking

the Nursing Interventions Classification to the Nursing Outcomes Classification found usable by the nurse experts involved with its design?

Methods

Deliverables for Research Question One

- A database framework for the prototype system will be developed and implemented.
- A manual review of the database will determine the degree of data integrity following data manipulation (i.e. Insertion, Deletion).

Functional Specifications

- The prototype will remain stable during the entry and reporting of data from four patient test cases. The test data will consist of data collected from four test cases described by the nurse experts during the first semi-structured interview.
- The database will be reviewed for data integrity after the insertion and deletion of the test case data. This review will consist of a manual audit of the data contained within the prototype's database, matching the data to the user's input.

Deliverables for Research Question Two

- A prototype system will be built based on the tested database design and the expert nurses' specifications.
- An evaluation of the prototype system's usability by the nurse experts will be carried out and presented.

User Satisfaction Specifications

- Information will be entered and retrieved in a manner found usable to the nurses. Semi-structured interviews will be conducted with the nurse experts to discover descriptors of satisfaction.
- Nurses will find the time spent using the prototype system worth the benefits in the potential nursing knowledge gained from the entered data. The nurse experts will be

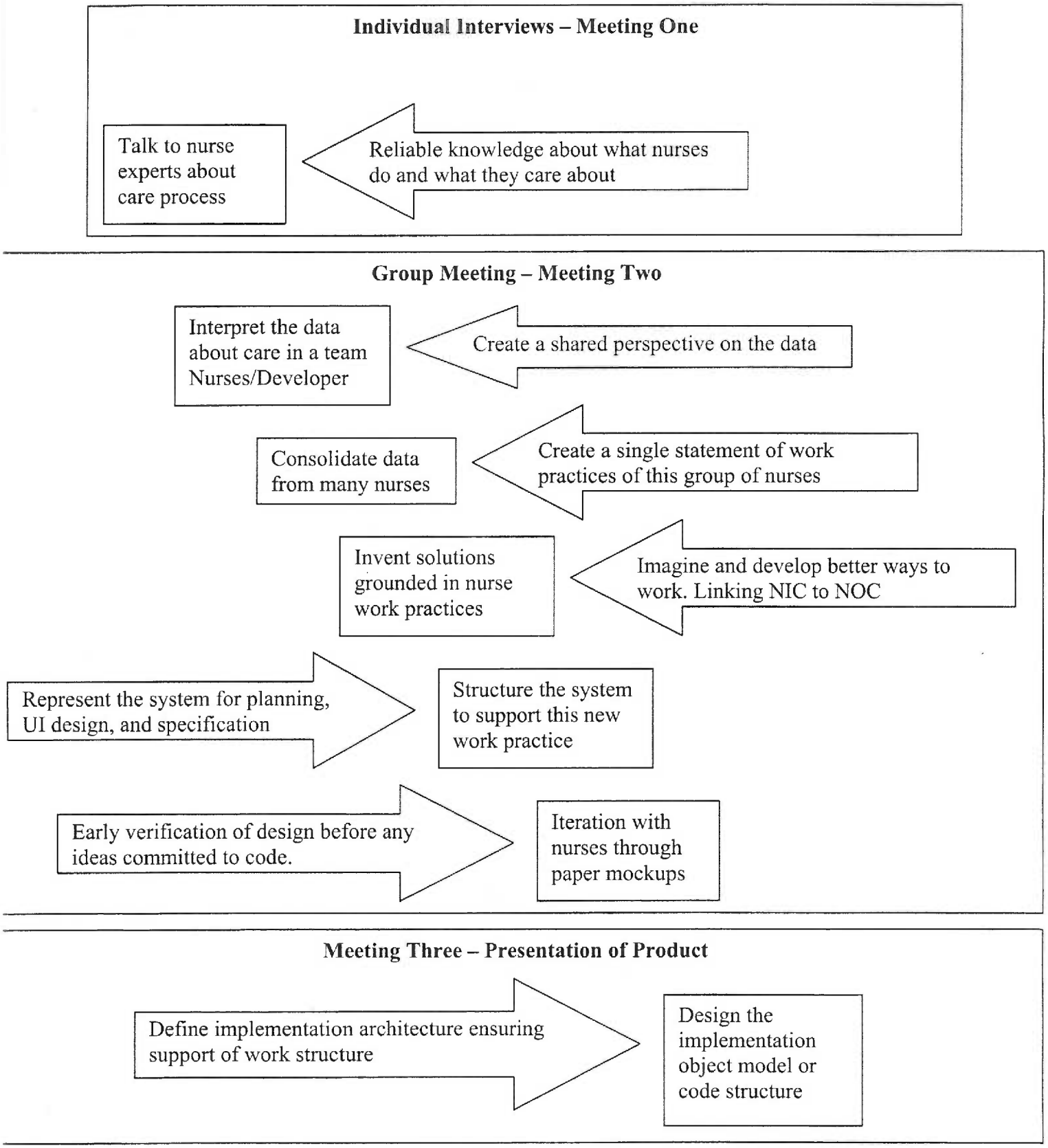
asked to describe potential benefits of the prototype and potential knowledge that may be gained from the data entered into the system. Descriptors of the system's potential benefit to nursing care will be sought.

The goal of this project is to develop a limited operational system utilizing the links between NIC and NOC as published by the University of Iowa. The prototype will be developed using the expert knowledge provided by two home health nurse experts. Using contextual design methodology the nurse experts will be involved in the system's development. The nurse experts will then evaluate the prototype system based on the user requirements specifications set during its design. The evaluation will be carried out in a research environment using pain management as the exemplar.

Design System

The process used to design a prototype linking the NIC to the NOC is based on the ideal contextual design model outlined in Figure 1. Figure 3 presents the modified model as used in the design of the prototype presented in this paper. Condensing of the steps required in the ideal design model is necessary due to limitations of meeting times with the nurse experts. Furthermore, a single iteration of the design process is carried out. Multiple iterations of the contextual design model are often required.

Figure 3. Modified Contextual Design Model.



Respondent Selection and Data Collection

- Nurses in home health nursing identified nurse experts within their community. Nurse experts each have a minimum of five years home health experience and a Masters degree in Nursing. Each have knowledge of the NIC and the NOC and have signed a consent form to participate in this study, as approved by the Institutional Review Board, Appendix C. Each nurse expert will be interviewed during the prototype's design phase to assess their degree of expertise in using computers.

  Meeting One

  - Semi-structured interviews will be conducted with each nurse expert, Appendix D. Audio recording and field notes will be used to capture data from the interviews. Each interview will last approximately one hour. The interviews will allow this developer to gain reliable knowledge regarding what the experts' wants and needs are in a NIS linking nursing specific outcomes to nursing interventions. Interviews will be coded for descriptions, workflow, information needs, and system usability requirements. Each nurse expert will also be asked to describe a situation where a patient's pain was easily managed and one in which a patient's pain was difficult to manage. These cases will be coded for themes and descriptors such as: a) what made the case difficult? b) What made the case easy? c) What interventions were performed to reduce pain? d) What were the outcomes of the interventions performed? Thus, allowing the developer to develop a set of test cases to evaluate the system.

Meeting Two

- Conduct a group meeting between the nurse experts and the developer. The meeting will present the codified data as potential requirements for the prototype system. The group of nurse experts and the developer will form a shared perspective to further validate a model based on the codified data. Based on the shared perspective formed from the codified data, a consensus statement depicting the NIC linked to NOC information system will be developed. This statement, or requirement specifications, will be the foundation of the developed NIS. Paper mock-ups will be presented to the nurse experts based on the preliminary requirement specifications formulated by the developer prior to the meeting. The mock-ups will allow the nurse experts to explore "new ways" to work with the prototype system. These "new ways" will form the template of the NIS. The template will address issues such as the incorporation of the prototype into workflow, prototype usability, and the NIS computer platform.
- Formal specifications will be written based on the nurse experts validated requirements and the NIS template produced using the paper mock-ups.
- The prototype will be designed based on the validated requirement specifications. The prototype will be built based on the design.

Meeting Three

- A working prototype will be presented to the nurse experts. Descriptors validating the user interface and the prototype's ability to function in the experts' work domain will be sought. The nurse experts, through the use of paper mock-ups and templates, will validate report specifications.

System Evaluation

- Each nurse expert will evaluate the system by using it to develop pain management plans and outcome evaluations. The cases the nurse-experts use will be drawn from those obtained during the system design phase.
- Each nurse expert will be given a copy of the formal requirement specifications developed during the early phases of the prototype's design. An open-ended questionnaire will be used addressing whether or not the system met the design specifications developed during the design phase of this project

Instruments

The development environment used for this prototype is Visual FoxPro 6.0 with the Visual Promatrix 6.0 development framework. Visual FoxPro 6.0 is a complete database development tool allowing this developer to develop the database and user interface components of the prototype. Visual Promatrix 6.0 is used due to it's built in audit tracking and security features. Furthermore, the enhanced data dictionary used by the Visual Promatrix 6.0 framework is superior to the standard Visual Foxpro 6.0 data dictionary.

The two research questions presented early in the chapter will be answered through completion of their respective deliverables. Qualitative techniques will be used to collect the data necessary to produce a prototype NIS found usable by the nurse experts. These qualitative methods will allow the development of test cases used during the evaluation of the NIC linked to NOC system. In the following chapter a discussion and report of the development process will ensue.

Limitations

Qualitative research methods require several iterations of the data collection process. Contextual design utilizes qualitative methods to collect the data necessary for

project development. This prototype's design method, outlined in the preceding sections, only undergoes a single iteration. A single iteration limits the ability to fully investigate every concept or idea introduced by the nurse experts during the design process. Furthermore, this limitation prevents the introduction of new users to further test and evaluate the final prototype's design. Generalization of the findings is limited to the nurse experts involved with this project, expert practitioners within the home-health nursing field, and pain management of the home-health patient.

Findings

The Nurse Experts

Using faculty input from the Department of Community Health at the Oregon Health Sciences University School of Nursing, experts were identified in home health nursing. Each expert identified was contacted by this researcher and asked if she would be interested in participating in this research project. Each identified expert was asked to refer any likely participants to this project. After five months of active recruitment two home health nurse experts were recruited for this project. Each nurse was identified as an expert in home health nursing by the criteria set forth in the research design. The limited number of nurse experts involved with the design of this prototype was offset by expertise in home health nursing. Each expert has extensive clinical and supervisory experience within the home healthcare community. Educational background reflected the expertise of each individual; one expert is a doctorally prepared nursing professor and the other a nursing doctoral candidate.

Step One: Interviews

Each expert was interviewed individually using the semi-structured interview guide in Appendix D. The data yielded from the interviews was coded for common themes and descriptors. These themes were used in the formulation of the initial requirement specifications. Listed below are the common themes identified by both experts for each section of the interview:

Descriptive data – the patient care process

- Could you describe for me how you would initially assess a patient's pain during a home health visit?

An assessment starts with a baseline general survey of systems. Pain is viewed as a feature of the survey. Information regarding the patient's pain management is obtained from family members and the primary care provider. If the patient reports pain during the initial visit, its onset, location, and duration are noted. Attempts are made to determine its cause and potential methods for reducing it.

- Could you describe the process used for creating a care plan to manage a patient's pain?

Nursing Diagnosis is used for the development of the care plan. The care plan takes into account the pain's onset, location, duration, characteristic, aggravators, relievers, and tried treatments. The care plan utilizes both physician ordered pharmacological and non-pharmacological (guided imagery, etc) methods for reducing pain. The care plan must encompass other things that may be contributing to the patient's discomfort (i.e. constipation and immobility).

- How do you choose which interventions are appropriate to manage a patient's pain?

Many agencies have placed great emphasis on clinical pathways to manage patient needs. Most of these clinical pathways are difficult to tailor to the individual. They work as guides. The best sources of consultation for choosing interventions to manage a patient's pain are hospice nurses (experts) rather than using a clinical pathway.

- How do you evaluate whether your interventions are working?

If the patient can speak, having the patient rate the pain from 1 to 10 helps evaluate the patient's current state of pain. Observation of body movement is another way to determine if the patient is experiencing pain. Family members are

often times relied on to help determine if the patient's overall state of pain is improving.

Evaluative data – patient care process

- How well do you feel the process to evaluate and manage a patient's pain is working?

  It's based on the skill of the care providers. Furthermore, cultural factors can limit pain management as well as the care provider and family beliefs.

- Have you ever used computers in your nursing practice?

  Not in home health nursing, but in hospital nursing. Home health agencies are just beginning to use computers in their practice.

- How do you feel about using computers in your practice?

  There is a great need for computers in nursing care. Having the latest patient data available could potentially improve a patient's care.

- How would you feel about using a computerized system linking pain management outcomes to pain management interventions?

  It would be beneficial to novices with little experience in managing a patient's pain.

- If this NIC/NOC system were available only to collect data to be used later by researchers, how would you feel about collecting data during your home health visits?

  It would be beneficial to have data collected surrounding a specific patient management issue. The available data could be reviewed when trying to resolve a problem. Some nurses would find the collection of data valuable, but others would not. Many nurses view paper work negatively. Nurses would have to see a need for it.

Non-Specific – patient care process

- What apprehensions would you have about using a system such as this?

  It would have to be something that would not add a lot of time to the nurses' routine.

Descriptive – computer

- Can you describe to me the critical elements of a computer system that make it either usable or non-usable in your care setting?

  It would have to be portable (laptop, palm pilot) the smaller the better. It would need to be inconspicuous and fit into the visit bag. It should have the ability to communicate with other people (check and see email). There should be enough capacity to store information about multiple patients and patient visits. The forms should be well designed, minimizing typing.

- What about input?

  A comfortable size keyboard with a mouse would be desirable. The use of other pointing devices (i.e. glide point and trackball) is not desired.

- What about output?

  Data output should be available in one location for ease of accessibility.

- What about the display's size and type (monochrome vs. color).

  Omitted - due to the limited hardware availability a laptop with color monitor will be used.

- What about computer devices' size (palmtop vs. laptop)?

  Answered above

Non-Specific – general

- Are there any issues regarding a computerized system linking NIC/NOC that we have not covered that you would like to cover at this time?

  Due to an oversight of this researcher, this question was omitted during one expert's interview; however, data was collected during the interview with the second nurse expert.

  The system should allow for guidelines or prompts to reduce the likelihood of forgetting to enter specific data. This would allow other care providers the ability to know which data needs to be collected on a specific patient.

Descriptive – Test Cases

- Could you describe to me two pain management cases:

  In the first case the patient's pain was easy for you to manage through nursing interventions? What was the outcome?

  Easy Case One

This patient is a patient with pancreatic cancer and minimal pain. The patient's pain was not notable until the end of her disease process. The patient's pain was managed effectively using narcotic analgesics.

Easy Case Two

This patient is a post-open neck, surgical patient denying pain. Despite the denial of pain the patient was unable to sleep. The nurse noticed the dressing was poorly placed and oversized for the wound. The nurse redressed the wound and administered

analgesics as prescribed by her physician. The patient was then able to get comfortable enough to sleep.

- In the second case you had a difficult time managing the patient's pain through nursing interventions? What was the outcome?

Difficult Case One

An obese woman in her forties with a husband as her sole support was diabetic with peripheral neuropathy, had gouty arthritis, and end stage renal disease. She had several open wounds due to the gout. She was allergic to most narcotic analgesics. Psychologically she was very optimistic and upbeat and willing to try most anything to manage her pain. The patient was having some success with guided imagery and relaxation (tapes, etc.). The pharmacological interventions had not been very successful. The care providers tried most pain medications, using anti-emetics and antihistamines, to help reduce her sensitivities to the analgesics. Her physician tried steroids to help reduce her pain. Ultimately, dilaudid seemed to be helping her with her pain. Prior to becoming a hospice patient she had an analgesic pump surgically implanted. The management of the patient's pain was not as successful as desired. The difficulty was due to her multiple allergies to the narcotic analgesics.

Difficult Case Two

A patient who was in the process of dying and experiencing high levels of pain was under the care of a hospice nurse. The patient's doctor had previously ordered a mild analgesic. The doctor was contacted by the hospice nurse regarding the patient's increased level of pain and was given an order to increase the frequency of the analgesic. Despite the increased frequency of the prescribed analgesic, it did not control the

patient's pain. As the patient's pain increased the family became more frustrated and concerned. After several unsuccessful attempts by the hospice nurse to have the pain management strategy changed, the family decided to have the patient admitted to a local hospital. Later, the patient expired. The nurse, physician and family were all very frustrated by the situation.

- Follow up question: Looking back on this situation how would you change things?

  If we get to the point in our practice where information is available to support alternative therapies and improve communication between care providers, patient care would be greatly improved. Better information would, perhaps, decrease the back and forth discussion (between nurse and doctor) as to what is best for managing the patient's pain.

Non-Specific general

- Do you have any questions about my project?

  "Will we get to see the results?"

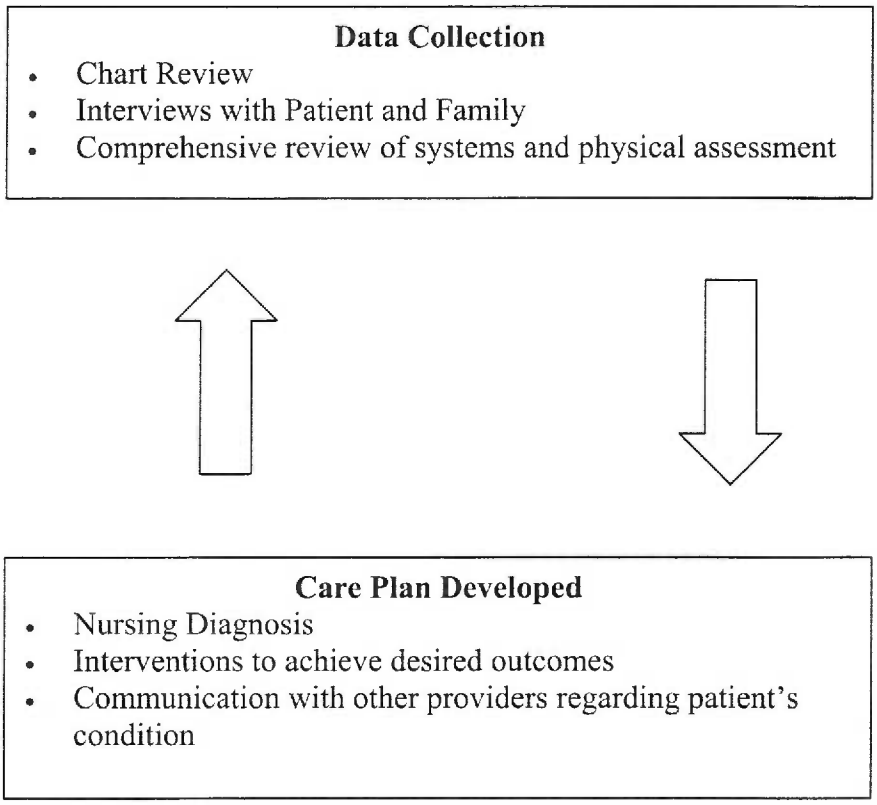
  Yes.

Summary of Data

The descriptors above are the results of comparative analysis of the data collected from the interviews. Data elicited during the interviews and correlating between the experts was used to generate the theme of each question's answer. These themes were used as descriptors in the initial draft of the users requirement specifications. The researcher used the descriptors elicited during the *care process* portion of the interview to develop an understanding of the work process used by the home health nurse. This work

process determined the data flow through the prototype system. Figure 4 summarizes the work process during a home health visit.

Figure 4. Summary of the work process during a home health visit.



Descriptors elicited during the computer portion of the interview indicate a computerized system should be contained on a small portable device. Both experts cited the use of a laptop or palm held device for such a system. Both indicated the preference of keyboard and mouse entry and a design minimizing the typing required by the home health nurse. Based on the care process data and the descriptors surrounding the *computer* needs of the nurses a tentative requirements document was developed, Appendix E.

First Group Meeting

Prior to this meeting the prototypes basic data framework was designed. The framework was designed using Microsoft Visual FoxPro 6.0 and Visual Promatrix 6.0 The database framework consisted of the look-up tables used to populate the forms with the Outcomes, Indicators, Interventions, and Activities. The database was normalized to

third normal form to decrease redundancy and decrease anomalies. Furthermore, the basic patient, nurse, and physician information tables were added to the framework. Basic operations of data insertion, deletion, and retrieval were performed and tested. The basic framework was determined robust after manual review of the table data after each basic operation.

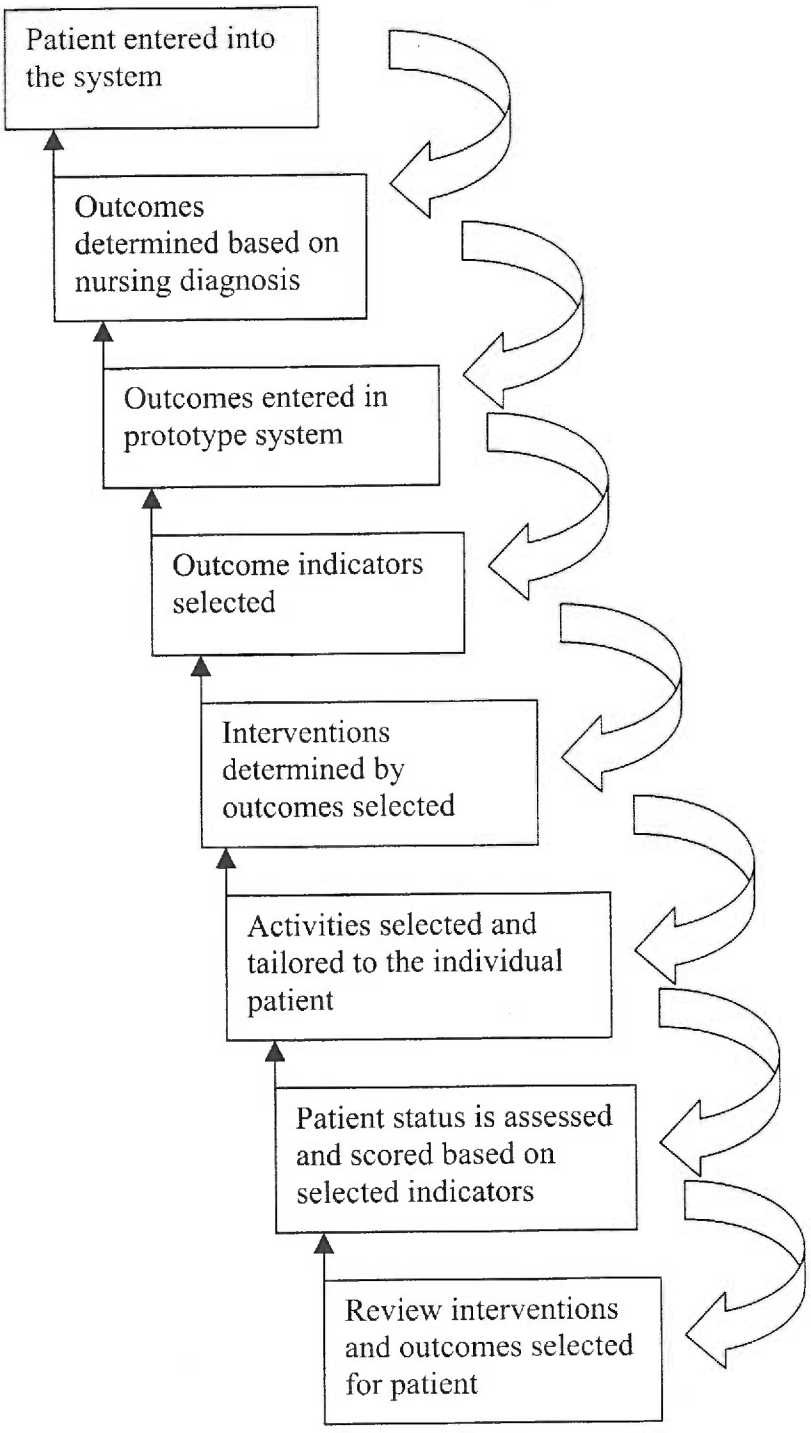
The meeting was organized in the following manner: 1) the nurse experts were presented with the initial requirement specifications document, 2) the purpose of the prototype was emphasized, 3) the goals of the prototype were stated, 4) paper mock-ups of the prototype's forms were used to match the home health nurse's work process, and 5) the hardware and software were presented. See Appendix E.

Initial Requirement Specifications Document

Both nurse experts validated the work process (Figure 4) used by home health nurses during a typical home health visit. The prototype's data flow, based on the home health nurses' work process, was presented to the experts. Figure 5 outlines the prototype's proposed data flow. Both nurse experts agreed that the data flow worked well with the work process identified and validated in the requirement specifications.

Figure 5. Data flow outlined in the initial requirement specifications.

Note: Care is not a linear process, thus the prototype's data flow is iterative.



The purpose of the prototype was re-emphasized prior to review of the paper mock-ups as were the goals of the prototype, see Appendix E - Section III and IV. This was to help focus the experts and the discussion during the paper mock-up presentation.

Paper Mock-ups

Menu

The following screen shots were presented to the experts for clarification of the prototype's dataflow and to elicit data regarding the forms used in the new system. Figure 6, shows the system's main menu.

Figure 6. Mock-ups of the prototype's main menu

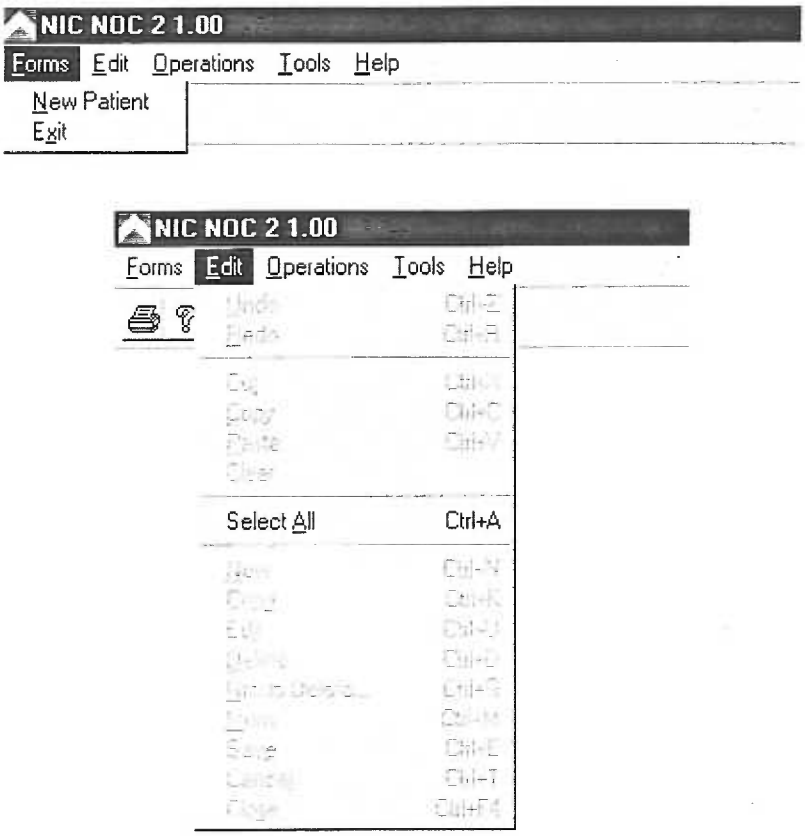
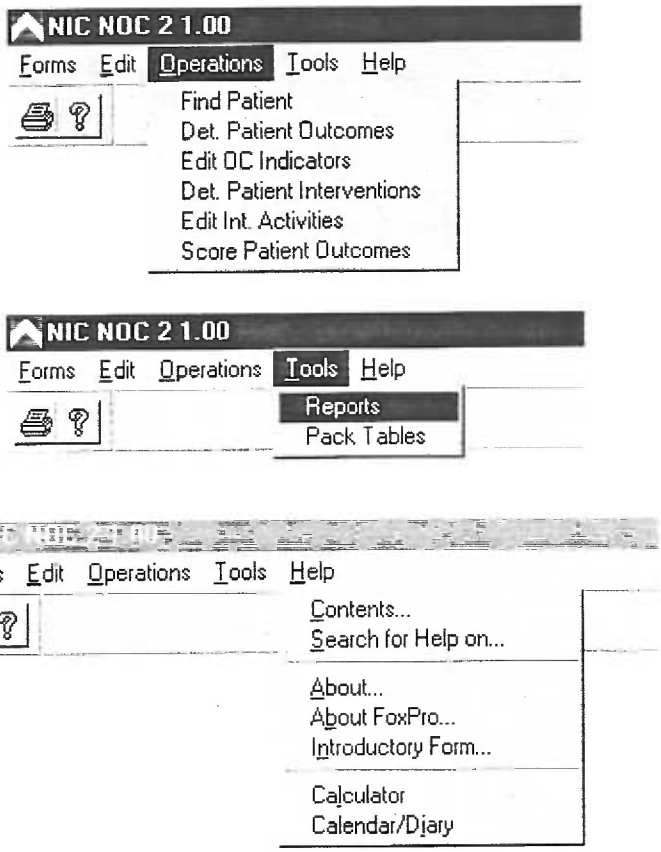


Figure 6 (cont.)



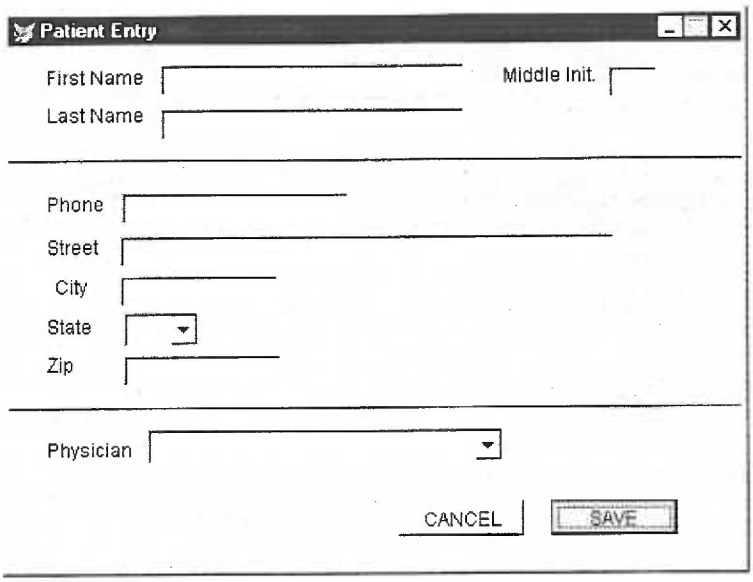
Overall the nurse experts were unsatisfied with the initial menu system as presented above. In the experts' judgment the menu choices were not user friendly due to their vague descriptions regarding each selection's functionality. Furthermore, both experts felt the menu was too complicated. Both agreed the menu should be simplified to minimize the amount of learning required by the user.

Patient Entry Form

Figure 7 is a screen mock-up of the patient entry form. Both nurse experts agreed more information on this form was necessary. Suggested additions to the form were: 1) primary doctor with contact information, 2) specialists with contact information, and 3) primary nurse with contact information. Both experts felt the patient's demographical

information should be pre-entered to further reduce the amount of time spent with the system by the nurse.

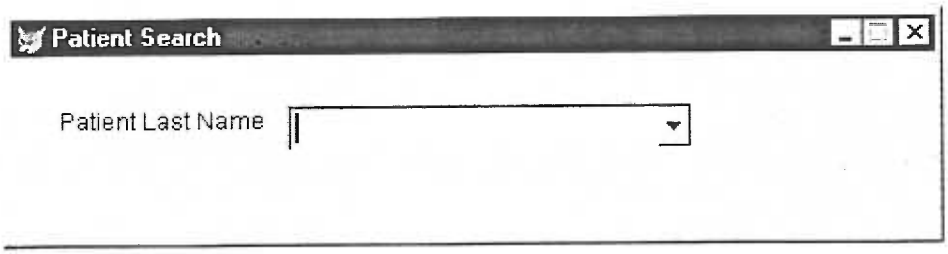
Figure 7. Mock-up of the prototype's Patient Entry Form



Patient Search

The experts agreed that search capabilities should be available to the home health nurse. Both experts were concerned about the limitation of the patient search form presented in Figure 8. The home health nurse needs to be able to search for a patient using various indexes. Example indexes suggested by the experts were: last name and medical record number.

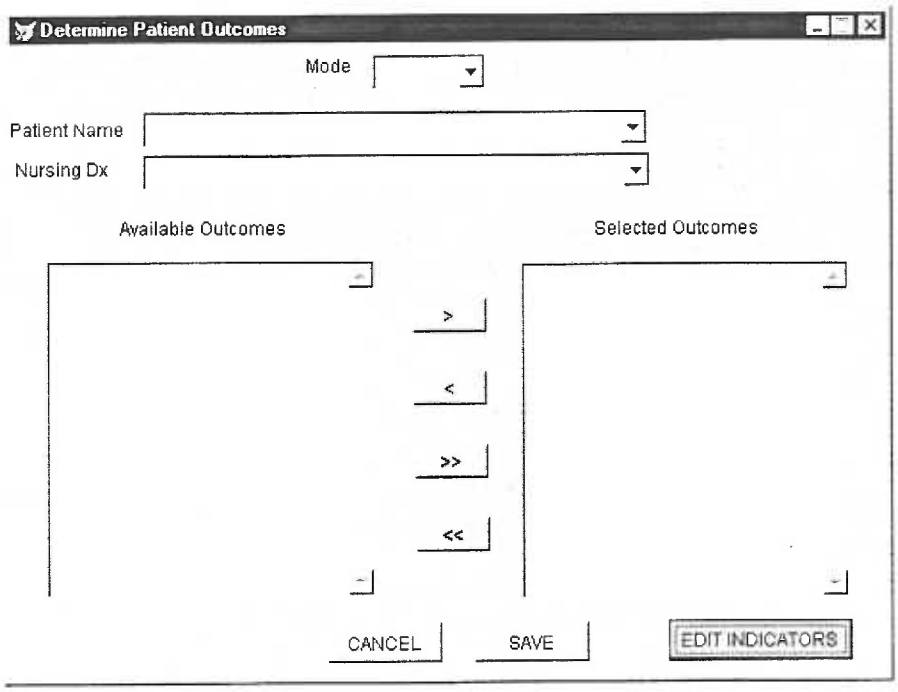
Figure 8. Mock-up of the prototype's Patient Search form.



Determine Patient Outcomes

The experts found the mover dialog used on the form in Figure 9 intuitive. Both had experience using computers and were familiar with the use of mover dialogs. The use of the "Mode" selector at the top of the form was found unnecessary. Suggestions made by the experts were to include more biographical information about the patient at the top of the form and allow the nurse to use macros to tailor the system to their specific nursing practice. The building of macros into this prototype will be saved for another researcher or serve as a basis for funding this researcher's grant application to develop a richer prototype.

Figure 9. Mock-up of the Determine Patient Outcomes form

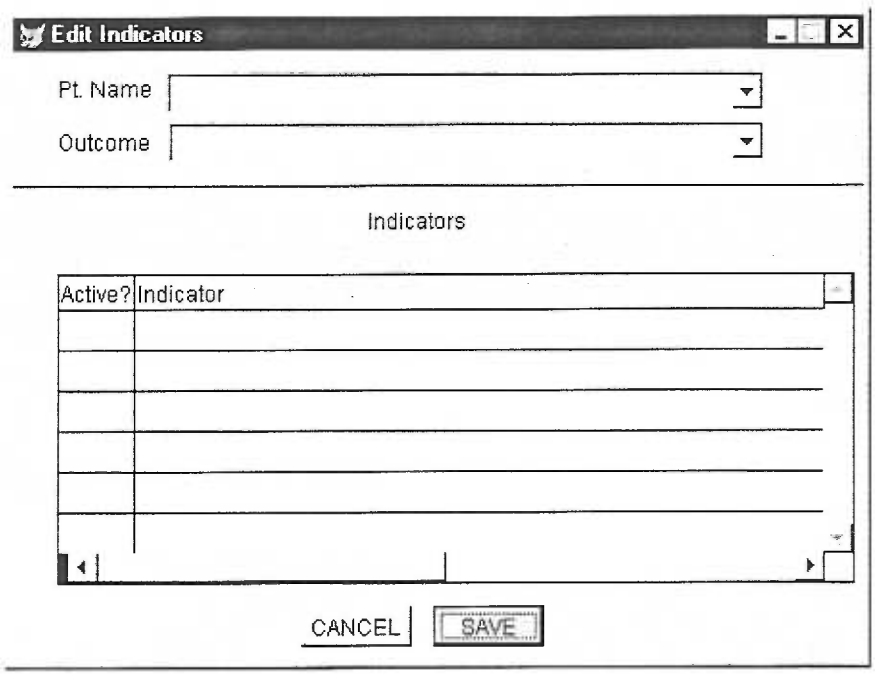


Edit Indicators

The edit indicator form, Figure 10, was presented a list of indicators with check boxes in the "Active?" column. If checked the indicator was determined active and would be scored by the nurse. It was determined that the indicators default to "not active", or

unchecked. The experts validated this format and requested a scoring key to be included at the top of the form. The ability to add patient specific indicators was also requested by the experts. This request would allow researchers to determine if additional indicators may need to be formally added to an outcome. Overall, the form was found to be intuitive and designed to fit well with the work process of the home health nurse.

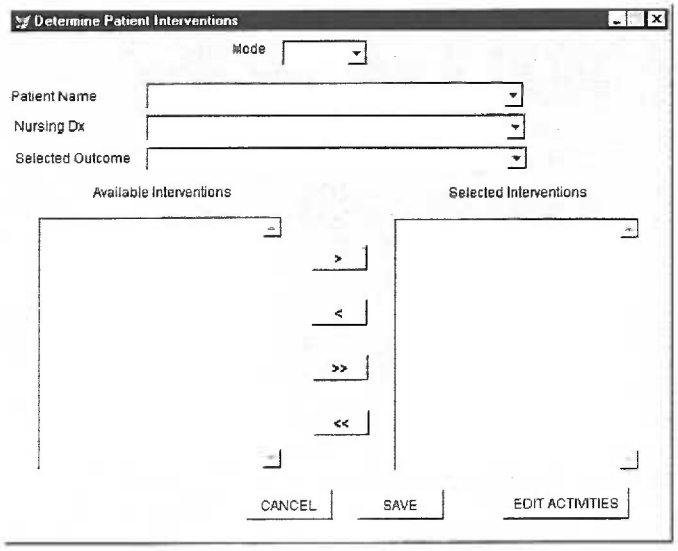
Figure 10. Mock-up of the Edit Indicators form



Determine Patient Interventions

The experts requested many of the same changes to this mover form (Figure 11) as were requested for the "Determine Patient Outcomes" form. Both experts found the "Select Outcome" drop down box not intuitive, even confusing. The mode dialog was found unnecessary and the request for macros was made by one of the experts. The experts were satisfied, once again, with the use of a mover form due to its intuitive nature.

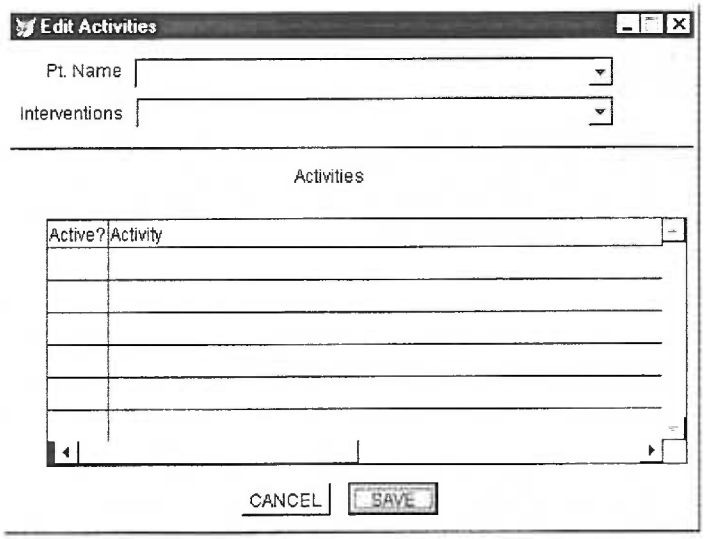
Figure 11. Mock-up of the Determine Patient Interventions form.



Edit Activities

The nurse experts found this form (Figure 12) intuitive in design. Similar to the "Edit Indicators" form, it consists of a list with check boxes to indicate whether or not the nurse is performing a given activity with the patient. The experts felt it important to allow the home health nurse to chart variances in the activities as either narratives or from a selection list. The ability to add activities specific to the individual patient was stressed by both of the experts.

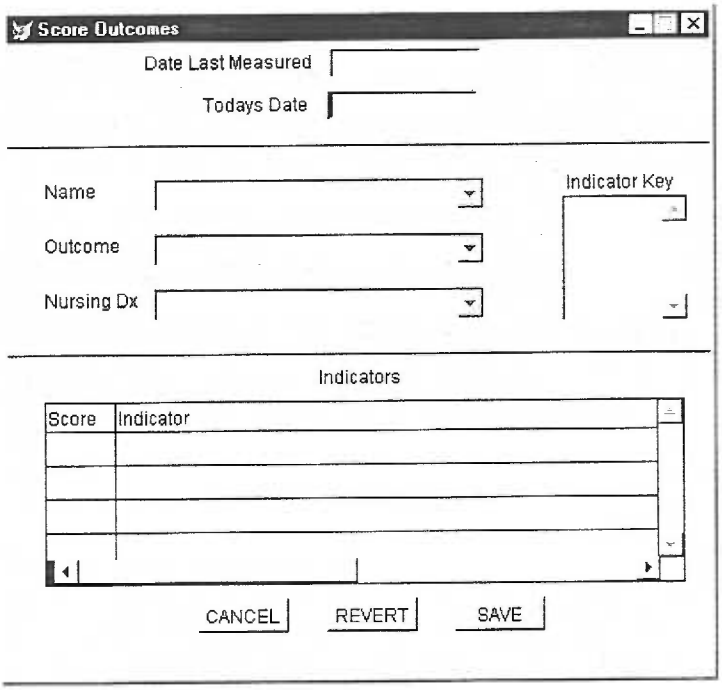
Figure 12. Mock-up of the Edit Activities form



Score Outcomes

The nurse experts found this form (Figure 13) very usable and well designed. Both requested the ability to add variances documenting narratives of any conditions affecting an indicator's score.

Figure 13. Mock-up of the Score Outcomes form



Prior to the closure of the meeting the nurse experts validated the hardware and software to be used for this prototype.

Summary of Data Collected in the Second Meeting

The nurse experts were presented with documentation stating the prototype's initial requirement specifications and this researcher's interpretation of the home health nurses' work process. Validation was obtained after asking the nurse experts to suggest potential changes to improve either document. Neither expert suggested any additions or

deletions to the document, thus validating the requirement specifications and the work process.

Upon presentation of the prototype's mock-ups, many changes were deemed necessary. The most notable changes were: 1) simplification of the menu structure, 2) the need for more information about the patient and his/her care providers, 3) expanded search capabilities, 4) the ability to add indicators and activities, and 4) the ability to chart variances when necessary. Overall, the experts were satisfied with the flow of data through the mock-up prototype, with the requested changes noted. The prototype will be designed and presented to the nurse experts in the next meeting.

Third Meeting with the Experts

Due to difficulty in scheduling, the nurse experts met with this researcher individually for the third meeting. This variation from the original research design was deemed necessary to continue moving the prototype's development forward. Prior to the meeting, a working prototype was developed incorporating the expert's requested changes into its design. Several fundamental changes were necessary to the underlying table structure in the database. The most notable was developing a means for tracking nurse added indicators and activities. Other table level changes included the addition of variance fields to store narratives entered by the nurses and fields used to audit nurse activities. These audit fields would be ultimately used to report data nurse to patient interaction. The login procedure incorporated in the Visual Promatrix 6.0 framework provided a stable means for logging the nurse into the system and tracking patient interaction.

Forms were developed to administer the prototype system. Although these forms were not used or evaluated by the experts they are presented in Appendix F. The administrative forms presented in the appendix were used to enter and maintain the data

contained in the look-up tables, patient information tables, and doctor information tables. Other forms were used to clear test data entered into the system during the prototype's design.

Templates were developed for the reports to be produced by the prototype. These templates were presented to the experts for validation following the expert's preliminary evaluation of the working prototype.

The meetings were organized in the following manner: 1) the prototype was demonstrated to the nurse expert. Descriptors regarding the performance and usability of the prototype were elicited during the demonstration, 2) the nurse expert was given free use of the prototype and more descriptors of usability were sought, and 3) the report templates were presented to the experts for validation. The descriptors were coded for themes and the results were documented in the following sections. Screen shots of the prototype system can be found in Appendix G.

Descriptors of usability and performance

Login and Patient Selection

To demonstrate the prototype this researcher logged into the system as a home health nurse with non-administrative privileges. The use of a standard login dialog was familiar to both of the nurse experts. Both experts were satisfied with the simplified menu structure. The use of a centralized form allowing most actions to be launched was appealing to the experts. The experts found the expanded patient search capabilities useful. The tabbed form containing the patient's biographical information, diagnosis, and provider information was found satisfactory. One expert requested the use of a bold font to enhance the tabs highlighting each section of patient information. The tabs were changed to bold font immediately following the meeting.

Outcome Selection and Intervention Selection Forms

The use of the mover form was carried over into the working prototype from the original mock-ups. The experts highly satisfied with the ability to view all the patient information at the top of these forms; facilitating review of patient data, as necessary, when selecting the outcomes or interventions. The detail button on the mover dialog was demonstrated to the experts. Both experts were satisfied with the ability to view each outcome or intervention's details prior to selection. The experts found these forms flowed well with the care process.

Indicator and Activity Selection Forms

These forms were found very usable to the experts. The additional scoring key added to the top of the indicator form made the form easy to understand and use. The experts were satisfied with the ability to add variances to the activity selection form. The highlighted color displayed after adding a variance was found to be beneficial. Both experts found the forms to be self explanatory and well matched to the work process. The ability to add indicators and activities was found beneficial. The display of nurse added indicators and activities in a contrasting color was found to be useful by both experts.

Indicator Score Form

Both experts were satisfied with the usability of this form. Both described the layout as allowing data entry to be quick and efficient. The display of contrasting colors facilitating the quick review of those indicators requiring scoring was found satisfactory to both experts. The ability to chart variances was noted to be satisfactory by the experts.

Free Use of the system by the experts

The system was found easy to use and required little explanation after the initial demonstration by this researcher. Descriptors of the system included its easy of use, clearly marked forms, and smooth flow throughout the data entry process. Both experts commented on the potential commercial applications for this prototype. One expert compared the system to a commercial product currently in use; stating this prototype was far superior.

Validation of the Report Templates

Each nurse expert validated the report templates. Both were satisfied with the output and format of the report. See Appendix H for the templates validated by the nurse experts.

Summary of Third Meeting with the Experts

Only one change was recommended to the prototype during these meetings with the experts. This researcher following the meeting made the change to the typeface on the tabs deliminating the patient information. Both experts validated the output report templates to be used by the prototype. The final meeting will allow the experts to evaluate the system as an entire entity.

Final Evaluation

Four test cases were developed based on descriptors obtained during the first interview with the nurse experts. Two of the cases were based on descriptors describing difficult pain management and two were based on those describing easy pain management, Appendix I.

Prior to the evaluation each expert was given a copy of the validated requirement specifications, Appendix K, to refer to during the evaluation process. Both experts used the test cases to assess the usability of the prototype. A questionnaire, Appendix J, was used to elicit descriptors of satisfaction or dissatisfaction regarding the usability of the prototype. Due to scheduling conflicts, Nurse B evaluated the prototype remotely (without this researcher present) while Nurse A performed the evaluation in the presence of this researcher. Following is a presentation of the data obtained from the questionnaire.

- As a home health nurse clinician what potential uses do you see for the information entered and retrieved by this prototype?

Nurse A

Speaking as a supervisor as well as a clinician: "The layouts are easy to use and scan. It is easy to see what I have done and what I haven't.... It would be nice to have a hard copy to see what the previous charting contains". I could see it being used for tracking patient progress and quality assurance. I see it possibly being used to improve quality of care and allowing review of whether the standard of care is being met. To be used for further research in pain management evaluation.

Nurse B

This prototype could be used by some agencies for their computerized record keeping. Currently, home health care providers are required to document the OASIS outcome data mandated by Medicare. Clinicians see this added documentation as a burden. If OASIS was built into the prototype its acceptance would be higher, otherwise, it may be viewed as an added burden. The prototype could be an important tool for the collection of outcome specific data; data specific to home health care nursing. OASIS is not specific to any single discipline and is unable to help the clinician pinpoint which

interventions may be effective in improving outcomes. Another potential way to improve acceptance of the prototype would be to adapt its functionality to a palm device. Kaiser telephone advice nurses currently track interventions and resulting outcomes using palm devices.

- Is the data collected by this prototype of potential use to home health nurse researchers? If so, give examples of potential uses for this data.

Nurse A

To help determine which interventions are most effective in pain management. The system could also be used to help determine if there are "regional differences in how pain is managed." Pain management among different cultures could also possibly be evaluated using this prototype.

Nurse B

"I really like the system for this purpose." A research collection tool is not as problematic to implement. Typically, researchers build in extra staff time to document using new research tools. Currently I am "working on a project that I would have preferred to use [the prototype] system over the DOCPlus system used by Kaiser." The download from the web and installation worked great and was easy to use. "Could you possibly also put it on CDROMS so that it is readily available for other researchers to try out?"

One difficulty we have with the DOCPlus system is tracking the effectiveness of interventions. All data for interventions is narrative and codifying the data is difficult. "It would have been nice to have a system like yours as an option when we were trying to design the clinical information database."

- Describe the degree of difficulty in learning to use this prototype in comparison to other Nursing Information Systems that you have used in the past.

Nurse A

"This has good intuitive sense in terms of the layout". I could figure out how to use the system on my own. It draws on common conventions used in other database (i.e. menu bars, scroll bars, and mover dialog). The sequential navigation ensures all data is entered and the user does not leave out any steps. This would be good for novice users.

Nurse B

"Versus the DOCPlus system, [the prototype] is a dream to use." The DOCPlus system requires a full time support person due to its difficulty to use. The prototype is far more intuitive for the user. An intuitive user interface is a tremendous advantage. "I really like the user interface in particular."

- How might expert nurse clinicians use this system differently from novice nurse clinicians?

Nurse A

"I think in a couple of different ways, one is individualization." Experts would want to tailor it a little more. The system would be helpful in "reminding the novice to do a specific task", whereas, the "system would be helpful in reminding the expert to chart a specific task". "It would do a better job in helping the expert remember to capture some of the performance behaviors". Experts may become impatient with the system due to its methodological format. The ability to add one's own indicators and activities would be used more frequently by the expert than the novice.

Nurse B

This program has a much-reduced learning curve for all clinicians because of the user interface. "More experienced nurses would be able to use this system to illustrate how their practice differs from novice nurses." The experienced nurse would use the system to "highlight how their practice identifies more opportunities for intervention, and how they are more efficient in selecting the best strategies to solve clinical problems."

Summary of Evaluation Data

Both nurse experts gave positive descriptors of usability for the prototype. Strong points of the prototype were: the methodological flow of data through out the system, the value of the system to both novices and experts, and the usability of the system as a tool for collecting data valuable to researchers. Specific comparisons to the DOCPlus system by one nurse expert gave valuable insight to this researcher regarding the usability of the prototype compared to another nursing information system. The following chapter will discuss the conclusions drawn by this researcher from the data collected.

Discussion

The research within this paper set out to answer two research questions: 1) Using expert judgments, can a prototype-computerized system be developed which links the Nursing Interventions Classification with the Nursing Outcomes Classification? 2) Is a computerized system developed using contextual design methods and linking the Nursing Interventions Classification to the Nursing Outcomes Classification found usable by the nurse experts involved with its design? Clearly the data shows the use of contextual design methodology can produce a highly usable system linking these two standardized nursing nomenclatures.

The Prototype's Usability

The nurse experts found the final design of the prototype usable. Usability as defined earlier in this paper is a multidimensional entity comprised of five components: 1) Learnability, 2) Efficiency, 3) Memorability, 4) Errors, and 5) Satisfaction.

Learnability

Descriptors by the experts indicating learnability of the prototype included "intuitive" and "reduced learning curve". These descriptors indicate to this researcher the high usability of the prototype with regards to its learnability.

Efficiency

Both experts describe the prototype as efficient. Descriptors such as "a dream to use" and "it is easy to see what I have done and what I haven't" give this research insight into the perceived efficiency of the prototype during data entry for the test cases.

Memorability

Due to time limitations the memorability of the prototype was not directly tested. However, an indication of this usability component may be evident in the reduced instruction necessary during the evaluation of the prototype.

In the third meeting both experts were exposed to the system. This meeting resulted in few changes to the final prototype, leaving the final prototype very similar to the system presented during this meeting. The need for very little instruction despite the lapse of several weeks between the third meeting and the final evaluation supports memorability of the system.

Errors

No errors were reported during the evaluation of the test cases.

Satisfaction

Both experts reported high satisfaction with the prototype. Descriptors of satisfaction included: "It would have been nice to have a system like yours as an option when we were trying to design the clinical information database" and "this has good intuitive sense in terms of the layout…I could figure out how to use the system on my own".

As seen above the system was found highly usable in four of the five usability components. The fifth usability component, memorability, is implied through the reduced instruction required during the prototype's evaluation.

Prototype Usability Among Different Practitioners

The distinction made by the experts between potential uses of the prototype by a clinician verses its use by a researcher is clear. The clinician is more likely to use the prototype as a tool for determining and improving the quality of care for the individual patient. The nurse researcher is looking at the data collected by the tool to determine differences in quality of care throughout patient populations.

Despite the difference in uses the experts determined both novices and experts would find the prototype usable due to the close match between the data input and the nurses' work process. Novices and experts would use the system differently due to patient care experience. The novice would view the system as a resource for patient care. The prototype would take on the role as a reminder system, suggesting care strategies. The novice is more likely to use the interventions and outcomes as presented by the system.

The expert would view the system as a resource for charting. The prototype would take on the role as a charting tool. Experienced providers would make more use of the ability to tailor the prototype's interventions and outcomes to the individual through the editing abilities built into the prototype.

The prototype's usability could be attributed to the incorporation of experts throughout the design prototype. The literature identifies the largest indicator of a software project's success is user involvement. If the user is not involved in the development of an application the likelihood of its success is greatly diminished. Another factor highly attributed to an application's success or failure is a clear statement of the project's requirements. By incorporating expert input in the development of the initial requirements specification and validating those specifications, the likelihood of user satisfaction was greatly increased.

Contextual Design's Usefulness

The use of nurse experts early in the design process of this project gave this developer insight into the work process of the home health nurse. The work process was incorporated into the prototype's design from the very beginning. Despite the incorporation of the work process into the mock-up system, the experts found the mock-

up unusable. This was evident throughout the discussion of the mock-up's screen shots. The experts suggested many changes to increase the prototype's usability.

The value of the paper mock-ups in this case was two fold. First, the experts validated the flow of data through the system. The order of the mock-ups was correct; this indicated a match in the nurses' work process. Second, the experts expressed concerns regarding the layout and design of the mock-ups; this indicated the user interface was unusable. If the mock-ups were not presented to the experts, valuable data would have been missed. Creating a product found unusable by the user.

Concerns identified by the experts in the interface design were in two areas: 1) the terminology used with the menu choices and 2) the complexity of the system.
Both experts found the terminology used within the menu system of the mock-ups unusable. During the semi-structured interviews little data was collected regarding the terminology of users in home health care. The deficiency of this domain specific language could only be discovered with the presentation of screen shots, or a completed program. Here the mock-up identified this language barrier. The comments of the experts allowed this developer to further refine the menu system and place menu terms in the users' language.

The experts found the complexity of the mock-up system unusable. According to the experts, a usable system should be methodological in its format. The initial mock-up allowed many choices and directions for the user to take in data entry during the care of the patient. The importance of collecting data in a complete manner was stressed. Both experts found a system matching the methodological work process would facilitate data collection and the system would be more usable. A system closely matching the work process could even serve as a reminder system during patient care.

The usefulness of contextual design methodology can be found throughout the prototypes development. The necessity of interviewing and interacting with the domain expert ultimately could save time in the development of domain specific applications. This is especially evident in the design of this system. If this developer had not presented and validated the user requirement specifications and the menu / screen layout to the experts prior to development, valuable time would have been lost and a less usable system developed. At the very least many modifications would have been required to the prototype after its initial design.

The use of two highly qualified and educated nurse experts from home-health nursing gave depth and reliability to the knowledge incorporated into the design of this prototype. The amount of rich data collected from the respondents' serves well as a sample basis of the expert knowledge incorporated by nurses in home-health care. Increasing the number nurses on the design team with varying expertise in home-health nursing would allow a broader sample of nursing knowledge to be collected. This broader sample would likely be more representative of the total knowledge used in home-health nursing. By incorporating a larger knowledge sample into the contextual design methodology the usefulness of the methodology would be increased, resulting in a more usable product.

The Database

The database framework was found to be very effective. Data was inserted, deleted, and changed while maintaining its integrity. The Visual FoxPro 6.0 and Visual Promatrix 6.0 development tools proved to be effective in the development of this project. The prototype installed and ran on the hardware specified in the requirement specifications without any technical problems. Manual audits of the data tables showed

no signs of insert / deletion anomalies. The nurse experts found the report structure satisfactory.

The shortcomings in the Visual FoxPro 6.0 database lie in its incomplete implementation of a data dictionary. The use of Visual Promatrix 6.0 solved many of these shortcomings. As a demonstration of concept the prototype was successful with this design tool. However, for a scalable application a more robust database backend (i.e. Oracle, SQL Server) should be utilized. Furthermore, the single tier design of this prototype should be substituted with n-tier architecture. N-tier architecture would facilitate the centralization of the data repository. N-tier architecture could even lend itself to development of a web-based application allowing users to collect and access data over the World Wide Web.

The results found in this paper are supported by the literature. The tool developed by The Standish Group and presented in Appendix K, indicates the number one criterion influencing the potential success of the any software project is "User Involvement". During the development of the prototype, the experts served as a proxy for the user. Their involvement from the earliest stages of design greatly improved the likelihood of a successful project. The Standish Group identifies a "clear statement of requirements" as another highly influential determinate of a project's success. Once again the experts were utilized to hone in on the requirements necessary in a system linking the NIC with the NOC, producing a clear statement of the requirements. By involving the users opinions from the earliest stages of design and using these opinions to form a clear requirements document for the prototype the findings presented within this paper are predictable.

Limitations

This prototype serves well as a demonstration of contextual design methodology and its use in the development of a nursing information system. However, this system is limited to pain management of the home-health patient.

Qualitative research is a time consuming iterative process. The design of this system only involved a single iteration of data collection. This single iteration of data collection did not allow additional nurses from outside the design team to evaluate the prototype. The experts were left speculating how users of differing expertise would benefit and use the system. Furthermore, it is impossible to determine the usability of the system outside this group of experts. This, too, is due to the domain experts being the sole evaluators of the prototype.

Implications of the Prototype

Contextual design methodology has allowed the development of a prototype data collection tool using two standardized nursing nomenclatures. However, the use of proprietary nursing nomenclatures relies on their developers to continue their expansion and refinement. Data collection tools such as this prototype could play an integral role in the advancement of the NIC and NOC. Data collected during the nursing care of patients could be incorporated into the nomenclatures to further their enhancement.

It is difficult to implement any new health information system. Resistance to change in current care practices and charting methods often creates formidable obstacles in health information system implementation. Nurses will have to recognize and value the systematic collection of care data to further nursing practice and accept change in the way they currently practice. These common implementation barriers may be over come, in part, through the use of contextual design methods. Methods allowing input from nursing domain experts to create systems closely matching the nursing work and care processes.

Future Research

This prototype serves well as a basis for demonstrating the ability to create a usable system incorporating the links published by University of Iowa between the NIC and NOC. Expansion of the prototype to include home-health nursing care outside of pain management would be the next logical step. Allowing novice and expert clinicians from outside the design team to evaluate the system would test the opinions of the experts. This increased knowledge could further refine the system and discover changes necessary to increase the overall usability of the system within the home-health field.

Expert nurses from different practice domains should also evaluate the prototype. This would allow researchers to gain insight into the usability of the prototype outside home-health nursing. The NIC and NOC would also be under scrutiny, as their usability throughout differing nursing domains would be tested.

Further expansion of the prototype to provide aggregate data would need to be explored. This new functionality would require the system to graphically display data collected over time. Domain experts could be utilized to determine the "best" graphical representation of aggregate data. Both individual patient and population based aggregate data could be reported. The data could be utilized in developing, reviewing, and refining individual care plans and moving closer to evidence based nursing practice.

Future Nursing Practice

Nurses could develop "a new way to work" using population based data. Using graphical analysis of centralized aggregate data nurses would be able to quickly identify interventions likely to be beneficial for his or her patient. As the nurse records the individual patient's interventions and outcomes the data could be uploaded to the central repository continually updating the data available to other practitioners. By making

informed decisions regarding patient care and providing up to date evidence based nursing practice patient outcomes could be improved.

Graphical data reporting would allow nurses to quickly review data collected over time for each of their patients and quickly determine where each patient lies on the outcome continuum. This improved representation of data allows nurses to review with family members and other care-providers areas of patient improvement and areas in need of improvement. This provides nurses with another "new way" to educate patients and their families regarding patient progress and to communicate patient progress to others in the healthcare community.

Summary

This research has shown that the incorporation of contextual design methodology into the design of domain specific software produces usable programs. Using this methodology, a highly usable prototype was produced. The domain experts involved with the development of the prototype evaluated the system as highly usable. The experts determined differences in how users with varying degrees of experience would utilize the system. Experts would use the system to differentiate their practice from novices and the system would serve as a reminder tool for charting. Novices would use the system for charting and as a reminder tool for interventions. Both domain experts determined the system would be useful in the collection of research data to further evidence based nursing care.

The contextual design methodology was found to be time consuming and required the development of interview skills by this researcher. Replication of this research should take into account the additional time required to collect data from domain experts. Additionally, the use of domain experts with varying backgrounds of expertise should be incorporated into any future research design. This larger development group would allow

the researcher to increase the variety of knowledge collected during the design process. This additional variety in knowledge would develop a product found usable to a wider group of users. Users outside of the design team should be used during the evaluation of any future prototypes. This would test the expert knowledge incorporated into the product's design.

The instruments used to develop this prototype were appropriate for the development of a limited demonstration prototype. For future development a more robust database development tool is recommended allowing for the scalability and increased database robustness in the prototype.

This prototype is a first step in creating a usable system for collection of patient care data. This data could be aggregated to help form a basis for evidence based nursing care. In the future, the expansion of this system should include interventions and outcomes outside pain management and home-health care nursing. This expanded system would allow nurses to utilize standardized nursing terminology to describe nursing interventions and nursing specific patient outcomes across the nursing care continuum. This new way to document and practice will allow nurses to view aggregate data regarding beneficial interventions for specific outcomes at the point of care. Through the informed selection of beneficial interventions patient health outcomes can be maximized and nursing health costs minimized.

Appendix A

From, (McCloskey & Bulechek, 1996).

Example of the Nursing Interventions Classification

Analgesic Administration

Definition

Use of pharmacologic agents to reduce or eliminate pain

Activities

- Determine pain location, characteristics, quality, and severity before medicating patient
- Check medical order for drug, dose, and frequency of analgesic prescribed
- Check history for drug allergies
- Evaluate the patient's ability to participate in selection of analgesic, route, and dose, and involve the patient, as appropriate
- Choose the appropriate or combination of analgesics when more than one is prescribed
- Determine analgesic selections (narcotic, non-narcotic, or NSAID), based on type and severity of pain
- Determine the preferred analgesic, route of administration, and dosage to achieve optimal analgesia
- Choose the IV route, rather than M, for frequent pain medication injections, when possible.
- Sign out narcotics and other restricted drugs, according to agency protocol
- Monitor vital signs before and after administering narcotic analgesics with first-time dose or if unusual signs are noted

Appendix A (cont.)

- Attend to comfort needs and other activities that assist relaxation or facilitate response to analgesia
- Administer analgesics around the clock to prevent peaks and troughs of analgesia, especially with severe pain
- Set positive expectations regarding the effectiveness of analgesics to optimize patient response
- Administer adjuvant analgesics and/or medications when needed to potentiate analgesia
- Consider use of continuous infusion, either alone or in conjunction with bolus opioids, to maintain serum levels
- Institute safety precautions for those receiving narcotic analgesics, as appropriate
- Instruct to request PRN pain medications before the pain is severe
- Inform the individual that with narcotic administration, drowsiness sometimes occurs during the first 2 to 3 days and then subsides
- Correct misconceptions/myths patient or family members may hold regarding analgesics, particularly opioids (e.g., addiction and risks of overdose)
- Evaluate the effectiveness of analgesic at regular frequent intervals after each administration, but especially after the initial dose also observing for any signs and symptoms of untoward effects (e.g., respiratory depression, nausea and vomiting, dry mouth, and constipation)
- Document response to analgesic and any untoward effects
- Evaluate and document level of sedation for patients receiving opioids

- Implement actions to decrease untoward effects of analgesics (e.g., constipation and gastric irritation
- Collaborate with the physician if drug, dose, route of administration, or interval changes are indicated, making specific recommendations based on equianalgesic principles
- Teach about the use of analgesics, strategies to decrease side effects, and expectations for involvement in decisions about pain relief

Appendix B

From, (Johnson & Maas, 1997).

Example of the Nursing Outcomes Classification

Pain Level

Definition

Amount of reported or demonstrated pain

PAIN LEVEL	Severe **1**	Substantial **2**	Moderate **3**	Slight **4**	None **5**
INDICATORS:					
Reported pain	1	2	3	4	5
Percent of body affected	1	2	3	4	5
Frequency of pain	1	2	3	4	5
Length of pain episodes	1	2	3	4	5
Oral expressions of pain	1	2	3	4	5
Facial expression of pain	1	2	3	4	5
Protective body positions	1	2	3	4	5
Restlessness	1	2	3	4	5
Muscle Tension	1	2	3	4	5
Change in respiratory rate	1	2	3	4	5
Change in heart rate	1	2	3	4	5
Change in blood pressure	1	2	3	4	5
Change in pupil size	1	2	3	4	5
Perspiration	1	2	3	4	5
Appetite loss	1	2	3	4	5
Other:	1	2	3	4	5

Appendix C

IRB# 5378

Approved: April 13, 1999

OREGON HEATLH SCIENCES UNIVERSITY

Consent Form

TITLE: Development of a System Linking the Nursing Interventions Classification to the Nursing Outcomes Classification.

PRINCIPAL INVESTIGATORS:

Sean Ressler, BSN, RN (503)657-3223

Katherine Caton, PhD, RN (503) 494-3809

PURPOSE:

You have been invited to participate in this research study because of your expertise as a Registered nurse caring for patients in the home healthcare setting. The purpose of this study is to develop a prototype computerized system linking the Nursing Interventions Classification (NIC) to the Nursing Outcomes Classification (NOC).

PROCEDURES:

The usability of a computerized nursing information system can only be defined by nurses familiar with the setting for which the system is designed. Likewise, a computerized nursing information system should incorporate the use of nurse experts during its design.

During this study, the principal investigator will conduct one interview with each individual participant. These one-hour, face-to-face, interviews will be used to elicit your expert knowledge to be used in designing a prototype-computerized system linking the

Nursing Interventions Classification (NIC) to the Nursing Outcomes Classification (NOC). These interviews will be audio recorded. Information from the individual interviews will be used to formulate an overall needs assessment for this prototype system. All interviews will be conducted in the Oregon Health Sciences University – School of Nursing, Community Health Department's conference room.

Two weeks following the interviews you will be required to attend the first of three one-hour focus group sessions. All focus group sessions will be held in the Oregon health Sciences University – School of Nursing, Community Health Department's conference room and held at two-week intervals. These sessions will be audio recoded for information used in the design of the prototype system.

The first group meeting will be used to define the prototype's design specifications based on information obtained by the principal investigator during the individual interviews. A prototype system will be developed by the investigator and presented during the second focus group meeting. The principal investigator will use information obtained during the second focus group meeting to further refine the prototype's design. The third meeting will allow you to evaluate the system based on the design specifications outlined at the beginning of the prototype's design.

RISKS AND DISCOMFORTS:

Due to the use of a focus group for information gathering, there is a potential risk of embarrassment and confidentiality cannot be guaranteed.

BENEFITS:

You may or may not personally benefit from participating in this study. However, by serving as a subject, you may contribute new information, which may benefit nurse clinicians in the future.

ALTERNATIVES:

You may choose not to participate in this study.

CONFIDENTIALITY:

Information concerning you in this study will be kept strictly confidential. Neither your name nor your identity will be used for publication or publicity purposes. All audio-tapes will be kept in a locked secure file cabinet, and you will not be identified on the tapes. At the end of the study all audio-tapes will be destroyed.

COSTS:

You will not be compensated for participation in this study. You will be responsible for the costs associated with your participation (i.e. parking and transportation).

LIABILITY:

The Oregon Health Sciences University, as a public corporation, is subject to the Oregon Tort Claims Act, and is self insured for liability claims. If you suffer any injury from this research project, compensation would be offered to you only if you establish that the injury occurred through the fault of the University, its officers or employees. However, you have not waived your legal rights by signing this form. If you have further questions, please call the Medical Services Director at (503) 494-6020.

PARTICIPATION:

Sean T. Ressler, RN, (503) 657-3223, has offered to answer any other questions you may have about this study. If you have any questions regarding your rights as a research subject, you may contact the Oregon Health Sciences University Institutional Review Board at (503) 494-7887. You may refuse to participate, or you may withdraw from this study at any time without affecting your relationship with or treatment at the Oregon Health Sciences University.

You will receive a copy of this consent form for your records. Your signature below indicates that your have read the foregoing and agree to participate in this study.

.....

Participant's Signature Date

.....

Witness Date

.....

Principal Investigator Date

Appendix D

Semi-structured Interview Guide

Introduction

- Introduction of myself and a brief description of my plans for this project.
- Answer any preliminary questions from the nurse expert.

Descriptive data

- Could you describe for me how you would initially assess a patient's pain during a home health visit?
- Could you describe the process used for creating a care plan to manage a patient's pain?
- How do you choose which interventions are appropriate to manage a patient's pain?
- How do you evaluate whether your interventions are working?

Evaluative data

- How well do you feel the process to evaluate and manage a patient's pain is working?
- Have you ever used computers in your nursing practice?
- How do you feel about using computers in you practice?
- How would you feel about using a computerized system linking pain management outcomes to pain management interventions?
- If this NIC/NOC system were available only to collect data to be used later by researchers, how would you feel about collecting data during your home health visits?

Appendix D (cont.)

Non-Specific

- What apprehensions would you have about using a system such as this?

Descriptive

- Can you describe to me the critical elements of a computer system that make it either usable or non-usable in your care setting?
    - What about input?
    - What about output?
    - What about the display's size and type (monochrome vs. color).
    - What about computer devices' size (palmtop vs. laptop)?

Non-Specific

- Are there any issues regarding a computerized system linking NIC/NOC that we have not covered that you would like to cover at this time?

Descriptive

- Could you describe to me two pain management cases:
- The first case is one where the patient's pain was easy for you to manage through nursing interventions? What was the outcome?
- The second is one where you had a difficult time managing the patient's pain through nursing interventions? What was the outcome?

Non-Specific

- Do you have any questions about my project?

Appendix E

Initial Requirement Specifications

I. What comprises a typical home health visit?

a. Chart review

b. Interviews (Patient, Family, other care providers)

c. Comprehensive assessment of patient and review of patient's needs.

d. Care plan developed.

1. Outcomes to achieve are determined

2. Interventions to meet Outcomes are decided

3. Patient assessed pre Interventions

e. Other care providers are kept informed regarding patient's health status and any changes in patient status.

II. Data flow into the prototype system.

a. After Assessment and review patient is entered into the system.

b. Outcomes are determined based on the patient's nursing diagnosis. Here we are using pain as the exemplar.

c. Patient specific outcomes are determined (selected) by the nurse.

d. Each outcomes indicators are selected (specific to the patient)

e. Interventions are determined based on each selected outcome

f. Activities within each intervention are selected by the nurse an are specific to the patient.

g. Patient's status (specific to each outcome) is assessed. This is the patient baseline measurement.

h. Each follow-up visit with the patient requires a review of current Interventions / Outcomes. Interventions and outcomes are modified based on patient's status and outcomes are assessed per visit.

III. The purpose of this prototype system.

a. To be used as a tool by the home health nurse to follow a ptient's status based on a standard set of outcomes and interventions.

b. To allow the nurse researcher to min the data collected on groups of patients and determine which interventions are most beneficial to achieving specific outcomes (evidenced based care).

IV. Goals of this prototype are to minimize the amount of work required by the home health nurse to collect a rich set of patient intervention / outcomes data. This may be the most difficult goal of any data collection system.

V. Hardware to be utilized.

a. Windows 95/98 operating system

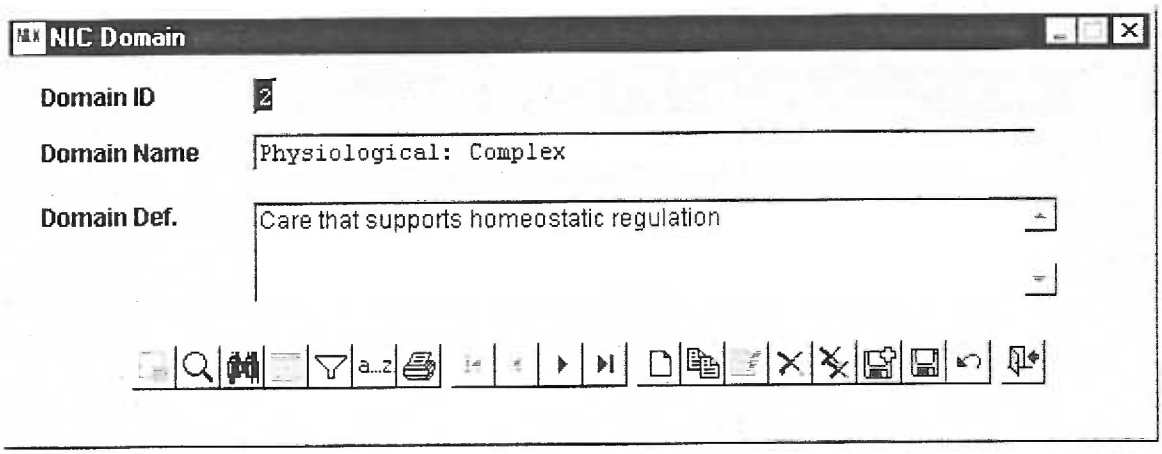
b. Laptop computer with mouse.

VI. Development Software

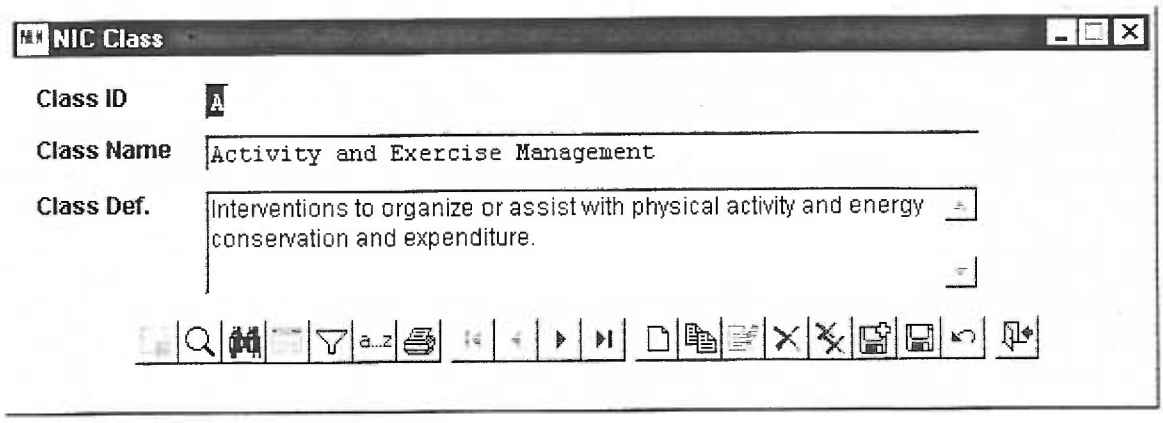
a. Visual Foxpro 6.0 with the Visual Promatrix Developers

Appendix F

Administration forms used by the prototype system.

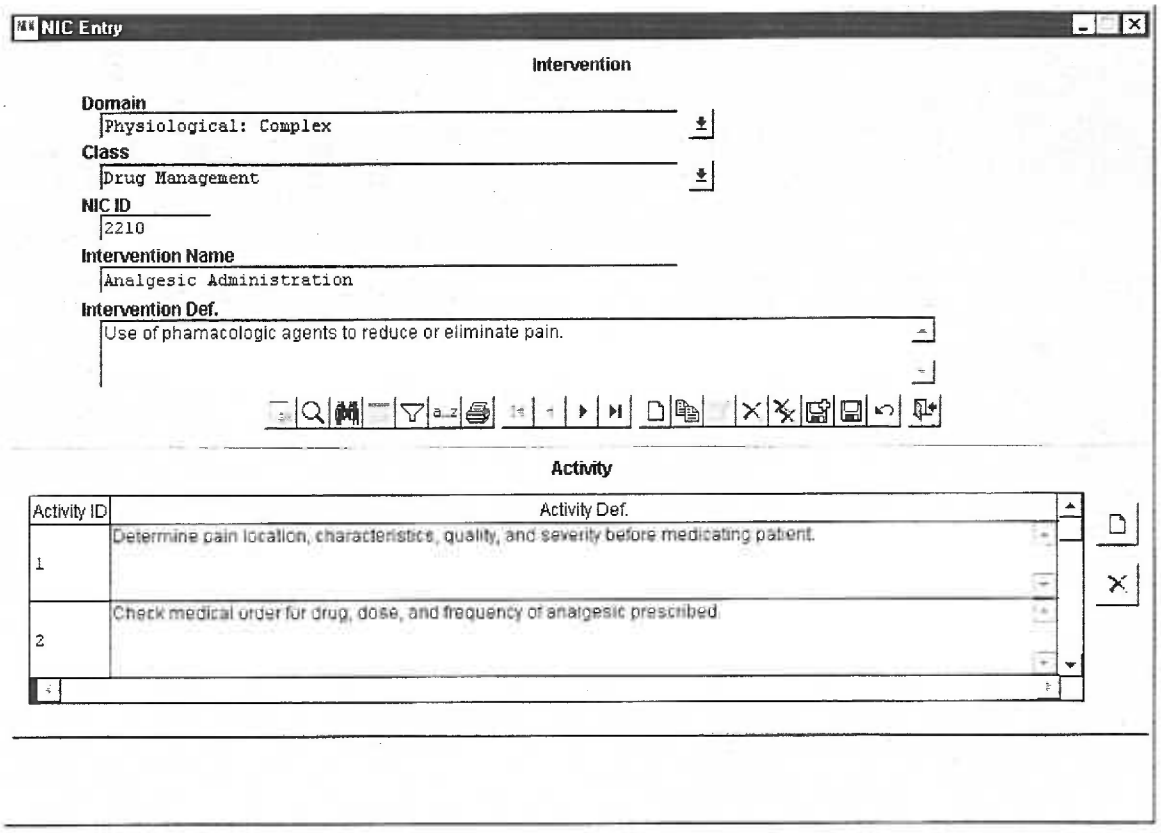


NIC Domain Entry Form.

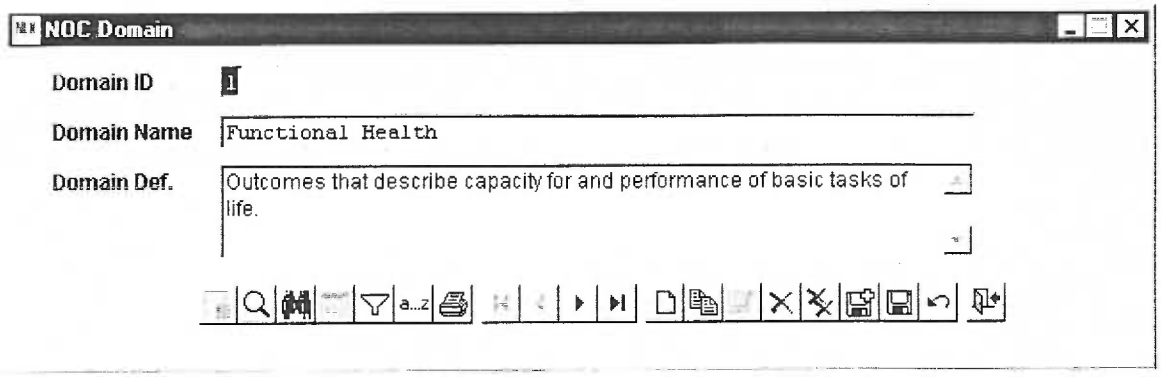


NIC Class Entry Form

Appendix F (cont.)



NIC Entry Form



NOC Domain Form

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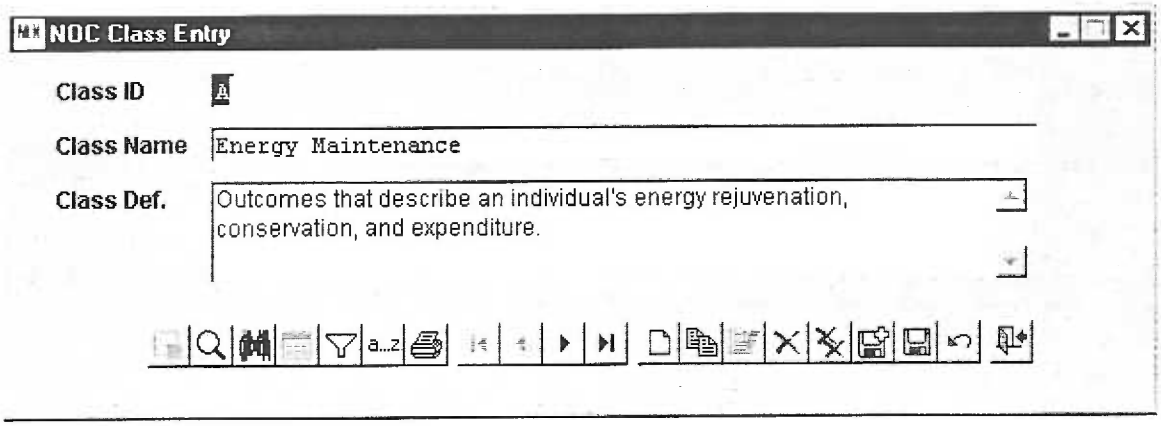
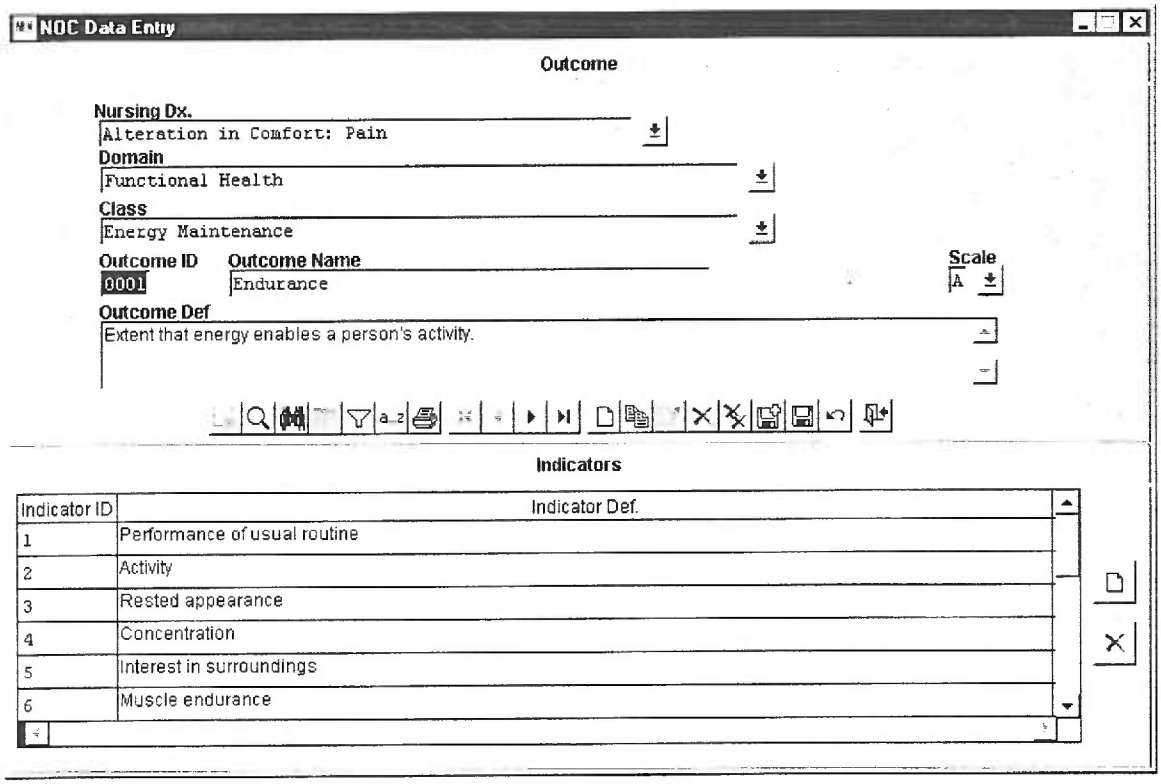
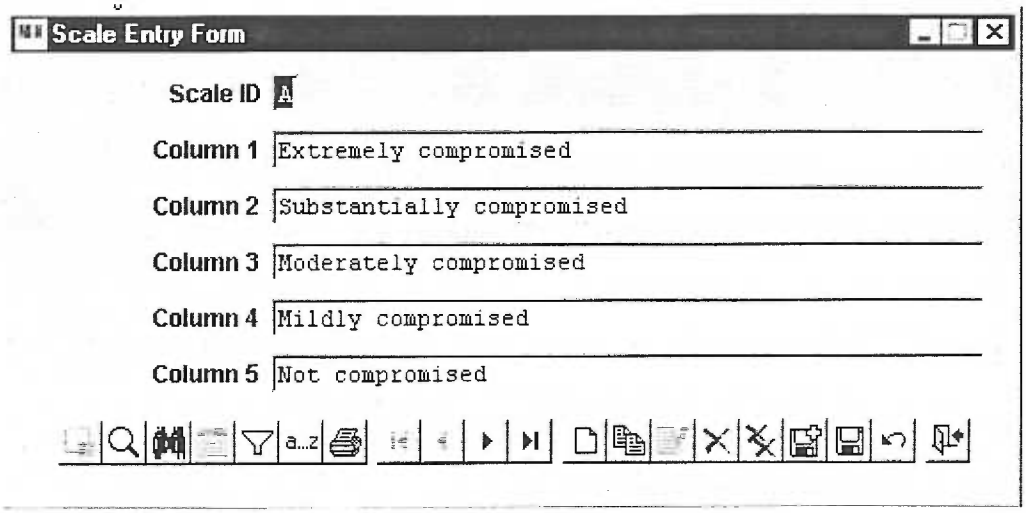


NOC Class Form

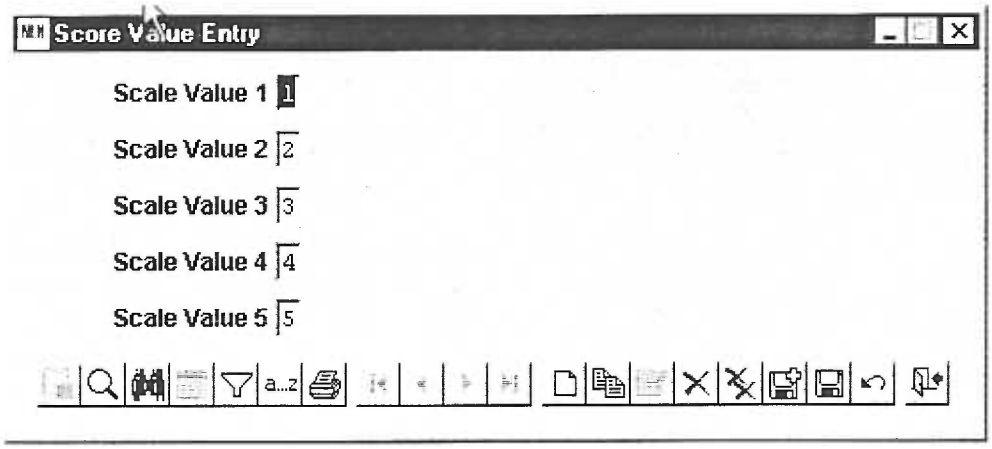


NOC Entry Form

Appendix F (cont.)

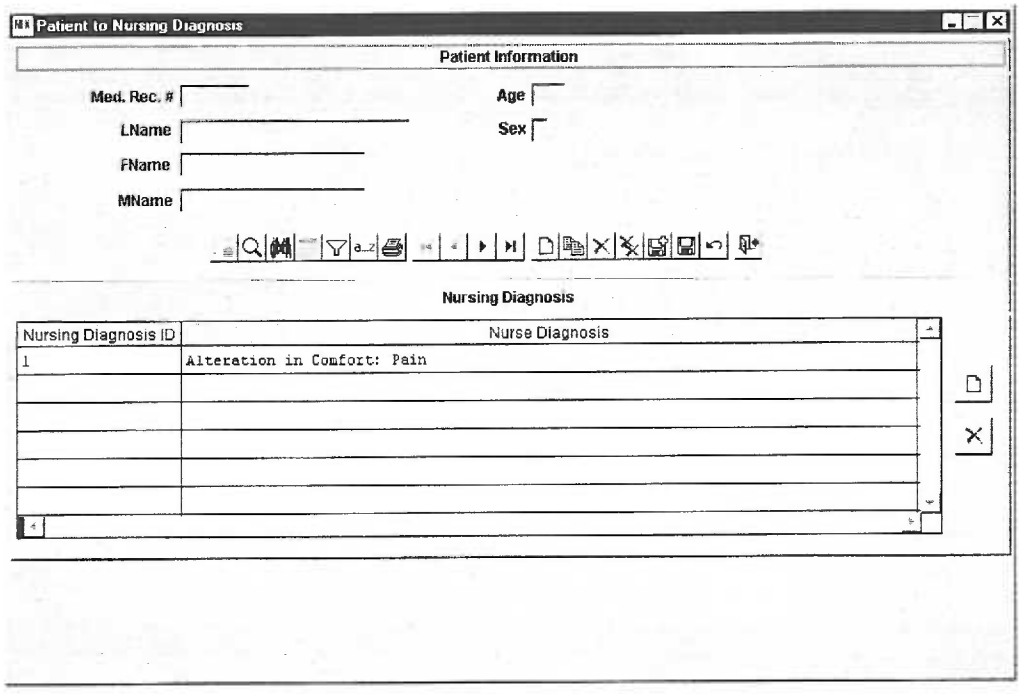


NOC Scale Form

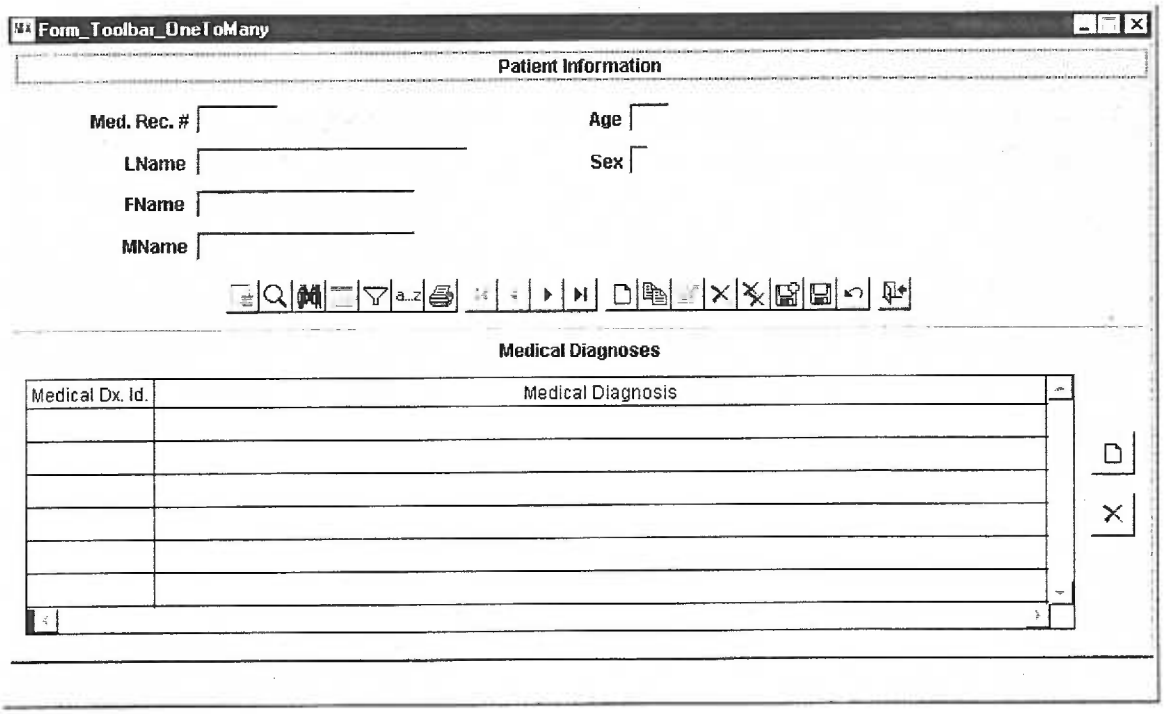


NOC Score Value Form

Appendix F (cont.)

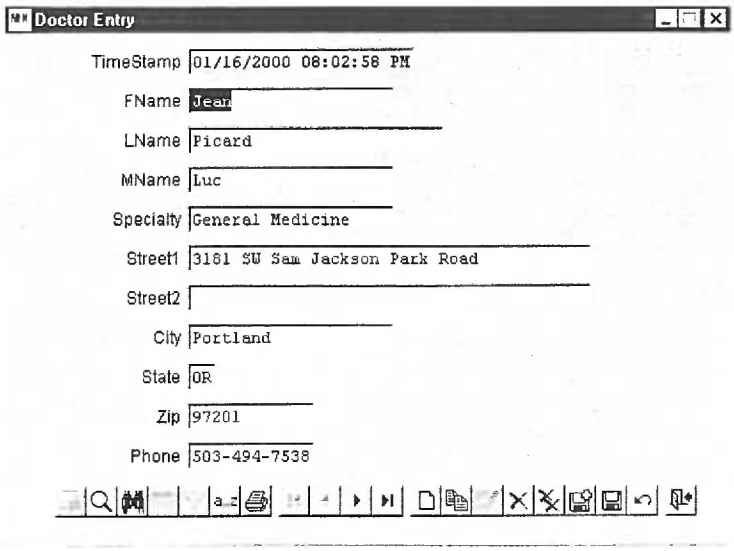


Nursing Diagnosis Entry Form

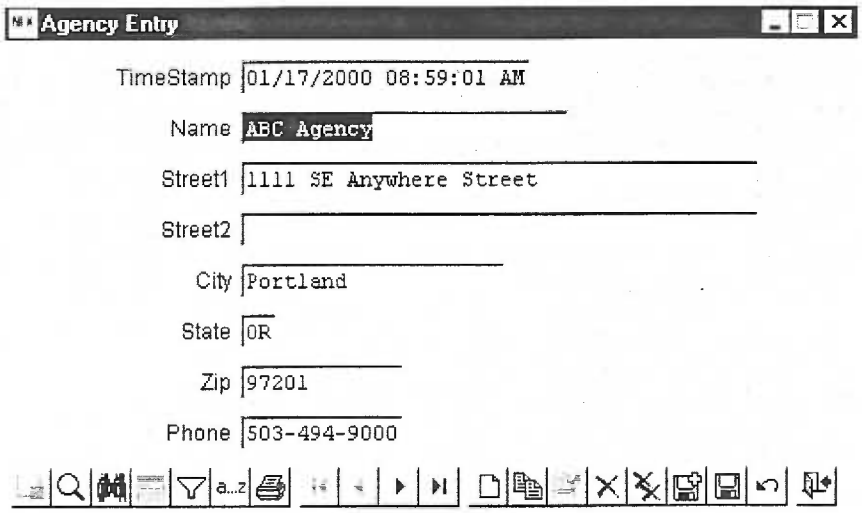


Medical Diagnosis Entry

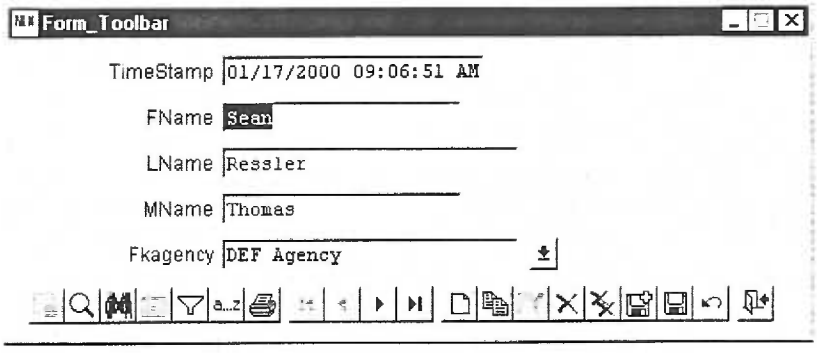
Appendix F (cont.)



Doctor Entry Form



Nurse Agency Entry Form



Nurse Entry Form

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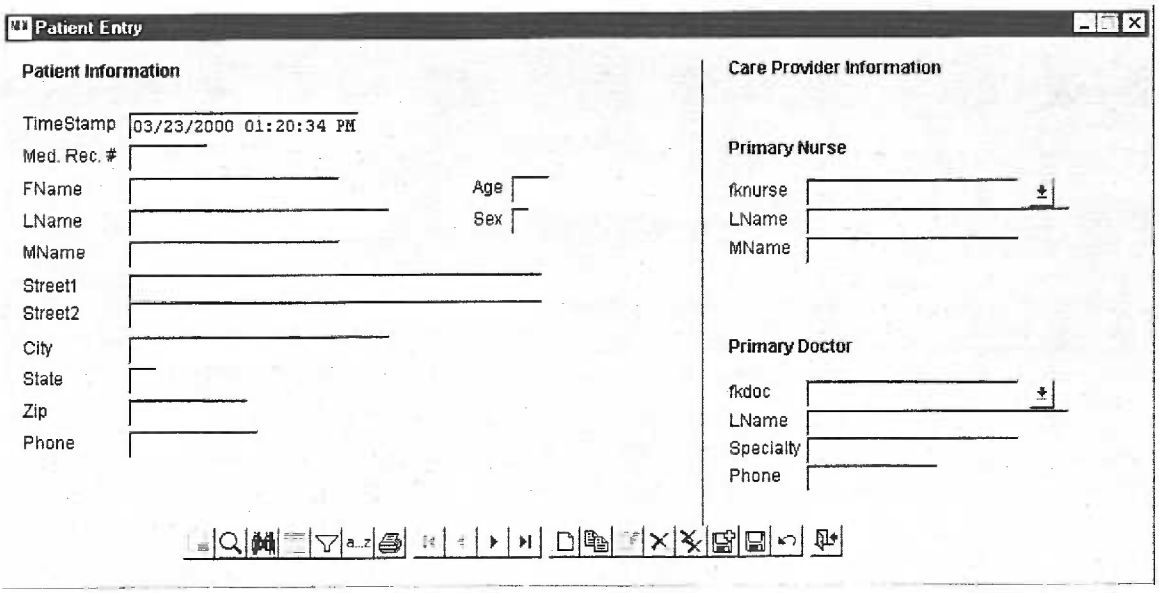
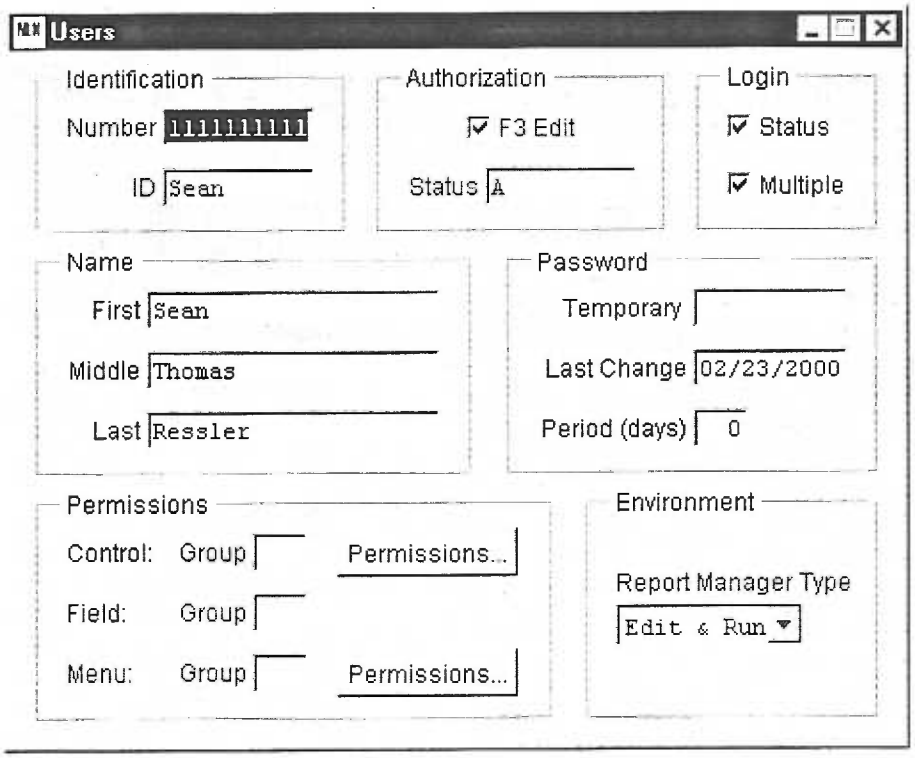


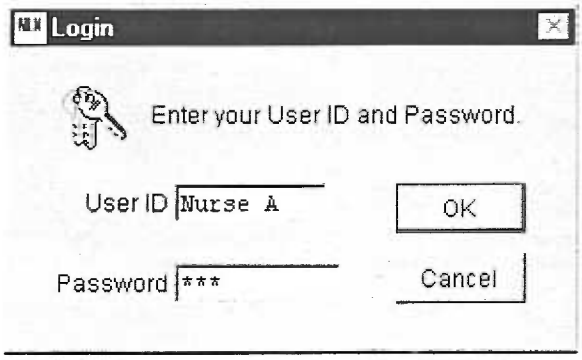
Patient Entry Form



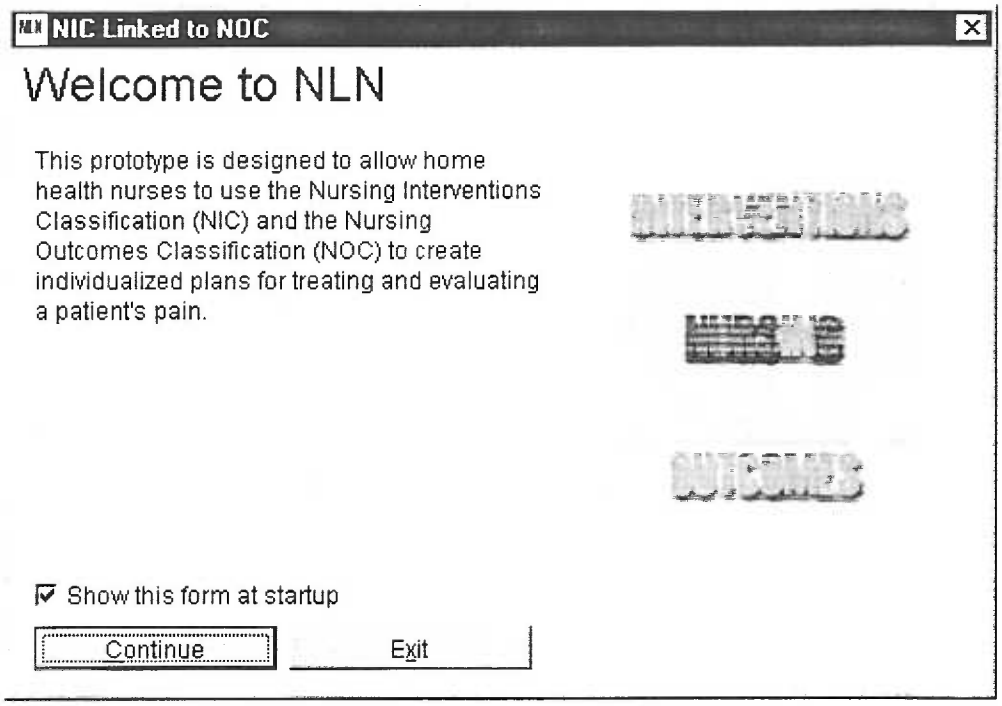
User Entry Form

Appendix G

Screen shots of the working prototype system

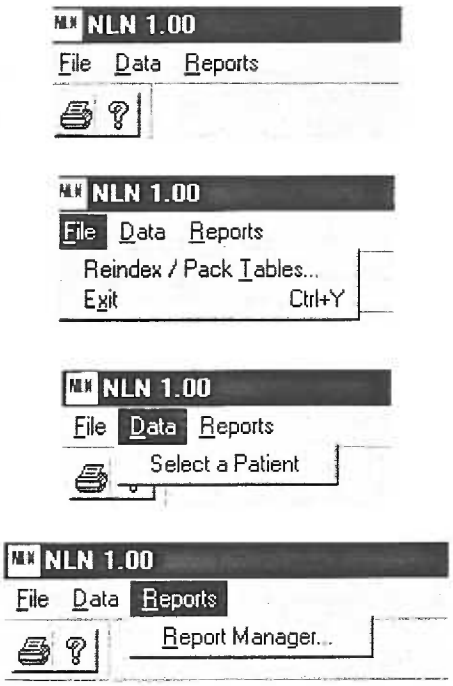


Main Login Screen

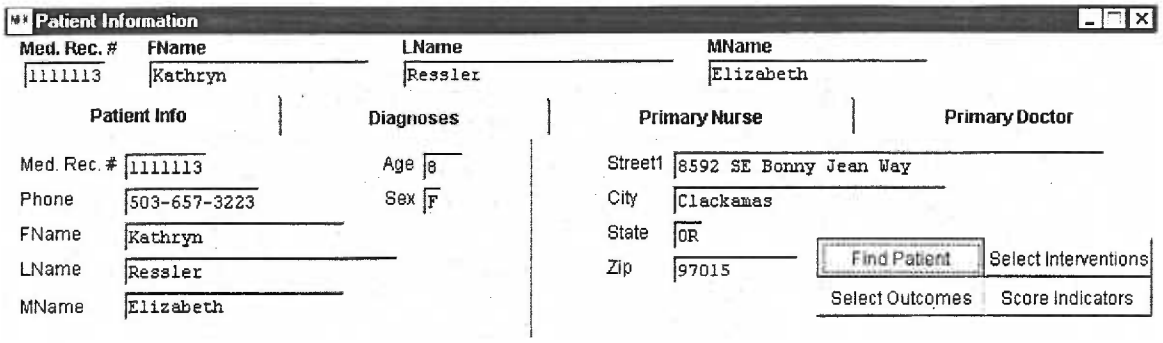


Introductory Splash Screen

Appendix G (cont.)

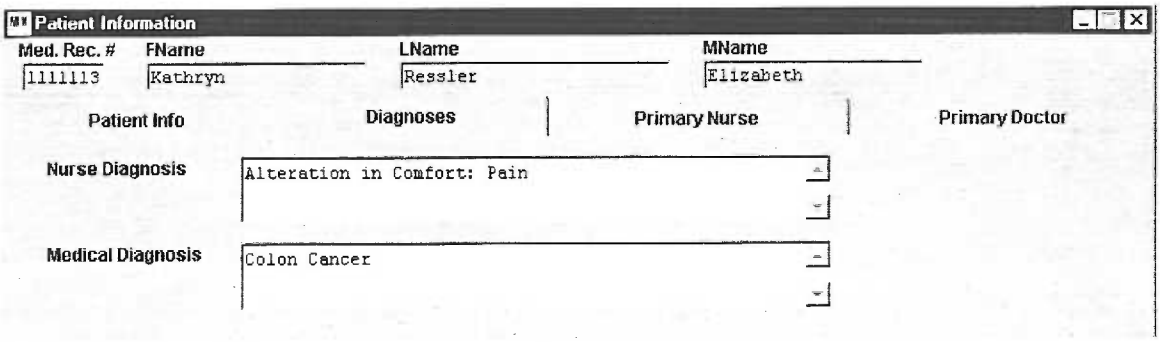


Main Menu

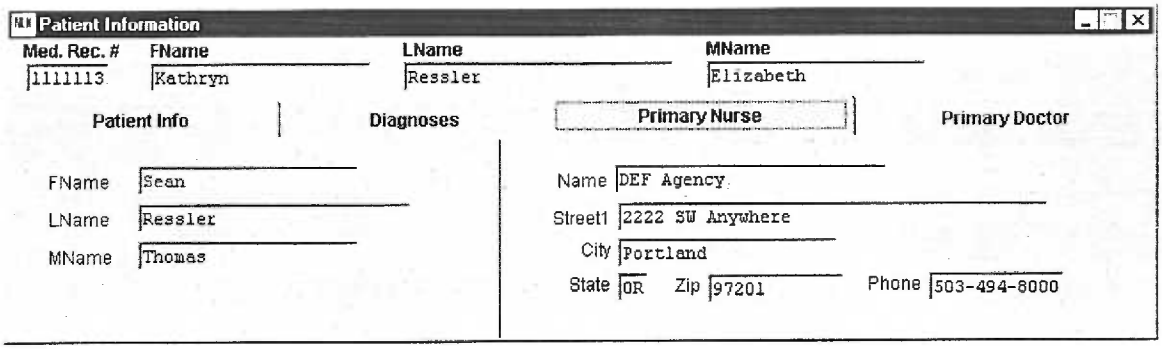


Patient Information Form – Patient Information Tab

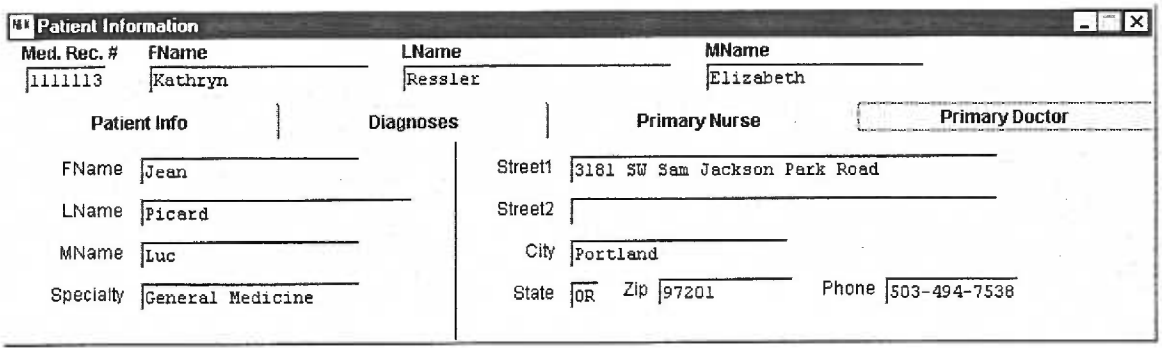
Appendix G (cont.)



Patient Information Form – Diagnosis Tab

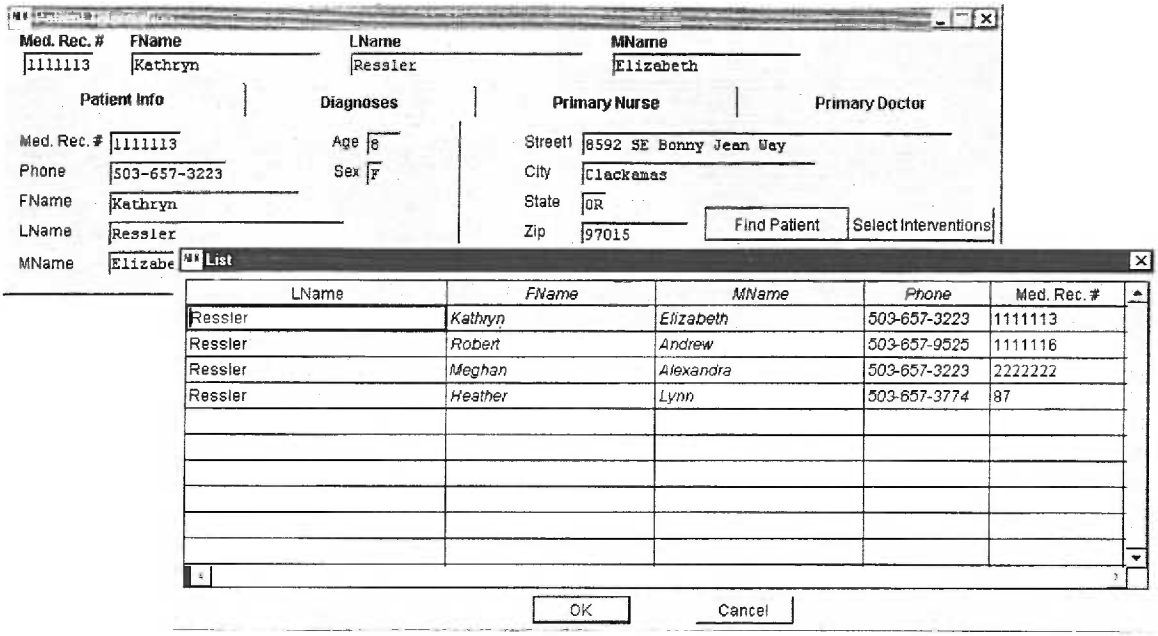


Patient Information Form – Primary Nurse Tab

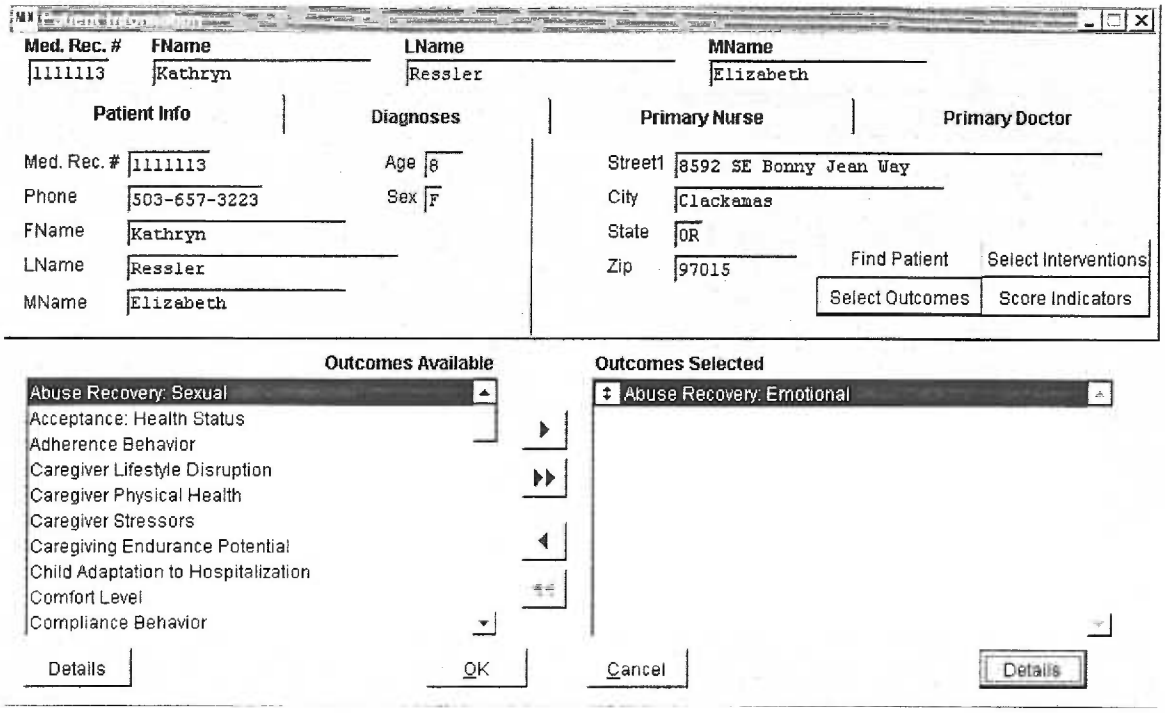


Patient Information From – Primary Doctor Tab

Appendix G (cont.)

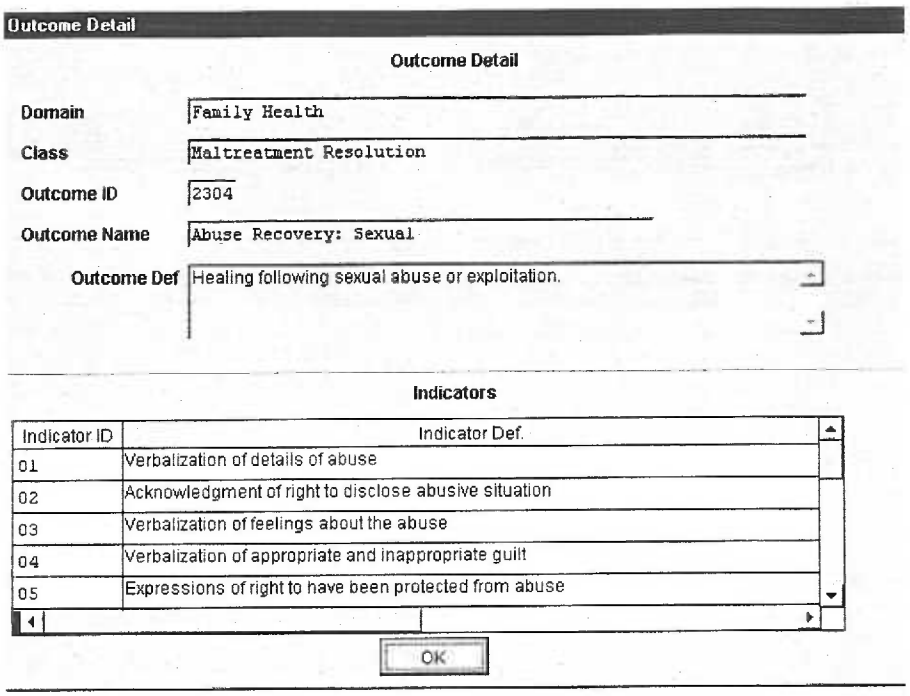


Patient Search Form

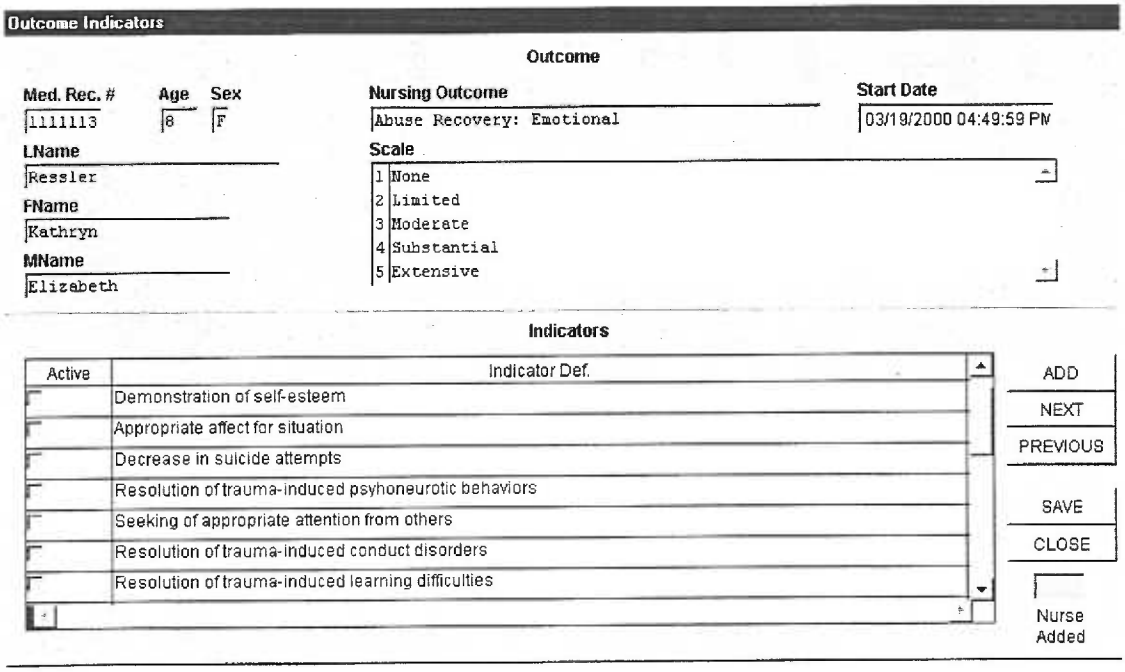


Outcome Selection Form

Appendix G (cont.)

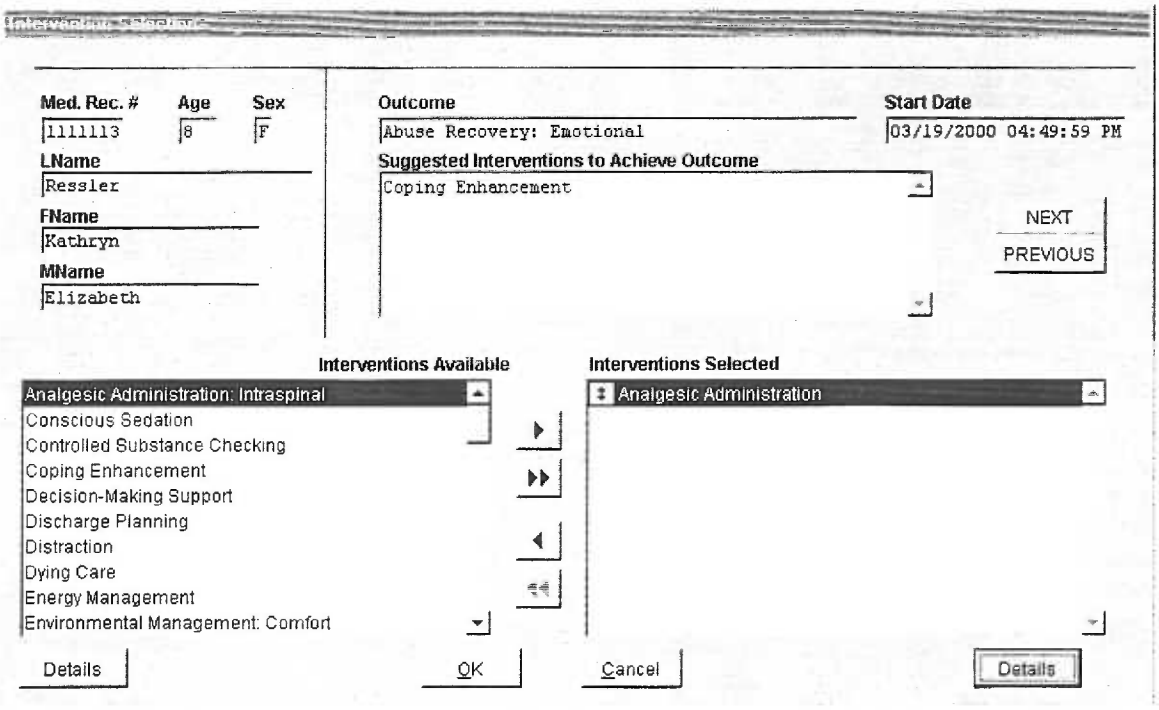


Outcome Detail Form

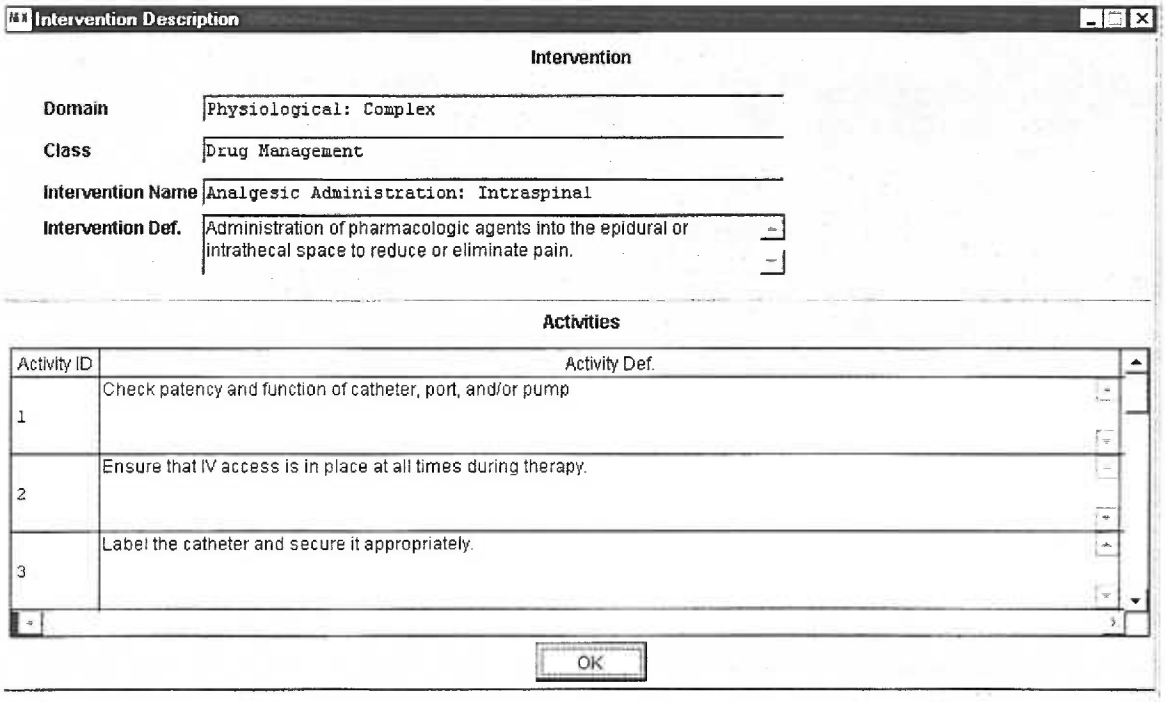


Outcome Indicator Selection Form

Appendix G (cont.)

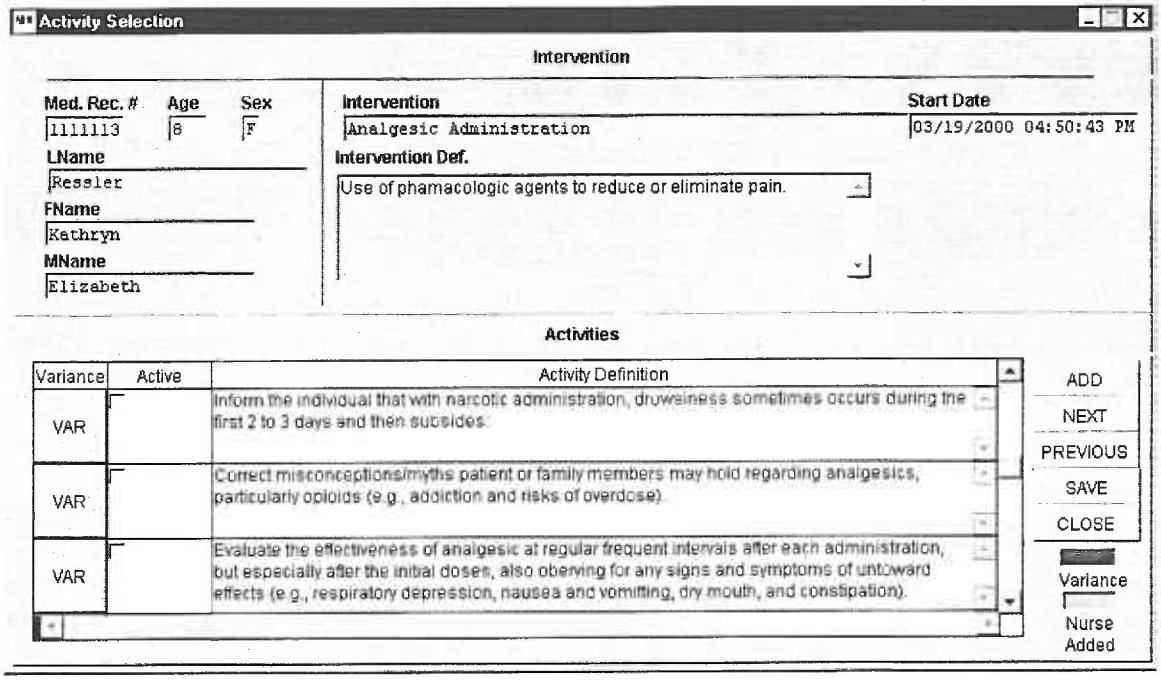


Intervention Selection Form

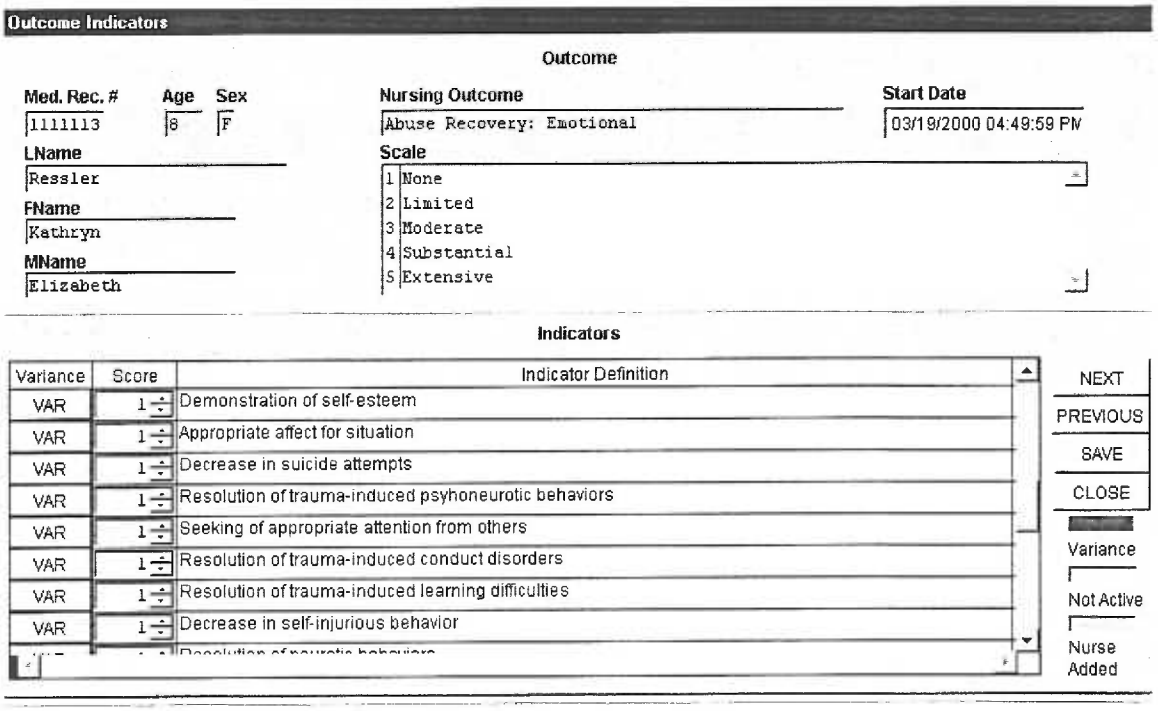


Intervention Detail Form

Appendix G (cont.)



Activity Selection Form



Indicator Score Form

Appendix H

Report Templates Presented to the Nurse Experts for Validation

Outcome Report

Date
Patient Medical Record Number
Patient Name
Address
City, State Zip

	Start	Nurse	End	Nurse
Outcome Name				
Outcome Definition				
Indicator (active)				
Indicator (not active)				
Indicator (variance)				
Charted variance				
* precedes all nurse added indicators				
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.				
.	Start	Nurse	End	Nurse
Outcome Name				
Outcome Definition				
Indicator (active)				
Indicator (not active)				
Indicator (variance)				
Charted variance				
. * precedes all nurse added indicators				
.				Page #

Appendix H (cont.)

Intervention Report

Date
Patient Medical Record Number
Patient Name
Address
City, State Zip

	Start	**Nurse**	**End**	**Nurse**
Intervention Name				
Intervention Definition				
Activity (active)				
Activity (not active)				
Activity (variance				
Charted variance				
* precedes all nurse added activities				

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	Start	**Nurse**	**End**	**Nurse**
Intervention Name				
Intervention Definition				
Activity (active)				
Activity (not active)				
Activity (variance)				
Charted variance				
* precedes all nurse added activities				

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Appendix H (cont.)

Outcome Score Report

Date
Patient Medical Record Number
Patient Name
Address
City, State Zip

	Date	Nurse	Score
Outcome Name			
Outcome Definition			
Indicator (active)			
Indicator (not active)			
Indicator (variance)			
Charted variance			
* precedes all nurse added indicators			

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	Date	Nurse	Score
Outcome Name			
Outcome Definition			
Indicator (active)			
Indicator (not active)			
. Indicator (variance)			
Charted variance			
. * precedes all nurse added indicators			
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Appendix I

Test Cases

Below are four test cases to help you evaluate the prototype developed during this project. There are no right or wrong care plans for these cases. Remember: the exemplar used here limits the prototype to pain management.

- Patient A is a 43-year-old obese, woman with gouty arthritis, diabetes and end stage renal disease. She has multiple open wounds on her lower extremities and is complaining of extreme joint pain due to her arthritis. She is allergic to Codeine, Morphine, Meperidine, and complains of nausea with most other analgesics.
- Patient B is a 48-year-old male, post surgical patient, left radical neck. States "I'm not in pain; I just can't get to sleep" even though it is 2300 at night. He has a very large bulky dressing on his surgical site. He has analgesics prescribed, but, has not had any for the last 8 hours.
- Patient C is a 74-year-old male with end stage liver cancer. The family has been providing care for the last month, but tonight "he is in the most pain he has ever been in". The physician is reluctant to change the currently prescribed analgesics despite the nurse's requests. The family is getting very frustrated with their loved one's care and increasing pain.
- Patient D is a 48-year-old woman with pancreatic cancer. Until recently she has been remarkably comfortable. Now she is complaining of pain due to her pancreatic cancer. She has analgesics ordered, but hasn't taken any for the pain she is experiencing.

Appendix J

NIC Linked to NOC Evaluation Questionnaire

1) As a home health nurse clinician what potential uses do you see for the information entered and retrieved by this prototype?

2) Is the data collected by this prototype of potential use to home health nurse researchers? If so, give examples of potential uses for this data.

3) Describe the degree of difficulty in learning to use this prototype in comparison to other Nursing Information Systems that you have used in the past.

4) How might expert nurse clinicians use this system differently from novice nurse clinicians?

Appendix K

Tool Developed by the Standish Group to Determine the Likelihood of Success for a Software Project

Success Criteria	Points Available	Points Attained
1) User Involvement	19	
2) Executive Management Support	16	
3) Clear Statement of Requirements	15	
4) Proper Planning	11	
5) Realistic Expectations	10	
6) Smaller Project Milestones	9	
7) Competent Staff	8	
8) Ownership	6	
9) Clear Vision and Objectives	3	
10) Hard-Working, Focused Staff	3	
Total	**100**	

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