Usability in Nursing Practice

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and
Factors of Usability in Nursing Information Tools

By
Katherine Caton

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APPROVED:

[redacted]

Joyce Collin[redacted]esearch Advisor

[redacted]

Barbara J. Stewart, Ph.D., Professor — Committee Member

[redacted]

Jean C. Scholtz, Ph.D.,
National Institute of Standards and Technology — Committee Member

[redacted]

Kathleen Potempa, RN, DNSc., FAAN — Dean, School of Nursing

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First Paper

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Katherine Caton

Oregon Health Sciences University

School of Nursing

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Abstract

An information system design comes about in a number of different ways. Systems or software applications may be designed using a controlled process, moving step-wise from a needs analysis to program code and installation. Systems may also be designed using general cognitive models of human cognition and action. However, if a design is to work successfully, efficiently, and with user satisfaction, the design process must allow user participation. Usability, as defined by the system users and their work, will make the difference in the final product. This paper will review information system design processes and assumptions. It will focus on how user needs are brought to the design process through requirements analysis, task analysis, and usability evaluation.

Without usability information systems ultimately fail—and rightly so. Usability is that characteristic of an information system that merges the system with workflow. The benefits of a highly usable information system include decreased errors, a decreased time necessary for training, higher productivity, and higher user satisfaction. Nurses, physicians, and pharmacists have yet to define usability in their information systems but they know when it is not present. Clinicians have kept poorly designed clinical information systems alive through overtime, work-arounds, and memorized keystrokes. Often, a frustrated management will recognize an unusable system as a hindrance rather than a help. The system will fade in disuse or be mercifully abandoned.

The obvious costs of any system failure are in the hardware and software procurements. Clinical information systems without usability also carry a high cost for users and management in inefficiencies and the obstruction of work patterns. Additional costs are the need for extensive and frequent user training, system implementation and maintenance, decreased productivity, and vendor contracting. Failed clinical systems potentially carry costs in patient safety and management-staff relations as well. Engineers and designers may avoid system failure by giving greater attention to the users' requirement for usability throughout the design process but most especially at the outset as systems are conceptualized.

Designing new ways to handle information, with a smooth integration into practice patterns, is not simple. What are the practice patterns in clinical nursing and healthcare? What part of the mountain of clinical information is most important for decision making? What makes a system usable in nursing practice?

To build any information system, analysts and design engineers first look to find order, or at least a schema of the information tasks in present practice. They then formalize the discovered goals and work patterns into an optimized *system* of software processes and hardware architectures. Design, in this sense, is as complex as the operation of a modern high-tech hospital. And, just as healthcare has become client-centered, system design is becoming user-centered.

User-centered system design requires system users as design participants, targeting their needs as system functions and factors of usability. This paper will review the historical evolution of general design methods along with underlying philosophical perspectives and focus on those phases and techniques of design that most depend upon clinical nursing participation: requirements analysis, task analysis, and usability. An understanding of system design and the growing body of usability research can be used to evaluate the effectiveness of nursing information systems.

Design

A design method contains the assumptions, discoveries, compromises, experiences, and objectives that will strongly affect product usability for nursing care. An information system for an information intensive discipline such as nursing cannot help but restructure practice patterns. Consequently, clinicians should responsibly question if a system can meet patient care needs while mediating stresses in the work environment. Of course, the best way to evaluate an information system is to use it in actual practice.

Adequate system evaluations are difficult to find. Published evaluations either focus on cost effectiveness, gained through documentation efficiencies, or on a decrease in patient care errors (Ford, 1990; Hendrickson & Kovner, 1990; Kahl, Ivancin, Fuhrmann & Markiewicz, 1990; Lower & Nauert, 1992; Staggers, 1988). Sinclair's (1991) evaluation offers only "potential" savings without explicit support. Staggers' (1988) survey of clinical information system evaluations reports that many of the studies available have methodological errors. Potential conflicts of interest also threaten evaluations authored by those who have participated in the system design. Beyond cost, little mention is made of the system impact on actual nursing practice.

If a system's effect on the working environment and practice can hardly be evaluated without the system first being installed and used, how can clinicians make informed purchasing decisions? The difficulty in discussing comparative systems in differing practice environments, transferability or transportability, is noted by Hendrickson and Kovner (1990) and van Gennip and Bakker (1995). Paganelli (1989) offered a criteria list for clinical information system evaluation. Zielstorff, Abraham, Werley, Saba, and Schwirian (1989) offered guidelines for the discussion of nursing information systems but as Brennan (1989) observed, their paper omitted any consideration of the nursing environment. Informed purchasing decisions and evaluation transferability may be assisted by the examination of a system's design method and a review of the design participants.

Up to now however, healthcare information system design has been proprietary magic. The literature contains no discussion of design methods for specific products. Vendors may naturally protect their design experiences. Function lists and the "look and feel" of each product are marketed as advantages of one system over another. The informatics literature contains only general references to design in a system life cycle (Jacobsen & Fennel 1989; Perreault & Wiederhold, 1990).

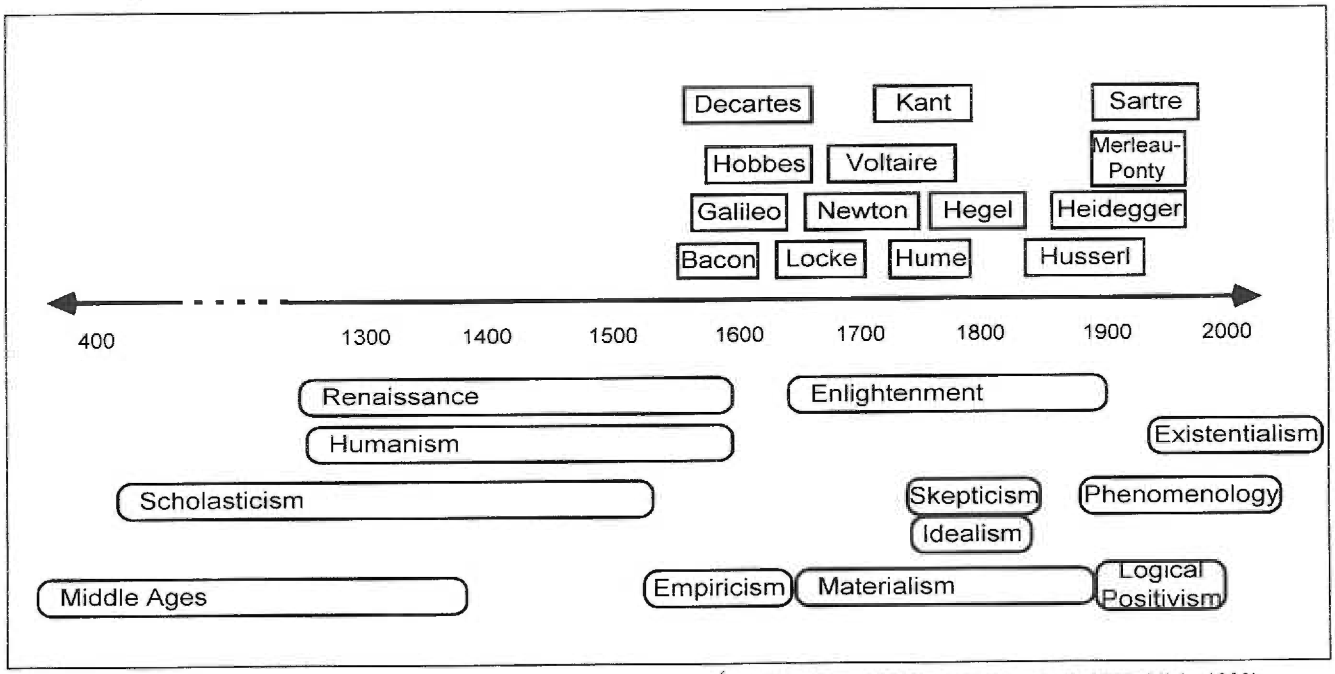
A design review will reveal the design participants and may offer clues as to their assumptions and views. For instance, automated clinical information systems are often touted as productivity tools (Hendrickson & Kovner, 1990; Sinclair, 1991). One approach to productivity is the automation of an assignment printout for each staff member, proposed as eliminating the need for a verbal intershift report (Kahl, et al, 1990). Although verbal intershift reports can be of varying quality, verbal descriptions, planning, and discussion are part of the report (Ames, 1993). All are activities of professional consultation and practice. Did system designers observe the form, content, and process of the intershift report? Was the value of the intershift report examined in interviews with clinicians? If the work discovery process does not observe the intershift report and interview the nursing participants, the full meaning of this practice event cannot be uncovered. If a desirable characteristic of a clinical information system is a tight integration with the work, then the work discovery process and the representation of work content and patterns in system design is important.

Philosophical Perspectives in Design

Our belief systems influence or even direct our actions. This can certainly be seen in the design of systems that assist humans in their work. Cultural values affect the goals formed and the attempted tasks. Design will also contain assumptions about process, work, and thought. Information system design processes have at their roots the philosophical perspectives of science and method.

Science and method were the products of The Age of Reason, also known as The Enlightenment, which began in the 17th century. The heroes of The Enlightenment—Bacon, Newton, Descartes, and Voltaire (see Figure 1)—used a method of analysis that broke phenomena into separate parts. They analyzed and reconnected each part into a mechanistic and logical universe (Harrison & Sullivan, 1971; Jones, 1969-1975). Their language was mathematics; their data were empirical. This was *rationalism.* It was a time when problem statements, measurements, analysis, and synthesis advanced science.

Figure 1 Timeline of Western Philosophical Perspectives



(Jones, 1969-1975; Levy & Greenhall, 1983; Mish, 1983)

Following the Enlightenment, and perhaps in reaction to it, Hume, Kant, Husserl, and Heidegger offered Skepticism, Idealism, and Phenomenology (Brightman, 1950; Dreyfus & Dreyfus, 1986; Jones, 1969-1975). Contrasting with the rationalist view, those of the post-Enlightenment era saw phenomena as embedded in experience and context. They viewed a phenomenon as inseparable into parts. It is a whole. Precisely because it is empirical, that is, relying upon experience, it cannot be objective. In this schema, phenomena cannot be separated from the persons encountering it, experiencing it, part of it. Methods of discovery and analyses really become methods of meaning and understanding.

Western philosophical perspectives and the progression of the scientific method offer us a backdrop to information system design. Design inherited the methods of science and engineering as well as their assumptions. Today, design methods are moving from the perspectives of rationalism and empiricism to the phenomenological and contextual. As the rationalist design approach seeks to find all the parts of a system and place them in logical order, the phenomenological design approach seeks to understand a user's experience and the environmental context.

Differing philosophical perspectives spill over into design assumptions held by some in the human-computer interaction (HCI) field as well (see the discussion of human factors, computers, and cognition below). HCI research and cognitive theory have borrowed the methods of the physical sciences and applied them to human and social processes. The assumption of a rational universe guided the conceptualization of " the user" and how the user thinks and behaves. Card, Moran, and Newell (1983) formalized a singular human cognitive process in problem definition and solution searching, proposing an information processing calculation model for human thought. In contrast, Dreyfus and Dreyfus (1986) and Winograd and Flores (1986) offer that there is no singular approach to a human experience and therefore there can be no single model of human thought. Indeed, defining human thought accomplishes the rationalist's separation of the human mind from the experience.

Design Methods

Design is seen as the creation of some human artifact to supplant a need (Carroll, Kellogg, Rosson, 1991; Coyne, 1995; Norman, 1988). If the artifact is to be a computer system that automates a task, then the computer system design process will require an understanding of how the system will support tasks within the larger view of the work. Design merges an understanding of the work with current computer technologies and software programming techniques.

Computer science and health informatics literature have frequently referred to a system life cycle in system design. Different names are applied to a single method but generally four to eight steps move linearly from goal statements and feasibility to coding and system maintenance. This is the classic "waterfall" model of system design. Over time, the design process has evolved from a linear progression to a series of smaller iterative phases.

The Waterfall Model.

The waterfall model of system development is the classic life cycle design process (see Figure 2). It originated in the 1970's when "building and fixing" no longer worked as a means of software design (Boehm, Gray, & Seewaldt, 1984). The waterfall model begins with a feasibility study as the initial phase (Jacobsen & Fennell, 1989; McDermid & Rook, 1993; Perreault & Wiederhold, 1990). Feasibility answers questions of development cost-effectiveness. Once feasibility is established, design continues with the problem definition, or goal statement, and proceeds to needs assessment. A needs assessment defines end-user groups and typically creates a user profile. The needs assessment also describes the physical and organizational environment where the system will be used. This is accomplished by mapping the information process of interest, including current records and forms, information flow diagrams, evaluations of current manual systems for adequacy, and work flow (Graves & Corcoran, 1988; Jacobsen & Fennell, 1989; McDermid & Rook, 1993; Sailor, 1990). Development continues with programming, testing and system configuration. The final phases of the design life cycle include implementation, training, and evaluation.

McDermid and Rook (1993) and Ellison (1994) in their review and case studies found that the waterfall model has been modified many ways. A simple modification includes small verification cycles between adjacent phases. However, it remains linear and hierarchical. Another modification is the V model where the waterfall is folded back upon itself (see Figure 3). The V model links conceptual requirements specifications to the system testing phase. Requirements become more specific in subsequent phases and drive early modular testing. Another waterfall modification is the incremental model (see Figure 4). The incremental model divides the project into modules early on and then staggers subsequent phases for each module. The incremental model assists in controlling project costs as specialized teams rotate through the modules maintaining a consistent work effort. Without the incremental approach, design projects will typically have large staff activity peaks. The incremental model also allows some initial design discoveries to affect later work.

Because the waterfall method and its' modifications remain top-down, only the initial user goals will affect the final product. But, users often cannot envision their needs at the outset. Requirements "creep," results as the users, designers, and analysts learn more about each other and the project at hand. A new design approach was necessary.

Prototyping and Participatory Design

Rapid prototyping addresses those changing requirements and takes advantage of new graphical interface design tools (see Figure 5). Working system and interface models are rapidly constructed using development software, paper prototypes, pseudocode, and iterative cycles within the design process (Browne, Summersgill, & Stradling, 1992; Gould & Lewis, 1987; Karat, Campbell, & Fiegel, 1992; Landauer, 1991; Perreault & Wiederhold, 1990). Prototyping is also amenable to object oriented programming structures (see Figure 6). Rather than completing the full design phase before testing and evaluation, a prototype is produced early in design and user feedback data are immediately collected, analyzed, and used for iterative design modifications.

There are multiple views of prototyping. One method uses the classical waterfall phases but places an iterative prototype cycle within the model. Giddings (1984) terms this "nesting." A more elaborate approach to prototyping is Boehm's (1988) spiral model (see Figure 7). With each cyclical loop the spiral model focuses on planning, objectives, alternatives, constraints, costs and risks. The prototype is developed iteratively with user participation in this way to an operational design before it is coded and tested (Denning & Dargan, 1996; Ellison, 1994; McDermid & Rook, 1993).

Prototyping advantageously avoids the limits of a generalizable cognitive theory with its' demand of exquisite exactness. There is no need to anticipate human cognitive reactions measured to the millisecond. Prototyping places test results in multiple feedback and redesign cycles, fine-tuning a product. Feedback and redesign used in this way initiate participatory design adding intuitive insights gleaned from direct user participation (Dorfman, 1990; Nielsen, 1993; Ramey, 1995). Drawbacks to prototyping and the iterative design process include the need for an initial information system prototype, numerous user samples for testing, the reliance upon interpreted results and opinions, and the danger of indiscriminately throwing code at problems as in a "hacker syndrome" (Browne, Summersgill, & Stradling, 1992; Landauer, 1991; McDermid & Rook, 1993).

The Cognitive Information Processing Model

The methods, assumptions, and goals of design are still changing. But nothing has transformed design as much as the approach to the end-user. The traditional design approach uses a number of techniques to create "device models," human cognitive models, and task models (Bayman & Mayer, 1984; Card, Moran, & Newell, 1983; Green, Schiele, & Payne, 1988; Karat, Campbell, & Fiegel, 1992; Payne, 1987; Scapin, 1990). Modeling in design derives from the theoretical model of rational-cognitive human information processing. The cognitive information processing model is familiar to many as "chunks" of information moving between short and long-term memory (see Chapter 2, "The Human Information-Processor" in Card, Moran, & Newell, 1983 or Chapter 14, "The Theory of Human Problem Solving" in Newell & Simon, 1972). Rational task behaviors are timed within a problem solving "space" and drive design choices toward an idealized cognitive efficiency.

A strength of the cognitive information processing approach has been its' quantitative nature. Calculations offer clear-cut design choices. Major weaknesses however are: 1) the need to decompose complex human problem solving situations into explicit, mathematically oriented elements; 2) an assumption of human behavior as rational, and 3) an information technology that is developed and installed more rapidly than a research-based theory of human cognition can hope to support (Carroll, Kellogg, Rosson, 1991; Coyne, 1995; Gould & Lewis, 1987; Landauer, 1991; Scapin, 1990).

Increasingly, designers are skeptical that formulas for design can be contained in complex theoretical models of human thought (Carroll, Kellogg, & Rosson, 1991; Landauer, 1991). Landauer (1991) speculates that the theoretical model of human information processing must be astronomically complex and resistant to full representation containing " 0 (10^{11}) heterogeneous nonsimple elements operating largely in parallel-cooperative statistical fashions, using a huge amount of genetic (10^{10} bits?), remembered (10^{9} bits?), and currently received (10^{9} bits/sec?) data that are only partially the same for any two people" (p. 61).

Design processes are now based less on general models of human cognition and more on heuristics (Nielsen, 1993), the system's environmental context (Carroll, Kellogg, & Rosson, 1991; Lanzara & Mathiassen, 1988; Mayhew, 1992; Wixon, Holtzblatt, & Knox, 1990) communication (Laurel, 1991; Winograd & Flores, 1986) and user participation (Eason & Harker, 1991; Kjaer & Madsen, 1995; Shackel, 1991). The pragmatic outcome of useful and usable computer systems in specific organizational contexts has replaced the goal of attending to human cognitive theory (Coyne, 1995; Landauer, 1991; Sachs, 1995). Participatory design and situational context will be examined in more detail below in the discussion of human factors.

Requirements

Many authors recommend specific activities to accompany each phase of the design process (Mayhew, 1992; Mrazek & Rafeld, 1992). Requirements analysis is typically one of the first activities. The results of the requirements analysis will be requirements specifications linking needs assessment with system programming (Kirwan & Ainsworth, 1992; Perreault & Wiederhold, 1990). Using observation and interview, designer's outline functional specifications along with information flow, user profiles, and task differentiation. Requirements analysis also explicitly states the business goals for system design and any current system or hardware constraints—the boundaries for the project (Roman, 1985).

The product of the requirements analysis process is a specification document with two sets of reviewers (Scharer, 1981). The specification document is first reviewed by the users asking, "Is this truly a model of the information system we desire?" The designers and programmers then use the requirements specification document to couple a software architecture with programming tasks, system goals, and objectives. This can become very exacting. User specifications are meant to be traceable to actual programming activities and system functions.

Requirements specification can break down when users must approve specifications written in a technical language outside of their understanding. How can users say a system represents their needs if they cannot recognize their needs anywhere in the requirements document? Scharer (1981) sees users as describing qualitative system requirements whereas analysts focus on functional specifications. Placing a greater emphasis on the user and including users throughout the design process is one remedy widely held in system design literature (Fowler, Macaulay, Castell & Hutt, 1989; Keil & Carmel, 1995; Scharer, 1981; Whitefield, Esgate, Denley & Byerley, 1993). Analysts, designers, and programmers however view the user with some ambivalence. Kyng (1995) warns that designers have difficulty with cooperative design techniques. Fowler, Macaulay, Castell, and Hutt (1989) found that although analysts place value on greater user involvement in the design process, they also see it as without management support and as increasing the design workload. Eason and Harker (1991) surveyed designers and found they felt users are often not available, cost effective or directly relevant and they possess a conflicting design philosophy. Ellison (1994) echoes this sentiment terming requirements as "apples" while the product is "oranges."

Requirements gathering or analysis may be as much art and experience as it is an engineering process. Requirements gathering techniques may include a mix of the following process or data oriented activities: structured analysis, object-oriented analysis, flow charting, task analysis, functional analysis, system mapping, interviewing, usability evaluation, focus groups, and observed functional and environmental constraints (Davis, 1990; Dorfman, 1990). Requirements gathering and specification are often formalized into sets of prescriptive methods or as software engineering products (see Davis, 1990; Davis & Leffingwell, 1995; and Stokes, 1991 for a description of general requirements methods and Timpka & Johansson, 1994 for a description of Action Design for clinical decision-support). One of the most frequently cited activities in requirements gathering is task analysis.

Tasks and Efficiency

A cornerstone of design for productivity in human systems is task analysis. Yet the emphasis of task analysis is enlarging from singular tasks to a larger view of the work. The time-tested core methods of task analysis remain but have been joined with new methods of interview and observation.

Task analysis began with the Industrial Revolution of the 19th Century where wide-scale mechanization brought repetitive tasks to human work. Production was the goal. Beyond the application of steam power and new transportation technologies, efforts were made to introduce efficiency into production lines. In the 19th and early 20th centuries, Charles Babbage, Frederick Taylor, and the Gilbreths looked for improvements in productivity while observing industrial workers (Barnes, 1958; Dubrovsky, 1989). Taylor offered time and motion studies that reduced production to subtasks as he looked for the "one best way" of production. Later, the Gilbreths systematically examined fatigue, monotony, safety, and delays in the production process. The Gilbreths also introduced formalized analysis to time and motion study with their process charts, flow diagrams, 3-D diagrams of worker movements, activity charts, time graphs, and work sampling. Using "man and machine" charts they found some tasks as more appropriately allocated to automation than to the human user or operator. Shovels were redesigned to fit the human capacity for lifting; work flow was reallocated to take advantage of the strength of the machine.

These same methods are used in automated environments today such as automotive manufacturing, food processing, electronics, and even nursing station design (Lockheed, 1969). Kirwan and Ainsworth (1992) have authored "A Guide to Task Analysis" that lists observation, structured interviews, activity sampling, critical incidents, and verbal protocols as activities for task data collection. Diaper (1989) adds pen and paper notes, audio and video recordings, computer session capture, think aloud and walkthrough methods. Although there is no explicit mention of task analysis, a National Center for Nursing Research (NINR, 1993) expert panel includes interviews, questionnaires, diaries, system monitoring, participant observation, and critical incident techniques as means to study " information uses in a professional group."

Once data have been collected, tasks can be categorized into an organizing conceptual framework. The conceptual framework is often hierarchical, separating tasks into goals, operations, and conditions in an increasingly specific process of redescription (Shepard, 1989). Wilson, Bernard, Green and MacLean (1988) suggest organizing a task framework as a guide to design. Similarly the Keystroke and GOMS (goals, operators, methods, selection) models of human behavior are hierarchical task structures that use task completion times to evaluate changes in a system's design (Card, Moran, & Newell, 1983).

Task categories are useful in assessing task appropriateness for one group or another and task allocation. Trivedi (1982) and Hagerty, Chang, and Spengler (1985) counted nursing tasks by type assessing the appropriateness of task delegation. Task appropriateness and delegation were also the object of task analysis in the Ried, West, Martin, and Force (1991) study concerning decentralized pharmacies. Prescott, Phillips, Ryan, and Thompson (1991) used task type to demonstrate the under utilization of professional nursing skills and over utilization of nurse's time in non-nursing tasks.

Corcoran (1986) first limited the task type to decision making before using task scenarios to assess expert and novice planning skills. Corcoran-Perry and Graves (1990) limited their analysis to information-seeking among cardiac nurses and decomposed the task by information type, reasons, sources, and constraints. Dubrovsky (1989) describes task decomposition as producing task actions, processes, contexts, and constraints.

As with the original purposes of time and motion studies, task analysis is still favored as a method to assess cost or to increase efficiency in a process. Hagerty, Chang, and Spengler (1985) looked at self-reported task completion times to calculate the proportion of nursing time spent in direct and non-direct patient care activities. Clark and Zornow (1989) used time and motion to compare team, primary care, and total patient care systems of nursing practice, finding no significant difference in efficiency. Using a time and motion analysis of nursing activities as a constant, Roddy, Liu, and Meiners (1987) investigated levels of nursing home resident dependency. Watson, Lower, Wells, Farrah, and Jarrell (1991) assessed task time, type, frequency, and cost of nursing functions and proposed a redesign of nursing work and hospital department organization.

The task analysis literature also critiques task analysis measurement procedures. Observation is one of the prime task analysis activities but it can be accomplished in many ways. The traditional time and motion procedure assigns one observer to one subject. All activities and their completion times are noted. The trained observer collects great quantities of data but can only observe one subject at a time. Random and timed interval work sampling have been proposed as less costly techniques. Finkler, Knickman, Hendrickson, Lipkin, and Thompson (1993) compared work sampling of various intervals with the time and motion observations of medical students. They found that task completion times and frequencies can be misrepresented using work sampling procedures. Infrequent activities will be missed in long interval sampling. Oddone, Guarisco and Simel (1993) compared the self report time estimates of house interns and residents with random work sampling and found that self report overestimated the time spent in a number of patient care activities.

Although task analysis remains a favored method among researchers, it is not without its limitations. As Sittig (1993) found when he reviewed a number of work sampling experiences in healthcare, bias and inaccuracies are evident in all observational methods. Work sampling requires an adequate picture of the task frequency and duration *a priori* or it will be faulty. Self reporting procedures rely too heavily upon memory. And, observational categories must already be known before data collection can begin. Task analysis and observation cannot be used in isolation but must validated with additional data collection methods.

Human Factors and Usability

Task analysis, although a necessary requirements activity, may focus too greatly on the task function or flow and not on the people who are part of the larger system of work. Human Factors refocuses design attention on the human attributes within the system while using task analysis and psychometric techniques.

Chapanis, Garner, and Morgan (1949) introduce Human Factors as an applied design science derived from previous discoveries in experimental psychology. Meister (1989) clearly includes the human experience by defining human factors as the study of "how humans accomplish work-related tasks in the context of human-machine system operation and how behavior and non behavior variables affect that accomplishment" (p. 2). Ergonomics, a term closely associated with human factors but used more frequently in Europe, emphasizes the physical to a greater extent as "the study of the relation between man and his occupation, equipment and environment, and particularly the application of anatomical, physiological, and psychological knowledge" (Shackel & Richardson, 1991,

p. 3). Some researchers place physical ergonomics and cognitive ergonomics wholly within human factors.

The history of human factors begins where task analysis and the emphasis on efficiency leave off. It began during World War I when the United States put over one million soldiers through "intelligence tests" (Chapanis, Garner, & Morgan, 1949; Hawkins, 1987; Shackel & Richardson, 1991). The purpose of the tests was to find the "man to fit the job." Following WWI human factors research branched out into manufacturing, most notably with the frequently cited studies in General Electrics' Hawthorne Works facility.

During WWII engineers and analysts realized that complex weapons technologies and machinery, as designed, exceeded human operating abilities. Armed Forces investigators began asking why airplanes crashed—was it mechanical failure or human error? Aircraft design and the notion of error or failure are still heavy contributors to human factors research (Bignell, Peters, & Pym, 1977; Hawkins, 1987). But, with an understanding of human limitations, researchers began to hunt for machine designs that fit within human physical, perceptual, reactive, and cognitive capacities.

<u>Human Factors, Computers, and Cognition.</u>

One of the increasingly complex machines of the post-WWII era was the electronic computer. The computer became a reality in the late 1940's and was adopted by business and government organizations on a large scale in the 1960's. A computer differs from a simple calculator in that it possesses memory storage and is programmable using computer languages. Because a computer is programmable, routines and problem solving algorithms take on complexities reminiscent of human thought. This is both an exciting and distracting analogy. Using this similarity along with the results of experimental psychology research, Newell and Simon (1972) proposed the Theory of Human Problem Solving and the Information Processing System introduced earlier in the discussion of design. Newell and Simon's description of human thought as serial information processing also greatly affected human factors research and engineering.

Even though problem solving task analysis was central to the work of Newell and Simon their driving goal was not the design of a computer tool. They used the computer as a model and means toward developing theories of human behavior. This resulted in an eccentric mixing of the metaphor—the computer—and human cognition. As their work took place using computer systems which were serial processing devices, their model of human cognition was likewise linear, serial, and task oriented.

Building upon the logical cognitive model, human factors research in computer systems became associated only with interface design—the portal of human computer interaction. However, it should be noted that computer systems at the time of Newell and Simon's (1972) seminal research (late 1960's, early 1970's) were largely used within an engineering domain. Programming was the central computer-based human factors task; programmers were the users. Early high-level programming languages were like algebraic formulas with words, a series of "computing" instructions forming a logical algorithm and dialogue (for example see Pascal, COBOL, FORTRAN). The goal was often discovering the one most efficient expression. The emphasis on logical, error-free, serial tasks using a restrictive human cognitive model restricted applications to other real human work environments.

Human Factors and a Return to Design.

Human factors and design researchers used the presumption of logical interaction and looked to break complex human tasks into manageable problems with logical solutions. Using laboratory game research (e.g. Chess, Tic-Tac-Toe, Towers of Hanoi) the goal, identified problem, and solution alternatives became the problem space. Problem space complexity was studied by Bayman and Mayer (1984) with students using calculators, Moran (1981) in computer system design and programming, and Corcoran (1986) in nursing practice. Card, Moran, and Newell (1983) developed the GOMS (goals, operators, methods, selection) system to assess and model the problem space in structured programming. They saw human computer interaction as an exercise in resolving a task problem.

Kieras and Polson (1985) and Payne (1987) expanded the concept of a problem space in computer systems to include a goal space, device space, and the user's conceptual representations of each. They saw human computer interaction as dictated by a user's perception of goals and system operations. They proposed that ease of computer use would be enhanced if users had an adequate "semantic map" between the goal space and device space. If a user understood the process of achieving the goal and how a device works, then the user would be able to use the device in a facilitative way. Payne (1987) and Scapin (1990) suggested mapping the device space, as designed, to the user conceptualization to discover cognitive mismatches. A mismatch would target a focus for design.

Norman (1988) also suggested mapping but used the term "artifact" for the device. An artifact is a tool or evolved product of everyday use and experience. Norman stated that there are natural "affordances and constraints" between human tasks and the human experience. Good design takes advantage of everyday common knowledge implied in the human experience. By placing the artifact within everyday human experience, Norman reached beyond an isolated task domain and information processing and into the phenomenological. His artifact examples of architecture (e.g. doorways, door handles, light switches) and appliance design (e.g. stove tops, radios) concerned the interface between design and user expectations. In Norman's view, one does not think about the process of opening a door in a linear way. But, using what one has experienced about doors and door handles, one simply reaches for a door expecting it to function in a way other doors have functioned within one's experience.

Giddings (1984) voiced his concern with the "domain independent" model of logical information processing while referencing the "software crisis." The software crisis was a hot design topic in the 1970's and 1980's and was seen as the inability of software applications to meet users' needs. Giddings proposed domain dependent models for design and an iterative prototyping method. However, he still wished to rely upon a human cognitive model, albeit of restricted scope, rather than participatory design.

In 1991, a number of opinions finding fault with the design emphasis on cognitive theory were published in human factors journals and texts (Bannon 1991; Bannon & Bodker, 1991; Carroll, Kellogg, & Rosson, 1991; Eason & Harker, 1991; Landauer, 1991). Carroll, Kellogg, and Rosson (1991) credited happenstance with a greater impact on design innovation than cognitive theory. Landauer (1991) called upon the design community to "get real" and recognize that grand cognitive theory will not produce as much improvement as the understanding of mundane work processes. For nursing, a

Interface design often relies upon inspection methods or evaluation techniques that assist designers in the discovery of usability problems. The human-computer interface is one of interaction: steps, decisions, processes, inputs and queries. Designers use inspection methods to detect inconsistencies and difficulties in that interaction process that may promote user error or frustration. Inspection methods are an assessment of the interface against guidelines (Mayhew, 1992), using paper prototypes or system walkthroughs (Karat, Campbell & Fiegel, 1992), empirical testing (Cuomo & Bowen, 1994; Gould & Lewis, 1987; Moran, 1981; Virzi, 1992), expert heuristics (Nielsen, 1992) or using focus groups (O'Donnell, Scobie, & Baxter, 1991). Empirical testing is the most expensive evaluation method, often resembling psychometric experimentation. It requires a usability lab or controlled environment for user observations, timed interactions, talk aloud recordings or video and keyboard data capture.

Nielsen (1992, 1993) and Virzi (1992) have focused on the effectiveness and costs of usability inspection methods. The questions they raised concerned the type and number of problems each method uncovers and the attendant costs. As some designers and engineers may harbor doubts about the benefits of usability evaluations, the discussion of cost arises from a need to demonstrate that while usability testing and other inspection methods do have their costs, this cost is justified when compared to the costs of poorly designed and poorly received software.

Believing expert review to be less costly than empirical user testing, Nielsen (1992) has researched a heuristic inspection method that employs usability experts and use scenarios. Experts in usability perform the tasks implied in the use scenarios and evaluate their experiences with respect to usability heuristics. While this process can uncover many usability problems without employing real users doing real tasks, effects related to the users' environment remain unknown (e.g., what happens if the user is called away from the task or, in the nursing environment, what happens if a patient crisis interrupts the task).

It is easiest to perform a usability evaluation once a product and interface exist. Typically this places usability considerations toward the end of the product development process. However, it is at the end of development that tight schedules and budget pressures constrict usability's impact. It is too late in the design process to make any substantial, functional changes other than to repair a catastrophic error. It is the belief that usability and interface design is little more than cosmetics along with the rush to ship an untested product that has contributed to the "software crisis" of unfriendly, unusable software. One answer to this situation is participatory, user-centered design.

Participatory design that reaches beyond requirements gathering is an approach widely used in Scandinavia. The users become design partners and participate throughout the design process. With users as participants in design, Bannon (1991) believes the difficulties in expressing needs, changing user needs, and representing needs within formal specifications can be avoided. Eason and Harker (1991) offer that generic systems can use a general user behavioral model in design but systems designed for a specific population of users must be based upon participatory design. Beyer & Holtzblatt's (1995) experiences emphasize the context within which a system will be used and introduce the notion of designers as apprentices within the user's domain. Keil and Carmel (1995) call this minimizing the linking distance between the users and designers.

Designers, using participatory methods, recognize that usability is bigger than the "look" of an information product. The functionality, sequencing of tasks, intuitive display, and system response or placement will change the work. Users are "doers." As Bannon and Bodker (1991) state, only with user partners can design and subsequent alterations in the work process be considered.

Summary

Three factors now play a role in changing the linear approach to system design. The first is a move toward the development of specialized information systems for smaller unique populations of users who have information needs specific to their work. When designing a word processor, telephone, or an Automated Transaction Machine (ATM) for banking, the needs of the general population must be considered. But, when designing an automated information system for patient care, the unique needs, knowledge, and approach of the clinician must be considered. The patient care system will be used by specialized users with specialized needs.

The second factor affecting the design cycle is the use of rapid prototyping design tools. Prototyping builds a "working model" of a system and interface, allowing user evaluation before full system implementation. Using prototypes, design becomes iterative. It is increasingly difficult to visualize a design cycle with a start and a finish. System evaluation can occur many times in the design process before the final product implementation. Prototyping then allows a greater use of empirical evaluative research, rather than relying upon a theoretical model of human cognition.

Finally, the system and software marketplace has awakened to the realization that usability makes the difference. No longer can lists of software functions sell a product.

Function lists are often similar across products. It is the way in which the application supports the user, in the user's tasks, that will differentiate products. The software or computer product must easily interweave with the work of the user and support experts in their fields rather than require all users become computer experts. This can only occur with user participation early in application design.

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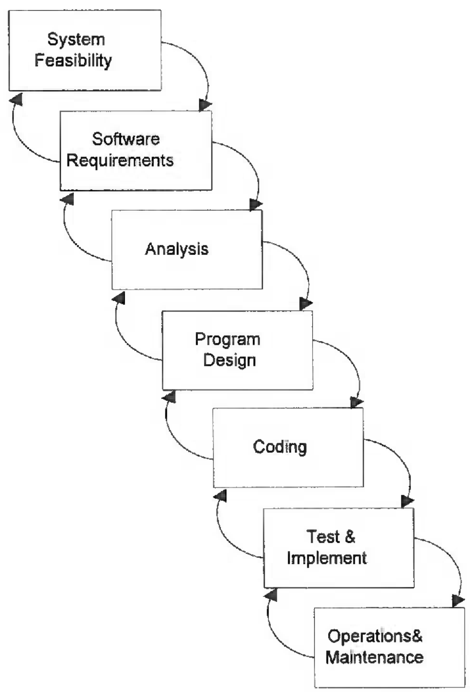
Section 1.

First Paper Figures

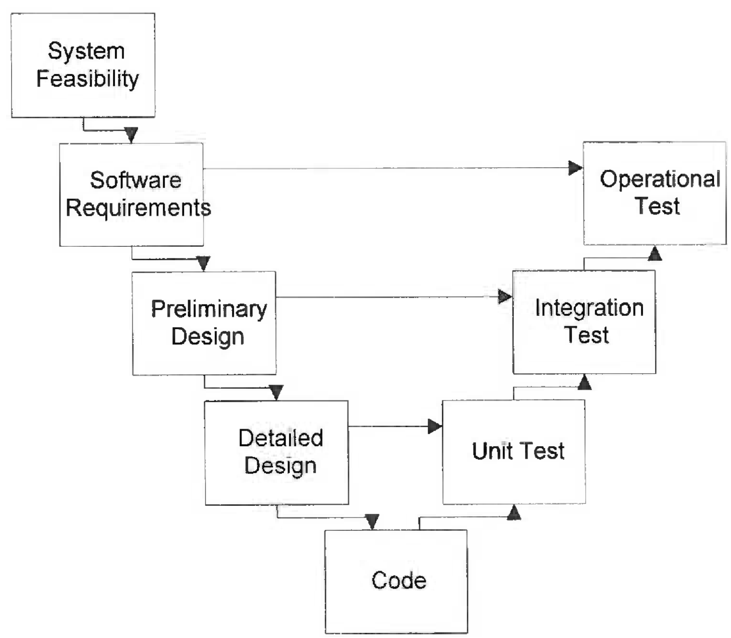
Figure 2 Waterfall Model and Authors' Terms



Waterfall Model Phases
System Feasibility
Software Requirements
Analysis
Program Design
Coding
Test & Implement
Operations & Maintenance

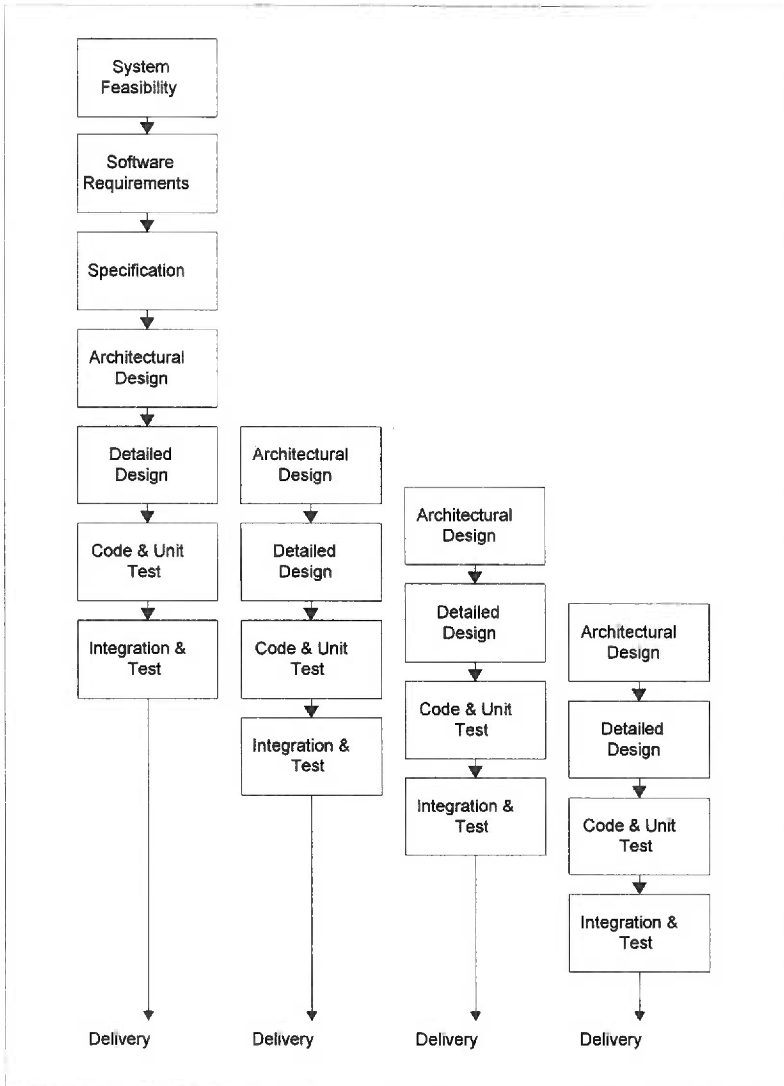
Jacobsen & Fennel (1989)	Perreault & Wiederhold (1990)
Feasibility Study	
	Requirements Analysis
	Specification
Systems Design	Design
Programming & Procedures	
System Acceptance	
Implementation & Support	Implementation
	Testing
Maintenance	Maintenance

Figure 3 V Model and Authors' Terms



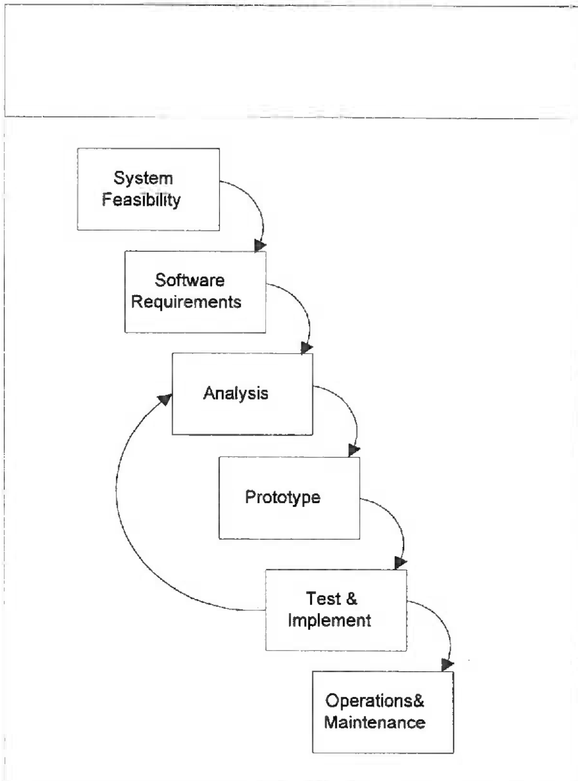
Zimmet (1994)		McDermid & Rook (1993)	
		Requirements Analysis Feasibility Study	Operation
		Project Initiation	Operation Test
Requirements Analysis	System Test	Requirements Specification	Acceptance Test
Preliminary Design	Integration Test	Architectural Design	Integration Test
Detailed Design	Unit Test	Detailed Design	Integration
Code	Walkthroughs & Inspection	Coding	Unit Test
→		→	

Figure 4 Incremental Model adapted from McDermid & Rook (1993)



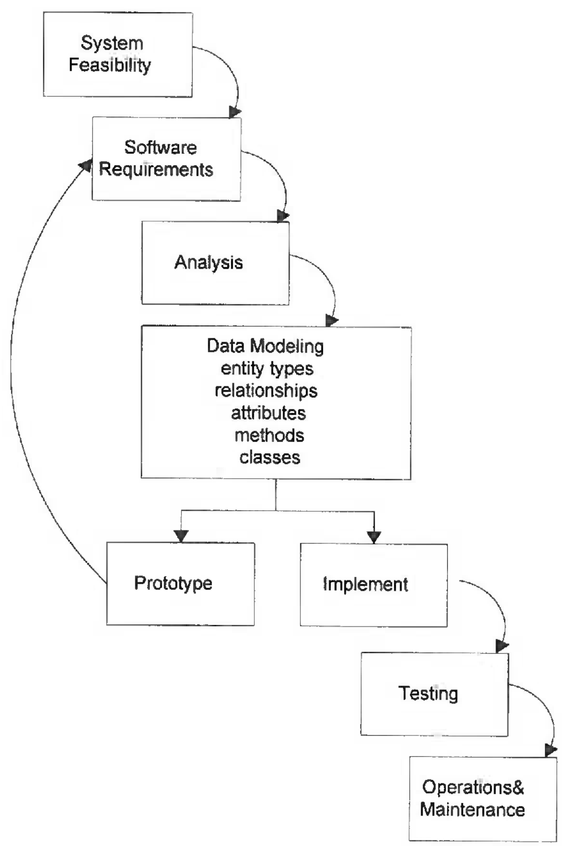
Adapted from McDermid & Rook (1993)

Figure 5 Prototype Model and Authors' Terms



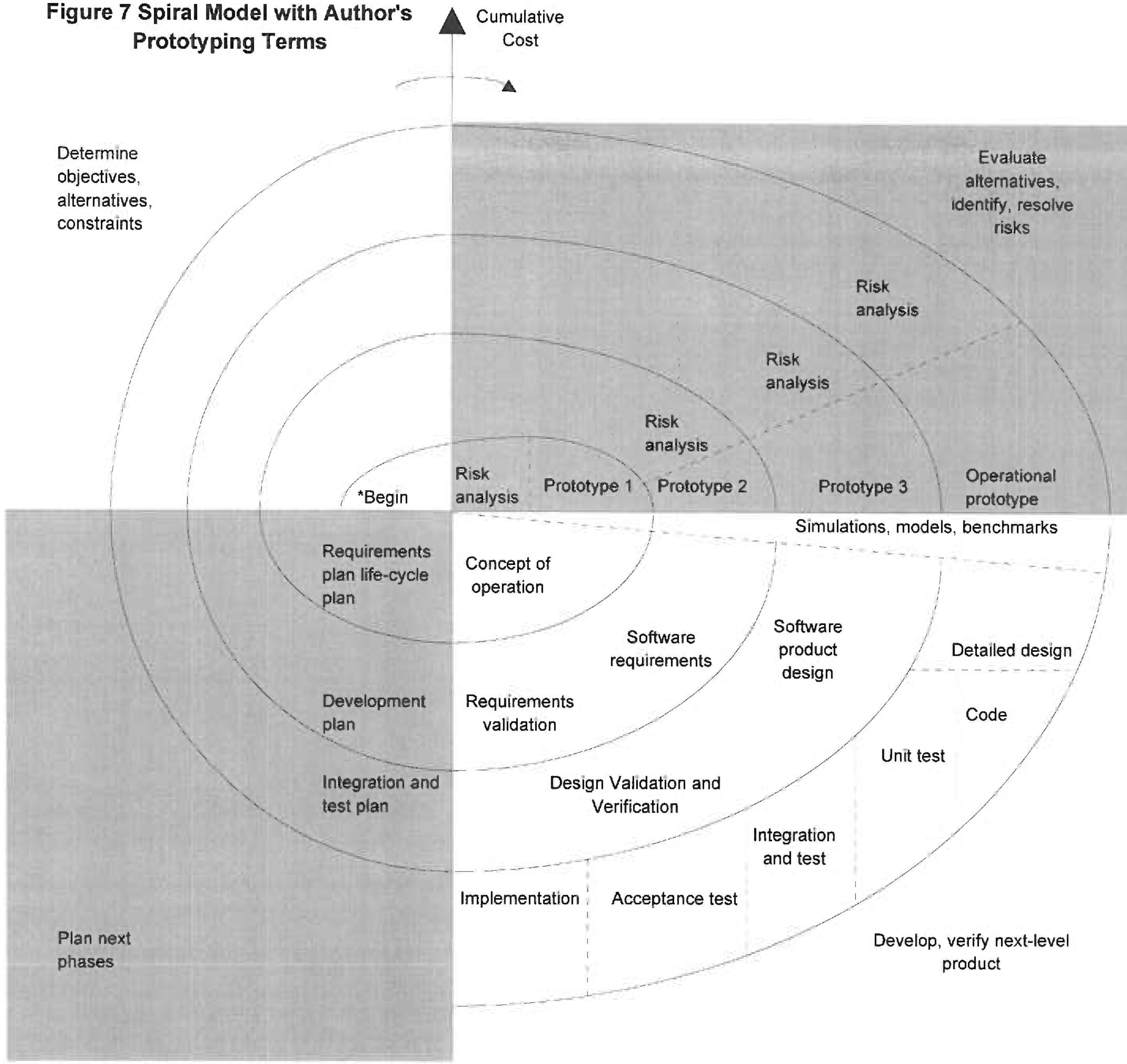
Prototype Model Phases	Mrazek & Rafeld (1992)	Mayhew (1992)	Laurel (1991)
System Feasibility	Understand the Customer	Scoping	Model
	Needs & Task Analysis	Functional Specifications	Specify
Software Requirements			Change
			Modify
Analysis		Design	Access
	Prototype and Evaluate	Development	Simulate
			Evaluate
Prototype			Mandate
			Formulate
Test & Implement		Testing & Implementation	Direct
	Iterative Testing		Control
Operations & Maintenance			Remember
	Alpha/Field Testing		Learn

Figure 6 Object Model and Authors' Terms



Batini, Ceri, Navathe (1992)	Connolly, Begg, Strachan (1996)	Davis (1990)
Feasibility Study	Database Planning	Problem Analysis
Requirements Analysis	Systems Definition	Knowledge Structure
	Requirements collection and analysis	Structured Requirements Specification
Conceptual Design	Conceptual Design	Define User-level Entity Diagrams
Logical Design	Logical Design	Combine User-level Entity Diagrams
Physical Design	Physical Design	Define Application - level Entity Diagram
Prototyping	Prototyping	
Implementation	Implementation	Define System Components
	Data Loading and conversion	
Validation and Testing	Testing	
Operation	Operation and Maintenance	

Figure 7 Spiral Model with Author's Prototyping Terms



Kirwan & Ainsworth (1992)	Neilsen (1993)
Concept	Know the User: Task Analysis; Functional Analysis
Flow Sheeting	
	Competitive Analysis
Preliminary Design	Setting Usability Goals; Financial Impact
Detailed Design	Detailed Design
Construction	Participatory Design
	Design of total Interface
	Heuristic Analysis
	Prototyping
Commissioning	
	Empirical Testing
	Iterative Design
Operating & Maintenance	Feedback from Field Use

From "A Spiral model of software development and enhancement," by B. Boehm, 1988, Computer, 21, p. 64. Copyright 1988 by IEEE, Inc. Adapted with permission of the author.

Section 1.

First Paper Appendices

Design Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Bignell, V., Peters, G., Pym, C. (1977). Catastrophic failures. Milton Keynes, UK: the Open University Press.	the examination of design, engineering, and process errors	recent loss of life disasters in the UK	review of the findings from official investions	7 case examples	design and process failures are traced to the lack of full information, communication process failures, lack of complete and thorough testing after installation, lack of environment evaluations, cost-cutting, and illegal practices; examines design and communcation failures in train wrecks, landslides, architectural design, fire and fire evacuation, traffic control, gas leaks and explosions	it seems one of the common errors is a failure to look at the bigger picture-beyond the immediate environment-as well as a failure to introduce a sufficient number of real case scenarios in testing
Giddings, R.V. (1984). Accommodating uncertainty in software design. Communications of the ACM, 27(5), 428-434.	domain dependent software requires a new development process	domain independent software, domain dependent experimental software, domain dependent embedded software	discussion	n/a	domain independent software contains solutions that are domain neutral-such as numerical algorithms; domain dependent experimental software is constructed without a clear idea of the needs and results and may focus on research; domain dependent embedded software interacts with the domain and will change the domain and perhaps the needs as well; proposes prototyping as a means to create domain dependent applications; high-level programming languages allow greater prototyping efforts; iterative prototyping can be assisted by reusing module libraries; problem solving environments are knowledge based environments; domain dependent problems can be formally modeled as algorithms using cognitive psychology; prototyping is a nested iteration within the waterfall model	addressing the "software crisis"; does not explicitly define the user and user characteristics as within the domain; proposes formal models of the problem solving domain but does not propose a method of model discovery; it is unclear if after discussing the impact of the domain, the author wishes to rely upon a general cognitive model of human interaction
Alavi, M. (1984). An assessment of the prototyping approach to information systems development. Communications of the ACM, 27(6), 556-563.	comparison of prototyping and classical life cycle design approaches for design control and communication with users	prototyping process, life cycle process, role playing system users, role playing system analysts	2 phases: (1) interviews with designers and analysts, (2) pre and post Likert questionnaires for role playing teams analyzed via Mann-Whitney U test	(1) 12 prototyped system projects with 12 project managers & 10 analysts; 63 MBA students in 9 teams	(1) interview results from those using a prototyping development model with real systems indicated that prototyping offers: user enthusiam, a common "real" system for discussion, better developer-user relationships; a prototype approach was difficult to manage and control and results could be oversold; prototyping may not be appropriate for large projects; (2) role playing case studies found prototyping significantly greater in user product satisfaction and process satisfaction; the life cycle approach was judged to have significantly greater user-designer conflict but also offer greater control; prototyping saw a greater number of user requirement changes	role playing was a graded exercise for graduate business students; although the comparative study was based entirely upoon role-playing students, the results are interesting in that those in the designer role felt they had less control while users felt greater satisfaction using a prototyping process; users did change their requirements more frequently in the prototyping exercise but this may be a good result - users did not have an opportunity to change their views in the life cycle experience

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Reference	Focus	Variables	Method	n	Results	Comments
Boehm, B.W., Gray, T.E., & Seewaldt, T. (1984). Prototyping versus specifiying: A mulitproject experiment. IEEE Transactions on software engineering, SE-10(3), 290-302.	investigate the results of a prototyping appraoch to design and compare with the specification model (waterfall)	application domain, effort distribution, schedule distribution, productivity, size, quality, maintainability, skills, specification process, prototyping process	descriptive comparison of averages and ANOVA	7 software development teams; 3 raters	the prototype product was 40% smaller than the specified product and required less time to produce while being equivalent in overall performance; prototyped products had lower functionality and error tolerance but were judged easier to use; the prototype product was also rated easier to maintain but this result is unclear; the prototyping teams spent less time planning and designing and more time "fixing"; all products seemed to exhibit unique and programmer dependent charactersitics	the development teams were composed of graduate students; the students additionally rated each student produced product; course grades were dependent upon the ratings; the usual approaches to specification and prototyping were altered to meet educational needs; time on the project was self reported
Winograd, T., & Flores, F. (1986). Understanding computers and cognition: A new foundation for design. Norwood, NJ: Ablex Publishing Corp.	design is "the interaction between understanding and creation;" an examination of the assumptions surrounding human cognition and their affect on technology design	rationalism, hermeneutics, the biology of cognition, language, representation	review and discussion	n/a	critiques a number of assumptions: that design begins with a problem, the computer-human cognition analogy is treated as fact, computers are capable of "understanding," the scientific process of discovery for the "hard" sciences can be transferred to human or social sciences; offers computer systems not as decision systems but as conversation systems	severe critique of the limitations of and contradictions within the rationalistic approach to designing human tools; suggests that "systematic" and "consensual" domains of action exist within which tools of communication (networked computer systems) can be utilizied
Reisner, P. (1987) Discussion: HCI, what is it and what research is needed? In J.M. Carroll (Ed.), Interfacing thought: Cognitive aspects of human-computer interaction (p. 337-352). Cambridge, MA :A Bradford Book, The MIT Press. :337-352	the need to define human behavior before concerning ourselves with pragmatic design; human cognition is the basic science of HCI	task analysis, human cognition, design, engineering, modeling	discussion	n/a	models are both descriptive (task analysis) and analytical; models offer a way of making intuitive knowledge explicit thereby giving designers the opportunity to make tradeoffs in design goals (e.g., consistency vs. naturalness)	proposes a semantic distance as a means of predicting the number of human computer interaction errors; can intuitive knowledge ever really be made explicit; builds on cognitive modeling theory-that there is one human pattern in cognition
Norman, D.A. (1988). The design of everyday things. New York: Doubleday.	design is often evolutionary, matching the design of "artifacts" with the users, the task, and "knowledge in the world"	affordances, constraints, human error, conceptual models, mapping, psychology of everyday things (knowledge in the world)	case studies, critique for what is a "successful" design from the user's perspective	n/a	using many examples of good and poor design, develops a set of principles for designing "artifacts" that match user's needs and conceptual models of phenomena: provide a good conceptual model, make things visible, map system behaviors with common knolwedge and user behaviors, provide feedback, simplify, design for error, standardize if necessary	although offers many heuristics for design, does not offer any metrics or methods for analyzing the success of ones design beyond trial and error

Design Literature
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Reference	Focus	Variables	Method	n	Results	Comments
Boehm, B. (1988). A spiral model of software development and enhancement. Computer, 21(5), 61-72.	relating how the spiral model of development has been used at TRW for risk management	development models, risk threats	review and description	n/a	first software development process was "code and fix" which proved unwieldly-creating "spaghetti code"-for large projects; waterfall model developed in 1970's and focuses on producing documentation hence discourages more effective approaches like prototyping; evolutionary and transformative models (prototyping) work better for interactive software products yet can become like "code and fix;" the spiral model allows iteration yet controls for the risk threats of: personnel shortfalls, unrealistic schedules, developing the wrong functions, the wrong interface, gold plating (unnecessary costs), requirements creep, shortfalls in externally produced components and tasks, performance short-falls, unrealistic computer science expectations	bases description of the spiral process on author's experiences at TRW and successful software development projects
Lanzara, G.F., & Mathiassen, L. (1988). Intervening into system development area projects: Tools for mapping situations. In G.C. van der Veer, T.R.G. Green, J.-M. Hoc, & D.M. Murray (Eds.), Working with computers: Theory versus outcome. London: Academic Press.	system development projects and the development actors, user needs, and organization needs should be evaluated on multiple levels; design as intervention	problem situations; the situation within the organization; goals or envisioned future situations; and project history	case evaluation using interviews, committee meeting minutes, and document review within 4 mapping techniques	1 project	4 maps are developed: a diagnostic map relates problem areas to previous occurrences and system actor behaviors; the ecological map relates the problems of the diagnoses to external and internal environments; virtual maps project the future desired situation; the historical map chronicles the system development	qualitative and group discussion techniques; proposes the mapping technique as a process of organizational development; seeks to provide new tools for project/system evaluation and invention; sees the captured knowledge of the groups involved as relevant if not rigorous in the traditional sense
Graves, J., & Corcoran, S. (1988). Design of nursing information systems: Conceptual and practice elements. Journal of Professional Nursing, 4(3), 168-177.	proposing information system structure that uses a nursing knowledge structure model	clinical decision making, data, information, knowledge, discipline, practice, practitioner	discussion, hypothetical case analyses for illustration	n/a	information flow model deductively formed from work on clinical decision making; a conceptual and practice model is adopted and interpreted for nursing information systems; proposes that current nursing information systems emphasize patient care documentation and individual patient inquiry but lack functions for aggregate data inquiry and access/links to the literature (knowledge base); conceptual mapping will assist in the design of nursing information systems but nursing's literature is not mature enough or of a quality to support domain mapping	the authors reference other work to support their models but do not mention the methods used to discover nursing information needs; the conceptual and practice model assumes that all practice is linked to a research based body of knowledge and nursing theoretical framework--omitting experienced based practice patterns and explicitly excluding the cognitive processes of the information flow model and the nurse's individual difference; practice is proposed to be affected by setting, client, and method but not the individual professional

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Reference	Focus	Variables	Method	n	Results	Comments
Morris, J.N., Hawes, C., Fries, B. E., Phillips, C.D., Mor, V., Katz, S., Murphy, K., Drugovich, M.L., Friedlob, A.S. (1990). Designing the National Resident Assessment Instrument for nursing homes. The Gerontologist, 30(3), 293-302.	recounts the development of the federal Health Care Financing Administration's first mandated minimum data set (MDS) for health care	Omnibus Budget Reconciliation Act '87 domains: medical hx, condition, functional, sensory, cognitive, physical, psychosocial, dental, and nutritional status, procedures, discharge, activity and rehab potential, drug tx; care plans, quality, planning, long-term care policy	survey current assessment tools, multiple expert panels, item testing, full system trial	10 nursing homes on the east coast: 6 for profit, 4 non-profit; 20 nurse assessors; 383 residents in three strata: new admissions, special problems, current residents	expert panel members represented nursing, social work, medicine, physical occupational and speech therapy, institutional activities, nutrition, consumers, advocates, providers, long-term care industry, state regulators, and measurement specialists; inter-rater reliability using percentage of item agreement, measures of association, measures of congruence (Spearman Brown correlation); items were retained if they had a reliability in the .40 or better range and if they were thought to contribute to care planning; MDS data was drawn from direct observation, resident chart review, resident interview, and staff input	the MDS is offered as an interdisciplinary tool yet only nurses participated in the data collection and resident assessment trial; extensive stay residents were underepresented; a lower than normal (.40) item reliability criterion was accepted based upon an assumed difference between the assessments by staff nurses and outside nurses--this assumes that the assessment scale is not independent of information it does not capture or that it cannot capture all information collected in nursing assessments; the opinions of the nurse assessors on applicability to care planning were collected in a formal debriefing but this process is not described; the nurse assessors self reported an estimated time to complete the MDS; no analysis of the pre-MDS assessment process and time is reported; the potential to automate the MDS using computer systems is offered but is not been investigated
Perreault, L.E., & Wiederhold, G. (1990). System design and evaluation. In E.H. Shortliffe, L. E. Perreault, G. Wiederhold, & L. M. Fagan (Eds.), Medical informatics: Computer applications in health care (pp. 151-178). Reading, MA: Addison-Wesley Publishers.	describe the issues surrounding HIS design and evaluation		discussion and review	n/a	computer system issues include functions, design (describes the system life cycle as a "waterfall model"), needs analysis, development and implementation, custom versus turn-key system, the match between design and use, involvement of users in the development process, and evaluation (performance, cost-effectiveness, user acceptance, safety); the traditional waterfall model may not be appropriate for complex design, prototyping may be preferable	user involvement and acceptability center around the system-practice match
Wixon, D., Holtzblatt, K. & Knox, S. (1990). Contextual design: An emergent view of system design. In CHI'90 Proceedings (p. 329-336). New York: Association for Computing Machinery.	describe and contrast contextual design with traditional design approaches and, especially, artifact engineering	users and work contexts	discuss contextual inquiry	n/a	rejects 'traditional, predictive research techniques' as too focused on theory development rather than usable design; looks to 'transform user work;' describes a purposeful sampling to accentuate user differences, observation, and user-owned interviews	while rejecting 'theory' authors still propose that generalizable design principles can be found, used, and reused; assumes and iterative design approach; technique descriptions have many similarities with naturalistic inquiry, grounded theory, and phenomenology

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Reference	Focus	Variables	Method	n	Results	Comments
Carroll, J.M., Kellogg, W.A., & Rosson, M.B. (1991). The task-artifact cycle. In J.M. Carroll (Ed.), Designing interaction: Psychology at the human-computer interface. Cambridge: Cambridge University Press.	reanalysis of HCI design from general theoretical psychology to situational discovery	design rationale, scenario-based design, psychology of tasks	review and discussion	n/a	emulation, development and redevelopment, craft, context, and happenstance play a greater role in design innovations than deductions from theory; "the evolution of HCI technology is a co-evolution of HCI tasks and HCI artifacts" (p. 79); our tasks produce requirements for the design of helpful artifacts which in turn produce possibilities that alter the original tasks themselves; proposes a knowledge base for design indexing hardware, software, application domain, user category, and psychological claims and trade-offs	pragmatic approach to what works; successes can be transferred to other situations without first forming grand theory; what of the artifacts of the workplace that were not designed by engineers or designers
Laurel, B. (1991). Computers as theatre. Reading, MA: Addison-Wesley Publishing Company.	designing for the computer as medium rather than as tool	representing action, character/agents, environments, objects	examples and discussion using theatrical principles	n/a	design using "dramatic foundations:" qualitative structure, orchestrating action, orchestrating human response; the interface as theatre and audience rather than mental models of behavior	the focus becomes less human-computer interaction and more human-computer experience
Landauer, T.K. (1991). Let's get real: A position paper on the role of cognitive psychology in the design of humanly useable systems. In J. Carroll (Ed.), Designing interaction: Psychology at the Human-Computer Interface. New York: Cambridge University Press.	discussion of the merits of theory driven design as opposed to empirical, formative design and evaluation		literature review and case examples	n/a	theories of human behavior and cognition will assist information system design minimally; theories are too general and built on linear approaches to problem solving; the complexity of human situations requires an iterative experiential approach for real gains in system design	the position taken is that human and information structures are more complex than can be represented in grand all-encompassing theories of human cognition and behavior
Batini, C., Ceri, S., & Navathe, S. B. (1992). Conceptual database design. Redwood City, CA: The Benjamin/Cummings Publishing Company, Inc.	relational database design	data modeling, functional analysis, logical design	description, case examples, exercises	n/a	briefly introduces a modified waterfall model for system design using prototype interations--feasibility study, requirements collection and analysis, design, prototyping and requirements iterations flows to implementation, validation and testing, operation; functional analysis contributes to data flow; conceptual analysis contributes to the entity-relationship data structure; logical design structures the relational model	all examples are toward building a relational database

Design Literature
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Reference	Focus	Variables	Method	n	Results	Comments
Mayhew, D.J. (1992). Design Methods. In Principles and guidelines in software user interface design (pp. 578-600). Englewood Cliffs, NJ: Prentice-Hall, Inc.	methodology for software user interface design	scoping, functional specification, design, development, testing/implementation	review	n/a	design is principally art: design principles are generally based upon expert opinion and logical deduction rather than empirical data, design is context sensitive and therefore difficult to generalize, some design principles are contradictory; scoping includes business requirments analysis, user profiles, hardware and software definition; functional specification is achieved through task analysis and goal setting; design is writing a style guide, coding, prototyping and testing; development includes training materials and an overall system test plan;	functional specification is achieved through task analysis-interview, questionnaires, usage studies; interface testing includes observation, benchmarking, comparative experiments
McDermid, J., & Rook, P. (1993). Software development process models. In J.A. McDermid (Ed.), Software engineer's reference book, (pp15/1-15/36). Boca Raton, FL: CRC Press, Inc.	comprehensive review of software development process, terms, and methods	life cycle, waterfall model, V-model, prototyping, incremental, spiral model	survey and review	n/a	purposes of developmental models are: risk assessment, planning and control, decision making; waterfall method initiated as method to control large software projects; waterfall method can be modified with iteration between each step; step iteration can be seen as verification and validation; iteration between phases is necessary if the goals are unclear or developmental but perhaps the protoyping or incremental model would be more appropriate; the V model requires test specification during the early phases; prototyping is appropriate when the project contains unknown technologies, uncertain requirements, or a new situation; weakness of the prototype method include "hacker syndrome" and difficulties scaling up; the incremental approach staggers module development to control project staffing; spiral model also portions the project into steps prototypes, completing a full lifecycle for every step, controlling for risks and costs	
Mezick, D. (1993). Data modeling: The building blocks to better apps (a structured approach to designing software applications). Data Based Advisor, 11(10), 79-86.	creating a data model using Extended Realtional Analysis (ERA) for better application design	entities, realtions, attributes	description	n/a	ERA is simple to understand and requires no advanced tools such as CASE; the results are tables in the third normal form	focus is on database systems but can be used to envision object-oriented design as well

Design Literature
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Reference	Focus	Variables	Method	n	Results	Comments
Heathfield, H.A., & Wyatt, J. (1993). Philosophies for the design and development of clinical decision-support systems. Methods of Information in Medicine, 32, 1-8.	review of clinical decision support research and implementation and an examination of design assumptions	expert systems, development philosophy, formalized methods, rapid prototyping, object-oriented design; ACORN chest pain diagnosis system	discussion; report of a failed system	1 case example	clinical decision support system development to date has emphasized knowledge representation research and theory rather than clinical application; clinician's needs are not adequately explored; decision support systems concentrate on diagnosis while clinicians most seek help in assigning therapies; development is often dictated by the choice of software tools, emphasizing computer artifacts over clinical problems; developer and user communication difficulties are based on the use of formalized design notations; recommends rapid prototyping approaches rather than formalized methods as innovative clinical systems cannot be fully specified at the outset; expresses the need to match development tools and methods with the problem structure at hand; system evaluation must begin to assess how a system was developed as well as system functions	the implementation goals of the ACORN system were unclear; the ACORN system was deemed a failure due to a poor interface, slow processing speed, output was too detailed to be usable, the decision support system was not linked to the hospital bed supply and therefore could consider decisions involving triage
Ellison, K.S. (1994). Developing real-time embedded software in a market-driven company. New York: John Wiley & Sons, Inc.	review of software design methodology for medium to small companies; offers "cookbook" recommendation s	design models: waterfall, spiral, incremental, process architecture; methodologies: structured programming, structured analysis, object oriented design, real-time methods	review, case examples, recommendations	n/a	the software development life cycle is a project management tool; waterfall model introduced in 1970's to manage large projects-no changes are anticipated, very rigid, each phase is completed before moving to the next; spiral model similar to waterfall model but adds planning and risk analysis between phases; incremental model may develop from a known goal and test and iterate or may use iteration for discovery; process architecture is each organization defining its own process based upon needs, feedback, and experience; structured programming - modules of software; structured analysis - event list, context diagram, data flow diagram, data dictionary, process specification; object oriented design - based upon" information hiding," inheritance, "things," attributes, messages, services	gives little importance to requirements gathering, sees it as a marketing task; requirements are "apples" while products are "oranges" - therefore why struggle with requirements (how does one then know that users will use oranges??); seems this is the us-them attitude found among programmers; offers practical advice in a recipe for design - what has worked

Design Literature
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Reference	Focus	Variables	Method	n	Results	Comments
Zimmet, J.A. (1994). Software quality assurance: A critical part of the software development life cycle. In S.J. Grobe & E.S.P. Pluyter-Wenting (Eds.), Nursing informatics: An international overview for nursing in a technological era (pp. 192-196). Amsterdam: Elsevier Science B. V.	overview of testing in the V model of software development	V model	discussion	n/a	V model emphasizes simultaineous development of testing protocol as software is designed; V model visualizes data flow and control; testing includes functional testing, structural testing, integration testing, and system testing; recommends nursing participation in the review of software functional testing process and results	recommends V model for health care software development but without explanation other than method overview
Irving, D. (1994). V is for software development. EXE, 8(11), 64-67.	developing a testing plan for software engineering	requirements, design, testing, V model of system life cycle	discussion	n/a	the V model of traditional software development addresses the ever narrowing and ever more specific software verification process; in the V model, testing criteria is developed in the early stages of development and linked to the testing phase later in the process; software testing has not been formalized to the extent of requirements; the testing plan needs to begin at project initiation and include test formats, administration, environment, tools, schedules, responsibilities, and software	software quality has many factors; testing has not had as central a role in the requirements process as necessary; the V model does not allow any feedback or iteration in design but sets up a strict testing mechanism linked first to conceptual and then coding levels of development
Coyne, R. (1995). Designing information technology in the postmodern age: From method to metaphor. Cambridge MA: The MIT Press.	moving from a theoretical to a pragmatic approach in the design of information systems	conservative v. progressive, pragmatic v. theoretical, critical v. compliant, and radical v. reactionary views of information technology	review of philosophical perspectives in design methods and the human relationship with information	n/a	the conservative theme in information technology lies in the assumptions one can capture and formalize knowledge and that human cognition is information processing - in design conservatism is control and method; the pragmatic holds that humans interact with technology toward some goal - in design pragmatism is community and needs and exploration; critical theory sees information technology as control - in design critical theory states that the community is non-explicit thereby making design a political activity; radicalism is undeveloped - radicalism in design is deconstruction	major thesis opposes rationalism (conservatism) transferance of scientific methods into human and social investigations (emic), namely design; pragmatism and hermeneutics offer a holistic and situated intrepretation of human phenomena (etic); models are not practice but analogies without disanalogies; proposes that the separation of system from interface is artificial; states most design is atheoretical pragmatism - searching for systems that can be used in some context; pragmatism uses theory as a tool

Design Literature
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Reference	Focus	Variables	Method	n	Results	Comments
Sachs, P. (1995). Transforming work: Collaboration, learning, and design. Communications of the ACM, 38(9), 36-44.	examine assumptions about organizations and work	two perspectives of work: organizational explicit and activity-oriented tacit	case description	1	explicit organizational view of functions: tasks, operations, methods, and procedures; activity-oriented view: communication practices, relationships, coordination, workers, managers; design depends upon user participation and reflection; problem solving and efficiency does not rely upon a logical sequence of tasks but on the human capacity to troubleshoot; a "community of practice" cannot be segmented into tasks; formalized processes may become obstacles that require innovative workarounds;	used a single case as an example of design activities - just what was recommended by Carroll (1991); activities are described as wholes rather than finely reduced tasks; noted that much work exists outside of formalized processes and within informal conversation; Sachs' organizational view and work-activity view correspond to McGregor's Theory X and Theory Y assumptions about human behavior - Theory X: people must be closely controlled, have no ambition, have little creativity and responsiblity - Theory Y: work is natural, creativity is widely dispersed in the organization, motivation is a social, esteem, and self actualized necessity, people can be self directed;
Denning, P., & Dargan, P. (1996). Action-centered design. In T. Winograd (Ed.), Bringing design to software (pp. 105-119). New York: Addison-Wesley Publishing Company.	classical software design models focus too much on functional specifications and too little on the practical domains in which the software will be used	software lifecycle model, object-oriented design, mapping actions	discussion and expert interviews	n/a	the classic design processes like the waterfall and spiral models rely on engineering assumptions and do not do an adequate job of connecting the product with the users needs; proposes an ontology of the practice domain in which software will be used; the ontology is a domain map with the following notations: linguistic distinctions, speech acts, standard practices, tools and equipment, breakdowns, ongoing concerns	proposes action mapping in addition to the familiar formalized processes of design

Requirements Literature
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Reference	Focus	Variables	Method	n	Results	Comments
Scharer, L. (1981, April). Pinpointing requirements. Datamation, pp.17-21.	there are two points of view in requirements definition - users and analysts	definability	compare user's and analyst's goals for system design and function	n/a	users have qualitative system definitions - analysts have functional definitions; definability affected by: type of system, size of system, complexity of system, similarity to existing systems, and environmental factors - user's understanding of their needs, user consensus, analysts understanding of user needs, user/analyst communication, representation of the "real" end-users, experience, personality, appropriate staffing, time line, budget, corporate pressure	straight ahead design approach, non-iterative
Roman, G.C. (1985). A taxonomy of current issues in requirements engineering. Computer (April), pp. 14-22.	expressing requirements throughout the development system life cycle	functional requirements; non-functional requirements or constraints; component; environment;	review	n/a	requirements specifications are functional and performance characteristics and environmental constraints; design specifications are internal structure and behavior; requirements classification criteria: formal foundation (theory and processes), scope, level of formality, degree of specialization, specialization area, development method; non-functional requirements specification is lacking in the industry; some ill-defined problems cannot, by their very nature, have functional specifications but rather evaluation procedures	requirements gathering is need assessment with the user - using task analysis and interview techniques - identifying problems, functional needs and environmental constraints; requirements specification is the problem solution; if requirements specification occurs once a solution has been identified, are not the discovery strengths of iteration lost; the focus is too problem-oriented rather than process oriented; the results of both requirements gathering and specification are evaluated at system implementation; while asks for new formalisms, predicts that future requirements techniques will be more open ended and descriptive rather than structural
Fowler, C., Macaulay, L., Castell, A., & Hutt, A. (1989). An evaluation of the usability of a human factors based requirements capture methodology. In A. Sutcliffe & L. Macaulay (Eds.), People and computers V: Proceedings of the fifth conference of the British Computer Society, Human-Computer Interaction Specialists Group, (p. 359-371). Cambridge: Cambridge University Press.	evaluating the early phase of design and use of the USTM (User Skills Task Match) requirements methodology	USTM method of requirements analysis: Describing a Product Opportunity (DPO), High Value Solution (HVS), Delivering a Business Solution (DBS); usability defined as easy to learn, useful, easy to use, enjoyable	Likert-type questionnaires and semi-structured interview	DPO workshop attendees: 1st questionnaire, 35; 2nd questionnaire, 23; interview, 11	DPO is offered as a 'structured framework' applying human factors to requirements analysis: easy to learn means that materials are complete, well structured, and understandable; useful means that it offers an improvement, can be used in the working environment, and is a 'good task match;' easy to use is assessed outside of the working environment; enjoyable is attitudinal and subjective; generally, the DPO workshop and method was well received on the usability critieria but believed to offer an increase in workload; DPO will succeed only with explicit managerial support; the DPO exercise is more valuable than the Human-Factors Description document output; a multimethod approach to usability evaluation is recommended	it is assumed that an automated product will be an improvement over a current system; the usability evaluation is not of the USTM method but of a seminar that taught the first phase of USTM - the DPO; Describing a Product Opportunity entails many activities that ultimately orient the designers to the goals and needs of the users and their environment; the operating style of a design team will greatly affect the use of a method that demands concensual decision making

Requirements Literature
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Reference	Focus	Variables	Method	n	Results	Comments
Sailor, J.D. (1990). System engineering: An introduction. In R.H. Thayer & M. Dorfman (Eds.), System and software requirements engineering. Los Alamitos, CA: IEEE Computer Society Press.	define systems, systems engineering, and design tools			n/a	requirements are defined in the abstract; system requirements "allocated" to lower levels of specification are "derived" or interpreted into the language of designers and programmers;	contains many term definintions;
Dorfman, M. (1990). System amd software requirements engineering. In R.H. Thayer & M. Dorfman (Eds.), System and software requirements engineering. Los Alamitos, CA: IEEE Computer Society Press.	survey of requirements engineering approaches as part of systems engineering	life cycle development models: baseline and waterfall, prototyping, incremental, spiral	survey and discussion	n/a	system requirements are defined from the user perspective - hardware and software requirements are targeted for the analyst; as the system components are decomposed into subsystems, requirements become less abstract and more specific; requirements engineering involves general methodology approaches, specific method approaches, and formalized processes or tools; lifecycle models include baseline management, prototyping, incremental development, spiral model; system requirements reflect the user's perspective, subsystem requirments specifications describe the operations from the developer's view; requirements specification process: partitioning (functions), allocation (functional specs), flowdown (low level specs); traceability is the mapping of low level specs to the system specs; requirements is the "what" of a system, design is the "how; requirements methods: process oriented - structured analysis (SA), structured analysis and design technique (SADT), PAISLey, Descartes, Vienna Design Method, Z; data oriented - SA, SADT, JSD, entity-relationship modeling; control oriented - flowcharting, SADT, SA; object oriented - object classes	differentiates between system requirements, formed from the user's perspective and the lower level functional and performance requirements formed from the developer's perspective; requirements is iterative; ultimately requirements must communication user needs to developers; requirements analysis and engineering tools are increasing in number but remain "under development" - seems there will always be art to requirements

Requirements Literature
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Reference	Focus	Variables	Method	n	Results	Comments
Keller, S.E., Kahn, L.G., & Panara, R.B. (1990). Specifying software quality requirements with metrics. In R.H. Thayer & M. Dorfman (Eds.), System and software requirements engineering. Los Alamitos: IEEE Computer Society Press.	review the process of measuring general software quality attributes across many software applications	attributes, quality requirements, quality metrics, metric-aggregates, quality goals	review and discussion	n/a	the goal is to measure high level "consumer-oriented attributes" and trace them to quantifiable criteria with greater meaning for software engineers; uses the Rome Air Development Center consumer attributes (n=13) mapped to technical attributes (n=29); 4 general group types are used: performance, design, adaption, general; the performance consumer factor of "reliability" is mapped to the engineers critieria of accuracy, anomoly management, and simplicity; criterion metrics may be weighted, summed and averaged into a factor metric; software operating goals are produced by prioritizing the consumer-oriented factors	interestingly, usability is not mapped to simplicity; each criterion requires a method of measurement which may be direct or indirect; the difficulty is placing a quantitative metric on qualitative attributes
Davis, A.M. (1990). The analysis and specification of systems and software requirements. In R.H. Thayer & M. Dorfman (Eds.), System and software requirements engineering. Los Alamitos, CA: IEEE Computer Society Press.	review of requirements phase activities and techniques	structured requirements definition, structured analysis by Ross, structured analysis by DeMarco, PSL/PSA by Teichroew, object-oriented analysis by Coad	stepwise review of five requirements analysis techniques with examples	n/a	requirements is the definition of what a system should do without specifying how it will do it; problem analysis can be structured by partitioning, abstraction, and projection within two frames: functional (processes, data, flows) or object oriented (object attributes, relationships, structures, services, information exchange); problem analysis goal is understanding, systems design goal is optimization	partitioning, abstraction, and projection are really modeling before applying analogous reasoning; systems are represented by inputs, outputs, and controls
Davis, A.M. (1990). The analysis and specification of systems and software requirements. In R.H. Thayer & M. Dorfman (Eds.), System and software requirements engineering. Los Alamitos, CA: IEEE Computer Society Press.	survey problem analysis, product description, and requirements specification activities	problems, tasks, functions, data, perspectives; structured analysis; object-oriented analysis	review and discussion	n/a	requirements describes what a system should do, not how it will do it but will be dependent upon the level of "system" definition and the desired level of abstraction; problems can be analyzed using functional descriptions or object oriented entity relationships; functions are processes, data flows, and controls; objects are described within classes using relationships and messaging between objects; a knowledge structure assists analysis; problems can be structured by partitioning entities, abstracting or classifying, and projecting differing perspectives on the problem;	processes and analyses use and are greatly assisted diagramming--whether objects and relationships or data flow; objects are linked by messaging, data however flows from one stage to be transformed via some process into another stage; nice description of data flow diagrams; author compares and critiques each of the requirements techniques for its ability to partition and abstract a problem and for its ability to provide an external perspective--each analysis tool offers its own set of strengths and weaknesses that must be matched to the problem at hand; offeres recommendations for a written structured requirements specification

Requirements Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Stokes, D.A. (1991). Requirements analysis. In J.A. McDermid (Ed.), Software engineer's reference book (pp. 16/3-16/21). Boca Raton, FL: CRC Press, Inc.	overview of the requirements gathering, specification, and tracking methods as well as the environmental constraints	SREM, CORE, PAISLey, SCS, MAL, ERAE, RML, KBRA, RLP, and other requirements methods	review and critique	n/a	requirements are the "interface" between the customer and the analyst - as such they are an abstraction, a model of the customer's real world; types of requirements include: functional, functional constraints, design constraints, environment models, data and communication protocols, project management; the problem with requirements is their need to be exact, verifiable, and traceable.	requirements specifications as outlined are part of a linear approach to software development; iterative design and protoyping introduce a need for new approaches modeling the customer's world.
Dawe, U., Warnock-Matheron, A., & Ross, S. (1993). Mapping the future of hosptial information systems: Priorities for nursing applications. Computers in Nursing, 11(2), 61-66.	what are the nursing preferences for HIS module implementation	existing application modules; modules not currently available	attitude toward computers questionnaire and Q-sort	1 hospital, 77 staff nurses, 33 managers	applications part of the UNISYS HIS; the currently available systems ranked on support for decision making and patient care were: results reporting, order entry, nursing station census, and message switching; priorities for future systems were: on-line charting, autmated medication record, and enhanced results reporting; responses were generally the same for staff and management personnel however, differences appeared when the nursing specialty context was considered	future modules were descriptions only, not observed systems; although the sample seemed to emphasize information retrieval needs, information flow and module description is not provided
Timpka, T., & Johansson, M. (1994). The need for requirements engineering in the development of clinical decision-support systems: A qualitative study. Methods of Information in Medicine, 33, 227-233.	discovery of methods to integrate requirements analysis into the design of clinical decision support technologies	design experiences; Action Design documentation - Action Design is a group design process utilizing a 'toolbox' of instruments that guide development; requirements analysis moves from project establishment (project plan, committee, budget), activity analysis (goals, business model, clinical problem analysis), supportive evaluation and requirements specification (document or prototype)	video-taped semi-structured interviews on knowledge, attitudes and behavior of system development; critique of Action Design method	14 system developers, designers, managers, HCI specialists, policy makers, informatics researchers, medical practitioners	general agreement was found in a 'life-cycle' process of system design but differences were seen in the scope of organizational and user involvement and in the definition of the 'client;' requirements analysis is valued but may not be applied effectively due mainly to cost restraints; goals should include process goals of commitment, economic benefit, and change; suggestions were offered to make the Action Design requirements analysis document more usable and therefore more likely to affect change; the 'paradox' in development is constantly underfunding requirements analysis and producing dissatifactory products; definition of all interested parties (users, customers, clients) and early and constant participation in dialogue and design is necessary	the subjects did not actually use Action Design techniques but only critiqued the written documentation; respondents seem to change from a straight-ahead approach to design (the life-cycle) voiced in initial interviews to an acceptance of a user dialogue and concensus development

Requirements Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Davis, A.M., & Leffingwell, D.A. (1995). Using requirements management to speed delivery of higher quality applications. Boulder, CO: Requisite Inc.	review of requirements gathering and managing within a project; marketing tool for requirements software tool Requisite 1.2	requirements, costs, errors, documentation, process maturity	description of software product within a requirments specification and tracing process	n/a	requirements mangement is needed for efficient development - requirements management is the construction of a requirements database, stepwise process (Capability Maturity Model), and document traces; requirement attributes include: priority, authors, responsible party, rationale, cost, date, version number, links to other requirements;	proposes a "science" of software development;
Hutchings, A.F., & Knox, S.T. (1995). Creating products customers demand. Communications of the ACM, (38)5, 73-86.	re-engineering the requirements management process to avoid "requirements churn" and to focus on "whole products" reflective of a full organizational perpective and use	requirements management process steps; change theory; whole products include requirements, design, prototypes, code, marketing, implementation - full customer solutions	case study pilots	11	understand system business needs, gather customer information, translate needs into internally consistent requirements, develop and prove key enabling concepts, compare solutions with competition, diagram subsystem dependencies and commitments, freeze product requirements, determine impacts of change, update product requirements definitions; two problems emerged - 1) deterministic expectations produced unsatisfactory results, 2) marketing departments did not see value in their participation - the goals were too narrowly engineering goals	the whole product includes a conceptualization beyond the software or the information system - the product is the entire effort and organizational change

Semantic Differential Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Osgood, C.E., Suci, G.J., & Tannenbaum, P.H. (1957). The measurement of meaning. Urbana, IL: University of Illinois Press	theoretical basis for the semantic differential, is development, and use as a multidimensional psychological measure	semantic space, direction, and distance; evaluation, potency, oriented activity, stability, tautness, novelty, receptivity, aggressiveness	bi-polar scales; correlation and factor analysis - the centroid method;	multiple studies are reported: 100 undergraduates, 40 undergraduates, 150 voters,	one can either assess subjects or concepts; SDs generally exhibit test-retest reliability; offers processes to assess validity of results and scale items; SD as a measure of meaning and attitude	the math will only take one so far - the rest is still interpretation
Jacobovits, L.A., & Osgood, C.E. (1969). Connotations of twenty psychological journals to their professional readers. In J.G. Snider, & C.E. Osgood (Eds.), Semantic differential technique: A sourcebook, (p. 609-617). Chicago: Aldine Publishing Compan	discover the 'image' of various pschological journals among clinical and research pschologists	20 concept x 20 scale semantic differential	factor analysis with varimax rotation	267 members of the APA	a three-dimensional model resulted - valuableness, interestingness, orientation; a fourth factor was described as scientific rigor; only a small number of the sample was familiar with all the journals; most of the respondents read journals that cooincided with their practice interests	the three dimensions are presented on paper in the typical xy axis with the third dimension represented along a continuum of size - the larger the size of the journal sphere, the closer the journal lies to the viewer on the z axis
Chin, J.P., Diehl, V.A., & Norman, K.L. (1988). Development of an instrument measuring user satisfaction of the human-computer interface. In E. Soloway, D. Frye, & S.B. Sheppard (Eds.), CHI '88 Conference Proceedings: Human Factors in Computing Systems	although not specifically termed a SD, the authors developed a Questionnaire for User Interface Satisfaction (QUIS) using bi-polar items and rating command line and menu driven computer applications	user background information; software application type; overall reaction rating; item ratings	items generated by the authors and expanded by students in version 2; three sections in version 3 included type of system and familiarity, computer experience, and rating items; multiple regression analysis eliminated items within sections for version 4; shortened version 5	113 students rating 2 applications (V3.0); 150 computer professionals and hobbyists each rated a single application (V5.0)-46 different applications were represented	Version 5 Cronbach's alpha of .94; the discovered latent factors were named Learning - learning to operate the system; Terminology and Information flow - consistent use of terms, message prompting; System Output - (undefined); System Characteristics - system capabilities rated on speed, mistake correction; comparative systems were also given an overall rating on liked/disliked; interpreting results over 46 separate software packages was difficult	scale items always presented as positive on right and negative on left - potential response set
Flagler, S. (1989). Semantic differentials and the process of developing one to measure maternal role competence. Journal of Advanced Nursing, 14, 190-197.	description of developing a semantic differential to assess the meaning of "myself as a mother"	maternal role competence: myself as mother & ideal mother; 15-item SD; factors of evaluation, potency, and activity	principal components factor analysis	60 first-time mothers	the original intention to assess the difference scores between 'myself as mother' and 'ideal mother' was not possible as different factors for each concept were discovered; the original SD factors of evaluation, potency, and activity were inappropriate; factors of 'joy,' 'difficulty,' and 'investment' were described for 'myself as mother'	small n for a 15 item factor analysis; factors other than the traditional evaluation, potency, and activity of Osgood are discovered; although the original research intent was an analysis of the difference between subjects on a concept, it was the concect that became the focus of research

Semantic Differential Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Deerwester, S., Dumais, S.T., Furnas, G.W., & Landauer, T.K. (1990). Indexing by semantic analysis. Journal of the American Society for Information Science, 41(6), 391-407.	investigate method for automatic indexing scientific literature to obtain greater bibliographic searching predision and recall	index terms from article titles and abstracts;	two-mode factor analysis; compare Latent Semantic Indexing (LSI), SMART terms, and the Voorhees method for searching literature databases	three tests -- MED database: 1033 documents, 30 queries, 5823 terms; CISI database: 1460 documents, 35 queries, 5135 terms; 1460 documents, 35 queries, 5019 terms	looking for an exact match on terms often misses articles of relevance; rather than an exact match, a semantic proximity offers a more sensitive method for searching; the LSI search exceeded the search results of the Voorhees method and matched the number	it was felt that the use of terms with multiple meanings distorted the factor analysis calculations; each term was a point in the semantic
Green, T.R.G. (1991). Describing information artifacts with cognitive dimensions and structure maps. In D. Diaper & N. Hammond (Eds.), People and computers VI. Cambridge: Cambridge University Press.	offers a descriptive language for mapping user activites and concepts	entity relationship modeling for information artifacts	description and examples	n/a	finds three "flaws" with HCI: problems and design are complex and without a terminology, the focus is on "surface" features and too biomechanical, analyses are too technical--missing the forest for the trees; problem and program characteristics include: viscosity - resistance to change, hidden dependencies, premature commitment - forcing early decision making, perceptual cueing, role-expressiveness - context and knowledge structures; cognitive mapping is a language and means of description not a method	essentially mapping the problem domain; author's use of the term cognitive dimensions recalls the HCI historical activities in attempting to model human cognition yet there seems something more--a stretch into a recognition of the importance of context and complexity; however, there is still a desire to generalize human problem solving; the "language" seems as yet incomplete
Albert, S.A. (1991). Cognition of caregiving tasks: Multidimensional scaling of the caregiver task domain. The Gerontologist, 31(6), 726-734.	investigation of the dimensions of "caregiving tasks as a domain of folk knowledge" (p. 726)	25 caregiving tasks	pile sort technique arranged into a proximity matrix using multidimensional scaling (MDS)	52 adult child caregivers	the cognitive structure of the caregiving domain was constructed within a three-dimensional solution; resultant dimensions are impairment type, location of caregiving, and competence of the parent; differences in the cognitive structure were not significant for demographic subgroups	the shared perspective on caregiving can be used as a means to assess idiosyncratic approaches and potential difficulties in care; the authors believe that although the MDS process offers a way to view general trends, some qualitative perspectives can be lost
Caton, K.A. (1992). The measurement of information tool relevance to nursing practice. Unpublished manuscript, Oregon Health Sciences University, School of Nursing, Portland, OR.	pilot development of a semantic differential to measure baseline relevance attributes of nursing information using various pencil and paper information tools in nursing practice	information tools in nursing practice identified were: policy and procedure manuals, Kardex, other nurse experts, textbooks, the nursing care plan, and report sheets	interviews for scale development; expert panel for content validity and clarity; Cronbach's alpha for internal consistency; parallel frequency of use test for validity	5 expert and novice inter-views; 3 person expert panel; 11 scale respon-dents	the final 7-point differential contained 12 bi-polar pairs representing attributes of: reliable, manageable, practical, accurate, current, available, speedy, essential, concise, at bedside, vital, and definitive; Cronbach alpha scores for each information tool ranged from .71 to .91	although the sample is too small for a valid factor analysis, a subsequent trial analysis of the differential scores revealed 3 or 4 factors for each information tool; nursing information factors included: validity, brevity, point of care, practical essence, current trends, pocket access, situation applicability, and guides

Task Analysis Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Barnes, R.M. (1958). Motion and time study. New York: John Wiley & Sons, Inc.	setting time standards for an economy of motion; the relationship of time and motion study to wage incentives; description of methods used for study	activities; workers; time; machines	work sampling; process analysis; activity charts; operation analysis	n/a	surveys the various techniques of time motion study: Taylor (1881) and the one best way - dividing tasks into subtasks; Gilbreths' focus on fatigue, monotony, delays - process charts, flow diagrams, 3-D diagrams of worker movements, activity charts, man and machine charts, time graphs, work sampling	Gilbreths' activity chart could be useful for marking flow of nursing activity with locale; man-machine chart adaptable to nurse-data or nurse-chart time markers
Verdier, P. (1960). Basic human factors for engineers. New York: Exposition Press.	task analysis methods	time motion	discourse and example	n/a	offers various representations of flow charts, time lines, and task information records for data collection; includes a notion of diagnosing employee ability (matching man with the machine?); proposes constraints that possibly could be seen in space travel	less is offered on data analysis; historically interesting for it's almost sci-fi view of space travel in the 1960's
Lockheed Missiles & Space Company. (1969). Technical report: Analysis of information needs of nursing stations (LMSC-682684). Sunnyvale, CA: Author. (Distributed by NTIS, PB 186246).	summary of information needs and flow research at nursing stations	nursing stations, hopsital forms, patient data, organizational data, communications, computer systems	work sampling, collected forms, work flow charting, interviews	9 hospitals, 160 nursing stations, 90, 130 random observations; computer systems survey 6 hospitals and 48 nurse interviews	terms the flow of information as information commerce; observed form processing, chart processing, work-related conversations and other work activities; observation tallys: patient centered conversations-34%, reading or writing on form-26%, reading or writing on chart-22%, other (telephone, journals, formulary)-16%; as the sample of hospitals was purposively selected to represent all hospital sizes and locations and as all nursing stations varied in their physical design, it is thought that there is no standard design for nursing stations; eight information functions were discovered: admission, examination, diagnosis, treatment, maintenance, supply, control, and disposition; 1,040 forms were typified into 95 general form structures within the 8 information functions; a model of nursing station information flow is produced that includes: hospital organization, nursing functions, nursing station functional groups; computer systems were found to generally model the paper systems and to lack user input and complete training programs; users felt computer systems did offer some efficiencies but this has no support as evaluations were not performed	there seems to be some confusion between nurses and nursing stations--nursing stations do not "determine" or "execute" care nor do nursing stations in and of themselves process information, collect data, or have "information needs"; it is interesting then to read the analysis and substitute "nurses" for the term "nursing stations" in all areas other than physical descriptions--I think this makes greater sense; the use of passive voice in the document is remarkable and effectively avoids any recognition of professional nursing practice beyond carrying out medical plan; assumed information processing occurred only at nursing station not at patient bedside or during report; why is the nursing station called the nursing station when so many others use it as well? why not unit station? (would distributed info systems change the perception and use of the nursing station?)

Task Analysis Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Newell, A., & Simon, H.A. (1972). Human problem solving. Englewood Cliffs, NJ: Prentice-Hall, Inc.	using investigations into solving problems in chess, logic, and algebra propose a general theory of human problem solving	Long-Term Memory (LTM), Short-Term Memory (STM), serial processing, problem space, task environment, programs, goals, individual differences	review; verbal protocol comparison and analysis	1 rule-based decision system (LT); cryp: 1 male college student, 1 high school educated adult, 3 additional subjects of unknown background; logic: 74 undergraduate and graduate students; chess: 6 computer programs, 1 subject	problems are chosen in the realms of cryptoarithmetic, symbolic logic, and chess; problems are defined within a state space; moving from the state space involves a number of algorithmic decision tree alternatives; the structure of the problem space dictates the possible solutions; verbal protocols are charted, analyzed, and classified for processing patterns; task environment and intelligence are predictors of subject behavior; there are elements of human information processing that are constant over all problems	subject actions are observed but their intentions are inferred without validation; although individual differences are seen as important little subject description is offered; underlying all is the goal to advance artificial intelligence; the forgoing work in artificial intelligence (games, puzzles) define the boundary of this work in human thinking hence the problems are not based upon real human problem experience; this is a theory of knowledgeable error free human thinking; it is admitted that the studies have a narrow scope yet a general theory of human information processing is offered; there seems to be confusion on whether the studies are theory generating or theory validating-both seem to be attempted simultaineously; human intelligence is undefined
Trivedi, V.M. (1982). Measurement of task delegations among nurses by nominal group process analysis. Medical care, 20(2), 154-164.	using a group process, assess the number and type of task delegations occuring within a hospital context	RNs, LPNs, essential activities, delegated activities	7 one-hour Nominal Group Process sessions listing, discussing, and prioritizing practice activities; self reported task frequencies	6 to 10 RNs in six sessions, 11 LPNs in one session; 30 RNs and 16 LPNs for the questionnaire	150 activites were listed; there was concensus on 79 of the activites; the tasks with the highest reported frequencies were medications, patient assessments, documentation of care, care planning, evaluation of care, and supervision and communication	activities were self reported not observed; observational task analysis is considered costly; purpose of the study was cost effectiveness and standards of practice
Card, S.K., Moran, T.P., & Newell, A. (1983). The GOMS model of manscript editing. The psychology of human-computer interaction (chap. 5, pp. 139-189). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.	analysis of the text editing task from the GOMS model (Goals, Operators, Methods, Selection) perspective	time, POET text line editor, corrected manuscript, GOMS, and the information processing model (image store, perceptual processor, motor system, reaction, cognitive processor, working memory, long-term memory, Fitt's law, power law of practice, uncertainty, rationality, problem space)	5A: computer record of editing interactions is used to infer GOMS of the user; 5B: time-stamped terminal actions and video taped users; 5C: time-stamped terminal actions and video taped behavior	5A: 2 secretaries and 1 computer scientist; 5B 2 secretaries and 2 computer scientists; 5C 1 secretary	GOMS allows a minute level of analysis; users break tasks into small subtask operations; if the tasks can be assessed, then predictions can be made on human performance; users have individual approaches to a problem; yet, no difference is found between the secretary and computer scientists in 5B;	the GOMS model has been criticized as modeling a user who commits no errors and acts rationally; GOMS assumes no concurrent mental operations; generally, the GOMS 'granularity' of the task is more useful for line code programmers than for functional and usability requirements analysis; the GOMS model is based upon human information processing theory (see chap. 2), problem-solving theory, and is heavily based on timed keyboarding; human information processing theory and problem-solving theory have been developed largely through laboratory studies using games or word lists, not real context based problems; inferences about user cognition or thought are not validated with the users

Task Analysis Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Hagerty, B.K., Chang, R.S., & Spengler, C.D. (1985). Work sampling: Analyzing nursing staff productivity. JONA, 15(9), 9-14.	identify types of nursing activities and analyze for efficiency and appropriateness	function categories: 1) direct patient contact; 2) indirect patient care; 3) nonpatient-related activities	self-report of time spent by nursing staff on 27 separate functions over a two-week period; results analyzed using Michigan Interaction Analysis System	not-stated	proportion of time in direct patient care is largest for a PCW I and smallest for the Head Nurse; proposes that results can be used to judge appropriate and inappropriate use of staff time	PCW I undefined; Michigan Data Analysis System undefined; no stated sample size; percentages of time in direct, indirect and nonpatient care activities offered without analysis; no validation offered for the function items or the data collection tool
Kieras, D., & Polson, P.G. (1985). An approach to the formal analysis of user complexity. Internation Journal of Man-Machine Studies, 22, 365-394.	quantitative model of complexity as the amount of knowledge required to use a system	user's task representation, user's device representation	theoretical walkthrough of representations and mapping	n/a	model notation is developed and a General Transition Network (GTN) is offered to represent changing system states; a user's device model or mental model is "how it works" knowledge; user's device models may be inaccurate; task and device are mapped using the GTN; solutions to incompatible mappings include changing the design of the device or altering the goals of the user; good device design communicates an accurate device model	although the authors use the term "user complexity," it is the complexity of the device as viewed by the user that is modeled; user's and task representation is within the GOMS model - based upon production rules and cognitive theory; although a formal theoretical specification of user complexity is desired, the authors give an additional emphasis on task environment or context; uses general word processing tasks not user domain tasks; assumes the rational human model devoid of experience or error; initial goal is the development of cognitive theory, theory will then be used for design
Corcoran, S.A. (1986). Task complexity and nursing expertise as factors in decision making. Nursing Research, 35(2), 107-112.	investigation into the relationships among task complexity, expertise, the quality of a plan, and the information processing approach	problem complexity, individual differences, expertise	criterion and rule-based coding of think-aloud transcripts for three hypothetical case scenarios of increasing complexity	6 experts 5 novices in hospice care	experts and novices did not vary their initial planning approach to the scenarios of varying complexity; the overall approach of the experts did vary significantly for differing levels of case complexity, using an opportunistic approach for the more complex cases; there was no relationship between the quality of the plan and the approach to planning	all plans of care developed by the subjects were assessed against the plans developed by a single consultant; it is proposed that opportunistic planning places a higher load on memory and thereby may cause elements to be missed
Roddy, P.C., Liu, K., & Meiners, M.R. (1987). Resource requirements of nursing home patients based on time and motion studies (DHHS Pub. No. PHS 87-3408). Rockville, MD: National Center for Health Services Research.	develop a basis for costing differing levels of care required by nursing home residents	level of dependency, need for special services, RNs, LVNs, 24 types of activity	work sampling, time motion	35 skilled nursing facilities; 3, 800 observations; 370 hours of time motion	charting is typically done at the end of the day - it's duration is sensitive to the amount of time available; time required for care activities will vary with the level of resident dependency; great variability exists between activity times discovered in this study and times developed in previous studies; within study variances in the times required for various patient levels were similar	data was collected before initiation of federal Minimum Data Set regulations for Medicare; it is unclear if work sampling observations occurred on a regular timed cycle or randomly; charting activities are not differentiated as medication record, free text nurses's notes, or assessment and vital sign forms; organizational communication functions are not noted;

Task Analysis Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Wilson, M.D., Barnard, P.J., Green, T.R.G., & MacLean, A. (1988). Knowledge-based task analysis for human-computer systems. In Veer, G.C. van der, Green, T.R.G., Hoc, J.-M., & Murray, D.M. (Eds.), Working with computers: Theory versus outcome (pp. 47-89	survey and analysis of human factors research results for the purpose of constructing an interface design methodology	human factors data to be found in human factors guides and Ergonomics Abstracts	developed a 3-phase meta-analytic approach to the human factors literature; Phase 1 - collection of human factors data; Phase 2 - characterize and classify human factors recommendations; Phase 3 - design rule format for recommendations and set design criteria	3 guides; unknown number of abstracts	criteria for a generic framework include: compatibility, consistency, user workload, adaptability, user explicit control, significance of codes (names for labels, commands), guidance, and error management	essentially looking for a set of generic rules used for designing an interface, yet states that the interface will be heavily dependent upon the set of tasks that the user requires; still conceptualizes tasks on a very low level (e.g., data entry, moving text); may be asking for more than is possible considering the multiple factors involved - design may ultimately be an art; the question becomes: which of these attributes are of most importance to specific (clinical nurse) users (see Landauer)
Clark, M.F., & Zornow, R.A. (1989). Nursing organizing systems: A comparative study. Western Journal of Nursing Research, 11(6), 757-764.	compare efficiency of three different systems of organizing nursing practice: team nursing, primary nursing, total patient care	acute care nursing activities clustered into 8 categories: medications, treatments, physical care, verbal, writing, observation, maintain environment, travel, other, personal; independent variables - nursing organization, classification of personnel, shift	observed and timed nursing activities or behaviors; 20 two-way ANOVAs	8 nursing units; 1,208 activities	no significant differences were found in the time spent on various nursing tasks among three different systems of organizing the work of nursing; the most amount of time was spent in physical patient care followed by medications and verbal activities, writing, treatments, observations, observation, personal, other, maintain environment, travel	comparative systems were all contained within one facility; no reliability measure is offered; the range of observation times for each activity is not presented
Woolf, S.H., & Bensen, D.A. (1989). The medical information needs of internists and pediatricians at an academic medical center. Bulletin of the Medical Library Association, 77(4), 372-380.	what kind of information pediatricians and internists look for in journals; compare information needs across differing levels of training	faculty physicians, physicians in training; practice in patient care; practice in research; types of information; sources of information; recommended journals; attitude toward computers; convenient access locations	Mann-Whitney U test with visual analog questionnaire	48 faculty; 32 interns, residents, and medical students at John Hopkins Hospital	types of information identified were different for faculty and housestaff and included: differential diagnosis; treatment recommendations; diagnostic criteria; drug information; basic science; other treatments; lab, physical signs and symptoms interpretations; sources of information included: textbooks, colleagues, handbooks, consults, journal browsing, mini-MEDLINE	focus is primarily medical reference information, does not include chart; does not ask if reference journal information is sufficient for decision-making; differentiated information need as to housestaff or faculty status but not as to the primary focus of practice - research or direct patient care (can it be assumed that faculty primarily do research while housestaff primarily do patient care?)
Shepard, A. (1989). Analysis and training in information technology tasks. In D. Diaper (Ed.), Task analysis for human-computer interaction. New York: Halsted Press, John Wiley & Sons.	convey data collection process and organization for hierarchical task analysis	task context, task description	discussion and example	n/a	Hierarchical task analysis is achieved by stating the overall goal, operations, and the conditions of the operations; each level is redescribed to the degree where the benefit of further specification disappears; time cycles and contingencies in operations are noted; operational information is collected from many sources - the best being an 'expert,' other source include documents and observation; finally the analysis is represented in tabular form or flow diagram	redescription is the process of getting more and more specific, smaller in detail, in examining a task; an extreme level of sprecification might be the GOMS keystroke level of analysis (see Card, Moran, & Newell); a good deal of judgment will be necessary to know when to stop the redescription process; task analysis is the process of learning what the user actually does and is goal directed

Task Analysis Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Dubrovsky, V.J. (1989). Simplified task analysis and design for end-user computing: Implications for human/computer interface design. SIGCHI Bulletin, 20(3), 80-85.	semistructured method of a simplified task analysis targeting interface design	tasks, subtasks, actions	description	n/a	level stages of task action include: goal setting, intending, triggering, approaching, obtaining control, activiating, internal checking, halting, external checking, releasing control, departing; stages of simplified task analysis: describe task context, describe cooperative links, decomposition of task into level stages (process), decomposition of task by the structure of the task object (constraints), routines and operations (subtasks); task analysis breaks tasks into subparts in top-down manner; design uses the parts for system construction bottom-up;	sees the difficulty with task analysis in the more cognitive non-repetitive tasks such as decision support; task analysis does not have to carried to a minute level as iterative prototyping techniques allow refinement; existing task protocols before systems design can be considered the "zero prototype"
Diaper, D. (1989). Task observation for human-computer interaction. In D. Diaper (Ed.), Task analysis for human-computer interaction (p. 210-251). New York: Halsted Press, John Wiley & Sons.	describe the observational method of data collection for task analysis in detail - complete with strengths and weaknesses	four-level hierarchy of project, task, subtasks, activities	record environment (real or simulation); pen and paper notes; audio recording; video recording; computer capture; interview; verbal protocols (talk aloud, think aloud, eidetic reduction, behavioural description); post-task walkthrough	n/a	observation is central to task analysis; verbal task descriptions are inadequate; observation is not objective; must first decide what needs to be recorded; once the task behavior has been captured there is always the problem of transcripts and coding	task analysis is qualitative research; suggests task analysis techniques are useful in eliciting expert knowledge;
Yoon, R., Chapman, R., Gourley, D.R., Murphy, J.E., & Ward, E.S. (1990). Multidimensional work sampling to quantify a pharmacokinetics resident's duties. American Journal of Hospital Pharmacy, 47, 1785-90.						
Hughes, K.K., & Young, W.B. (1990). The relationship between task complexity and decision-making consistency. Research in Nursing & Health, 13, 189-197.	measuring nurse's decision-making under uncertain and complex conditions	task complexity; decision outcome utility values; normative decision analysis model for 3 hypothetical patient care situations; characteristics of consistent decision makers	probit analysis for the construction of a decision maker profile	101 RNs medical-surgical	consistent decision makers were judged to be those subjects whose greatest and least decision utilities matched the normative model; the majority of the subjects did not make decisions consistent with the model on any of the 3 levels of complexity nor consistent with their own stated utility values; subject characteristics suggest that: expertise may be task specific; consistency is enhanced by concurrent enrollment in a degree-granting program; decision consistency may influenced by work setting	hypothetical case scenarios developed with input from nurse experts and textbooks; little information offered as to the development of the comparative model decision utilities

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Reference	Focus	Variables	Method	n	Results	Comments
Corcoran-Perry, S., & Graves, J. (1990). Supplemental-information-seeking behavior of cardiovascular nurses. Research in Nursing & Health, 13, 119-127.	investigation into the types of information nurses seek; why; what are the external information resources; what problems are encountered	setting; environment; time; education; experience; full or part-time employment;	descriptive; interview and observation	46 nurses and 175 instances of info seeking	4 categories of supplemental information: patient-specific; institution-specific; domain knowledge (medications, related conditions, treatments, other health problems); procedure reasons for seeking information included: direct patient care; unit and personel management; and othersources of information including: other nurses; other personnel; specific patient records; reference materials; documents on groups of patients; documents on groups of personnel; computer terminals; cardiac monitor difficulties with information included: availability; too much; incorrect; incomplete; misplaced; inconsistent; illegible; difficult to understand; unanswered phones; non-functioning computers; consumed too much time	reveals the multiple responsibilities and multiple directions nursing information may take; the "realities of nursing practice" define the information content category needs; authors found nurses spent a great deal of time in managing non-nursing information; nurses did not seek out aggregate patient information (authors wonder if it is ever available); the form and presentation of information was not addressed
Prescott, P.A., Phillips, C.Y., Ryan, J.W., & Thompson, K.O. (1991). Changing how nurses spend their time. IMAGE: the Journal of Nursing Scholarship, 23(1), 23-28.	to understand an experienced nursing shortage by examining how time is used in professional nursing practice	time, patient care demographics, nurse demographics	review of work sampling literature in nursing	7 reported studies	although the total number of hospital beds decreased from 1979 to 1988, the proportion of intensive care beds increased; nurses are both underutilized in areas of professional practice and overutilized in general areas of unit management; RNs are relatively cheap yet versatile enough to take on the work of other disciplines - esp. during week-end and off hours	RNs are trained to perform beyond their hospital-designed duties and are therefore a wasted health care resource; there is a hope that automated information systems may simplify increase work efficiencies
Ried, L.D., West, T.E., Martin, P. & Force, W. (1991). Multidimensional work sampling to study the activities of decentralized clinical pharmacies. American Journal of Hospital Pharmacy, 48, 1211-1219.	classification of hospital pharmacists activities for costing	activities: clinical, distributive, administrative, personal, travel/waiting	self report random sampling of work activities	6 hospitals; 6609 observations	proposes that most pharmacist activities are problem-solving and therefore difficultly observed; participants recorded the task activity, contact, location, and function - task multidimensions; functions included: drug monitoring, review patient information, drug information, research, documentation, rounds, meetings, formal education, educating others, patient teaching; pharmacists spent 40% of their time reviewing patient information	sees that categorized tasks need to be broken down into activities that include a locale and recipient before work redesign can occur; participants had a two-hour training session on the reporting process and categories; perhaps a chart organized and automated around retrieval mechanisms rather than charting mechanisms would decrease tha amount of time necessary to access patient information
Diaper, D., & Addison, M. (1991). User modelling: The task oriented modelling (TOM) approach to the designer's model. In D. Diaper & N. Hammond (Eds.), People and computers VI. Cambridge: Cambridge University Press	a representation of operational modeling using logical notation	the designer's conceptualization of the user; the user's conceptualization of the work and the world; the work performed; the computer and operational guides	user modeling literature review and discussion	56 published papers	proposes that previous models of user's cognitive processing are without empirical task-related support; offers an observational method of Task Analysis for Knowledge Descriptions (TAKD) using video taped task behaviors and user interviews	the authors criticize the assumptions that have accompanied the use of psychological cognitive theory (STM a case in point); even though they criticize the accuracy of user task and cognition descriptions, the authors make use of user recall albeit with the added prompt of actual video tape

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Reference	Focus	Variables	Method	n	Results	Comments
Watson, P.M., Lower, M.S., Wells, S.M., Farrah, S.J., & Jarrell, C. (1991). Discovering what nurses do and what it costs. Nursing Management, 22(5), 38-45.	types, time, frequencies, and costs of nursing functions	173 observed nursing activities collapsed into 30 groups; time; cost per nursing minute	descriptive; three-hour observations using the Nursing Functions Recording Schedule (NFRS)	208 three-hour observations; exact number of individuals observed is unreported	within a three-hour period the greatest amount of time is spent in direct patient care (47.63 minutes); other information activities include: verbal reports (15.31), charting (9.42), review of chart (5.11), conferences (4.87), physician's orders (2.78), sharing information with physicians (2.38), using references (1.53), desk management (1.50), written reports (1. 35), patient/family teaching (1.02), nursing care plan (0.56); cost calculations of nursing functions provided a realignment of work and department structures	the times reported for nursing functions are averaged over 24 hours and represent uninterrupted blocks of time; averages include 0 minutes if the function was not observed; the observations underlie the numerous task interruptions nurses experience during their shift of care; development of the tool is unreported
Browne, D.P., Summersgill, R., & Stradling, P. (1992). The user interface: The poor relation in structured methods. In H.R. Hartson & D. Hix (Eds.), Advances in human-computer interaction (Vol. 3, pp. 34-68). Norwood, NJ: Ablex Publishing Corporation	systems analysts are investigated for the process they use with the Jackson System Development method of system modeling and development	aspects of system development; sources of information; availability; tool requirements; project scoping; problems	task analysis using structured interviewing and observation	8 systems analysts	coded interview data structured generic actions and objects and their attributes into a task hierarchy; 4 human factors issues emerged: user-designer communication problems, informal models, non-explicit HCI aspects, and tool requirements	iterative data analysis is similar to coding using the constant comparative in grounded theory; much of the difficulty between users and analysts lies in the non-convergent domains of expertise and expression
Kirwan, B., & Ainsworth, L.K. (Eds.). (1992). A guide to task analysis. London: Taylor & Francis.	description of task analysis methods and examples of their use	six human factors issues: allocation of function, person specification, staffing & job organization (communication requirement), task & interface design, skills & knowledge acquisition, performance assurance	task data collection (activity sampling, critical incidents, observation, questionnaires, structured interviews, verbal protocols), task description methods, task simulation methods, task behavior assessment methods, task requirements evaluation methods	10 case studies; represent much of the system life cycle	various task analysis techniques and their attendant goals are placed within the system life cycle: Concept, Flow Sheeting, Preliminary Design, Detailed Design, Construction, Commissioning, Operating & Maintaining, Decommissioning; implementation of a new system is also decommissioning of the old	task analysis techniques assume repetitive manufacturing processes rather than a service process such as nursing care or case management with attendent contingencies; based on linear "waterfall" design process
NCNR Priority Expert Panel on Nursing Informatics. (1993). Nursing informatics: Enhancing patient care. Bethesda, MD: National Center for Nursing Research, National Institutes of Health (NIH Pub. No. 93-2419).	research priorities	data, information, knowledge, practice, tools, patient care	expert panel review of literature in nursing Informatics	n/a	does not mention task analysis per se but offers methods for 'studying information uses in a professional group' (p. 23) including: interviews, questionnaires, information-seeking diaries, automated monitoring of system interactions, participant observation, critical incidents; finds information uses grounded in: time, psychological factors, specialty differences, social networks, organizational - demographic factors	does not mention a phased cycle of system design but offers a cycle of information research and a cycle of system implementation (p. 25); examines research needs in physical and psychological ergonomics

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Reference	Focus	Variables	Method	n	Results	Comments
Finkler, S.A., Knickman, J.R., Hendrickson, G., Lipkin Jr., M., & Thompson, W.G. (1993). A comparison of work-sampling and time-and-motion techniques for studies in health services research. Health Services Research, 28(5), 577-597.	comparing work sampling and time and motion data collection techniques	medical residents' activities; time and motion data; work sampling intervals of 15, 30, and 60 minutes	using the time and motion data previously collected, various intervals of work sampling data are extracted, percent of total observations are noted and compared	eight medical residents observed for a total of 13, 383 minutes	the greater the work sampling interval, the more likely tasks and task durations will be misrepresented; work sampling is less costly and less intensive than time and motion studies; time and motion studies observe a greater number of activites but with a necessarily smaller number of subjects; capturing tasks with a low frequency will require a sampling interval so small as to negate cost benefit of work sampling; eight categories of tasks were observed: education activties, information gathering, personal, testing, consultation, documentation, transit, procedures, patient interaction, administration	if cost is no object, time and motion studies are the desired technique for capturing accurate task data
Whitefield, A., Esgate, A., Denley, I., & Byerley, P. (1993). On distinguishing work tasks and enabling tasks. Interacting with computers, 5(3), 333-347.	differentiate between tasks that accomplish the user's work goals and tasks that merely put the system in a state to accomplish work goals	work tasks, system tasks or enabling tasks, text editing, familiar and unfamiliar word processors	video recorded user-system interactions; verbal protocols	2 experienced word processor users	proposes the development of a "user-centered" design approach based on an understanding of the work domain and user's goals; using either a familiar or unfamiliar word processor, more time was spent on enabling tasks than the actual work tasks; when using an unfamiliar word processor, the percentage of time spent on all tasks increased - the greater increase was seen in the enabling tasks	initial pilot, timing the differentiated tasks, was based upon the fairly simple goal of text editing; as the porportion of time spent on enabling decreases, the system becomes more "transparent" to the user decreasing the distraction of the enabling tasks
Oddone, E., Guarisco, S., & Simel, D. (1993). Comparison of housestaff's estimates of their workday activities with results of a random work-sampling study. Academic Medicine, 68(11), 859-861.	comparison of estimates of time and time-analysis methods	time spent in: patient evaluation, education, administration, personal, miscellaneous	self report mean activity time and random work sampling	18 interns and 18 residents	26 residents estimated the time spent in each of 20 work activities; the total estimation exceded 100% of the available hours; random sampling occurred on average of 3.2 times per hour; the number of events for each activity was averaged over the number of all activities to obtain an activity purportion; housestaff over estimated the amount of time that they spent with patients, in teaching, and reading while underestimating the amount of time alone or with attending physicians	states that traditional time analysis techniques lack validity yet offers no support for this position; without knowing the actual time spent in each activity assumes that random work sampling will provide a valid view

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Sittig, D.F. (1993). Work-sampling: A statistical approach to evaluation of the effects of computers on work patterns in healthcare. Methods of Information in Medicine, 32, 167-174.	survey of work evaluation techniques in health care; focus on work sampling	time and motion studies; subjective evaluations; review of records; personal diary of activites; work sampling	review	n/a	time and motion studies are labor intensive, subject to worker and observer bias; subjective evaluations are quick and easy to administer but may offer inaccurate information; record reviews must be retrospective and do not provide a complete picture of activities; personal diaries rely upon memory and may not be updated during periods of high activity; work sampling requires an a priori expected frequency for the task to be sampled, random sampling offers the best approach, observation categories must be preset; the best evaluative results are obtained when multiple data collection methods and analyses are used; work sampling cannot determine work quality	work sampling will only be as sensitive to observed activities as our a priori understanding of the frequency of the activites we wish to observe
Suchman, L. (1995). Making work visible. Communcations of the ACM, (38)9, 56-64.	explicit representations of work contain tacit assumptions which must be examined	work representation	discussion and examples	n/a	workers should be allowed to reflect upon their own work practices; recognize that work representations serve interests and are not "objective" models; the farther (more abstract) a representation is from the actual work, the more stereotypical it becomes; work is more than cognitive, it is social; normative accounts of how work is accomplished are idealizations not specific practices; representations can be the origin of dialogue	approximates a critical/emancipatory view; desires to use the lessons of ethnographic representation which now is moving past the "we" and "other" objectivist perspective and into comparing and contrasting - becoming overtly part of the interpretation
Kjaer, A., & Madsen, K.H. (1995). Participatory analysis of flexibility. Communications of the ACM, 38(5), 53-60.	describing participatory analysis and design techniques used to anticipate the need for system flexibility	flexibility - non standard ways of doing things, the unexpected and exceptional in work patterns; work organization, technical artifacts, physical space	case study	1	blueprint mapping - mapping tasks to spaces; uses an 'organizational game' where situation walkthroughs propose uncommon situations; design goal is to allow for exceptions	case study example is the flow information in a hospital radiologic department; conceptual framework centers work activities within technical artifacts, space, and work organization
Kyng, M. (1995). Making representations work. Communications of the ACM, 38(9), 46-55.	representations of work as developing artifacts discovered with users	work situation descriptions; future use scenarios	example and discussion	n/a	Initial analysis and design - mutual learning; exploratory prototyping implementation; prototyping sessions - evaluation, analysis, and design; design; "conventional" prototyping implementation; "conventional" prototyping sessions; "traditional" specifications; building final system; continued development	final "warning" is a note on the difficulties designers have with cooperative techniques; "artifacts, including representations, develop over time based on use" (p. 46)

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Chapanis, A., Garner, W.R., Morgan, C.T. (1949). Applied experimental psychology: Human factors in engineering design. New York: John Wiley & Sons, Inc.	introduction to a "new branch of science" applied psychology, human factors, in designing tools to "fit the man"	human performance, human physiological and sensory capacities, control design, work environment, work patterns	review of the history of human factors, description of the state of knowledge in human experimental psychology	n/a	experimental psychology and time-motion studies both began in the 1880's, merging them into an applied science of man-machine studies; one of the first forays into human factors was intelligence testing during WWI to find the "man to fit the job;" as technology advanced in WWII, machines were designed that no one was able to operate-hence the increased focus on human factors for design; now engineering is challenged to design machines that fit human capabilities	first the defense department and then aviation have rich histories in driving machine design and human factors research
Kochen, M. (1976). What makes a citizen information systems used and useful. In M. Kochen, & J.C. Donohue (Eds.), Information for the community. Chicago: American Library Association.	what are the attributes of a useful information system				found 5 qualities that account for a systems' use: relevancy/salience, significance/imposingness, validity/authoritativeness, clarity/simplicity, novelty/impression-of-newness	
Moran, T.P. (1981). An applied psychology of the user. Computing surveys, 3(1), 1-11.	survey of the current state of user psychology and its integration with computer science	users, user behavior, system (including users) behavior, user interface, system designer	literature survey (all research literature is stated to be based on empirical results)	n/a	systems are human-computer systems and must be designed with human user needs in mind; "folk psychology" may be a term to describe unfounded assumptions about users; users are goal oriented, not necessarily rational; an applied psychology of the user will be used to predict and control user behavior; system evaluation factors include: functionality, learning, time, errors, quality, robustness, acceptability; a user interface is physical, perceptual, and conceptual; the system's conceptual model must be taught to the user; user psychology can be empirical (experimental, features, factors) or theoretical (calculated information processing - modeling)	defines users as programmers and non-programmers in addition to being novice or expert users; evaluates work on the psychology of the user to be (to date - 1981) lacking methodologically and the results overgeneralized; few interface features result in great operating improvements
Bayman, P., & Mayer, R.E. (1984). Instructional manipulation of user's mental models for electronic calculators. International Journal of Man-Machine Studies, 20, 189-199.	ascertain if there is a difference between the user's mental models of calculator operations and actual operations; can instruction enhance the user's mental models	a line model of calculator operation; a stack model of operation; and no model	chi square for difference in group portions on a sample of mathematical operations	3 groups of 24 college students	those subjects using the line model of calculator operations used significantly more sophisticated problem solving strategies for the simpler problems; as the problems increased in complexity, no difference was found between groups; those subjects with previous programming experience performed better	a number strategy that is similar to algebra is considered the most sophisticated strategy; the line model may stimulate an algebraic strategy; the subjects with programming experience may simply be more familiar with the conceptualizations of designers of calculators

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Reference	Focus	Variables	Method	n	Results	Comments
Krobock, J.R. (1984). A taxonomy: Hospital information systems evaluation methodologies. Journal of Medical Systems, 8(5), 419-429.	taxonomy of system evaluation with a focus on system effectiveness for the user	efficiency, effectiveness,	not stated	n/a	although hospital information systems are marketed as a means to decrease costs, this has not been demonstrated; evaluations usually occur post-implementation; effectiveness measures are more subjective and not as concrete as efficiency; data collection for evaluation studies include: observations, time studies, work sampling, record review, discussion groups, interviews, and questionnaires; a taxonomy from effectiveness to level, measurement, structure, domain, and characteristic is presented	assumes users are affected by effectiveness but not efficiency; up until the date of publication, most evaluation studies concerned the El Camino hospital experience; a taxonomy of effectiveness is presented without discussion as to how it was constructed
Meister, D. (1986). Human factors testing and evaluation. Amsterdam: Elsevier.	overview of evaluation methods	task observation, interview, questionnaire, rating (psychometric scaling), miscellaneous (critical incidents, diaries), activity analysis, objective measures (reaction times, duration)	discussion	n/a	the focus of evaluation should be on how well the system - equipment and personnel - work at achieving the system goal	evaluation techniques are qualitative evaluation and quantitative measurement
Gould, J.D., & Lewis, C. (1987). Designing for usability: Key principles and what designers think. In R.M. Baecker & W.A.S. Buxton (Eds.), Readings in human-computer interaction: A multidisciplinary approach. San Mateo, CA: Morgan Kaufmann Publishers.	two-fold: assess the processes and priorities of system designers; present and discuss design process methodology	three principles of design: early focus on users and tasks; empirical measurement of users with simulations and prototypes; iterative design cycle	descriptive open-ended survey questionnaire; case presentation and discussion	447 system planners, designers, programmers, developers;	62% of survey subjects mentioned 1 or less of the design principles as part of their approach to system design; usability testing may be confused with testing system function; usability testing is often thought of as a final phase in system design; the use and evaluation of a design prototype enhances the discovery of items for usability	authors admit that their orientation to design may differ from others and do not suppose that they offer a "one true process;"
Payne, S.J. (1987). Complex problem spaces: Modelling the knowledge needed to use interactive devices. In H.-J. Bullinger, & B. Shackel (Eds.), Human-computer interaction - INTERACT '87. Amsterdam: Elsevier Science Publishers.	predicting and/or assisting the learnability of computerized tasks	the conditions of the user defined goal is termed the goal space; the user conception of the computer program is termed the device space; user instructions that rely on previous but unrelated experience is termed metaphorical representation	the performance of two user groups, differing in their orientation to the computer device, are compared	group sizes unknown	when a goal space is described metaphorically (e.g., as a game), rather than abstractly, users will perform better on measures of ease of use: command memory, memory of command name abbreviations, and problem solving efficiency	comparisons between the goal space and device space are termed "semantic mapping;" ease of use will be enhanced if there is direct mapping between the two user conceptualizations

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Reference	Focus	Variables	Method	n	Results	Comments
Hawkins, F.H. (1987). Human factors in flight. Aldershot, UK: Gower Technological Press, Ltd.	development and use of human factors in aviation	ergonomics, human factors	review	n/a	defines ergonomics as man and working environment and human factors as human performance and design; elements of human factors are: hardware, software, liveware, and environment; issues include: error, fatigue, sensory performance, attitude, motivation, training, physical environment; recounts the development of human factors through Taylor and the Gilbreths in the 1880's, WWI and manufacturing and intelligence tests; studies at the Hawthorne Works at General Electric in the 1920's; complexity and plane crash (human failure) investigations of WWII; and finally formal human factors education in the 1940-50's	ergonomics and human factors are often used interchangable but many say human factors contain ergonomics; with the inclusion of the notion of design and engineering in human factors, the term error has a broader definition as well--user error vs. design error
Meister, D. (1989). Conceptual aspects of human factors. Baltimore: The Johns Hopkins University Press.	moving human factors from a machine focus to a work focus	philosophy of science, behavioral science	discussion	n/a	sees a move from "molecular knobs and dials" in human factors to the molar issues of workload, stress and organizational variables; defines human factors as: "how humans accomplish work-related tasks in the context of human-machine system operation and how behavior and non behavior variables affect that accomplishments" p. 2; believes that there is a "mind set" common to all scientists evidencing a struggle in the research-application dichotomy as well as the goals of human factors research; questions whether a reference situation-the prototypical work situation-can be set up in a lab; questions whether a work situation can be broken down into parts and still be representative	focuses on the conceptual assumptions in human factors research that are not often examined; asks if research should not have a proposed utility (vs. research for research's sake); are the goals of human factors research clearly stated
Nielsen, J. (1989). What do users really want? International Journal of Human-Computer Interaction, 1(1), 137-147.	investigates the importance of program characteristics and their relationship to usability	has needed features, pleasant to work with, easy to learn, overall user friendliness	Likert-type rating, correlations, multiple regression	60 heavy Macintosh users; 24 popular Macintosh programs	'pleasant to work with' has the highest correlation with and is the greatest predictor of overall user friendliness, 'easy to learn' is a much weaker predictor of overall user friendliness while 'has the needed features' is totally independent of 'over all user friendliness'	if a program does not have the needed features can it really be usable? Shouldn't use imply purpose?

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Reference	Focus	Variables	Method	n	Results	Comments
Curley, S.P., Connelly, D.P, & Rich, E.C. (1990). Physicians' use of medical knowledge resources: Preliminary theoretical framework and findings. Medical Decision Making, 10, 231-241.	a cost-benefit model of physician choice among information resources to support practice	knowledge resources:general medicine text, computer bibliography, same specialty colleague, subspecialty text, Index Medicus, other specialty colleague, research article, clinical manual, and review article measured across usage rate and a proposed model	non-parametric sign test; multiple linear regression	228 physicians	the information resource of greatest use was other colleagues; the least used resource was the Index Medicus; colleagues and clinical manuals were available, searchable, understandable, and applicable but were less extensive and credible; the less experienced the physician, the greater the use of other information resources	No Cronbach's alpha is reported for the questionnaire; interestingly the medical relevance of the knowledge resources was not assessed and was assumed to be equivalent; the regression model indicated variance unexplained by the proposed model
Lowery, J.C., & Martin, J.B. (1990). Evaluation of healthcare software from a usability perspective. Journal of Medical Systems, 14(1/2), 17-29.	summarize usability issues for healthcare	offers a usability framework to include: 1) Logical organization of procedures; 2) screen design for data entry; 3) error handling; 4) data retrieval/report generation; 5) learning/help; 6) consistency	literature review	n/a	logical organization offers a structural flow of menus and functions; screen design uses principles of visual naturalness; errors are user errors, data entry errors, and system malfunctions; data retrieval focuses on ad hoc administrative reports; learning emphasizes adequate documentation and context-sensitive help prompts; consistency is a desire for an interface operational style throughout the entire software package	as the review covers the literature of the 1970's and early 1980's, the focus on one best way for system organization and preventing user errors is evident; there is also an assumption users will function with a stationery screen and largely perform data entry rather than retrieval; suggests a comparison with paper systems for defining functionality
Scapin, D.L. (1990). Organizing human factors knowledge for the evaluation and design of interfaces. International Journal of Human-Computer Interaction, 2(3), 203-229.	review and compare eleven techniques of task analysis as a means to view the user/system relationship	types of knowledge represented; user centered goals; cognitive limitations; how is the technique used	literature review	11 tech-niques collapsed into 4 groups	task functions and task training requirements; mapping the consistency of commands with the task; assessments of system or program complexity and learnability; modeling the state of the information device with user behavioral goals; classification of user errors and cognitive mismatches; and mental activity descriptions are offered	focus is on the user's knowledge of the information system rather than knowledge of the user and the task represented within the system; uses "internal task" as the workings internal to the information system - "external task" is the system output; seem to look for training that might increase user performance
Harris, B.L. (1990). Becoming deprofessionalized: One aspect of the staff nurse's perspective on computer-mediated nursing care plans. Advances in Nursing Science, 13(2), 63-74.	what are the negative meanings of a computerized nursing care plan system for the nurse user	deprofessionalization; deautonomizing; deindividualizing; deexpertising;	qualitative; semi-structured interviews analyzed within a symbolic interaction framework and grounded theory methodology	15 RNsfull-time staff nurses	general themes emerged characterized as a loss of professionalization; nurses felt controlled by both the computer and an institutional "authority;" nursing activities lost their rationale; both patient and nurse were seen as losing individuality; nursing activity becomes thoughtless and less valued.	the computerized system is not described; all but one respondent is from a single hospital; hospital care is organized using a primary nursing care model

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Reference	Focus	Variables	Method	n	Results	Comments
Caton, K.A. (1990). Cooking with nursing knowledge. Unpublished manuscript, Oregon Health Sciences University, School of Nursing, Portland, OR.	pilot study to define nursing information and the use of nursing information from the clinician's perspective and explore the value of nursing diagnoses and care plans in nursing practice	nursing information; nursing practice; nursing diagnosis; nursing care plans	qualitative; intensive interviews	3 expert intensive care nurses	characteristics of nursing information include: urgency, changability, brevity, the visual, congruence, noise, and patterns; information may be defined within: situation familiarity, practice experience, situation expectations and anticipation, and novel or overwhelming situations; generated hypotheses included: as experience increases, the information need decreases and as situation familiarity increases, likewise the need for information decreases; a desired form of information is described as a "cookbook"	the sample is narrow in its practice perspective; a third dimension of information need was partly identified as complexity and is deeper than can be represented in the care plan format; the care plan offered only a minimum situation presentation
Gassert, C.A. (1990). Structured analysis: Methodology for developing a model for defining nursing information systems requirements. Advances in Nursing Science, 13(2), 53-62.	develop a graphic model defining administrative and clinical nursing information system requirements	five model elements were identified from the literature: nurse users, information processing, nursing information systems, nursing information, and nursing system goals	descriptive, structured analysis and content validation using a visual analog questionnaire in a Delphi-like process	75 NIS "decision makers"	a 5-step process model for the extraction of nursing requirements; the model is at the finest level of detail in a 4 level modular information system hierarchy; the last level in the model is composed of requirement goals not the actual data elements themselves; all model elements, derived from the literature and refined by an expert panel, were validated as necessary NIS elements in the opinion of the research sample	theoretical deductive approach here produces a highly abstract process model; information system hierarchy produces a depiction of NIS within HIS today; sample had been involved in previous NIS decisions but it is unclear if the sample is representative of clinician users; model elements based upon a discipline-focused conceptualization of practice; unclear if the author believes nurses involved in defining information needs should have informatics knowledge; author found no previous literature on defining nursing information needs
Bannon, L.J. (1991). From human factors to human actors: The role of psychology and human-computer interaction studies in system design. In J. Greenbaum & M. Kyng (Eds.), Design at work (pp. 25-44). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.	promotes a move away from a psychology of passive system users and toward competent "actors" who use a system; refocus design from the product to the process	human factors, human actors, design	case review and discussion	n/a	users are not idiots nor are they naive or simple components in a computer system--they are active agents within their own environment; the application of generalized knowledge about users is not successful in new situations; HCI focuses on individual work processes but needs to add collaborative work; design cannot rely upon laboratory setting and experimental results--iterative prototyping in context with particpant actor/designers is necessary	appropriately refers to a statement by Newell and Card who see conflict in the "race between the tortoise of cumulative science and the hare of intuitive design" (p. 35)

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(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Shackel, B., & Richardson, S. (1991). Human factors for informatics usability - background and overview. In B. Shackel & S. Richardson (Eds.), Human factors for informatics usability. Cambridge: Cambridge University Press.	development of the study of human factors	ergonomics; human-systems interaction; human-computer interaction; informatics usability	review and discourse	n/a	'ergonomics ... the study of the relation between man and his occupation, equipment and environment, and particularly the application of anatomical, physiological and psychological knowledge;' human-systems interaction is the 'methods, media and mechanisms for enhancing cooperation between people and systems in an interactive organizational environment;' HCI is physical and cognitive ergonomics, cognitive ergonomics is 'the study, measurement, analysis and modelling of human cognitive behavior in relation to advanced technology issues'; human factors experts are needed to bridge the increasing system complexity that separates users from designers; questions whether cost-benefit studies include the costs of training, down-time, technical support, and full implementation costs; human-systems interaction (HSI) includes social goals, organizational goals, interface ergonomics, system performance	authors represent a broad spectrum in the approach to usability - namely: physical, cognitive, organizational, practical, linear, non-linear, prescriptive, experiencial; although cognitive ergonomics is included, the authors intimate a move from the prototypical to user participation; system design rather than software design is emphasized; sees computer use as evolving from strictly data processing needs to the discretionary user to systems fully integrated with the work; once the designers were no longer the users, usability became an issue; authors critique previous human factors research as being concerned primarily with the office environment when questions of human intelligence and cognition have arisen
Bannon, L.J., & Bodker, S. (1991). Beyond the interface: Encountering Artifacts in use. In J.M. Carroll (Ed.), Designing interaction (pp. 227-253). Cambridge: Cambridge University Press.	review and critique HCI authors, theories, and practices for their impacts on useful and usable software; emphasize the need to place artifacts within their context	theory, design, task analysis, HCI, artifacts, cognition	review, discussion, and examination using social praxis and activity theory	n/a	HCI has studied and used cognitive theory without examining its' assumptions and without assessing what benefits it might offer to design; cognitive theory assumes: the problem solving computational model is the way all human problems are approached, cognition is "in the head information processing," human problems can be reduced to their parts and separated from their context in order to be studied in a lab; most of HCI examines only the user and interface and not the human and human system; artifacts cannot be studied in isolation but must be studied in situ and in real use situations; this should alter design from a focus on the product to a focus on the process at hand; the traditional formalized design process works to freeze time (the current work process) rather than collaborate with the doers to build a flexible framework for a changing work environment	forthright criticism of cognitive theory and the confusion it has brought to design; minces no words, coddles no authors; uses nursing and carpentry as examples of praxis; artifacts are products of use and history; HCI should be more akin to archeology than psychology; suggests studying the contradictions found between an artifacts intended and actual use as this may be a key to a changing environment

Usability Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Chapanis, A. (1991). Evaluating usability. In B. Shackel & S.J. Richardson (Eds.), Human factors for informatics usability (p. 359-395). Cambridge: Cambridge University Press.	designs for evaluating usability	objective measures of performance & subjective feelings	review and critique	n/a	usability evaluation is hard to do; 'evaluations of usability should take into account how users feel. That in turn means administering an attitude questionnaire or rating scale' (p. 367); to assess usability one must construct and perform a test; usability is a comparative measure;	offers contradictory focus for usability - the entire system interface is important yet measures only mental effort; assumes an office environment for information systems; evaluations are performed through the mediating factor of human performance variation; if there is an unexplicable nature to expert cognitive processes, how would anyone but an expert 'know' what performance to measure; shares view with Landauer that system improvements are often of the specific kind for specific systems
Eason, K., & Harker, S. (1991). Human factors contributions to the design process. In B. Shackel & S.J. Richardson (Eds.), Human factors for informatics usability. Cambridge: Cambridge University Press.	the design process and how human factors knowledge can support design	design processes (innovative, generic, bespoke application, end-user), designers, users, human factors knowledge	literature review, survey	63 computer system designers	generic systems can use generic human factors knowledge in their design but specific "bespoke" systems with a specific known population of users must use participatory design methods; designer's stated barriers to the application of human factors knowledge: is not available, takes too long, not cost beneficial, not directly relevant, opposition, conflicting design philosophy; scaled the 'usability' of various human factors knowledge sources	recognizes that design methods are currently evolving with rapid prototyping techniques; states there is a danger in adopting a user model for design as model are generalizations and have been developed without careful research methods
Shackel, B. (1991). Usability - Context, framework, definition, design and evaluation. In B. Shackel & S. Richardson (Eds.), Human factors for informatics usability. Cambridge: Cambridge University Press.	define usability	user, tools, task, environment	review and discourse	n/a	defines usability as composed of goals: effectiveness (required tasks, users, speed, errors), learnability, flexibility, attitude; once goals are described, specific measurable usability attributes are set: dimensional criteria, performance criteria, attitude criteria; key precepts for a usability design process include: user-centered design, participative design, experimental design, iterative design, user-supportive design (training, help systems, manuals)	states that usability is more than system performance yet still offers a model for assessment that is dependent upon linear, step-wise operations; the repetative manufacturing process is still the dominate scenario when discussing usability issues; emphasizes that specific systems are made for specific users, not general human models
Mitta, D.A. (1991). A methodology for quantifying expert system usability. Human Factors, 33(2), 233-245.	a quantifiable measure for usability in expert systems	Function Identifier expert system;	pairwise hierarchycal regression	36 undergrad students, 18 algebraic function problems	usability is calculated with regression weights for each usability function as: (user confidence - user perception of difficulty) + (correctness of solution - number of responses required of users - inability of expert system to provide solution - rate of help requests); user actions are recorded and opinions are obtained using a rating scale	the assessed expert system was also built by the author; the usability functions were offered by 'interface design experts' not users; the expert system is found to be usable on the basis that its' score exceeds midpoint on a normalized scale - no other applications were tested; offers a problem state space and transitions as a model for user performance

Usability Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Carroll, J.M. (1991). Introduction: The Kittle house manifesto. In J. M. Carroll (Ed.), Designing interaction: Psychology at the human-computer interface (pp. 1-16). Cambridge: Cambridge University Press.	an examination of applied psychology science and its role in system design	specificity; applicability	introduction, review and discussion	n/a	formal psychology has not contributed much to design yet formal design principles are desirable; science demands the generalizable while application demands specific context sensitive design; application can inform the science (and usually preceeds it); early HCI efforts concerned the psychology of programming, structured programming techniques, coding error frequency and performance times; then HCI research focused on cognitive psychology and information processing theory; the nature of scientific research ("direct empirical contrasts") however does not support the complexity inherent in HCI; and, the assumptions of theory overlooked domain specific needs, error handling, expertise, and goal directed human behavior; has HCI evaluation confused "statistical significance with practical significance;" evaluation has yet to offer design recommendations when HCI problems are discovered	this chapter serves as an introduction and survey of chapters to follow; there is disagreement over the value of formal psychology theories for design--a few authors feel that any theory must generalize but generalization will exclude the very specificity that users require; domain and context are the current fields of endeavor in HCI research--how to discover and represent them in design; a recurrent theme is technology leading science rather than the other way around--bridges were built before formal physical science; perhaps theory can be drawn inductively from HCI experiences but HCI application gains little from theory; design has the potential to inform psychology but is the reverse true
O'Donnell, P.J., Scobie, G., & Baxter, I. (1991). The use of focus groups as an evaluation technique in HCI. In D. Diaper & N. Hammond (Eds.), People and computers VI (p. 211-224). Cambridge: Cambridge University Press.	investigate the use of the focus group for interface evaluation	Honeywell SUNDIAL 6000 central heating control interface	using a software prototype, users are videotaped working through scenarios; interaction is timed and errors are logged; rating scale; questionnaire; 3 moderated focus groups (content analysis)	18 male technical university students	findings from the focus group correlated with findings from questionnaires and the error logs supporting focus group evaluation validity; focus groups may be more worthwhile in formative evaluation	users rarely have an overall mental model of a device but rather use the device interactively or reactively
Mrazek, D., & Rafeld, M. (1992). Integrating human factors on a large scale: Product usability champions. In P. Bauersfeld, J. Bennet, G. Lynch (Eds.), Proceedings of ACM Conference on Human Factors in Computer Systems (p. 565-570). New York: Association of Computing Machinery.	increase usability focus in product development	design personnel without formal usability training	restructuring development team responsibilities and usability resources	19 design team members	general awareness increase of usability issues; program requires longer implementation before effects can be evaluated	compiled usability issues and "how to" resources throughout the system development cycle for design professionals; included surveys, interviews, market research, interface guidelines, and walkthroughs

Usability Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Nielsen, J. (1992). Finding usability problems through heuristic evaluation. In P. Baversfeld, J. Bennet, & G. Lynch (Eds.), CHI'92 Conference Proceedings ACM conference on Human Factors in Computing Machinery (pp. 373-380). Monterey CA: The Association of Computing Machinery.	assessment of usability evaluation using heuristic research techniques	major usability problems - potential for system to be used erroneously; minor usability problems - system use is slowed or user inconvenienced	user interaction scenarios of a phone-based banking system are presented for evaluation; the number of major and minor problems discovered by the evaluators are tallied	31 usability novices; 19 usability specialists; 14 usability double specialists	no one evaluator was able to recognize all usability problems; the difference between the number of problems discovered by the novices and specialists was statistically significant as was the difference between the specialists and double specialists; two to five specialists are necessary to discover a high proportion of usability problems; specialists have experience with usability issues and/or a specific interface	could actual users have done as well; system was designed for general public use - what of a system for specific users with unique professional needs; would usability experts be able to recognize major and minor problems with a healthcare system; problems were judged minor or major subjectively by the author; assumes characteristics of the general public user are well known
Virzi, R.A. (1992). Refining the test phase of usability evaluation: How many subjects is enough? Human Factors, 34(4), 457-468.	assess effective discovery of usability problems with various user sample sizes	sample size, user expertise, usability problems, usability problem severity	compare simple proportion of problems discovered across sample sizes and across Monte Carlo permutations	I - 12 novice users and 3 case scenarios; II - 20 novice users and 21 tasks; 6 'double' usability experts, 20 subjects and 7 tasks	80% of all problems with varing severity were discovered using 5 subjects; increasing sample size beyond 5 did not greatly increase the number of problems identified; severe problems were discovered first; small user samples can be useful in iterative design processes	double usability experts are expert in usablity evaluation and in the application content domain;
Arnold, J.M. (1992). Development and testing of a student software evaluation form for computer-assisted instruction. In J.M. Arnold & G. A. Pearson (Eds.), Computer applications in nursing education and practice (NLN Pub. # 14-2406, pp. 363-371). New York: National League for Nursing.	tool for student evaluations of the usefulness of computer tutorials and simulations	3 tutorials and 5 simulations evaluated for time of use, self-pacing, clinical preparation, ease of learning, enjoyment, and usefulness of feedback	4 point Likert scale with accompanying Cronbach alphas and comparison of simple item counts	303 student cases	the number of evaluations for each tutorial or simulation varied from 30 to 49; Cronbach alphas ranged from .75 to .88; actual response counts reported in bar-graph form revealing response range and relative variability; although some tutorials or simulations evidenced greater variability across scale items, all software programs were rated positively	evaluations were distributed and collected immediately after the software program was completed, not after a clinical experience
Karat, C.-M., Campbell, R., & Fiegel, T. (1992). Comparison of empirical testing and walkthrough methods in user interface evaluation. Proceedings of CHI'92 (pp. 397-404). New York: Association of Computing Machinery.	what are the outcome differences between methods	evaluation on number of usability problems; reliability; cost; interpretation of data	content analysis and simple tally and comparison of the evaluation results of empirical lab testing, individual walkthrough, and team walkthrough	48 end-users and GUI develop-ers	the empirical method of evaluation resulted in the largest number of usability problems, the largest number of differing types of usability problems, and the least amount of time investment per discovered problem	it is unclear what the empirical testing method entailed; participants had varying levels of evaluation expertise
Nielsen, J. (1993). Usability engineering. Boston: Academic Press, Inc.	defining usability and usability assessment methods; cost/benefit arguments for usabilty methods	engineering life cycle, heuristics, testing, assessment methods, standards	review, discussion, case studies	n/a	usability is a factor of usefulness; usabilty is multidimensional: easy to learn, efficient to use, easy to remember, few errors, subjectively pleasing; user characteristics will affect the way a system works - computer experience, knowledge of the domain, system expertise; expert heuristics are more cost effective than large programs of usability testing	focus is on the interface design as engineering rather than testing; Landauer would say the focus is still too small (only interface) while the user model is too large (everyman rather than specific users); heuristic relies upon usability "experts"

Usability Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Cuomo, D.L., & Bowen, C.D. (1994). Understanding usability issues addressed by three user-system interface evaluation techniques. Interacting with Computers, 6(1), 86-108.	comparison of three usability evaluation approaches within an HCI framework	user-system problems, type of problem, time to complete evaluation, ability to assess directness of interaction	problem discoveries in a military airspace scheduler prototype are compared with usability lab results	5 human factors experts; 6 usability lab participants	structured judgment techniques: cognitive walkthrough, heuristic evaluation, Smith & Mosier guidelines; the goal of system evaluation is to identify potential design problems; the user's goals can be expressed as 'intentions'; semantic distance is a measure of directness between the user's intentions and system operation; cognitive walkthrough provided the smallest number of total problems yet contributed the greates number of unique problems and action-oriented problems; guideline and heuristic methods were quite similar; cognitive walkthrough produced a greater percentage of problems confirmed by the usability test	due to the prototype's level of completion, some problems were disallowed in the evaluation; 'system bugs' are differentiated from interface design problems without explanation; the results suggest ways to efficiently match evaluation techniques with system problem types
Keil, M., & Carmel, E. (1995). Customer-developer links. Communcations of the ACM, (38)5, 33-44.	survey of communication links developed using techniques for requirements gathering from/with users and their assessed success	customer-developer links: facilitated team, MIS intermediary, support line, survey, user-interface prototyping, requirements prototyping, interview, testing, email/bulletin board, usability lab, observational study, marketing and sales, user group, trade show, focus group; package development and custom development environments	structured interviews and survey in multiple software development case studies	17 organizations; 31 software projects	four to six links are ideal for a cost/benefit gain in project success; indirect links are frequent but often ineffective communication links - indirect links are system analysts, technical support and reseller personnel, internal consultants, external consultants, non-representative consumers, supervisors, marketing personnel, developers; custom development and package development environments characteristically use different customer links; non traditional links should be considered in each development environment	a support line approach can be seen as a route to continuous improvement but it can also be a lazy form of beta testing - using the the unwary purchaser of version 1.0; custom development serves to produce one, tested application; package development serves to produce a continually evolving application
Ramey, J. (1995, June). Advanced usability testing. Seattle WA: Seminar conducted at University of Washington.	usability testing and investigation techniques for all system development life cycle stages	pre-development; early development; mid-development; late developement; beta test; post-release	survey and discussion	n/a	emphasize usability investigation, usability engineering, throughout product development rather than testing a completed product; pre-development (industrial anthropology): users profiles, task analysis, work contexts, use patterns, social issues; early development: requirements definition, prototyping, verify, lab methods; mid development: verify profiles, scenarios, goals, and lab data; late development: design validation, performance measures; beta test: real world testing, usability and usefulness conflicts, evaluate against pre development goals; post-release: evaluate change in the workplace	iterative design and prototyping demand usability investigations at all phases of development - no longer will a usability test at the final stage of the linear "waterfall" design process suffice

Usability Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Hendrickson, G., Kovner, C.T., Knickman, J.R., & Finkler, S.A. (1995). Implementation of a variety of computerized bedside nursing information systems in 17 New Jersey hospitals. Computers in Nursing 13(3), 96-102.	describe actual selection and implementation experiences	commerical stand-alone nursing systems, customized HIS applications	structured interview and site visits	17 hospitals, 2 site visits one year apart	the initial site visit focused on implementation plans; the susequent site visit looked at how the plan had or had not occurred, reasons, and attitudes; the most successful implementations were the simplest-installing commercially prepared free-standing applications without modifications; complications to the implementation plan and process occurred when modifications or interfacing with other systems were necessary; experiences included: recommendations for slow implementation processes, increased nursing time in patient rooms, increased nursing time on their feet while charting, beneficial prompting for inexperienced staff, increased size of the paper chart, more readable documentation, variable assessments of time saved, and mismatched systems in some ICU environments	the interviews seemed to be two pronged: 1) management weighted system-wide plans and selection processes and 2) staff nurse opinions of the implementation impact on care and work environment; automated charting makes for large print jobs for a chart that remains paper based
Beyer, H.R., & Holtzblatt, K. (1995). Apprenticing with the customer. Communications of the ACM, 38(5), 45-52.	describe the requirements Contextual Inquiry process as "apprenticing" with the customer	customer, the work, structure, focus	qualitative techniques of ethnographic study: interview, observation, participation, validation	n/a	designing work support systems is redesigning the work itself; multiple task instances and variances in the work and workers will reveal an underlying pattern - the structure of the work; work structure includes: work strategies, constraints, physical environment, work roles, recurring patterns; the designer's purpose is to improve the design of the work with the application of technology; designer as apprentice and worker as expert soon develop a dialogue over the work; apprenticing leads to participatory prototyping	the learning process focusing on the work is similar to the "talk aloud" process; rather than a knowledge engineering approach, apprenticing allows physical action and interaction with the work and one who knows the work the best; apprenticing is observation and talk aloud - ethnography
Brown, S.J., Cioffi, M.A., Schinella, P., & Shaw, A. (1995). Evaluation in a rapidly changing community hospital. Computers in Nursing, 13(6), 280-284.	evaluation process for a bedside terminal implementation	RN time in direct patient care, RN overtime, medication error rate, RN attitudes	random work sampling pre and post terminal implementation; Bedside Terminal System Questionnaire for nurse attitudes	a 35-bed surgical unit; 13 RNs complete pre and post	1093 observations before implementation and 699 observations after implementation were coded into the 4 preset variable categories; RN time in direct patient care was reduced after bedside terminal implementation; RNs were statistically less positive toward bedside terminals after implementation; medication error rate was unchanged; RN overtime was decreased by 42%	the nurses had used an automated system for order entry and care planning before the bedside terminal implementation; history threat to validity as the studied unit was restructured and reduced in size before the study was completed; major hospital-wide staff and patient reductions occured during the study; staff morale was assumed to have been affected; post data was collected 5 months after implementation

Usability Literature
(in ascending chronological order)

Reference	Focus	Variables	Method	n	Results	Comments
Goldberg, P. (June 1996). Computerized records project falters at Peace Health. Oregon Nurse, 61(2), 8.	reporting failed computerized records system implementation	implementation, work flow	description	1 hospital	a $31 million dollar Community Health Record software development and implementation project is halted after 5 weeks when record design, system speed, the consistent need for nursing overtime for documentation and double charting are realized	nurse staff criteria are minimal impact on nursing work flow, no impact on quality patient care, and an incremental rather than system-wide process of implementation
Pabst, M.K., Scherubel, J.C., Minnick, A.F. (1996). The impact of computerized documentation on nurse's use of time. Computers in Nursing, 14(1), 25-30.	the efficiency and quality impacts of an automated documentation system on bedside terminals	automated intake and output, vital sign, progress note, and care planning software modules; bedside terminals; documentation time; timing site and quality of documentation	pre and post-test interval work sampling; focus groups	8 nursing units	14,000 observations on each nursing unit over a 3-year period collapsed into seven categories; the categories were: direct patient care, indirect patient care, unit care, personal, personnel education, standby, faculty time; 10-minute intervals were used; the time required for documentation dropped from 13.7% of the nurse's time to 9.1% on the units with bedside terminals; nurses on the automated units still charted at the nursing station; care plans were updated more frequently using the automated system but differences in documentation quality were not observed; user satisfaction was high in the automated nursing unit but patient care information became fragmented across automated, paper chart, and flow sheet systems	the system vendor and nursing care system were not identified; only a portion of the total nursing documentation need was possible in the automated system; the authors propose that savings in documentation time be examined for work restructuring rather than staff cuts; the automated system changed work patterns in ways not totally understood as yet

Section 2.

Second Paper

Factors of Usability in Nursing Information Tools

Katherine Caton

Oregon Health Sciences University

School Of Nursing

RUNNING HEAD: Factors of Usability

Abstract

The development of effective automated clinical information systems for nursing practice requires the evaluation of the current paper-based systems, clear design goal statements, and the participation of nurse users in the design process. Requirements gathering is the design activity that addresses goals, system evaluation, and user identification. Iterative participatory design is the system design method that employs users and their work experiences in design, targeting both system functionality and usability. Although nursing information system evaluation has been addressed in the area of productivity, no definition of usability for nursing systems exists in the public literature. Even nursing functionality has little discussion beyond care planning.

This paper describes a requirements gathering and the development of an instrument to measure usability for nursing in long-term care. Nurses were observed (n=12) in practice and interviewed at 11 different long-term care facilities in Oregon for a total of 24.5 hours. Paper-based information tools (n=171) such as the 24 Hour Report and Medication Administration Record were collected and described for form, content, and users. A semantic differential (SD) instrument of 30 bi-polar descriptors for 11 paper-based nursing information tools was developed. The SD utilized the collected qualitative data as well as usability terms such as Concise-Wordy, Powerful-Weak from the human-computer interaction literature. The SD was administered to 112 nurses from 21 long-term care facilities in Oregon. A principal components factor analysis with oblique and varimax rotations were performed on the SD data producing 6 factors of usability each. Paper-based tools evidenced usability in the oblique analysis if they were Guiding,

Artistic, Lucid, Portable, Client-Centered, or Regulated. The total oblique usability factor scores for each tool ranked the Personal Worksheet as the most usable paper-based tool while the federally mandated Minimum Data Set was the least usable.

The resulting requirements data, including information flow and tool placement, and the measurement of usability in long-term care nursing practice can be used in the design of automated information systems. Usability was defined within a baseline of paper-based information tools. New automated systems must at least be as usable as the tools nurses have developed over time and now employ in practice.

Introduction

Behind the development of computerized information systems is the desire to find some way to improve the human relationship with information. Our desire to manage information efficiently and effectively in health care is represented by the over 7,722 computerized patient care applications installed as of 1991 (Anon., 1991a). But in our attempt to make information work for us, we are often overwhelmed by the volume of data and the complexity of the data relationships. Health care organizations generally, and the discipline of nursing specifically, share this frustration.

Experiences with automated information systems in health care have not always been successful. While Nursing Information Systems (NIS) have been installed with the hope of saving time, expense, and reducing errors in patient care, many accounts of failed and abandoned systems argue the opposite. Something is just not working. Our automated information tools remain inadequate.

There are many reasons for automated system implementation to fail. Training may be weak, performance expectations may be unrealistic or oversold, system access may be insufficient, or organizational support may be slight. From the perspective of the clinical nurse, one reason may be that practice realities have not been adequately captured. What nurses do with information and the way they do it is only partly understood. Nurses, as users, have not had a hand in communicating their needs or designing today's automated systems. Nor, can it be surmised, that nurses necessarily understand how they use information and for what purposes.

New techniques in the information system design process offer system designers and clinical practitioners design opportunities. As information systems have the potential to transform and restructure nursing practice, these opportunities should not be missed. The purpose of this study was to examine a selection of information tools currently in use in long term care nursing practice. The examination used methods of information system requirements analysis and a semantic differential (SD) questionnaire. Information tools and their uses were identified and described. A semantic differential questionnaire was explored for its ability to discover factors of usability. The questionnaire was applied to the current paper-based information tools that have been developed by nurses and their organizations over time to meet their needs. Factors of usability in current information tools can be seen to be part of the context of nursing practice in long-term care and should inform the design of future automated tools.

Review of Related Literature

The background for this research lies within multiple disciplines. The design and evaluation of information systems is the concern of computer science. Human Computer Interaction (HCI) is the discipline within computer science that examines the use of information systems toward accomplishing human goals especially for characteristics of usefulness and usability that can be codified into design guidelines, practices, and specifications. HCI has used cognitive and decision making theory along with anthropology and engineering in its framework of usability. Nursing informatics has limited its perspective to the relationship between nursing practice and clinical or managerial information. And finally, semantic space is defined as experience and attitude using psychometric measurement.

Information System Life Cycle and Design

Computer science and health informatics literature has frequently referred to a life cycle in system design (Jacobsen & Fennell, 1989; McDermid & Rook, 1993; Perreault & Wiederhold, 1990; Sailor, 1990). The life cycle often referenced is the waterfall design process, moving from system feasibility studies, software requirements definition, analysis, program design, coding, testing and implementation, to operations and maintenance. The waterfall moves forward in steps, completing one phase before moving to the next. Boehm (1988), McDermid and Rook (1993), and Ellison (1994) have reviewed design methods and find that this process has been modified in many ways, usually by adding verification feedback and emphasizing control of cost or personnel.

Shortcomings of the waterfall design life cycle include a heavy reliance upon the initial set of user requirements. Requirements are the functions, data flows, controls, objects, and environmental specifications of the users or purchasers of a system—what they want it to do (Davis, 1990; Stokes, 1991). Requirements are usually gathered through interview, task analysis, and structured analysis techniques (Dorfman, 1990; Fowler, Macaulay, Castell, & Hutt, 1989; Sailor, 1990). However, as Scharer (1981) points out, there are usually two separate points of view in requirements gathering, the user's view and the analyst's view. The system analyst who will write the requirements and specifications may not perceive what a user describes as a goal with the same degree of importance. Complex problems and needs are additionally difficult to understand, for both the users and designers (McDermid & Rook, 1993; Scharer, 1981).

Researchers in HCI have also criticized evaluation in the waterfall process. They have found that evaluation and usability assessments are not made until the final phase of development when a product is fully structured and programmed. This is too late for any real modifications to meet misunderstood or overlooked user needs (Gould & Lewis, 1987; Ramey, 1995). When Gould and Lewis (1987) surveyed software designers for their views on evaluation, the designers related that budgetary concerns and the pressures to bring a product to market often overtake efforts at user evaluation.

Rather than rely upon direct and frequent user participation, designers have applied guidelines derived from cognitive theory and their own user experiences. Moran (1981) termed this general interactive user model the "psychology of the user." Payne (1987) worked at modeling the knowledge a user would need to use an application while Scapin (1990) mapped the distance between the user model and the device (application) model of behaviors. The smaller the distance, the less time needed in user training.

This approach to design began to fall apart after the discovery of the "software crisis"—user dissatisfaction. Giddings (1984) noted that software could not rely upon a general user model and be domain independent if it is to truly meet user needs. Users live in complex worlds, performing complex activities in complex organizations. Meister (1989) felt that humans must be seen as greater than "molecular knobs and dials" but living in molar systems. Landauer (1991) tells us outright that design must "get real" and leave cognitive research behind in order to build usable systems.

Iterative prototyping and participatory design techniques are efforts to, as Denning and Dargan (1996) state, connect the product with the user. Object oriented programming and development software allow the rapid production of at least partly functioning applications. When users are included as design participants and are asked to use the prototypes, they bring their context-based needs and perspectives to what then becomes a design cycle of testing and refining. Bannon (1991) in his case review notes that prototyping with users casts aside the requirement that users explicitly describe their needs. They can run with their best intuition as to what will work. There are additional benefits to a prototyping design approach. Boehm, Gray, and Seewaldt (1984) evaluated seven student projects contrasting prototyping with the linear product specification process. They found that the prototyped products were smaller and more efficient, required a shorter development time, and were easier to learn than the products developed using the traditional linear design methods. The prototyped products were judged lower in functionality but perhaps the users did not need all the functions produced without their participation. Alavi (1984) found the prototyping process difficult to control but saw that it strengthened developer-user relationships and resulted in greater user satisfaction. Increased user participation in design then, has required that the linear, user modeled design approach be set aside for an iterative user-centered though less controlled participatory design method.

Nursing Information Systems

An NIS supporting the nursing process and nursing research is outlined in the literature (Graves & Corcoran, 1988; Harris, 1990; Zielstroff, McHugh, & Clinton, 1988).

Graves and Corcoran (1988) envisioned an NIS design that included practice relevant data and an ability to retrieve information by nurse-directed inquiry. More typically, NIS supports only the nursing roles of record keeping, decision support for error checking, or for financial planning. This is evident in Sneider's (1987) list of the major components of a NIS as: schedule generation, interactive schedule maintenance, historical record keeping, nursing management report generation, personnel/position control, patient acuity record keeping, and care planning. Ross, Gore, Radulski, Warnock-Matheron, & Hannah, (1991) equate system components of admission/discharge/transfer and order entry/results reporting in their discussion of patient care systems. Yet claims of nursing involvement in system design are made while the literature reports nursing participation only after the vendor and system have been chosen (Dowling, 1989; Ross, Gore, Radulski, Warnock-Matheron, & Hannah, 1991; Simpson, 1992; Summers, Ratliff, Becker, & Resler, 1989).

Although most of the NIS literature concerns hospital-based acute care nursing systems, the first federally mandated Minimum Data Set (MDS) for Resident Assessment and Care Screening is now used in long-term care (Morris, Hawes, Fries, Phillips, Mor, Katz, Murphy, Drugovich, & Friedlob, 1990; Morris, Murphy, Nonemaker, Smit, Stegemann, Swerengen, Zimmerman, 1995). Various state agencies require additional client assessment tools and data report sheets (Anon., 1991b; Downey & Hood, 1992; Miller & Giamporcaro, 1992). Clinical nursing involvement in the development of these information tools varies and a plan for tool evaluation is often missing.

Information Needs and System Evaluation for Usability

The definition of useful and relevant information is formed with a personal understanding of nursing practice needs and routines. Benner and Wrubel (1989) suggest that studying the practice of nurse experts can expand understanding. They describe the nurse as a "knowledge worker and a developer of clinical knowledge" (p. 20). The work of nursing was firmly removed from a simple count of tasks more than 30 years ago when Kelly (1964) and Hammond (1966) studied the clinical inferencing process in nursing. Later, Grier (1984) reviewed inferencing in the nursing information processing literature but found the greatest discussion concerned the recognition, measurement and organization of nursing data. Dowling (1988) defined data as basic, objective, indivisible elements whereas information "is composed of data that have been transmuted to a form that is understood easily and rapidly and is usable by the decision maker" (p. 180). Practice and practitioner needs guide the transformation of data to information.

The nurse as knowledge worker is a consistent theme in the nursing practice literature. While information processing models have been used to examine this aspect of nursing practice, it remains evident that individual variances exist in problem solving among nurses. Experience makes a difference, as does the practice context and individual situations. Grier (1984) states, "computerized systems of nursing information must be based on studies of information needs and processing and on conceptual frameworks appropriate to nursing practice" (p. 280). Corcoran-Perry and Graves (1990) examined information within a framework of practice in the work place. Defining information need as "any activity undertaken to identify a message that satisfies a perceived need" (p. 120), Corcoran-Perry and Graves assessed both observed and reported information-seeking behaviors. Four data content categories and frequencies were identified: patient-specific, 49%; institution-specific, 27%; domain knowledge, 21%; and procedure information, 3%. Verbal sources and written sources were accessed equally (45%). Difficulties encountered when seeking information included factors relating to difficulties with the information itself, time, unavailability, too much information, and incomplete information.

Woolf and Benson (1989) examined the costs and benefits of information for physicians. The cost was the effort expended to gain desired information. The benefit was the impact the information would conceivably have on a practice decision. The researchers found that the use of information,

> could be improved if designers better understood physician practice behavior and professional peer networks, the personality and psychology of the physician user, and the need to match information processes with the nature of the work task. It has been suggested that system designers are developing products that are inconvenient for doctors and, by virtue of providing the wrong type of information, neither responsive to their needs nor cost-effective (p. 377).

Using the qualitative method of a semi-structured interview, Harris (1990) discovered that there was a serious cost for nurses using computer generated care plans. Harris described a system that only allowed data input and was designed for the purposes of documentation and efficiency. The nurses experienced a feeling of deprofessionalization, being controlled as they performed "mandated" activities they did not value or find relevant to their practice.

Schmitz (1987) called for a "systematic and unbiased evaluation methodology" extending beyond technological issues and the organizational environment. Limiting an adequate system evaluation, however, is the inadequate assessment of clinical nursing information needs as well as what Grier (1984) terms "baseline data." Grier (1984) notes that an impediment to the adequate evaluation of computerized information systems is the lack of comparative manual system evaluations. That lack persists today.

Efficiency has consistently been the primary evaluative factor offered for NIS (Hendrickson & Kovner, 1990; Kahl, Ivancin, Fuhrmann, & Markiewicz, 1990; Lower & Nauert, 1992; Sinclair, 1991; Sneider, 1987). Developers and researchers have additionally made claims for computerized NIS as saving on personnel expenses and avoiding errors (Hendrickson & Kovner, 1990; Kahl, Ivancin, Fuhrmann, & Markiewicz, 1990; Lower & Nauert, 1992; Sinclair, 1991; Sneider, 1987). System efficiency has been measured as a reduction in the time required to complete nursing documentation tasks. Task efficiencies have been promoted as providing a saving in staff costs. Yet, many installed systems are unsatisfactory to the clinical nurse (Feeney & Donovan, 1989; Harris, 1990; Johnson, 1987; Kahl, Ivancin, Fuhrmann, & Markiewicz, 1990; McHugh, Denger, & Cole, 1991; Packer, 1989).

The ultimate information system evaluation occurs at implementation. Developers offer multiple reasons for system implementation failures including: inadequate hardware, resistance to change, lack of appropriate training, insufficient assessment of information needs, and a perceived loss of control and professionalism (Gould & Lewis, 1987; Norman, 1988; Summers, Ratliff, Becker, & Resler, 1989). However, it is difficult to ascertain specific reasons for nursing system failures because an NIS evaluation process, except for hardware and software performance specifications, has yet to be outlined. Simple resistance or inexperience can be explanations for failure only if information system development has followed a user oriented design methodology, that is, if the design itself is based on an assessment of user information needs and considers the multiple demands of the clinical nursing environment. Systems must "not only meet user's requirements for information, but also fit smoothly into their everyday routines" (Perreault & Wiederhold, 1990, p. 152). Nursing frustrations with NIS indicate that evaluations based on observed efficiency and system costs are insufficient.

Semantic Differential

The semantic differential is a tool which has been used extensively to assess attitudes, values, preferences, concept meanings and to define product markets (Kerlinger, 1973; Nunnally, 1978). Using scales of bi-polar descriptive terms (e.g. hot, cold; fast, slow) and difference distance summations, a semantic space can be constructed representing a concept or set of subjects. Because attributes of information usability are descriptive, multidimensional, and meaningful to the information system users, the semantic differential (SD) appears especially useful for needs assessment and evaluation (Osgood, 1969; Osgood & Suci, 1969; Osgood, Suci, & Tannenbaum, 1969). Employing such an approach, information tools used in nursing practice may be plotted against one another in the ideal semantic space for usable nursing information systems.

Osgood & Suci (1955) propose the SD as "a scaling instrument which gives representation to the major dimensions along which meaning reactions or judgments vary" (p. 325). Kerlinger (1973) suggests the SD scale is a way to "see" how someone else might think or feel; to see the relative value one places on a concept. Absolute distances are the descriptors of difference. If the distance is small, then variables are clustered. If the absolute distance is large, then the variables are distinctly separate.

In nursing, Jacobson (1984) used the SD technique in a comparison of nursing theory models for practice relevance. Flagler (1989) developed a SD scale for the comparison of the idealized maternal role with self perceptions of maternal competence. Wikblad, Wibell, and Montin (1990) constructed a SD scale and assessed the patient's experience of diabetes.

Four steps in the development of a SD scale are: 1) choose the concepts to be rated, in this case nursing information tools, such that the concepts must produce some variance and provide adequate coverage of the semantic space; 2) select appropriate adjective pairs or scales based on the extent to which they possess factor representativeness and relevance to the concepts used; 3) format the opposing adjective descriptors as anchors on 3, 5, 7, or 9-point scales for each concept; and 4) analyze one or more of the three sources of variance - concepts, scales, or subjects (Kerlinger, 1973).

As part of my doctoral course work, I developed a SD scale as a pilot for the discovery of nursing information usability. Using an intensive interviewing technique for data collection and analysis (Loftland & Loftland, 1984), five critical care nurses with varying levels of expertise were asked about the meaning of information in their work — what was it; when did it help; when did it get in the way; when did they seek out information; what were their information sources. The interview transcriptions were reviewed and coded. The nurses discussed nursing care plans, the Kardex, nurse experts, textbooks, report notes, and policy and procedure manuals. They described the information tools they used with attributes such as authoritative, organized, difficult, at the bedside, and available. When using information tools the nurses expressed their goals as anticipating or organizing care.

From a total of 23 descriptive terms and 14 information tools initially mentioned in the interview transcripts, 12 descriptive adjectives and 6 information tools were identified as consistently referenced across all interviews and were used to construct a pilot SD instrument. An additional sample of intensive care nurses with varying levels of experience were asked to complete the SD. The number of respondents completing the pilot SD was small (n=11) yet there was adequate variability in the responses to allow a trial factor analysis. The mean information tool scores across all scale items ranged from 3.80 to 6.14 (1 being a negative and 6 being a positive attribute). The scale coefficient alphas for each tool ranged from .71 to .91.

Using a principal components extraction, only two factors were extracted across all tools in the pilot study—Ready & Able and Definitive. However, by simply examining the mean item scores I saw a preference for using the Kardex and a dislike for the nursing care plan. While the SD and factor analysis demonstrated usefulness in describing the attributes of information tools, additional subjects and additional item range were needed to define tool usability.

For this research, the pilot instrument development was expanded with additional SD usability items from the HCI literature and additional subjects. The domain of nursing practice was narrowed to long-term care with the information tools used in that environment and practice. Using the requirements gathering techniques of interview, observation, and tool description, the goal was to further a definition of context-based usability. Data from the requirements gathering were used to describe the long-term care practice environment and nursing information flows. A SD scale was additionally developed from the initial qualitative data as well as from the HCI literature as a means to identify the key factors of usability from the nursing perspective. Finally, the usability factors, identified using the paper-based tools in current practice, serve to establish a baseline for information tool usability and an evaluative measure for the design of automated nursing information tools.

Methods

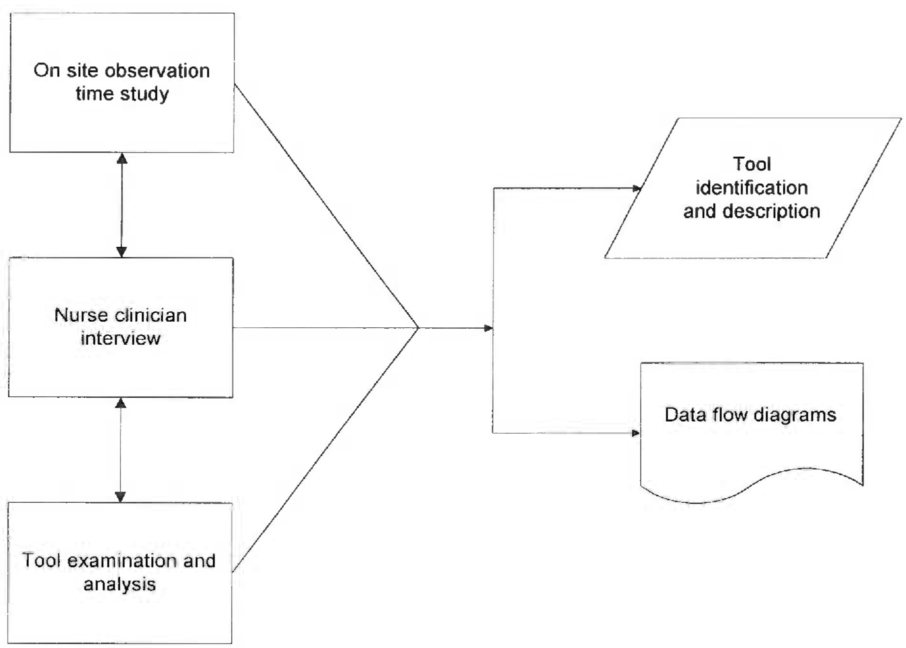
To describe the usability of information tools in long term care nursing, three phases of research were carried out. The first phase used the requirements analysis techniques of observations, interview, and tool analysis with a sample of nurses practicing in long term care in the state of Oregon. During the second phase, a SD questionnaire was constructed using data collected in the first phase, a review of HCI literature, and items retained from the pilot study. The third phase collected SD questionnaire data from an additional sample of nurses in long term care in Oregon and a factor analysis for factors of usability was performed.

Phase 1 Requirements Analysis

A purposive sample of nursing home facilities, representing urban, suburban, and rural communities as well as facility size was chosen from a list of all nursing home facilities in Oregon. Repeated samples of nursing homes were selected until the requirements analysis produced repetitive data (Strauss & Corbin, 1990). From a total of 30 facilities, 11 permitted on-site observations and suggested appropriate nurse subjects. The nursing home facilities provided skilled nursing care, intermediate care, and long term care. Their size ranged from 26 to 160 beds with a mean of 94.

Twelve nurses (two at one site) consented to participate as subjects of observation and interview and were assured of anonymity (see Figure 1a). A $20 dollar honorarium was offered to all observation and interview subjects who participated in this phase of the study. Observations typically began after a change of shift report and averaged just over 2 hours. The subjects were instructed to proceed normally with their daily care routines

<u>Figure 1a.</u> Requirements Analysis



during the observation period. The use of any identifiable information tool either to record data or to retrieve data was noted by the observer with a start time, tool name, tool location when used, purpose, and stop time. Subjects also answered questions about tool purpose or to clarify their actions.

Following the observation period, the nurse subjects participated in a semi-structured interview (see Appendix A for the data collection instruments including consent form, observation records, interview guide, tool description, and SD questionnaire). The nurses answered questions about tool placement, tools they liked, disliked, their characteristics, frequency of use, decision making tasks, trustworthy information, and specific questions about their use of the federally mandated Minimum Data Set (MDS). Subjects also replied to demographic questionnaire items.

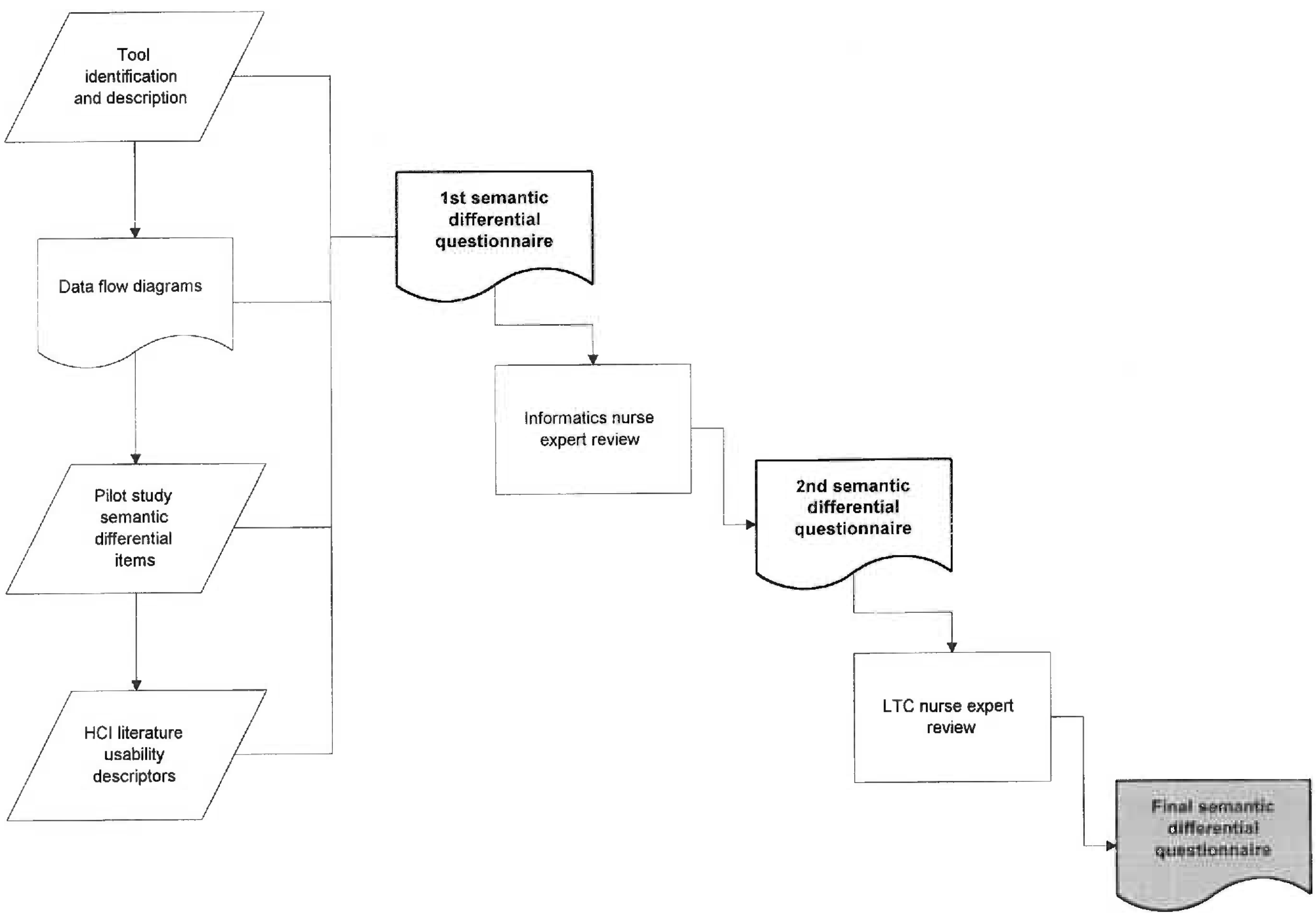
Information tools used during the observation period as well as other information tools identified in the resident care environment were examined. Tool content characteristics were noted such as resident, process, or organizational data. Tool form characteristics such as table structure, check charting, free text, color, and placement were also collected. A review of the observation, interview, and tool characteristic data produced the selection of common information tools for semantic differential analysis, information flow diagrams, and a tool placement diagram on a typical nursing care ward.

Phase 2 Semantic Differential Construction

The pilot study factor analysis resulted in only two factors across all tools. This indicated that the scope of SD terms describing information tool usefulness and usability may be constricted. This could have resulted by relying solely upon interview data for the scale items. Consequently, a list of usability descriptors was gathered during a review of HCI literature. This list was reviewed for repetitiveness and clarity. A reduced list was submitted to three nursing informatics experts for a critique of scope, clarity, and true opposite SD anchors (see Figure 1b). Using their comments, the list was reduced further and submitted to two additional nursing experts in long term care. A final list of semantic differential bi-polar anchors was produced following this review.

The information tools represented in the SD questionnaire were identified from the requirements analysis data. Tools were chosen to represent a wide scope of nursing activities, placement, and frequency of use. Finally, demographic items describing respondent characteristics were added to the questionnaire.

Figure 1b. Semantic Differential Scale Development

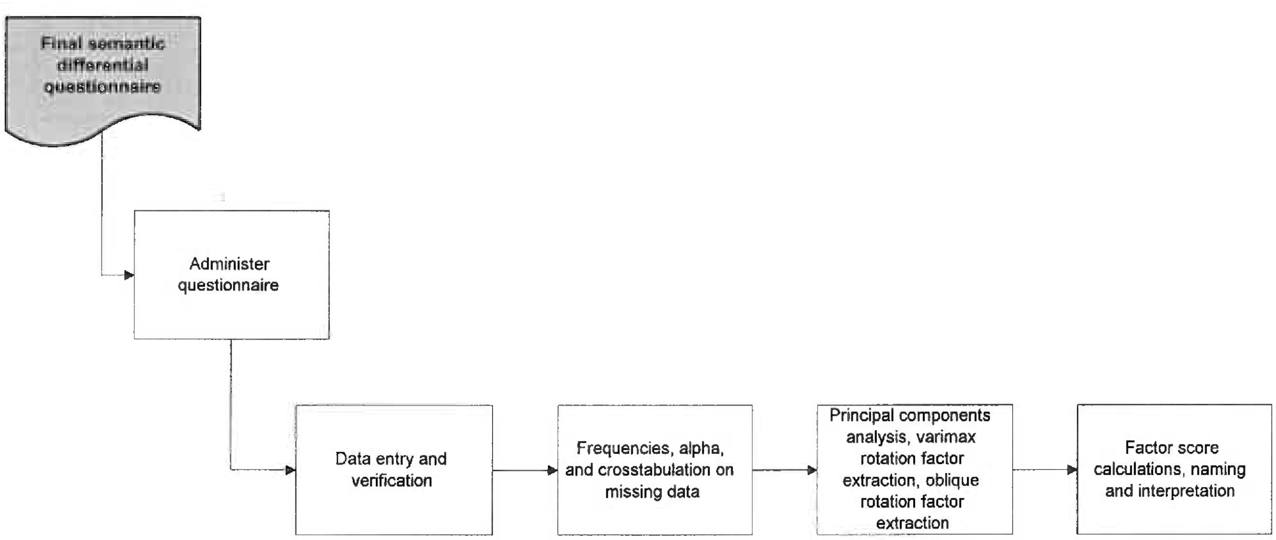


Phase 3 Demographic and Factor Analysis

Again the list of nursing homes in Oregon was used to produce a purposive sample of representative nursing homes. Of 32 facilities contacted for inclusion in the study, 21 agreed to either distribute the questionnaires themselves or allow the questionnaires to be administered to their licensed nursing personnel. A five dollar honorarium was offered to each nurse completing the questionnaire.

Questionnaire data were entered into database tables and verified. Descriptive frequencies over all information tools and for each tool were run using the SPSS statistical software application. A crosstabulation was performed to assess for patterns in missing data. The cases responding "never" for frequency of use were removed from the data table. A principal components analysis, varimax rotation factor extraction, and oblique rotation factor extraction were completed for the tools used occasionally or more frequently (see Figure 1c). Factor variables with the greatest loading on each factor were

Figure 1c. Usability Factor Extraction



used to name the factors in the varimax and oblique rotations. Two informatics nurse experts also reviewed a list of up to five variables for each factor and offered factor names. Factor scores were used along with each tool's standardized factor values to calculate factor score values as:

tool's factor score value = ∑ (standardized variable value x variable factor score value)
(Norušis, 1992, p.74)

The factors score values for each tool were used to place the questionnaire items and the nursing information tools into the resultant factor space. Factor values were totaled for each information tool as the tool's usability index.

Results

Phase 1 Requirements Analysis

Twelve subjects were observed using 171 information tools over 24.5 hours of observation. However, each of the eleven long-term care facilities utilized a slightly different name for their nursing information tools. Consequently tool descriptions (see Appendix B) assisted in aggregating tool names to 87 separate and unique tools. Table 2 lists the observational counts and task completion times. The most frequently used information tool was the phone, followed by the medication administration record (MAR) and the resident's chart. The median time for phone use was 1 minute. Medication bubble packs, which arrive from the pharmacy as a 1 month supply on a numbered card with resident name, dose, and dose schedule, were used for the longest average and median completion time. Passing medications was a continuous task frequently taking up most of the morning. Many tools were used for completion times of less than 1 minute. Often two tools could be used simultaneously.

Most information tools were located at the nursing station, with other placements on the medication cart, physically with the nurse, or at the resident's bedside. Figure 2 depicts a typical resident care ward with information tool locations. Some reference tools were hung from the walls in the nursing station or at the bedside while others were placed under glass on table tops. Most information tools were table or column formats. A few, such as admission forms used fill-in fields.

All observation and interview subjects were RNs, six from day shift, four from the evening shift, and one was observed during the night to day change of shift. Respondents averaged 41.8 years of age, have practiced nursing for an average of 9.2 years and long-term care nursing for an average of 4 years. Their education was primarily an Associate Degree: 8 ADN, 3 Diploma, and 1 BSN. Respondent ethnicity reflects Oregon's largely white population with only one respondent of Native American descent. Seven were functioning as the charge or lead nurse with 3 resident care managers, one medication nurse, and one per diem nurse. The census on the nursing wards ranged from 26 to 80 residents with an approximate care ratio of 1 staff (RNs, LPNs, CNAs, and RCMs) to 6 residents.

During the interviews, six respondents mentioned their personal worksheet or "cheat sheet" as a tool that worked best for them. Also mentioned (more than one answer was possible) were the assignment sheet, medication administration record (MAR), drug reference, physician call sheet, 24 hour care sheet, Minimum Data Set (MDS), nursing care plan (NCP), and the pharmacist. One nurse mentioned that her favorite tool was her self—her professional judgment. In descending order, the best placement for information tools was the nursing station, on their person, on the medication cart, or at the bedside.

Tools that didn't work well included some of the same tools: 24 Hour Care Sheet, intershift communication book, CNA chart audits, ADL sheets, I&O sheets, free text charting, MDS, NCP, functional measures, resident classification tool, dietary intake sheets, procedure book, PDR, and MAR. Tools did not work well if they were unstructured, unfocused, redundant, wordy, one-way information that only meets baseline standards for care, make work, or not current. When nurses use a tool, frequently they are backtracking information and following a trail as they puzzle out some order of events. Other goals include validating information, communicating, "getting to know a resident," a memory aide, a decision tool, or scheduling resident movements. Tools used infrequently yet valued highly included care guidelines or the MDS, drug reference texts, and bedside care sheet. Five of the twelve respondents stated that they do not use the MDS. However, one nurse stated that since she uses the bedside care sheet, which results from the MDS, her care is affected indirectly.

The decision making events nurses frequently encounter are related to assessing a change in a resident—knowing how far to push residents in their activities or knowing if a perceived change is real and requires medical consultation. Pain medication orders and staffing also require decision making and are assisted by information tools.

Many information sources were seen as invalid or incomplete. For instance, resident transfer information received from social workers was not deemed well structured for nursing care. Some vital sign, skin assessments, bowel and bladder training records were felt to contain falsified information; the very concept of bowel and bladder training was not seen as realistic. Doctor's notes were suspicious as " how do they know the resident if they only see them 5 minutes every 3 months." The sheer duplicity of information in long term care was evident to the respondents and seen as one of the reasons information may seem incomplete. Even with the great number of information tools in the long term care environment, three respondents stated that most communication among staff was verbal. Appendix C contains a summary of all interview responses.

Using the data collected from the interviews, observations, and tool examinations, a diagram of information flow among tools and personnel could be constructed. Figure 3 depicts the flow of data from the resident to the Lead Nurse, Resident Care Manager (RCM), Certified Nurse's Aide (CNA) and various information tools. Figure 4 is a diagram of the telephone order process in greater detail. No physician or pharmacist was identified during the observations. However, nursing staff did track resident problems requiring medical consultation and did track phone messages to and from physicians and their offices. Medication orders received over the phone were copied onto triplicate telephone order forms, faxed to the pharmacy, placed in the chart and copied onto the MAR.

Phase 2 Semantic Differential Construction

Review and analysis of the interview data, along with HCI literature and pilot study data, produced a selection of 89 bi-polar descriptors and 44 information tools (see Table 1). After reviewing the list for redundancy, 44 bi-polar descriptors were submitted to three informatics nurse experts for their review. The resulting 38 bi-polar descriptors were submitted to two nurse experts in long term care for their review. The final review produced 30 bi-polar descriptors to be used on each information tool in the questionnaire.

Eleven information tools observed in use, mentioned in the interview, or that were diverse in content and form were chosen for the final questionnaire. Three separate sequences of the bi-polar SD descriptors were rotated among three sequences of information tool order. A number of the bi-polar descriptor items were also reversed from right to left. Nine versions of the final questionnaire were used to prevent a response set in the data. In trial, the questionnaire took approximately 15 to 20 minutes to complete.

The tools represented in the SD questionnaire are summarized in Table 3 and include the 24 Hour Report, Activities of Daily Living (ADL) Sheet, Bedside Care Sheet, Nurse's Drug Reference, Medication Administration Record (MAR), Minimum Data Set (MDS), Nursing Care Plan (NCP), Nurse Experts, Physician Call Sheet, Personal Worksheet, and Resident's Chart. Figure 5 illustrates the observation counts for nine of the selected information tools with the MAR most frequently used. The Bedside Care Sheet and Nurse Experts were not observed in use. However, Nurse Experts were included in the SD questionnaire because they are frequently mentioned as information resources in the nursing literature. The Bedside Care Sheet was included to capture point-of-care usability data. The graph in Figure 6 illustrates the median use completion times observed for the same nine tools. The highest median completion time belongs to the 24 Hour Report.

Phase 3 Questionnaire Data Analysis

Of the 206 semantic differential questionnaires distributed or administered at 21 long term care facilities, 112 were returned (54%). One questionnaire arrived too late for inclusion in this study. Four questionnaires were removed from analysis as they were less than 75% complete. Frequencies and measures of central tendency were assessed for the remaining licensed nurse (RN or LPN) respondents (n = 107; 96% of the returned questionnaires).

The questionnaire respondents largely represented registered nurses (RN) at 78.5% of the sample. LPN respondents were 21.5% of the sample. Almost half of the questionnaire respondents were over 45 years of age (47.7%). Only 7.5% were younger than 30 years of age. The respondents were also experienced nurses, nearly half (46.7%) practicing longer than 10 years. However, their practice experience has not been in long term care. Here over half the sample nurses have 5 or less years experience. Fifty-five percent are Associate Degree trained. No respondent reported an advanced or graduate degree in nursing. Ethnicity is represented as African or Caribbean 2.8%, Asian or Pacific Islands 5.6%, Caucasian 88.8%, and Native American 0.9%. Most work on the day (73.8%) or evening (20.6%) shifts with only 5.6% on the night shift. They describe their working role for the day as charge nurse 41.1%, resident care manager 28.0%, director of nursing 8.4%, other 8.4%, staff nurse 6.5%, medication nurse 3.7%, lead nurse 1.9%, and per diem 0.9%. The facilities represented in the sample range from 27 to 161 beds (mean 106) and are located in 14 separate municipalities in Oregon.

Figure 7 represents the frequency of use for each information tool in the questionnaire as well as over all tools. The resident's chart was reported as the tool most frequently used. All but one of the information tools reportedly were used at least occasionally. Only the Bedside Care Sheet possesses an average frequency of use less than the scale midpoint. If the SD scale items are seen to have a positive pole, then Figure 8 depicts all tools with responses averaging positively (>4). However, the Bedside Care Sheet, ADL Sheet, NCP, and MDS average below the mean for all tools.

This administration of the SD produced a Cronbach's alpha value for internal consistency of .91. Item variances ranged from 1.82 to 5.11. Those variables with an item to total scale correlation of less than .45 included: At Bedside, Multidisciplinary, Person-Oriented, Creative, Nursing, Lightweight, Portable, and Flexible. At Bedside was the only variable correlating negatively with the scale.

To assess for trends in missing data, a crosstabulation was performed on the questionnaire responses by questionnaire form, respondent license, years in practice, years in long term care practice, education, age, ethnic status, work role, shift, information tool, and frequency of use. Although there was a significant difference ($p > .000$) in two of the questionnaire versions, missing data in 21.5% of the questionnaires in format T2S3 and 28.6% of the questionnaires in format T3S1, these versions were not alike in the order of tool presentation or variable items. A significant difference in the number of questionnaires with missing data was also seen by years in long term care practice. Nurses with greater than 20 years of long-term care practice returned 25.3% of their questionnaires with missing data ($p > .000$). However, when viewing differences by age it was the younger (less than 25 years of age) respondent who left a higher number of responses blank (36.4% of those 25 to 29 years of age, $p > .000$).

By role, staff nurses (27.3%) and charge nurses (18.4%) have a significantly higher percentage of missing data in their returned questionnaires ($p > .000$). A significant difference ($p > .007$) in missing data was also seen in the SD items for the Bedside Care Sheet (22.4%), Minimum Data Set (22.4%), and Physician Call Sheet (21.5%). This last trend may be explained by the significant difference in missing data for the tools used "never" (67.6%, $p > .000$) or less frequently and hence less familiar to the respondents.

Generally, the missing data took on a bi-modal picture, younger nurses and more experienced nurses returned higher percentages of questionnaires with missing data. Teasing out the characteristics of the nurse respondents, all nurses who described themselves as staff nurses (100%) and most of the nurses who described themselves as charge nurses (61%) were over 40 years of age. The younger nurses, 25 to 29 years of age, described themselves as medication nurses (50%) as well as charge nurses (26.1%), and lead nurses (23.9%). It could be surmised that nurses enter long-term care as staff nurses and progress in their careers to charge nurses, resident care managers, and directors of nursing. The experienced nurses who remain as charge nurses and staff nurses do not have experience with the Minimum Data Set (MDS) and do not use the Bedside Care Sheet.

After all cases that entered "never" for frequency of use were removed from the analysis, a principal components analysis produced six factors with eigenvalues greater than 1 (see Figure 9 for the scree plot). Even though respondents equal 107, the removal of all cases with frequency of use as never and a pairwise deletion of missing data produced 1013 to 1043 cases for each item in the factor analysis (107 respondents x eleven information tools = 1177 possible cases). All variables loaded on at least one component in the analysis with communalities (the factor model explanation for the variable) ranging from .46 to .68.

A varimax rotation solution and an oblique rotation solution each produced six factors with all variables loading on at least one factor. Up to the first five variables for each factor are presented in Table 6 along with names given to the factors by each of two informatics nurse experts and the investigator. The variable items are plotted on the first three factors of the varimax solution in Figure 10 and on the first three factors of the oblique rotation in Figure 11. Multidisciplinary lies quite separately from the other item variables in both rotations. An oblique rotation was attained assuming that there would be some usability factor correlation. The oblique solution produced only one moderate to low factor correlation of .41 between factor 1 and factor 4 (guiding and portable).

Standardized values for each variable were calculated and multiplied by the factor score coefficients to produce factor values for each information tool in each rotation. The factor values were used to plot each information tool in a three-dimensional factor space using the first three varimax and the first three oblique factors in Figure 12 and Figure 13. In Figure 12 the MAR (e) can be seen as highly productive while the MDS (f) is not seen as simple, productive, or artistic in the varimax rotation. In the oblique rotation in Figure 13 Nurse Experts (h) and Personal Worksheets (j) can be seen to be very artistic while the

Nurse's Drug Reference (d) and MAR (e) are guiding and the MDS (f) is characterized as thick.

Each tool is also represented on a radar graph formed of the six axes of the factor rotation in Figures 14 and 15. Factor three in the oblique rotation has been reversed in polarity from thick to lucid to present factors in the positive. This is a pictorial representation of tool usability. The tools are presented in their total usability index rank order (please refer to Table 5). The Personal Worksheet tool is ranked the highest in usability in both the varimax and oblique solutions. Its radar graph therefore has the largest area in both Figures 14 and 15. Interestingly, the MDS tool is ranked the lowest in usability in both the varimax and oblique solutions.

Discussion

The primary question of this study has been: " What is usability as revealed by information tools employed by nurses in long term care practice?" And, answering the previous question: " How can a measure of usability affect design in automated nursing information tools?" However, it is evident that nursing information tools, the nursing practice environment, and the state of nursing knowledge are reflective of one another. They are a system. A change in one alters the others. An examination of nursing information tools then is much like digging up ancient pottery or craftwork and asking questions about how the artifacts were used, how they evolved with the needs of the culture or in reaction to the environment. A tool is designed to meet a need and yet the design of a tool has the power to change the environment as well. An example might be the plow changing our landscape or the printing press altering education, science, and religion.

Usability then, can only be measured while considering the nursing practice environment, goals, and state of practice knowledge. Shackel's (1991) review stated that usability will be defined by goals and that viewpoint is supported here. But an over riding question, which surfaced during this examination of usability in information tools, was " What are the nursing goals in long term care?" Nursing practice often states its goal as individualized client-centered care but this is not the primary attribute revealed by this study. Nursing information tools exist in a usability space primarily defined by the organizational needs for productivity as perceived by nursing staff. Practice needs for creativity and individualized care, regulation, and personal needs for clarity are secondary. Usability space in this examination is similar to the patient-specific, institution-specific, domain knowledge, and procedure information content discovered by Corcoran-Perry and Graves (1990) in their analysis of information-seeking.

Current practice in long term care may be circumscribed by a few of its tools such as the MDS, 24 Hour Report, and MAR. Yet these tools are not especially valued for resident care information content by this sample of practicing nurses. Nursing information tools in long term care are generally valued for the ability to keep the nurse on time and on task. This may be reflective of the practice patterns of nurses trained in earlier times or without much experience in long term care as was this sample, but that is not clear. The emphasis on productivity likely is part of the organizational and societal healthcare climate.

The Semantic Differential

The high Cronbach's alpha reliability score (.91) suggests there is evidence that the SD has captured usability and that the SD tool has some redundancy. This is also evident with the large number of scale variable items clustering in the first factor. Handy, Accurate, Essential, and Natural could most likely be removed along with other items without any noticeable change in scale function. This would make the questionnaire shorter and therefore more acceptable to the respondents.

Indeed, whether using the principal components extraction, varimax, or oblique extractions the same variables seemed to cluster as the first factor. First factor items were: Helpful, Effective, Logical, Reasonable, Functional, Therapeutic, Diagnostic and Saves Time. Additional variable items were variously combined with the above selection: Natural, Reality, Safe, Accurate, Current, Handy, Essential, and Powerful. Complex variable items, loading on more than one factor in one or more extractions included: Current, Saves Time, Handy, Flexible, Enjoyable, and Lightweight. Current was both part of the Guiding factor and the Portable factor. This no doubt reflects the up-to-date nature of the Personal Worksheet, which is also portably stored in the nurse's pocket. That which Saves Time is appreciated both for its productive nature and simplicity. If a tool is Handy, it not only assists productivity but it is simple and artistic.

The Multidisciplinary variable item behaved in its own unique way in this scale. It was either a misunderstood variable or needs additional like-items to further reveal how it affects nursing tool usability. Multidisciplinary however, could also be a poorly defined practice reality. Does nursing know what multidisciplinary practice is? Are we doing it?

At the Bedside, while performing well with the concept of client-centered, should also be questioned for inclusion. It is not really an "attitude" that can be assessed. It either is or it isn't. However, as point-of-care technologies are taking hold in nursing practice it remains important to measure whether and what information tools are worthwhile at the bedside. These data can be collected through observation.

The Lightweight-Heavy polar pair was an item that also performed in complex ways. Does lightweight mean easy or of little value? Does heavy mean ponderous, important, or burdensome? As Easy is addressed in other items (Simple, Easy to Learn) perhaps the concept of value should replace Lightweight. Heavy on the other hand seemed to correlate with Legal and issues of importance.

Was Usability Defined?

Many definitions of usability, found in the HCI literature, were present in this assessment. Functional, fast, and helpful were part of the guiding or productive factor; enjoyable, pleasant, satisfying were seen in the artistic factor; easy to learn, understandable, easy to remember were in the lucid factor (Gould & Lewis, 1987; Foss & DeRidder, 1987; Lanzara & Mathiassen, 1988; Norman, 1988; Rust & Golombok, 1989; Shackel, 1991).

Information tools were notably different in the way they guided care, allowed expression and creativity, supported regulatory or legal needs, or were lucid and clear, mobile and client-centered. Guiding care was complex. Guiding was seen as leading the caregiver toward safe and effective personalized care. However, in this environment, guiding also returned to the need to "stay on track" toward the accomplishment of a list of tasks without omission and with efficiency.

What the SD offered was a measure of degree for the factors of greatest importance in this environment with this set of users. Usability was context based and, as Landauer (1991) and Carroll, Kellogg, and Rosson (1991) state, of importance to a specific user group. The SD additionally offered a usability index for the domain as suggested by Carroll, Kellogg, and Rosson (1991) and obtained by summing factor loadings.

Using the SD tool with this selection of information tools, usability was assessed as truly multifaceted. Six factors of usability were revealed using either the oblique extraction or the varimax rotation extraction. Many of the factors named in both extractions were the same or similar, such as Artistic, Portable, Client-Centered, and Simple/Lucid. But as usability is undoubtedly complex with interrelated, correlated factors, this focus of analysis stresses the oblique results.

A focus on the oblique rotation solution is worthwhile. Rotation in factor analysis simply twists the dimensional axes to best align the scattered variable values onto the factor lines. Interpreting a solution is easier when variables are right on a factor line. This is the varimax solution process. However, one of the assumptions of the varimax solution is that all factors are exclusive from one another. As this is hardly likely in the "real" and interpretable world of usability, an oblique solution allows factors to be less than perpendicular to each other; factors may be correlated to some degree.

The oblique rotation produced six factors. Variables loading on the factors were as follows: diagnostic, logical, helpful, effective, functional, reasonable, and therapeutic were Guiding; creative, flexible, and enjoyable were Artistic; complex, multidisciplinary, hard to learn, wordy, and difficult were Thick; portable, available, and lightweight were Portable; person-oriented, and at bedside were Client Centered; and legal and current were Regulated. Although each usability factor name can be interpreted and named in multiple ways, the requirements analysis exercise offered a placement for the usability score values. Requirements gathering through observation and interview gave additional interpretation to the SD factors. The SD factors indicated what tools possessed what sort of usability, but it was the requirements analysis that supported this information with data on how the tools were used and where.

Frequency of use did not appear to have a direct relation with tool usability (see Table 5). A tool's frequency of use however was not entirely a matter of choice; using some tools was mandatory. The MAR and the Resident's Chart were observed in use most frequently (observed counts equal 23 and 21 respectively) and the Resident's Chart and Personal Worksheet had the highest reported frequency of use in the SD questionnaire with means of 4.69 and 4.41 on a frequency of use scale of 1 (never) to 5 (all the time). Yet the Personal Worksheet ranked highest in overall usability (1.43) in the oblique rotation solution while the Resident's Chart ranked eighth (-0.14) in usability (range was –1.88 to 1.43). The MAR was second in overall usability (1.01). Tools with high frequency of use however, should be carefully crafted with healthy doses of usability as they most frequently affect practice patterns.

The oblique dimensions of usability formed a semantic space composed of Guiding, Artistic, Lucid, Portable, Client-Centered, and Regulated. For illustration purposes, the first three factors can become x, y, and z axes forming a usability space into which the information tools can be plotted (see Figure 13). Guiding tools were the Nurses Drug Reference, MAR, Resident's Chart, Personal Worksheet, and Nurse Experts. Tools that did not guide were the MDS, ADL Sheet, NCP, Bedside Care Sheet, and 24 Hour Report. Oddly, one of the intentions of the MDS and NCP has been to specifically guide care. Perhaps the nurse respondents were removed from the assessment and planning activities the MDS and NCP were first designed to elicit.

Artistic tools were the Nurse Experts and Personal Worksheet. The Nurse Experts were problem solvers, adaptable to many situations. The Personal Worksheet was usually free-form and also adaptable to multiple data collection needs. Again, those tools seen as not artistic were the MDS, ADL Sheet, 24 Hour Report and the MAR. Only the MAR retained its value as usable, indicated by the total usability factor sum (see Table 5). Lucid tools (reverse scoring for Thick) were the Bedside Care Sheet, Nurses Drug Reference, Physician Call Sheet, 24 Hour Report, ADL Sheet, and the MAR. Thick, unwieldy tools were the MDS, NCP, and Resident's Chart. The Personal Worksheet, MAR, and Nurses Drug Reference stood out positively on two factors each.

Evidently, the nursing care task or situation will differentiate between an MAR, seen as guiding and lucid and an MAR that was not artistic. Perhaps its very sound, unalterable nature was part of its value as a guiding tool. The Resident's Chart also offered guidance but with the difficulty of thickness. Its comprehensive nature offered nurses the opportunity to validate resident care activities yet made the Resident's Chart difficult to search and scan.

Recommendations for the Design of Information Tools

There is plenty of information to track in long term care but much of the information handling that nurses do is for someone else. Data are copied, summarized, and validated for administrators, physicians, and regulators. Indeed much of the MDS are data that the Resident Care Manager (RCM) pulls from other sources so that it can be viewed in one place (see Figure 3). For instance, the National Drug Code is requested for every medication. This is simply a process of looking up data in another index and transcribing it to the MDS sheet. A few of the interviewees rightly question the accuracy of data collected for someone else or copied in multiple locations. Recopied data and summated data activities are prime indicators of the need for data automation. Nursing data users other than nurses must define their differing data report needs and must find a way to meet those needs without getting in the way of the resident-focused care that nurses desire. Data then collected in the process of nursing care can be queried to meet the needs of quality assurance, financial management, and medical practice.

This may also be true within nursing practice itself. We have compartmentalized our practice to meet varying needs. Nursing in long term care is not exactly one thing. The responsibilities and activities of the charge nurse are quite different from those of the medication nurse or the resident care manager. The nursing practice role will also differentiate usability and information tool design.

The nature of clinical nursing information, its placement, flow, and form, also arises in this study. Information tools were found in the resident's room, on the movable medication cart, at the nurses station, and physically with the nurse. The farther a tool was placed from the resident, the more likely it contained task or summated organizational data. The tools that said the most about the resident in a quick and simple way, as a person, were the Bedside Care Sheet and the ADL Sheet located the resident's room. These were tools that helped the nursing staff " get to know" the resident, thumbnail sketches of required daily care and resident preferences. The tools with aggregated resident summaries or task lists were the 24 Hour Record and Physician Call Sheet found at the nurses station. Although the Bedside Care Sheet and ADL Sheet were consulted less frequently than other tools, and did not directly guide care, the thumbnail sketch format could be used to develop a trended view. A trended Bedside Care Sheet could be designed as the end-point of the MDS assessment and possibly useful in answering one of the most frequent decision making problems namely, " is this a real change in the resident?" Resident sketches are very important for safe care if there is a greater use of temporary nursing personnel.

Examining the information flow diagram shows that data from the MDS may indeed be reaching the Bedside Care Sheet but only informally through the RCM. In fact, the information dead-end from the RCM through the MDS, RAP (Resident Assessment Protocol), and NCP is worrisome. Of course, this same information will be brought to care conferences and relayed through other more informal verbal communications. But it would be helpful for the advancement of nursing care knowledge if the information impact could be traced and studied.

Information tools as memory aides are also evident among the tools assessed here. That which works best is of the nurse's own design, specifically the Personal Worksheet. In some sense, the Personal Worksheet is not much more than a "Things to Do" list and free-form notepad. This is an aspect of nursing and its frequent interruptions that will no doubt remain unchanged in the future. Personal ToDo lists may already be in their best form. But the MAR is also a potentially powerful memory and information tool.

The MAR was used beyond its purpose as a schedule and record for medications. It was also used as a memory aide and recording tool for any task with a regular schedule or critical event. Due to the graphical design, the MAR offers an "at a glance" view of what is needed and what has been done. However, nurses are attempting to crowd a great deal of information into a space often less than ½ centimeter square. A zoom feature may be what is required of task management using the MAR. From a distant perspective, tasks missed or soon due could be visually identified. Then, in an enlarged view, the specific task data would be available and readable.

<u>How would the SD tool be used in information system design?</u>

Most clinical information systems are not designed for single facilities. This is too costly for both the vendor and purchaser. Therefore the SD questionnaire is not envisioned as a tool to be administered for each proposed installation. It can be used in requirements gathering and within prototyping, as a background to product development.

Participatory design techniques invite user collaboration but the "how to" in participatory design is still under investigation (see Kjaer, & Madsen, 1995, for research using exceptional work scenarios with users; Timpka, & Johansson, 1994, for action design in clinical information systems; Beyer, & Holtzblatt, 1995, for apprenticing with customers; Sachs, 1995, for defining a community of practice, reflection and making organizational needs explicit). With additional research the SD could be a valuable tool accompanying an assessment of organizational climate and goals. Requirements analysis is part of the linear design process but should not be abandoned while using participatory and prototyping design methods. Practice-based usability content can then be the starting point for participatory reflection and system design.

With the assessment this SD has provided, a conscious effort at designing resident-focused care into nursing information tools is also possible. A requirements analysis might discover the usability and organizational needs evident within the baseline paper-based information tools. The semantic space circumscribed by the tools in use could initiate a discussion of organizational goals. Information and communication system design become tools of organizational development, as they surely will impinge on organizational functioning. For example, starting with the usability semantic space defined by the tools in use, iterative prototyping exercises could concentrate on moving tool design toward a stated goal of a client-centered focus. Repeated measures of usability, targeting practice goals, could then be added to the usual design assessments for system functionality.

Significance for Nursing

Why be concerned with usability at all? Just as a well designed hammer will improve construction—speeding the framing of a wall, decreasing the number of bent nails, and diminishing user fatigue—well designed nursing information tools will advance patient care, improve patient safety, and increase the nurse's efficiency and level of satisfaction. Anything information activity, and there are many in nursing, can potentially be improved through increased information tool usability.

Information requirements gathering and analysis certainly must become a research concentration in nursing informatics. If the power of implicit organizational or professional goals is amplified by information system design, then nursing is obligated to better understand information needs assessment and design. While an emphasis on human cognition and a generalized "intuitiveness" have affected system design decisions throughout computer system design, this approach is not sufficient for nursing. Information tools that are usable in nursing practice must fit within both the physical and cognitive flows of practice, within the environment of care, and must support required information flows for both resident care and management decision making. Nursing information tools must also be designed with an overt goal statement. A requirements analysis is necessary. The SD instrument developed in this study supports this requirements gathering obligation.

Recommendations for Further Research

The SD instrument should be employed with other information tools in the long term care nursing environment as well as in other nursing environments to increase the scope and understanding of usability. An accompanying exercise assessing administrative goals would help interpretation. Or, if information system design is truly to be participatory, perhaps the results of a tool survey using the SD can be used to assist in designing nursing practice to meet collaborative goals. Introduction and testing in a prototyping exercise is also necessary.

The varying information needs of special roles in long-term care nursing practice also require further research. It is apparent from this study that the data used by RCMs, lead nurses, medication nurses, and directors of nursing are quite different in form, content, and locale.

Electronic data systems, especially systems accessible from remotely located sites, will have an impact on the entire telephone contact process with physicians. No longer will the lead nurse be charged with managing telephone messages and consultations. An examination of the reason for calls, recorded on the Physician Call Sheet, is additionally worthwhile. Telehealth applications might wisely target a number of the care situations documented with this tool. More broadly, assumptions about multidisciplinary practice situations deserve a careful examination as multidisciplinary care and the term itself is poorly understood.

Summary

A requirements analysis is a powerful exercise necessary before any new information system design is attempted. While some requirements analysis activities such as task analysis are well understood, discerning the needs of nursing information system users is more difficult. User information needs will be couched within the demands of their work, their environment, and their experience. Usability will define an information system designed not only to meet information needs but also to easily mesh into and support work functions, including the functions of decision making.

Nursing information systems and tools are no different. Nursing practice in long-term care demands data collection and information retrieval tools that support practice while not getting in the way—interrupting the flow and focus of the nurse. The paper and pen based information tools currently used in long-term care practice have been honed by the needs of the resident, the nurse, and the facility. These historical information tools deserve inspection, defining a baseline of usability that can be used developmentally in information system design. A semantic differential, planned with nursing information usability in mind, has the ability to reveal usability in the long-term care practice environment. Once defined, the semantic differential and the understanding of usability may be used in participatory and iterative information system design for nursing practice.

Nursing information systems however will powerfully reflect the goals of healthcare organizations. Organizational goals may not be expressed explicitly but are apparent when assessing usability in nursing's information tools. Nursing efforts may also be ineffectively spent meeting the organizational productivity goal rather than individualized resident care. Usability assessments cannot be performed without running into this goal inherent in practice realities. Beyond productivity, nurses express usability requirements of simplicity, nursing practice expression, portability, client-centered views, and the need to meet regulatory constrictions. The requirements analysis process and semantic differential usability instrument have the potential to inform information system design in a prototyping process. This process will however only follow the explicit or implicit goals of nursing care.

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Section 2.

Second Paper Figures

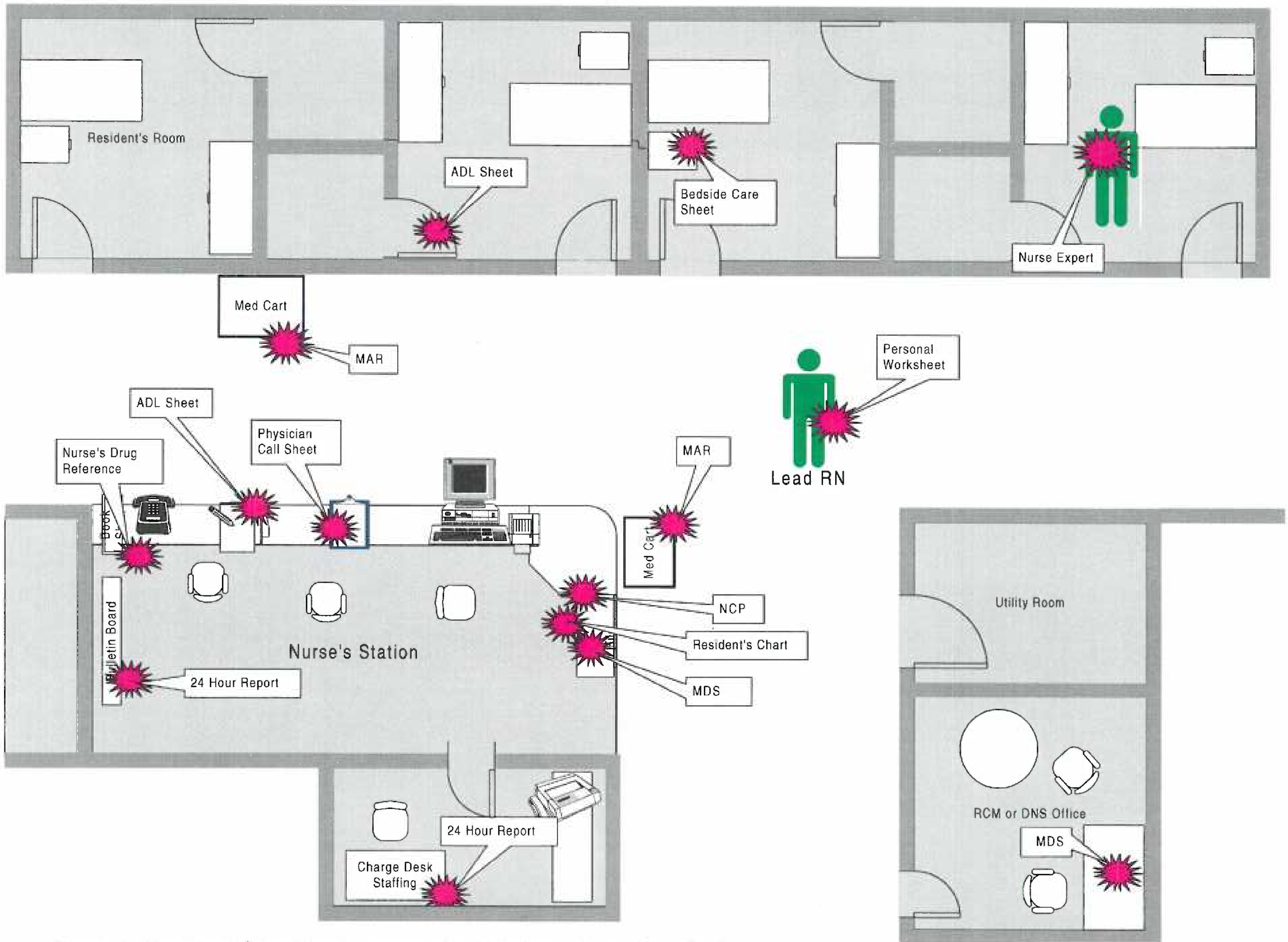


Figure 2. Resident Care Ward Layout with Nursing Information Tools

Figure 3. Information Flow Among Observed Information Tools and Care Providers in the LTC Setting

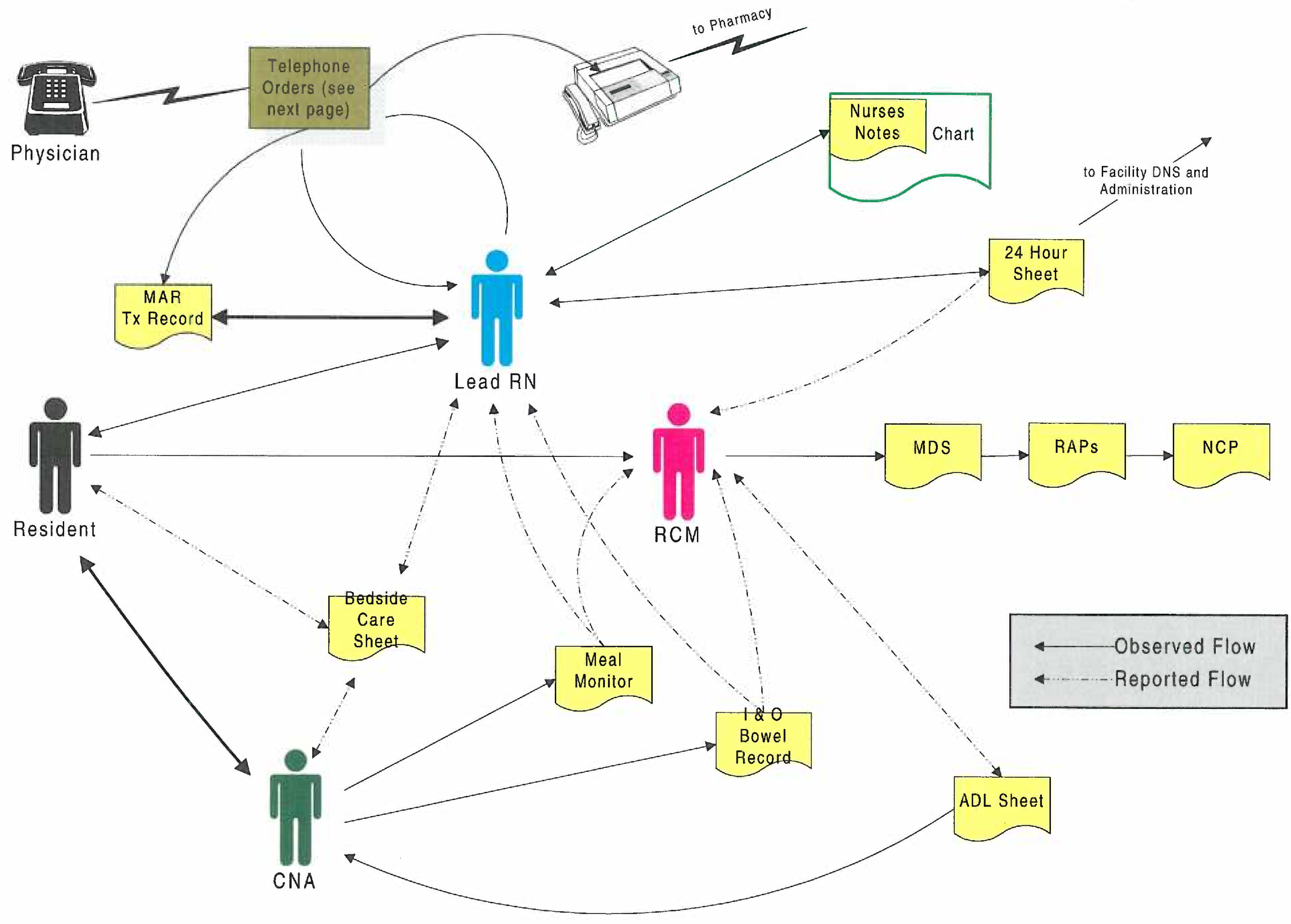


Figure 4. Telephone Orders Process

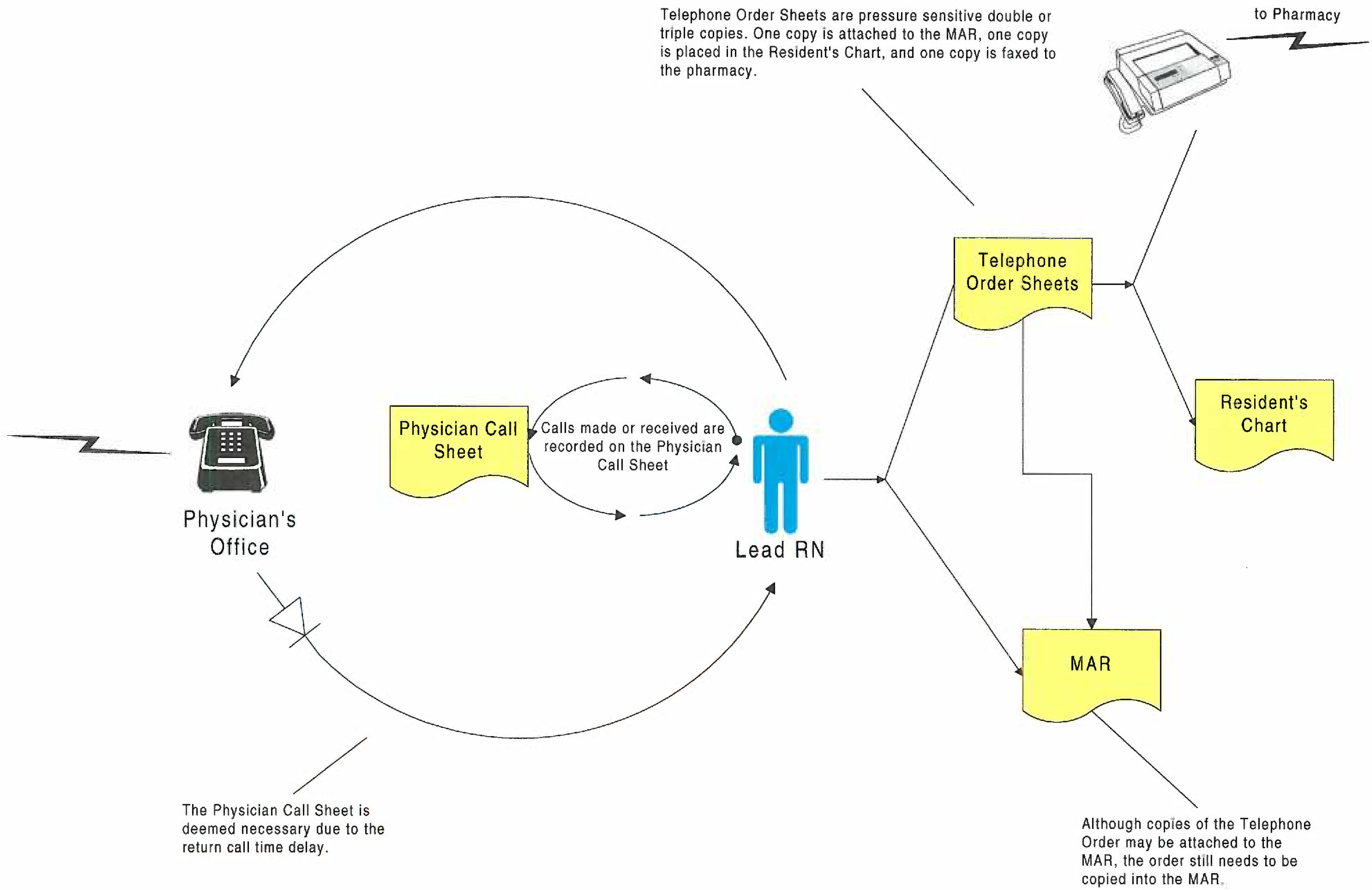
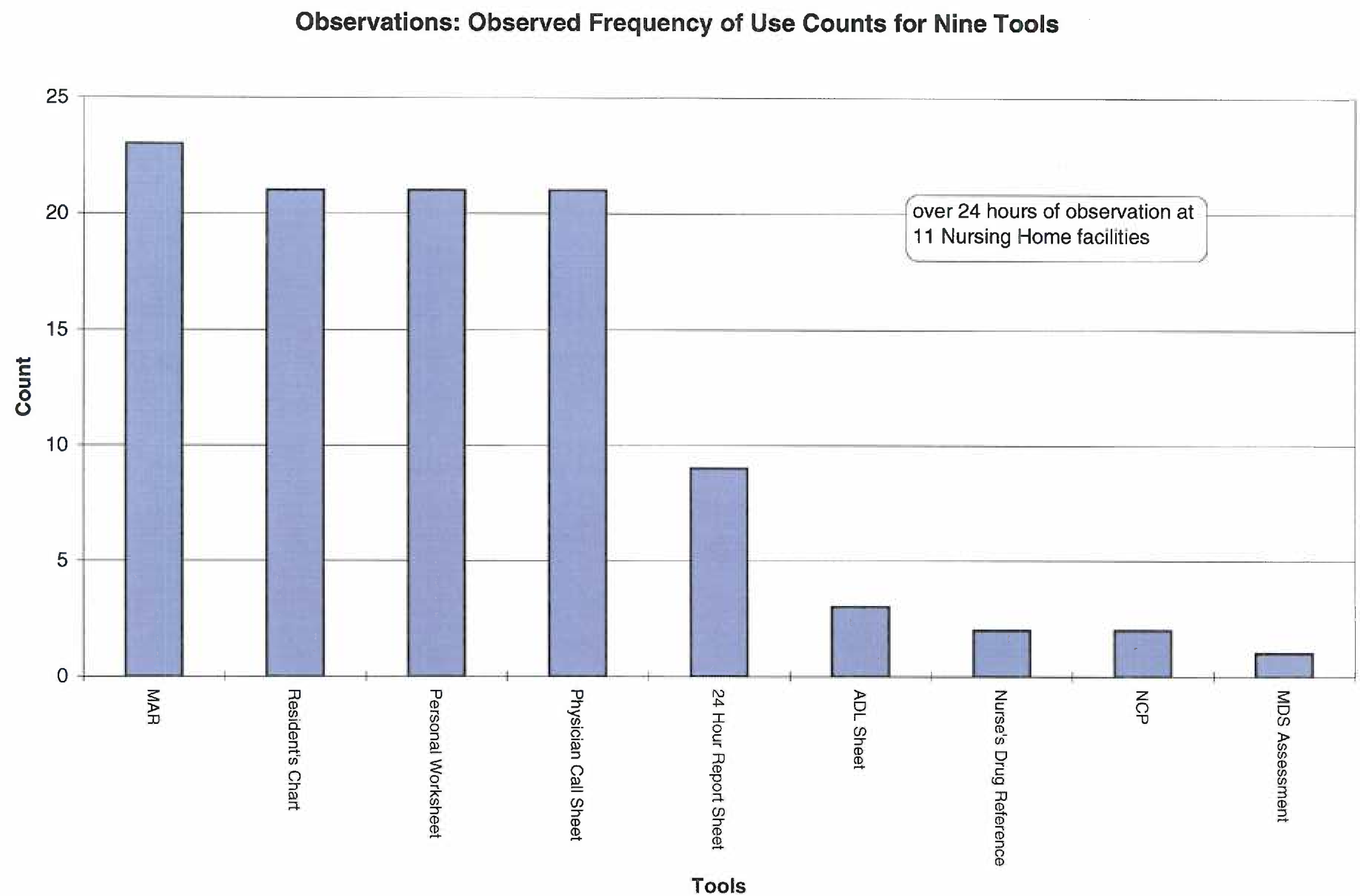
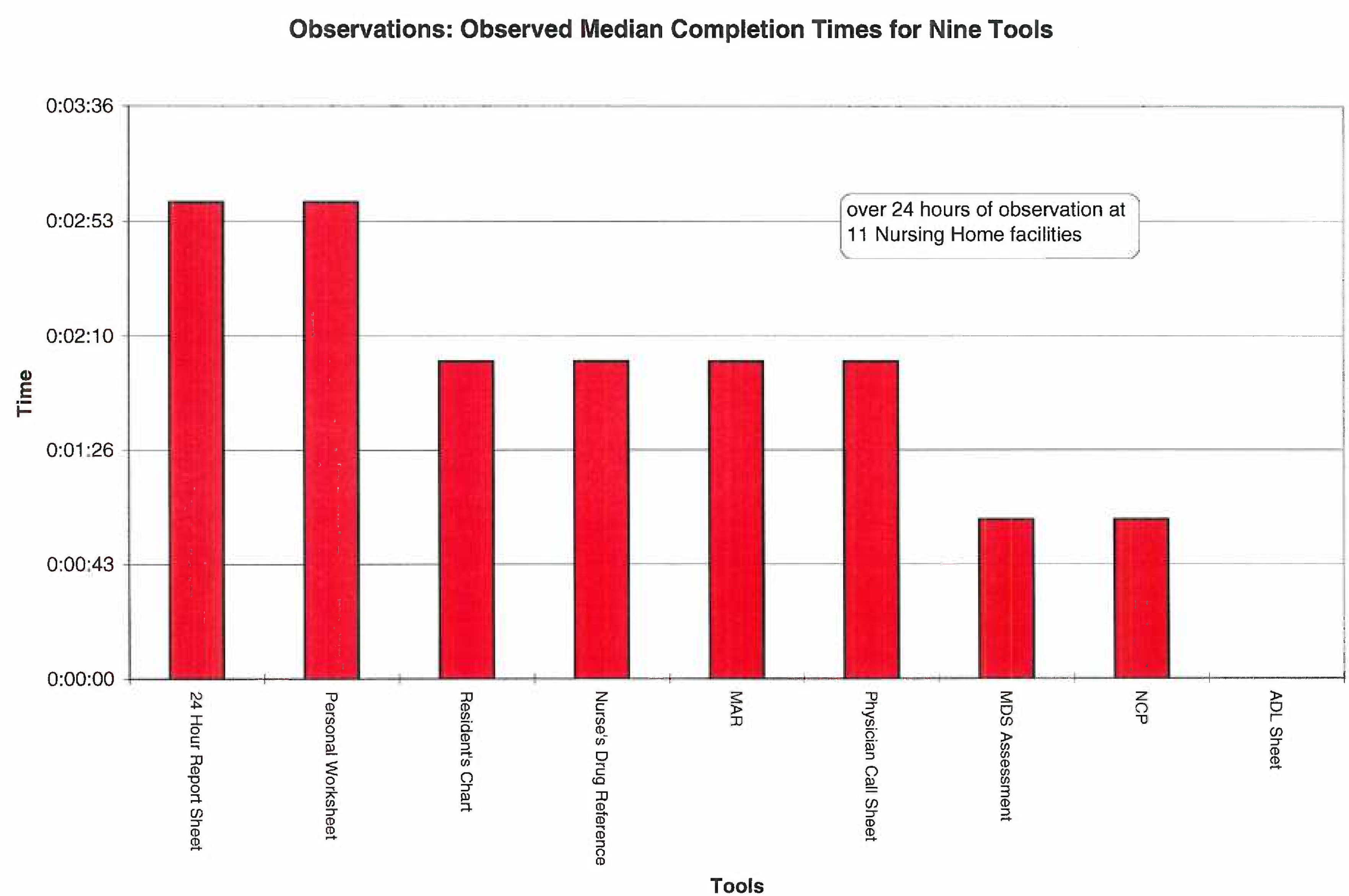


Figure 5.



Observations: Observed Frequency of Use Counts for Nine Tools
over 24 hours of observation at
11 Nursing Home facilities
Count
25
20
15
10
5
0
MAR
Resident's Chart
Personal Worksheet
Physician Call Sheet
24 Hour Report Sheet
ADL Sheet
Nurse's Drug Reference
NCP
MDS Assessment
Tools

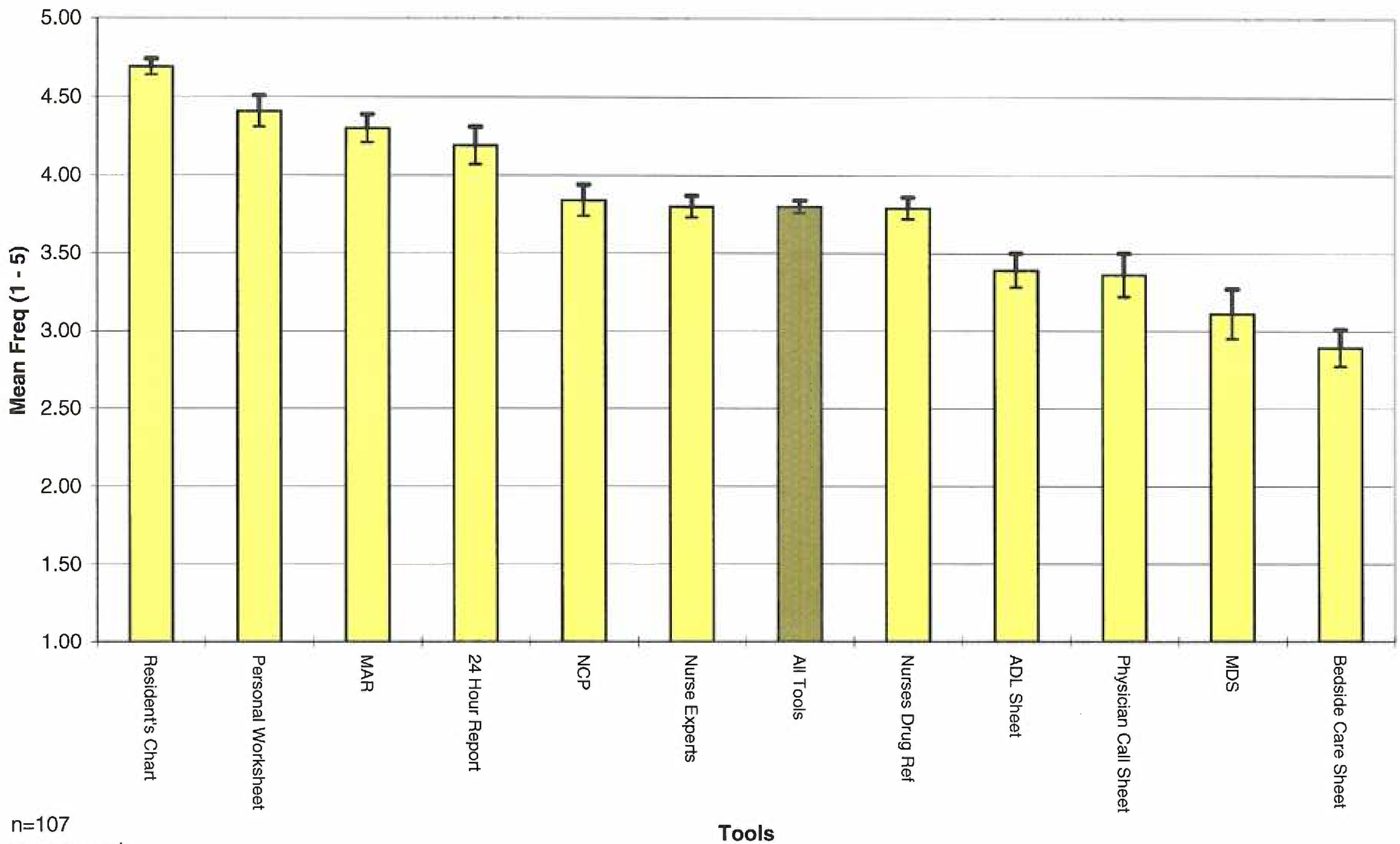
Figure 6.



Observations: Observed Median Completion Times for Nine Tools
over 24 hours of observation at
11 Nursing Home facilities
Time
0:03:36
0:02:53
0:02:10
0:01:26
0:00:43
0:00:00
24 Hour Report Sheet
Personal Worksheet
Resident's Chart
Nurse's Drug Reference
MAR
Physician Call Sheet
MDS Assessment
NCP
ADL Sheet
Tools

Figure 7.

SD: Mean Reported Frequency of Tool Use from the SD Questionnaire



n=107
spss-sum.xls

Figure 8.

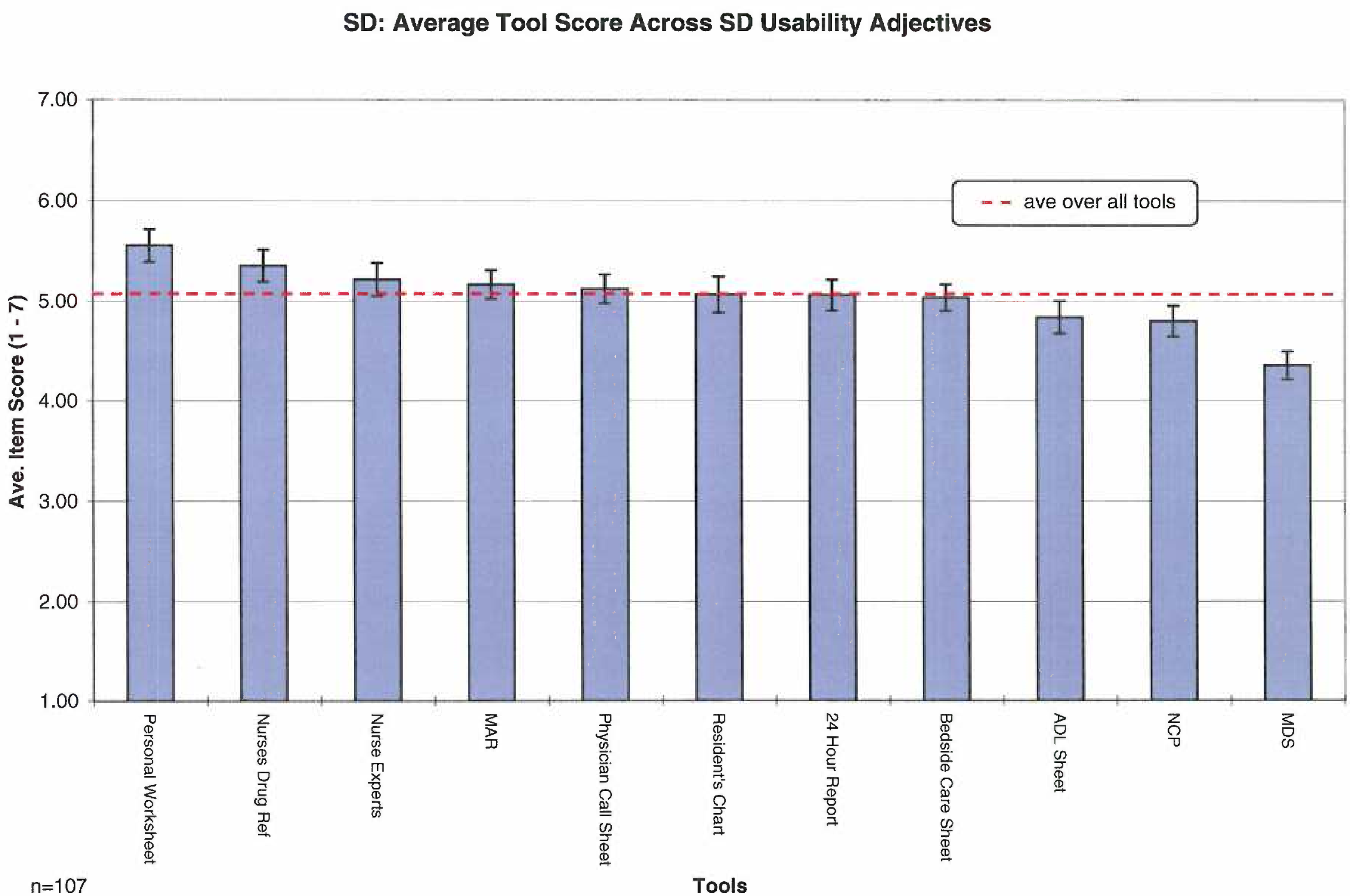
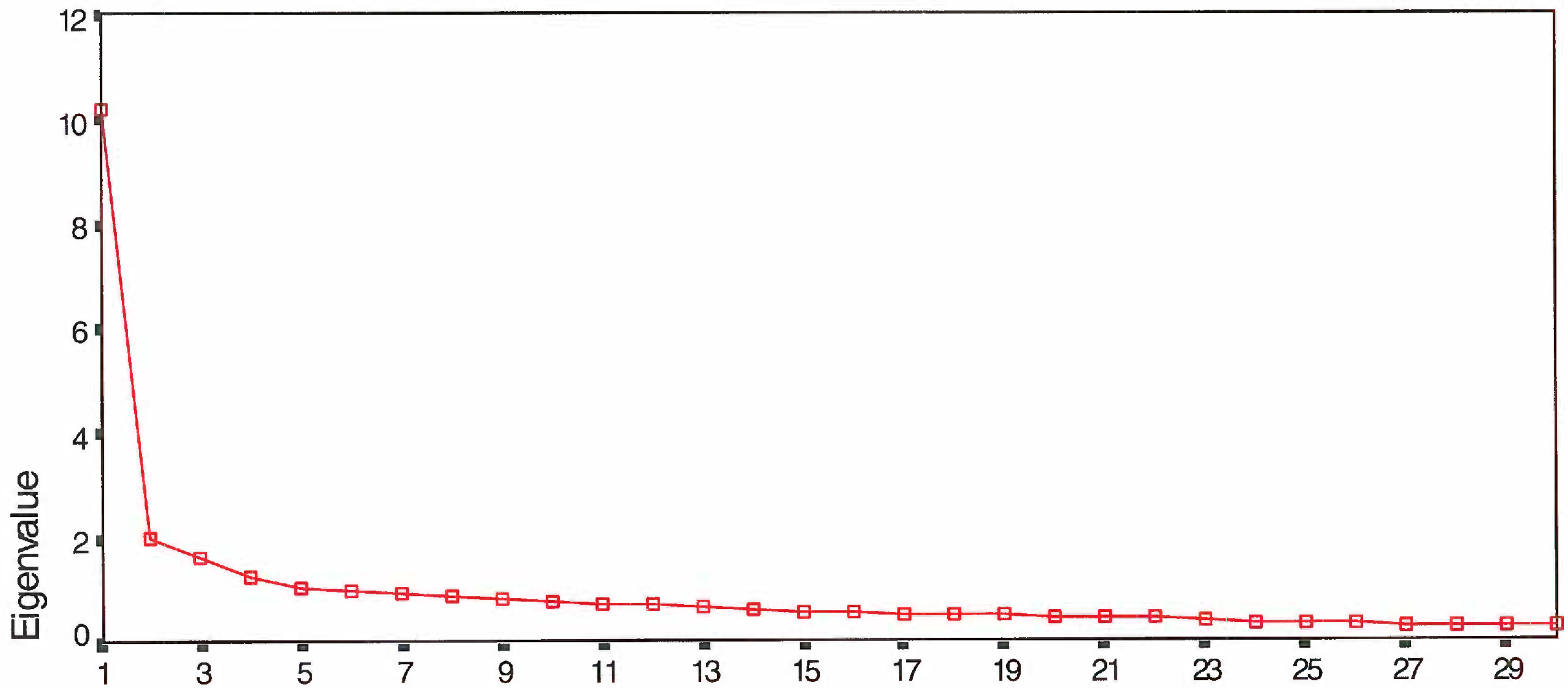

SD: Average Tool Score Across SD Usability Adjectives
ave over all tools
Ave. Item Score (1 - 7)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
Personal Worksheet
Nurses Drug Ref
Nurse Experts
MAR
Physician Call Sheet
Resident's Chart
24 Hour Report
Bedside Care Sheet
ADL Sheet
NCP
MDS
n=107
Tools

Figure 9. Factor Scree Plot

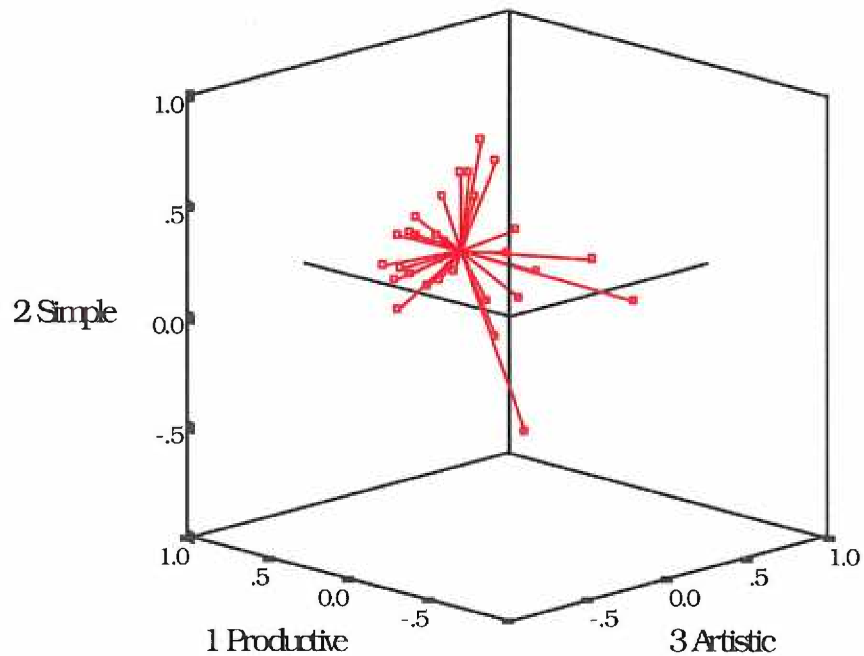
Freq of Use > never



n=96; screnevr.cht

Figure 10. Factor Plot Varimax Rotation

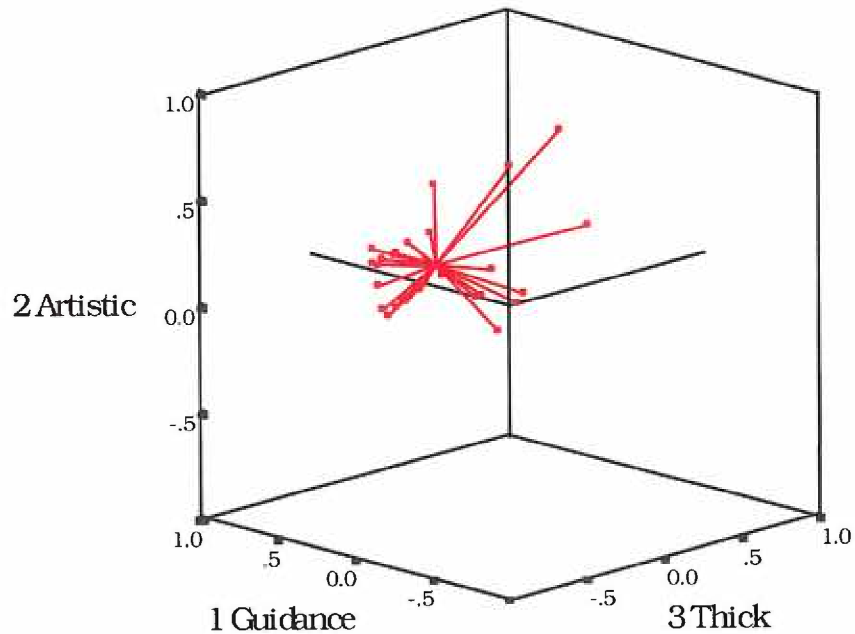
Factors 1, 2, 3 (Freq of Use > never)



n=96; vmaxnevr.cht

Figure 11. Factor Plot Oblique Rotation

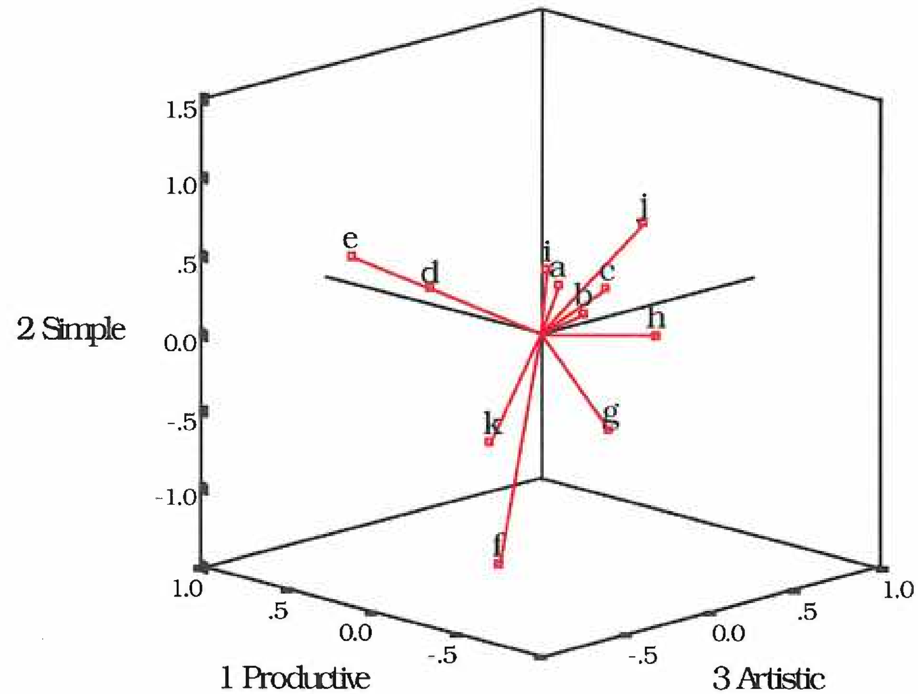
Factors 1, 2, 3; (Freq of Use > never)



n=96; oblinevr.cht

Figure 12. Information Tools in Varimax Rotation

Freq of Use > never

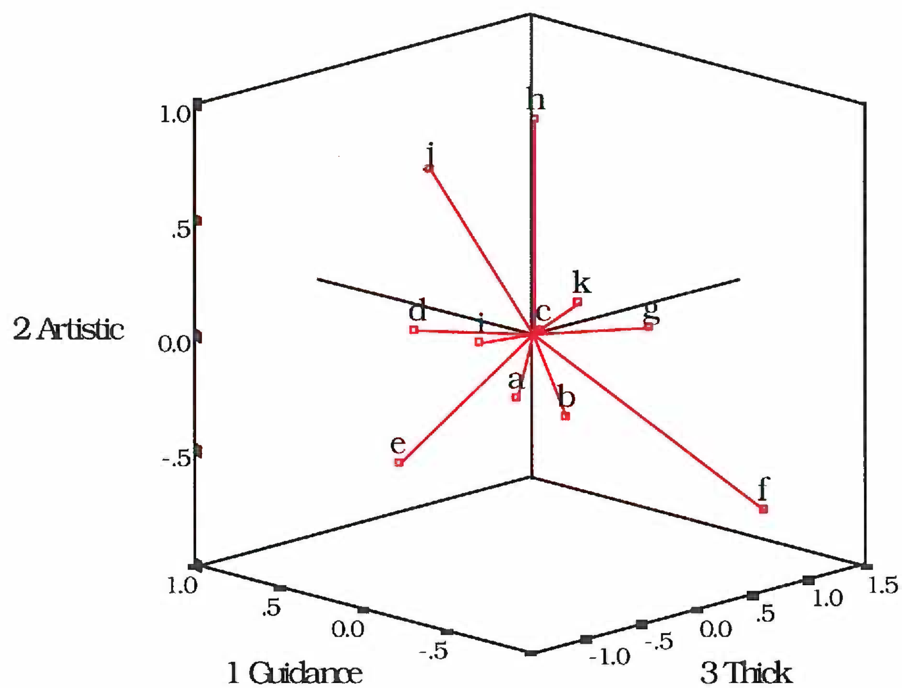


a	24 Hour Report
b	ADL Sheet
c	Bedside Care Sheet
d	Nurse's Drug Reference
e	MAR
f	MDS
g	NCP
h	Nurse Experts
i	Physician Call Sheet
j	Personal Worksheet
k	Resident's Chart

n=96; tlvmnevr.cht

Figure 13. Information Tools in Oblique Rotation

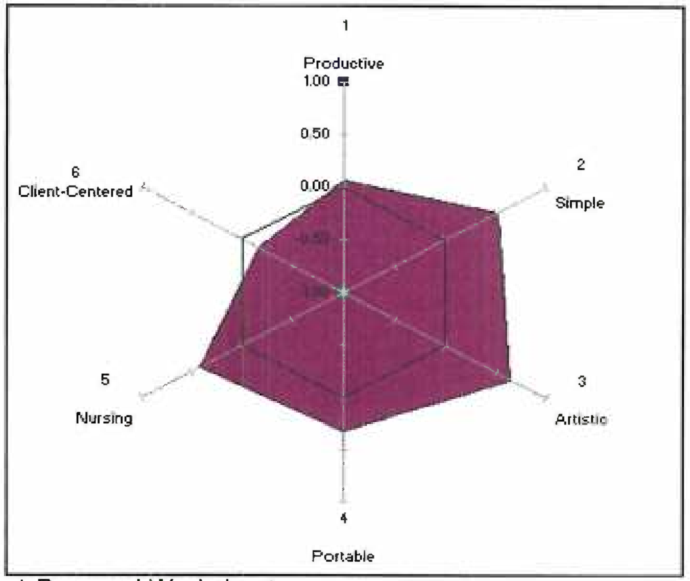
Freq of Use > never



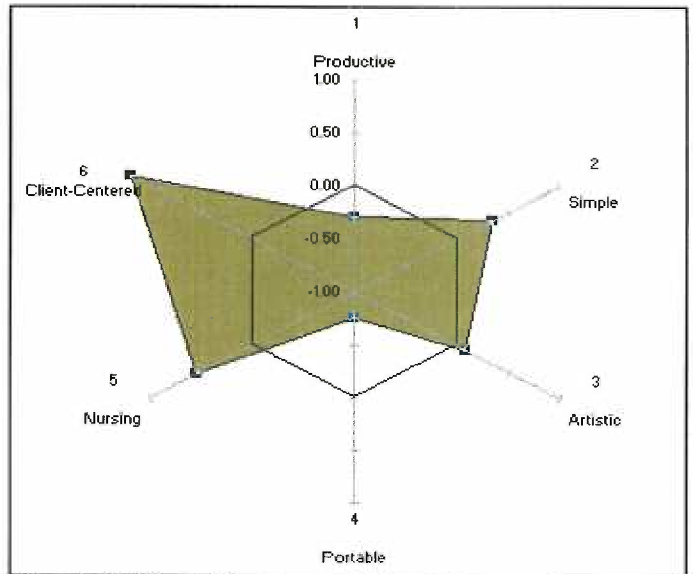
a 24 Hour Report
b ADL Sheet
c Bedside Care Sheet
d Nurse's Drug Reference
e MAR
f MDS
g NCP
h Nurse Experts
i Physician Call Sheet
j Personal Worksheet
k Resident's Chart

n=96; tlobnevr.cht

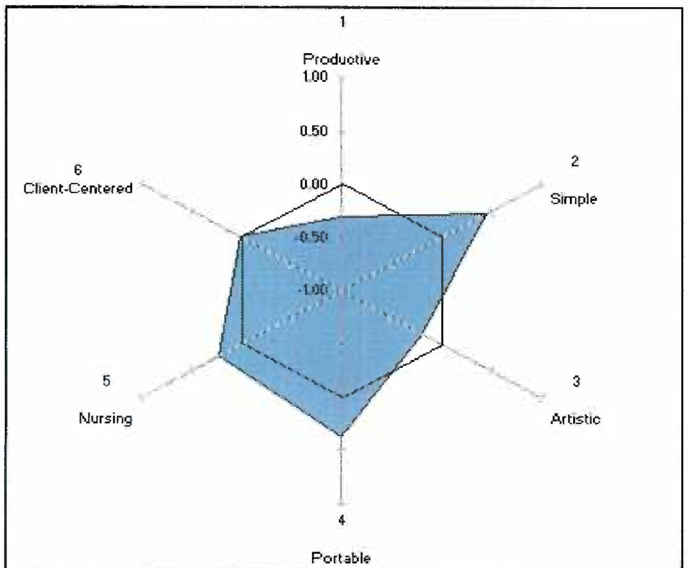
Figure 14. Nursing Information Tools on the Varimax Factors (freq > never)



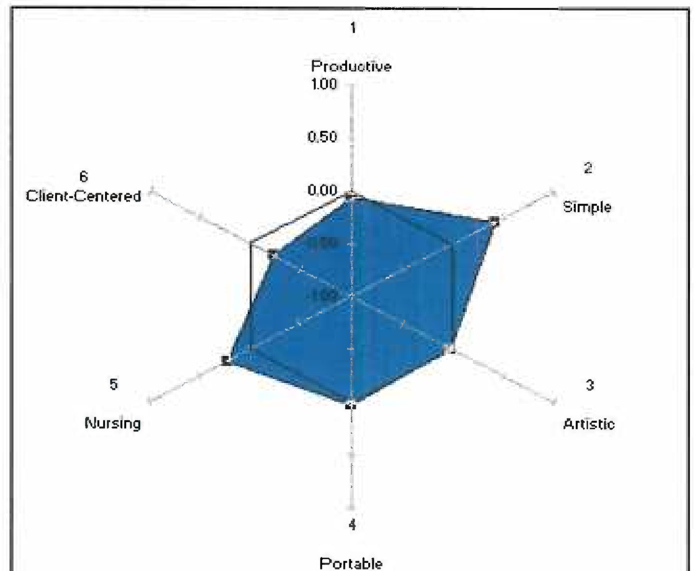
1 Personal Worksheet



2 Bedside Care Sheet

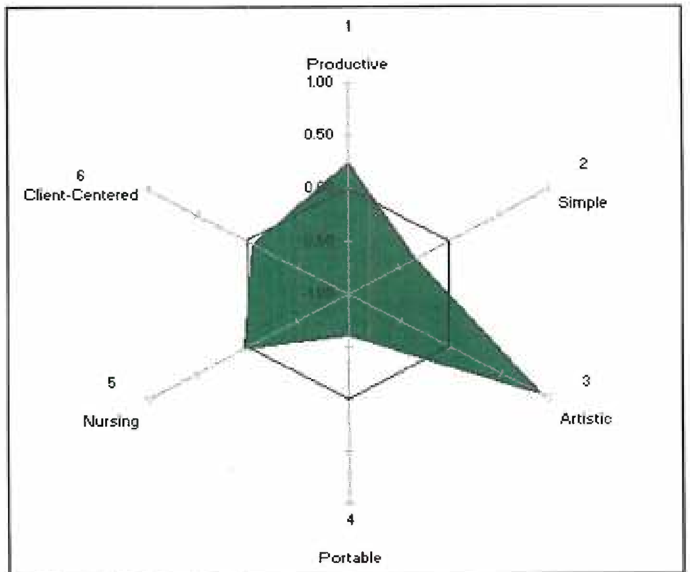


3 - 24 Hour Report

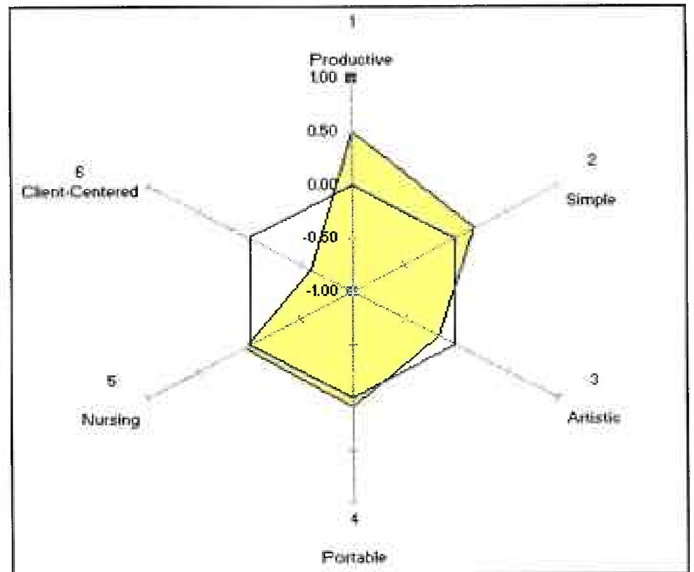


4 Physician Call Sheet

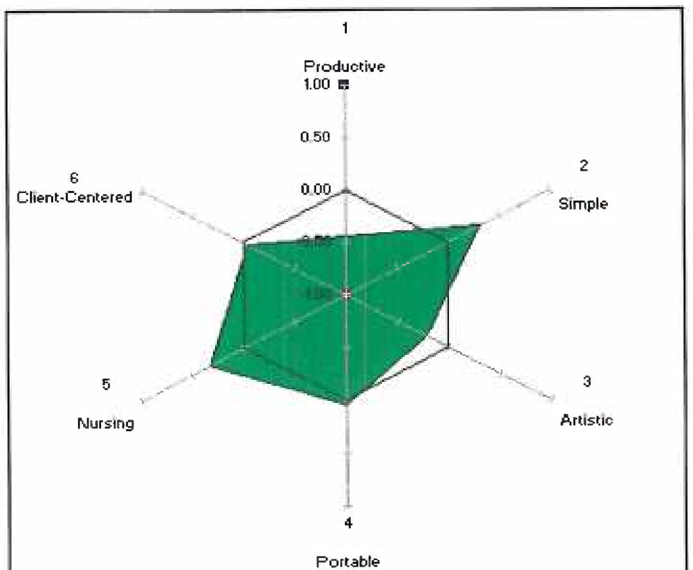
Figure 14. Nursing Information Tools on the Varimax Factors (freq > never)



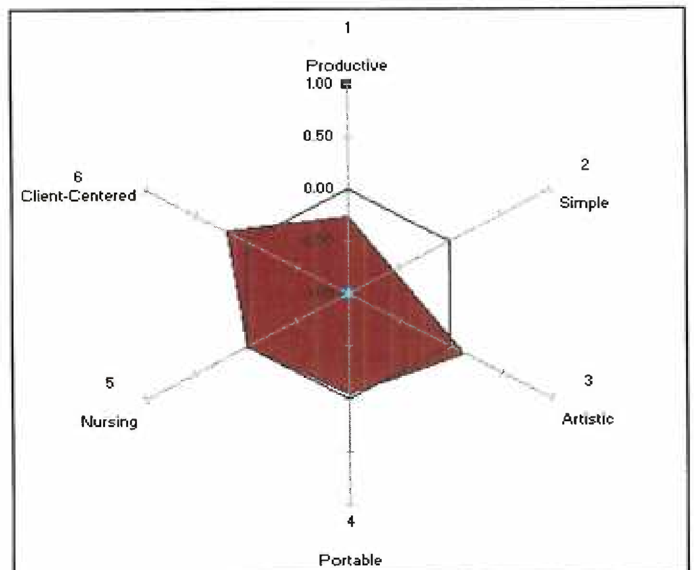
5 Nurse Experts



6 Nurse's Drug Reference

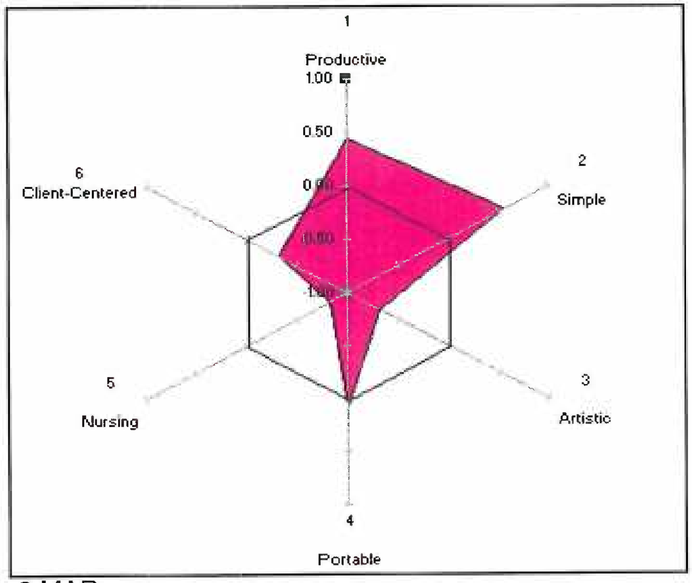


7 ADL Sheet

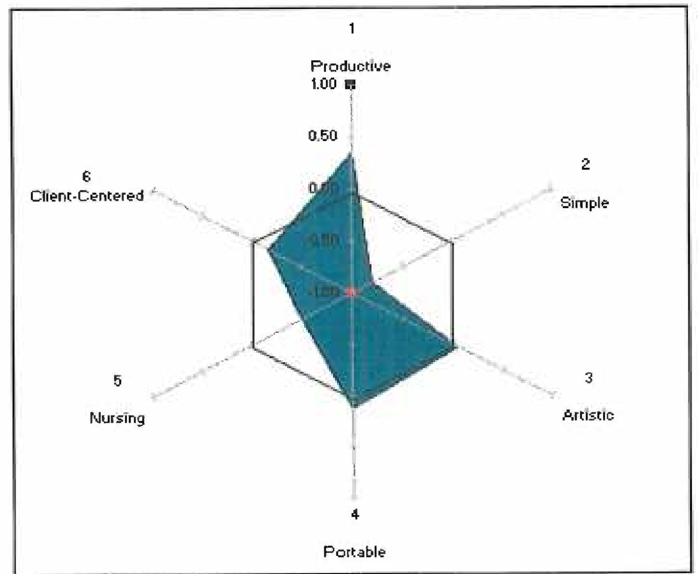


8 NCP

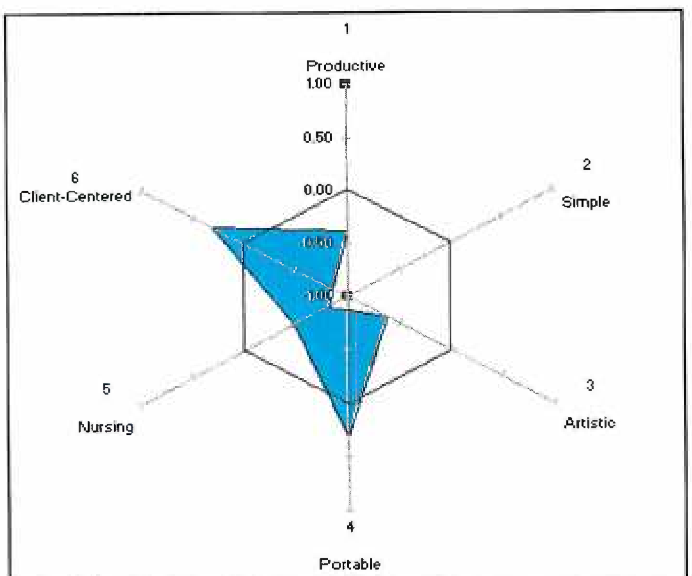
Figure 14. Nursing Information Tools on the Varimax Factors (freq > never)



9 MAR

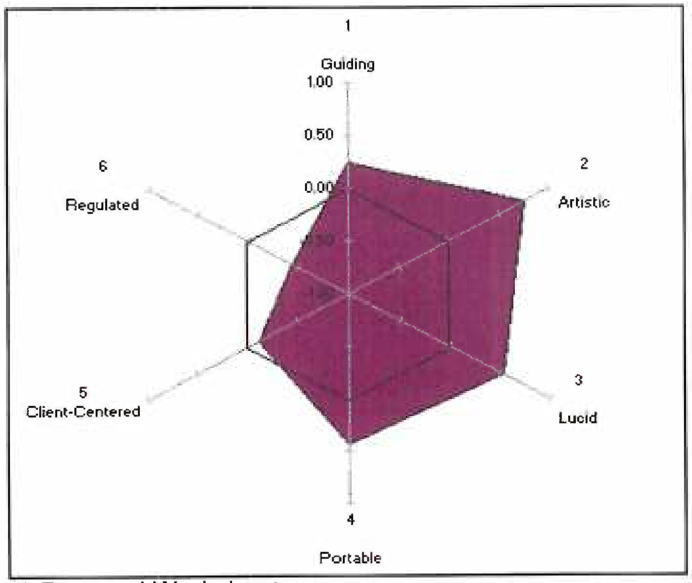


10 Resident's Chart

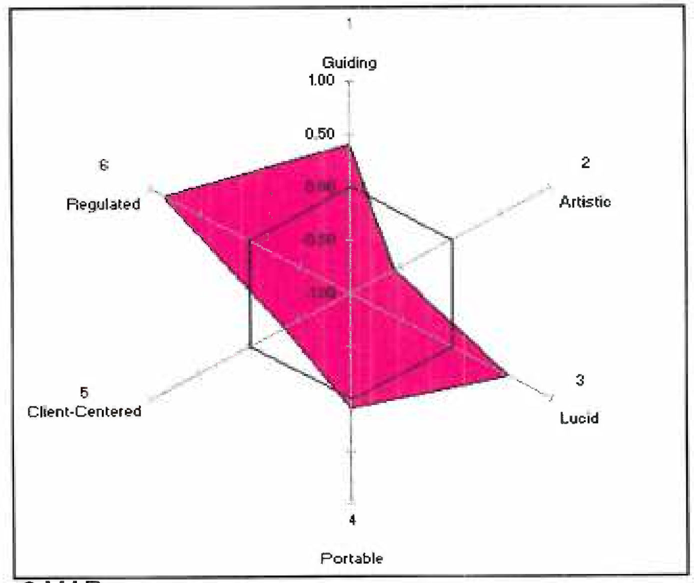


11 MDS

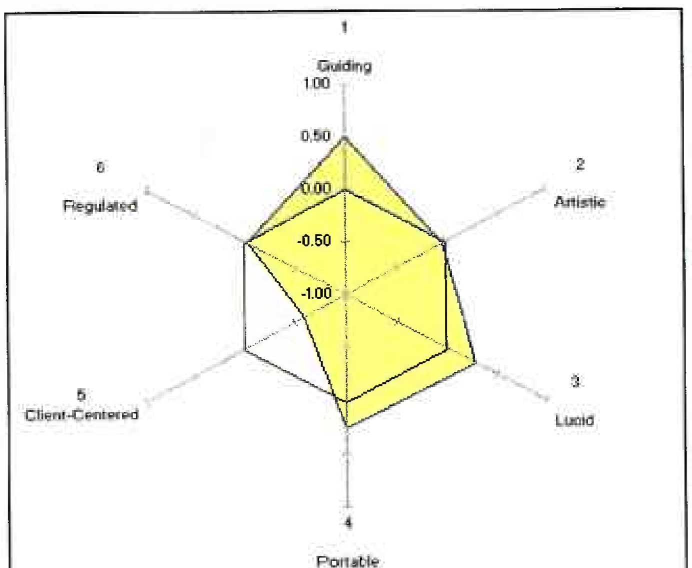
Figure 15. Nursing Information Tools on the Oblique Factors (freq > never)



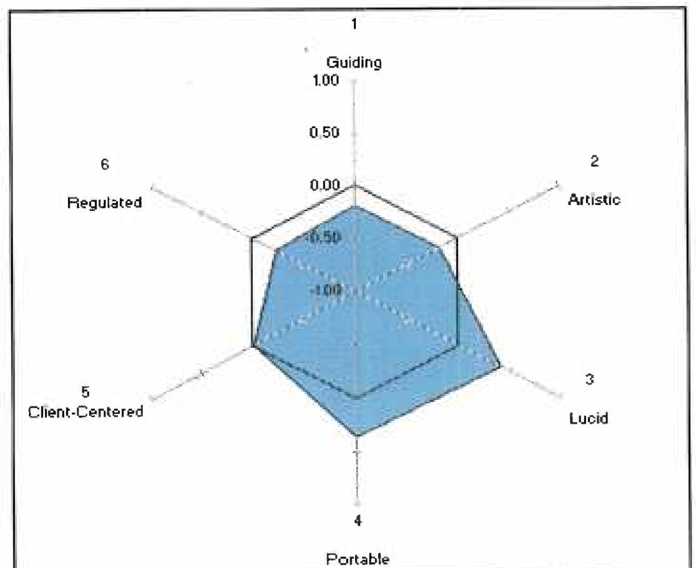
1 Personal Worksheet



2 MAR

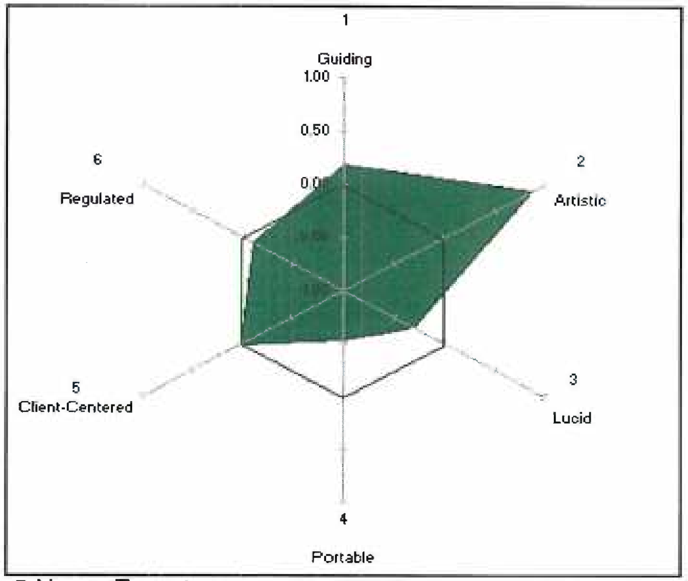


3 Nurse's Drug Reference

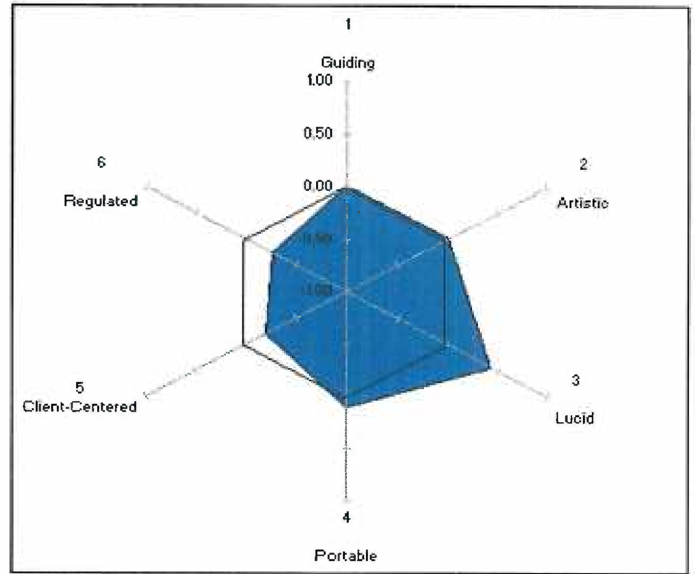


4 - 24 Hour Report

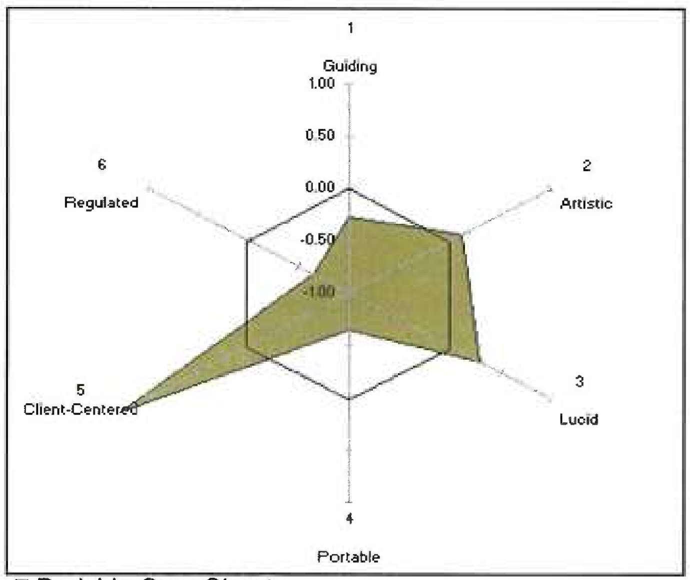
Figure 15. Nursing Information Tools on the Oblique Factors (freq > never)



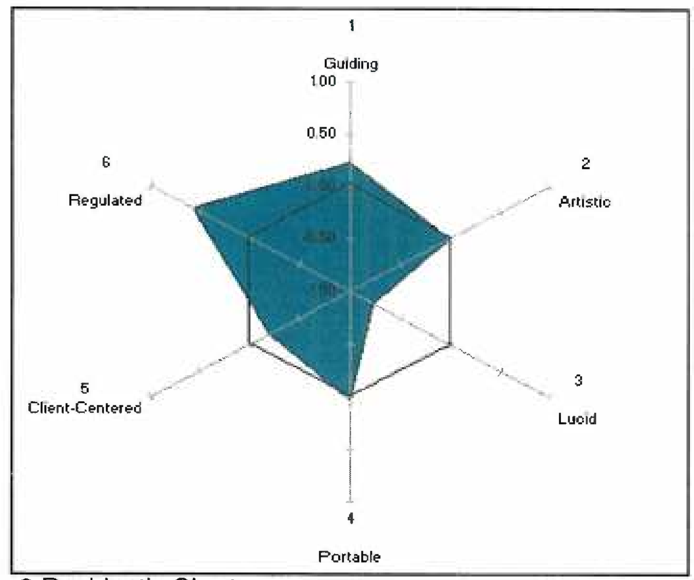
5 Nurse Experts



6 Physician Call Sheet

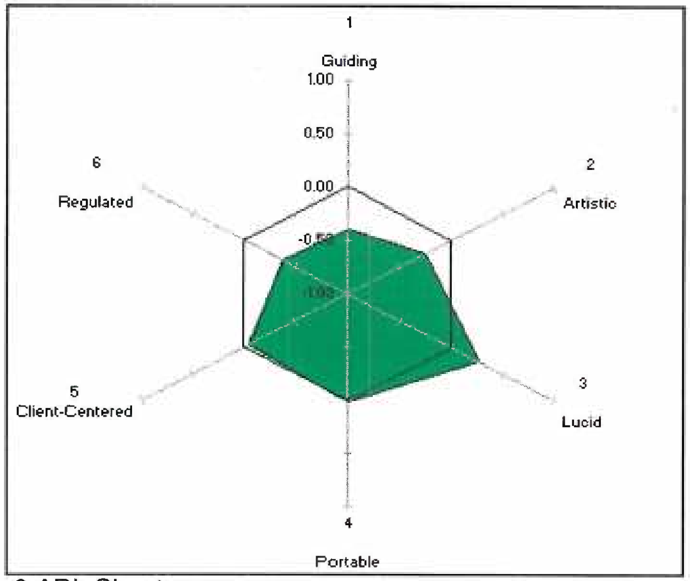


7 Bedside Care Sheet

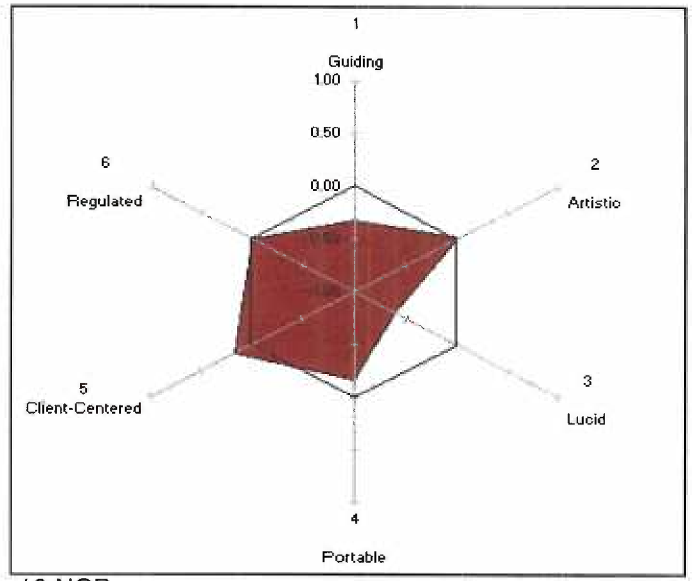


8 Resident's Chart

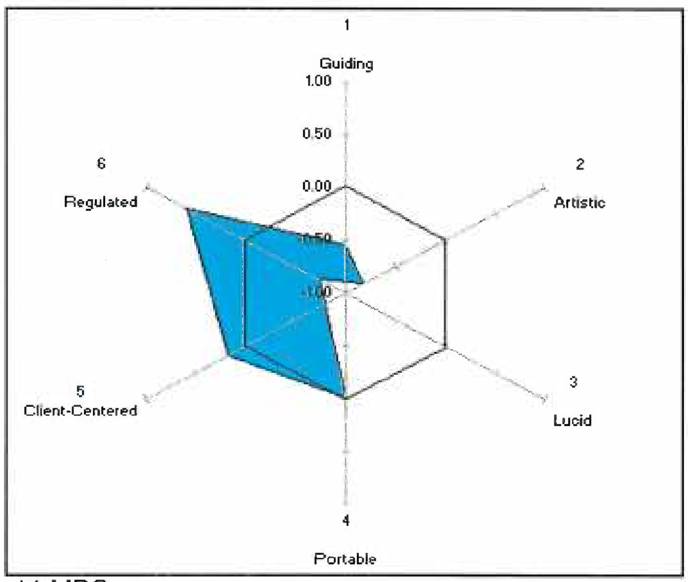
Figure 15. Nursing Information Tools on the Oblique Factors (freq > never)



9 ADL Sheet



10 NCP



11 MDS

Section 2.

Second Paper Tables

Table 1. Semantic Differential Term List

Pilot Study terms highlighted

	HCI source	Positive	Negative	comment
1	pilot SD	Reliable	Inconsistent	error prone
2	"	Manageable	Cumbersome	
3	"	Practical	Abstract	Theoretical
4	"	Accurate	Inaccurate	
5	"	Current	Dated	
6	"	Available	Unavailable	
7	"	Speedy	Time Consuming	
8	"	Essential	Busy Work	
9	"	Concise	Wordy	
10	"	At Bedside	Elsewhere	
11	"	Vital	Superfluous	
12	"	Definitive	Vague	
13	Gould & Lewis	Easy to Learn	Hard to Learn	
14	"	Easy to Remember	Hard to Remember	
15	"	Useful	Useless	might replace Vital; see Ess
16	"	Functional		
17	"	Pleasant	Intolerable	
18	"	Easy to Use	Difficult	might replace Manageable
19	"	Tolerable	Intolerable	
20	"	Effortless	Difficult	
21	Foss & DeRidder	Creative	Conventional	
22	"	Inexpensive	Costly	
23	"	Fast	Slow	
24	"	Easy to Learn	Difficult to Learn	
25	"	Satisfying	Frustrating	
26	"	Faultless	Error Prone	
27	Rust & Golombok	Constructive	Obstructive	
28	"	Helpful	Hindrance	
29	"	Skillful	Clumsy	
30	"	Simple	Confusing	
31	"	Powerful	Weak	
32	"	Saves Time	Wastes Time	
33	"	Exact	Vague	
34	Scapin	Compatible	Incompatible	
35	Lanzara & Mathiassen	Accurate	Inaccurate	
36	"	Understandable	Incoherent	
37	"	Complete	Incomplete	
38	"	Functional		
39	"	Organizing	Disrupting	
40	"	Constructive	Disruptive	see guiding; diagnostic; pro
41	"	Problem-Solving	Inert; Sluggish	
42	"	Deciding	Indefinite	see Diagnostic
43	"	Interactive	Passive	
44	Other	Predictive	Indefinite	see Diagnostic

45	"	Informative	Concealing	
46	"	Goal Oriented	Random	
47	"	Outcome Oriented	Regulation Oriented	
48	Woolf & Bensen	Convenient	Inconvenient	
49	"	Handy	Clumsy; Awkward	
50	"	Diagnostic	Uncertain	
51	"	Therapeutic	Injurous	
52	Shackel	Learnable	Complex	
53	"	Effective	Ineffective	
54	"		Frustrating	
55	"	Comfortable	Uncomfortable	
56	"	Convenient	Inconvenient	
57	"	Effortless	Difficult	
58	"	Stimulating	Tiresome	
59	"	Satisfying	Frustrating	
60	"	Effective	Ineffective	
61	"	Flexible	Rigid	
62	"	Comprehensive	Exclusive	
63	Arnold	Enjoyable	Wretched	
64	Miller & Sheridan	Patient-Focused	Task-Focused	
65	"	Primary Care	Team Care	
66	"	Single Discipline	Multidiscipline	
67	Browne et al.	Integrated	Isolated	
68	"	Present	Historical	
69	"	Changable	Constant	
70	"	Error Checking	Error Prone	
71	Norman	Strong	Weak	
72	"	Intelligent	Stupid	
73	"	Fast	Slow	
74	"	Protective	Neglectful	
75	"	Accurate	Faulty	
76	"	Cohesive	Disruptive	
77	"	Safe	Dangerous	
78	"	Appropriate	Inappropriate	
79	Meister	Assuring	Threatening	
80	"	Controllable	Uncontrollable	
81	"	Descriptive	Distorting; Abstract	
82	"	Consistent	Inconsistent	
83	"	Simple	Complex	
84	"	Resonable	Ridiculous	
85	McMaster & Ubitrex	Heavy	Lightweight	
86	"	Portable	Fixed	
87	Lowery & Martin	Logical	Illogical	
88	"	Guiding	Confusing	
89	"	Natural	Unnatural	

Table 2.

Tool Aggregate Name and Observation Data

shaded data indicates tool represented in the SD questionnaire

Aggregate Name	Count	Average Completion Time	Median Completion Time	Min Completion Time	Max Completion Time	SD of Completion Time
phone	36	02:25	01:00	00:00	0:34:00	0:05:47
MAR	23	20:23	02:00	00:00	2:45:00	0:40:36
chart	21	05:00	02:00	00:00	0:45:00	0:10:12
personal worksheet	21	30:57	03:00	00:00	8:30:00	1:50:16
physician call sheet	21	05:40	02:00	00:00	1:16:00	0:16:13
alert sheet	12	03:20	01:30	00:00	0:10:00	0:03:36
progress notes	11	03:22	03:00	01:00	0:08:00	0:02:09
physicians orders	10	03:42	01:30	00:00	0:14:00	0:04:47
24 hour report sheet	9	07:07	03:00	00:00	0:35:00	0:10:53
notepad	9	02:33	01:00	00:00	0:09:00	0:03:30
narcotic sheet	8	14:45	04:30	00:00	1:30:00	0:30:33
vital sign sheet	7	07:26	03:00	00:00	0:37:00	0:13:09
assignment sheet	6	03:30	00:30	00:00	0:12:00	0:05:12
telephone order form	6	03:00	01:00	00:00	0:12:00	0:04:31
calendar	5	< 1:00	00:00	00:00	0:00:00	0:00:00
communication book	5	03:48	04:00	00:00	0:09:00	0:03:54
recorder	5	09:36	06:00	04:00	0:18:00	0:06:04
treatment sheet	5	04:36	02:00	00:00	0:15:00	0:06:19
FAX	4	01:45	01:00	01:00	0:04:00	0:01:30
lab report	4	01:15	01:00	01:00	0:02:00	0:00:30
nurses notes	4	02:00	01:30	01:00	0:04:00	0:01:25
report worksheet	4	15:45	10:00	06:00	0:37:00	0:14:40
ADL sheet	3	01:20	00:00	00:00	0:04:00	0:02:19
admission assessmen	3	22:40	18:00	13:00	0:37:00	0:12:40
clinic referral	3	06:40	05:00	01:00	0:14:00	0:06:39
computer	3	02:20	02:00	01:00	0:04:00	0:01:32
face sheet	3	04:20	02:00	02:00	0:09:00	0:04:02
phone book	3	02:00	02:00	01:00	0:03:00	0:01:00
pink stat sheet	3	13:00	02:00	00:00	0:37:00	0:20:49
post-its	3	01:00	01:00	01:00	0:01:00	0:00:00
staff schedule	3	02:00	03:00	00:00	0:03:00	0:01:44
admission record	2	15:30	15:30	13:00	0:18:00	0:03:32
behavior sheet	2	01:30	01:30	01:00	0:02:00	0:00:42
drug reference guide	2	02:00	02:00	02:00	0:02:00	0:00:00
hospital chart	2	27:30	27:30	18:00	0:37:00	0:13:26
I&O sheet	2	00:30	00:30	00:00	0:01:00	0:00:42
incident report	2	04:30	04:30	01:00	0:08:00	0:04:57
interdept communicat	2	02:00	02:00	01:00	0:03:00	0:01:25
interdis prog note	2	03:00	03:00	01:00	0:05:00	0:02:50
level of care sheet	2	00:30	00:30	00:00	0:01:00	0:00:42

Table 2.

Aggregate Name	Count	Average Completion Time	Median Completion Time	Min Completion Time	Max Completion Time	SD of Completion Time
med bubble pack	2	1:23:00	1:23:00	1:16:00	1:30:00	0:09:54
med cards	2	04:30	04:30	02:00	0:07:00	0:03:32
NCP	2	01:00	01:00	01:00	0:01:00	0:00:00
phone list	2	00:30	00:30	00:00	0:01:00	0:00:42
PPD sheet	2	1:00:30	1:00:30	01:00	2:00:00	1:24:09
resident census	2	1:22:30	1:22:30	08:00	2:37:00	1:45:22
verbal report	2	20:30	20:30	04:00	0:37:00	0:23:20
visual survey of res	2	missing data	23:00	missing data	0:23:00	10:45:35
admission inquiry	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
aide chart audit	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
ambulance transfer	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
antidpress sticker	1	01:00	01:00	01:00	0:01:00	#DIV/0!
assessment copy	1	18:00	18:00	18:00	0:18:00	#DIV/0!
bowel care sheet	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
colored clips	1	03:00	03:00	03:00	0:03:00	#DIV/0!
computer walkthru sh	1	45:00	45:00	45:00	0:45:00	#DIV/0!
consultation	1	01:00	01:00	01:00	0:01:00	#DIV/0!
copier	1	02:00	02:00	02:00	0:02:00	#DIV/0!
cork bulletin board	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
decubitus photo	1	01:00	01:00	01:00	0:01:00	#DIV/0!
emergency med sheet	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
enteral bag tag	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
FAX lab report	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
immunization record	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
incident investigati	1	08:00	08:00	08:00	0:08:00	#DIV/0!
interagency referral	1	01:00	01:00	01:00	0:01:00	#DIV/0!
intercom	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
lab request	1	09:00	09:00	09:00	0:09:00	#DIV/0!
MD appt. calendar	1	06:00	06:00	06:00	0:06:00	#DIV/0!
MDS assessment	1	01:00	01:00	01:00	0:01:00	#DIV/0!
med cup	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
med label	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
Medicaid sheet	1	02:00	02:00	02:00	0:02:00	#DIV/0!
missing/damaged ite	1	01:00	01:00	01:00	0:01:00	#DIV/0!
old chart	1	02:00	02:00	02:00	0:02:00	#DIV/0!
PT/OT white board	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
resident ID bracelet	1	missing data	1:16:00	16:00	1:16:00	#DIV/0!
rolodex	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
sign in sheet	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
skin sheet	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
sticky chart page	1	02:00	02:00	02:00	0:02:00	#DIV/0!
stock drug order she	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
supply check list	1	02:00	02:00	02:00	0:02:00	#DIV/0!
team activity sheet	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!

Table 2.

Aggregate Name	Count	Average Completion Time	Median Completion Time	Min Completion Time	Max Completion Time	SD of Completion Time
treatment calendar	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
weekly flow sheet	1	< 1:00	< 1:00	< 1:00	< 1:00	#DIV/0!
weight sheet	1	04:00	04:00	04:00	0:04:00	#DIV/0!
Total	336					
The use of Other Nurse Experts and Bedside Care Sheet not observed						

<u>Table 3.</u> Semantic Differential Tool Descriptions

Information Tool Name	Description
24 Hour Report	The 24 Hour Report is a daily summary of admissions, discharges, accidents, orders, events, and names of residents who require special care, observations, or charting.
ADL Sheet	The ADL Sheet is a record of ADL care (Activities of Daily Living) required and given to the resident.
Bedside Care Sheet	The Bedside Care Information Sheet contains a resident's personal preference information, allergies, and possibly a schedule of activities.
Medication Administration Record (MAR)	The MAR is the Medication Administration Record. It usually contains the resident's name, room number, diagnosis, allergies, prescribed medications, doses, administration schedule, and nurse's initials.
Minimum Data Set Assessment (MDS)	The Minimum Data Set Assessment is a federally mandated assessment of the resident's physical and psychosocial condition. It is required for Medicare reimbursement.
Nurses Drug Reference	The Nurses Drug Reference is a textbook of drug names, actions, routes of administration and dosage, side effects, and nursing actions.
Nursing Care Plan (NCP)	The Nursing Care Plan is a document containing the resident's name and diagnosis as well as a problem list, goals, professional responsibilities, interventions, allergies and code status.
Other Nurse Experts	Many of us consult with out co-workers for advice or suggestions in resident care. A nurse expert is someone you have identified as a knowledgeable.
Personal Worksheet	A Personal Worksheet is a paper that you use throughout the day — taking notes during report, noting resident data during your shift, noting "things to do," and often used to give report at the end of your shift. The Personal Worksheet (or "cheat sheet") may be your own design or it may be pre-printed.
Physician Call Sheet	The Physician Call Sheet is a communication sheet noting the time physicians have been called, the phone number, the resident problem cause for the call, whether the physician has called back and any subsequent orders.
Resident's Chart	The Resident's Chart is typically a collection of diagnostic lab work, progress notes, physician orders, multidisciplinary plans and notes, and the resident's face sheet of demographic information.

Table 4. **Information Tool Factor Loadings**

Oblique Rotation Solution (Freq of Use > never)

	1 Guiding	2 Artistic	3 Lucid	4 Portable	5 Client-Centered	6 Regulated	Usability Total
24 Hour Report	-0.19	-0.19	0.41	0.36	-0.01	-0.23	0.16
ADL Sheet	-0.39	-0.25	0.27	0.02	-0.03	-0.38	-0.76
Bedside Care Sheet	-0.27	0.11	0.31	-0.65	1.25	-0.66	0.10
Nurse's Drug Reference	0.50	-0.04	0.28	0.25	-0.58	-0.01	0.40
MAR	0.41	-0.56	0.57	0.09	-0.36	0.85	1.01
MDS	-0.55	-0.82	-1.26	-0.02	0.17	0.59	-1.88
NCP	-0.31	0.02	-0.60	-0.17	0.17	0.00	-0.90
Nurse Experts	0.18	0.87	-0.30	-0.53	0.02	-0.11	0.14
Physician Call Sheet	0.01	0.02	0.43	0.10	-0.20	-0.26	0.11
Personal Worksheet	0.24	0.74	0.55	0.44	-0.10	-0.43	1.43
Resident's Chart	0.22	0.00	-0.77	0.04	-0.20	0.58	-0.14

Varimax Rotation Solution (Freq of Use > never)

	1 Productive	2 Simple	3 Artistic	4 Portable	5 Nursing	6 Client-Centered	Usability Total
24 Hour Report	-0.30	0.45	-0.20	0.37	0.23	0.01	0.56
ADL Sheet	-0.45	0.32	-0.21	0.05	0.33	-0.03	0.02
Bedside Care Sheet	-0.29	0.35	0.09	-0.76	0.55	1.17	1.12
Nurse's Drug Reference	0.50	0.19	-0.16	0.10	0.05	-0.60	0.08
MAR	0.44	0.56	-0.68	0.08	-0.82	-0.31	-0.74
MDS	-0.38	-1.19	-0.63	0.32	-0.47	0.32	-2.03
NCP	-0.26	-0.57	0.13	-0.05	0.01	0.19	-0.54
Nurse Experts	0.24	-0.34	0.91	-0.60	0.02	-0.07	0.17
Physician Call Sheet	-0.05	0.43	-0.02	0.03	0.23	-0.22	0.39
Personal Worksheet	0.07	0.51	0.66	0.31	0.41	-0.17	1.79
Resident's Chart	0.34	-0.81	0.04	0.12	-0.49	-0.15	-0.94

Table 5. **Overall Information Tool Usability Rank**

Usability Rank and Factor Sums

	Mean Reported Freq of Use	Rank on Oblique Factors Sum	Oblique Factors Sum	Rank on Varimax Factors Sum	Varimax Factors Sum
Personal Worksheet	4.41	1	1.43	1	1.79
MAR	4.30	2	1.01	9	-0.74
Nurse's Drug Reference	3.79	3	0.40	6	0.08
24 Hour Report	4.19	4	0.16	3	0.56
Nurse Experts	3.80	5	0.14	5	0.17
Physician Call Sheet	3.36	6	0.11	4	0.39
Bedside Care Sheet	2.89	7	0.10	2	1.12
Resident's Chart	4.69	8	-0.14	10	-0.94
ADL Sheet	3.39	9	-0.76	7	0.02
NCP	3.84	10	-0.90	8	-0.54
MDS	3.11	11	-1.88	11	-2.03

Oblique Factor Names	Varimax Factor Names
Guiding	Productive
Artistic	Simple
Lucid	Artistic
Portable	Portable
Client-Centered	Nursing
Regulated	Client-Centered

Table 6. Comparison of Factor Names

		1st Expert	2nd Expert	Named
V1	Effective Logical Helpful Reasonable Functional	Useful	Goal-Directed	Productive
V2	Simple Single Disciplinary Easy to Learn Effortless Concise	Basic	User-Friendly	Simple
V3	Creative Flexible Enjoyable	Nursing, Art	Fun	Artistic
V4	Portable Available	Mobile	There-for-you	Portable
V5	Nursing Lightweight	??	??	Nursing
V6	Person-Oriented At the Bedside	Patient-Focused	Point-of-care	Client-Centered
O1	Diagnostic Logical Helpful Effective Functional	Clinical, Medical	Performance support	Guiding
O2	Creative Flexible Enjoyable	Primary Care	see above	Artistic
O3	Complex Multidisciplinary Hard to Learn Wordy Difficult	MDS	Problematic (AKA pain in the butt)	Thick (Lucid)
O4	Portable Available Lightweight	Clipboards	??	Portable
O5	Person-Oriented At the Bedside	Primary Care	see above	Client-Centered
O6	Legal Heavy Current	Patient Chart	Burdens	Regulated

OREGON HEALTH SCIENCES UNIVERSITY
Consent Form

TITLE: Factors of Usability in Nursing Information Tools.

PRINCIPAL INVESTIGATOR: Katherine A. Caton, MS, MPA, RN [under the supervision of Joyce Colling, PhD, RN]

The purpose of this study is to develop a process for evaluating nursing information systems. I will be using observation, interviews, and a newly developed semantic differential scale to rate nursing information tools currently used to provide gerontological nursing care. This information will form a baseline of usability for future information systems designed for the clinical nurse.

Usability for clinical nurses can only be defined by clinical nurses. Therefore I'm looking to your knowledge, practice, and nursing experience as a means to discover what information tools nurses currently use, how are they used and how are they valued in practice. Participation in this study does not entail any anticipated risks. Potential benefits include the formation of a picture of how nurses value information content and information formats that have relevance to practice. Usability representations of current tools will guide further nursing information system design and evaluation.

Your name or identity will not accompany any materials used in this study or in any resulting publication. Participation in this study is voluntary. You may refuse to participate or you may withdraw from this study at any time. You will receive a copy of this consent form once you have signed it. Your signature below indicates that you have read the foregoing and agree to participate in this study.

....

Signature Date

....

Witness Date

Facility______________________ Date__________________

Time On	Tool	Location	User	Purpose	Time Off

Interview Guide (if any question seems sensitive, you can refuse to answer)

Demographics
Size of Facility:
Type of Patients on this unit: [medicare, LTC, rehab]

Unit is skilled or unskilled care?

Staffing ratios: [RN/LPN/NA]

How long have you been practicing nursing?

RN or LPN?

How long have you been practicing in LTC?

Position? - charge, lead, DNS...

Age? Education? Ethnicity?

I saw you use:_______________. What information tools work best for you? Why? What placement work best?

What information tools don't work or get in the way? Why?

Question for interview in scale development: "What is your goal when you reach for ....(Kardex, text, other expert)? May reveal information characteristics of importance to the planning of the nursing situation.

What tools are used most frequently? How frequently?

What tools are used infrequently but are highly valued? How frequently? [how frequently do you have care conferences or such?]

Tell about how you use the national MDS for long-term care? Rap sheets etc. Does it help to focus care? Is there some assurance that things don't get overlooked? How was planning accomplished before?

Task design includes: "record task knowledge in detail; clarify <u>information flows</u>; confirm <u>adequacy of information flows</u>; identify links between task attributes, provide detailed specification [what needs to be there]"

What are some of your decision-making needs in a day?

Do you get the sense that some information is more valid than other forms? "Questions of validity and reliability of information collecting need to be asked"

Tool Name:

Facility:

Tool Description:
Patient data [fields: demographics, assessments, plan, activities, care tasks, interventions]

Nursing data [fields: who, what, where, when; primary nurse]

Format [tables, check charting, date/times, free text, formatted text]

Placement [at bedside, at nurse station, other]

Nursing Information Tools:
Evaluation of Nursing Information Tools in Long-Term Care

The following is a questionnaire asking for your opinion about information tools used in nursing practice. Answers to this questionnaire will be used in a National Institutes of Health funded research project. The research project is investigating the usability and usefulness of nursing information tools in long term care. Your participation in answering all of the questions would be helpful. You may of course, refuse to answer any or all of the questions. All answers will be treated anonymously; please do not write your name or place of work on the questionnaire. Your consent to participate in this research is implied by filling out the questionnaire. A $5 honorarium is offered to thank you for completing the questionnaire.

Katherine Caton, RN, Ph.D. Candidate
Oregon Health Sciences University
School of Nursing
(503) 658-4918

Please mark the correct response to the following demographic items:

1) **Professional license.**

- 1☐ LPN
- 2☐ RN

2) **Years in practice.**

- 1☐ less than 1 year
- 2☐ 1 - 5 years
- 3☐ 6 - 10 years
- 4☐ 11 - 20 years
- 5☐ greater than 20 years

3) **Years in Long-Term Care practice.**

- 1☐ less than 1 year
- 2☐ 1 - 5 years
- 3☐ 6 - 10 years
- 4☐ 11 - 20 years
- 5☐ greater than 20 years

4) **Highest educational nursing degree.**

- 1☐ Licensed Practical Nursing Program
- 2☐ Associate Degree in Nursing
- 3☐ Baccalaureate Degree in Nursing
- 4☐ Masters Degree in Nursing
- 5☐ Doctoral Degree

5) **Age.**

- 1☐ less than 25 years
- 2☐ 25 - 29 years
- 3☐ 30 - 34 years
- 4☐ 35 - 39 years
- 5☐ 40 - 44 years
- 6☐ 45 or greater

6) **Ethnic heritage.**

- 1☐ African or Caribbean
- 2☐ Asian or Pacific Islands
- 3☐ Caucasian
- 4☐ Native American

7) **What is the role(s) you will be filling in your work <u>today</u>? Check all that apply.**

- 1☐ Charge Nurse
- 2☐ Director of Nursing
- 3☐ Float Nurse
- 4☐ Lead Nurse
- 5☐ Medication Nurse
- 6☐ Per Diem Nurse
- 7☐ Resident Care Manager
- 8☐ Staff Nurse
- 9☐ Other

8) **Which shift best describes your normal work hours?**

- 1☐ Nights
- 2☐ Days
- 3☐ Evenings

Evaluation of Nursing Information Tools

Various tools are used for the management of nursing information in long term care. Some of the tools are standardized guides to practice, such as Drug References or resources of the institution like Policy and Procedure manuals. Other tools are more informal and have been developed to meet a need in everyday practice, such as report sheets. This questionnaire asks your opinion of the usefulness of some nursing information tools.

On the next few sheets you will find a description of an identified information tool followed by a list of characteristics. Mark an X for every characteristic on the end of the scale that most closely reflects your opinion. For instance, if you feel that an information tool is very simple, mark the scale like this:

Simple _X_ _2_ _3_ _4_ _5_ _6_ _7_ Complex

However, if you feel an information tool is somewhat complex, mark the scale like this:

Simple _1_ _2_ _3_ _4_ _X_ _6_ _7_ Complex

If you feel a tool is not at all simple but is very complex, mark the scale like this:

Simple _1_ _2_ _3_ _4_ _5_ _6_ _X_ Complex

Be spontaneous, there are no right or wrong answers; this is your opinion. If you do not feel that the characteristic applies, mark the center of the scale.

ALL RESPONSES ARE ANONYMOUS - DO NOT WRITE YOUR NAME ANYWHERE ON THE QUESTIONNAIRE.

Personal Worksheet

A personal worksheet is a paper that you use throughout the day -- taking notes during report, noting resident data during your shift, noting "things to do," and often used to give report at the end of your shift. The personal worksheet (or "cheat sheet") may be your own design or it may be pre-printed.

PW

Please mark the following characteristics as you believe they describe the Personal Worksheet:

How frequently do you use a personal worksheet (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1) Accurate	1	2	3	4	5	6	7	Inaccurate
2) Current	1	2	3	4	5	6	7	Out of Date
3) Unavailable	1	2	3	4	5	6	7	Available
4) Non-Essential	1	2	3	4	5	6	7	Essential
5) Concise	1	2	3	4	5	6	7	Wordy
6) Simple	1	2	3	4	5	6	7	Complex
7) At Bedside	1	2	3	4	5	6	7	Elsewhere
8) Decorative	1	2	3	4	5	6	7	Functional
9) Therapeutic	1	2	3	4	5	6	7	Harmful
10) Difficult	1	2	3	4	5	6	7	Effortless
11) Conventional	1	2	3	4	5	6	7	Creative
12) Easy to Learn	1	2	3	4	5	6	7	Hard to Learn
13) Saves Time	1	2	3	4	5	6	7	Wastes Time
14) Awkward	1	2	3	4	5	6	7	Handy
15) Diagnostic	1	2	3	4	5	6	7	Uncertain
16) Dangerous	1	2	3	4	5	6	7	Safe
17) Effective	1	2	3	4	5	6	7	Ineffective
18) Bothersome	1	2	3	4	5	6	7	Enjoyable
19) Helpful	1	2	3	4	5	6	7	Hindrance
20) Rigid	1	2	3	4	5	6	7	Flexible
21) Person-Oriented	1	2	3	4	5	6	7	Task-Oriented
22) Portable	1	2	3	4	5	6	7	Fixed
23) Hypocrisy	1	2	3	4	5	6	7	Reality
24) Legal	1	2	3	4	5	6	7	Nursing
25) Weak	1	2	3	4	5	6	7	Powerful
26) Reasonable	1	2	3	4	5	6	7	Ridiculous
27) Heavy	1	2	3	4	5	6	7	Lightweight
28) Logical	1	2	3	4	5	6	7	Illogical
29) Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30) Natural	1	2	3	4	5	6	7	Unnatural

24 Hour Report Sheet

The 24 Hour Report is a daily summary of admissions, discharges, accidents, orders, events, and names of residents who require special care, observations, or charting.

24

Please mark the following characteristics as you believe they describe the 24 Hour Report Sheet:

How frequently do you use a 24 Hour Report Sheet (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1) Accurate	1	2	3	4	5	6	7	Inaccurate
2) Current	1	2	3	4	5	6	7	Out of Date
3) Unavailable	1	2	3	4	5	6	7	Available
4) Non-Essential	1	2	3	4	5	6	7	Essential
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27) Heavy	1	2	3	4	5	6	7	Lightweight
28) Logical	1	2	3	4	5	6	7	Illogical
29) Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30) Natural	1	2	3	4	5	6	7	Unnatural

Nursing Drug Reference

A Nursing Drug Reference is a textbook of drug names, actions, routes of administration and dosage, side effects, and nursing actions.

DR

Please mark the following characteristics as you believe they describe the Nursing Drug Reference:

How frequently do you use a Nursing Drug Reference (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1) Accurate	1	2	3	4	5	6	7	Inaccurate
2) Current	1	2	3	4	5	6	7	Out of Date
3) Unavailable	1	2	3	4	5	6	7	Available
4) Non-Essential	1	2	3	4	5	6	7	Essential
5) Concise	1	2	3	4	5	6	7	Wordy
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29) Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30) Natural	1	2	3	4	5	6	7	Unnatural

Physician Call Sheet

The Physician Call Sheet is a communication sheet noting the time physicians have been called, the phone number, the resident problem cause for the call, whether the physician has called back and any subsequent orders.

PC

Please mark the following characteristics as you believe they describe the Physician Call Sheet:

How frequently do you use a Physician Call Sheet (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1) Accurate	1	2	3	4	5	6	7	Inaccurate
2) Current	1	2	3	4	5	6	7	Out of Date
3) Unavailable	1	2	3	4	5	6	7	Available
4) Non-Essential	1	2	3	4	5	6	7	Essential
5) Concise	1	2	3	4	5	6	7	Wordy
6) Simple	1	2	3	4	5	6	7	Complex
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9) Therapeutic	1	2	3	4	5	6	7	Harmful
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29) Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30) Natural	1	2	3	4	5	6	7	Unnatural

Nursing Care Plan

The Nursing Care Plan is a document containing the resident's name and diagnosis as well as a problem list, goals, professional responsibilities, interventions, allergies and code status.

NCP

Please mark the following characteristics as you believe they describe the Nursing Care Plan:

How frequently do you use a Nursing Care Plan (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1)	Accurate	1	2	3	4	5	6	7	Inaccurate
2)	Current	1	2	3	4	5	6	7	Out of Date
3)	Unavailable	1	2	3	4	5	6	7	Available
4)	Non-Essential	1	2	3	4	5	6	7	Essential
5)	Concise	1	2	3	4	5	6	7	Wordy
6)	Simple	1	2	3	4	5	6	7	Complex
7)	At Bedside	1	2	3	4	5	6	7	Elsewhere
8)	Decorative	1	2	3	4	5	6	7	Functional
9)	Therapeutic	1	2	3	4	5	6	7	Harmful
10)	Difficult	1	2	3	4	5	6	7	Effortless
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23)	Hypocrisy	1	2	3	4	5	6	7	Reality
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28)	Logical	1	2	3	4	5	6	7	Illogical
29)	Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30)	Natural	1	2	3	4	5	6	7	Unnatural

Other Nurse Experts

Many of us consult with our co-workers for advice or suggestions in resident care. A nurse expert is someone you have identified as knowledgeable.

NE

Please mark the following characteristics as you believe they describe Nurse Experts:

How frequently do you consult a Nurse Expert (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1) Accurate	1	2	3	4	5	6	7	Inaccurate
2) Current	1	2	3	4	5	6	7	Out of Date
3) Unavailable	1	2	3	4	5	6	7	Available
4) Non-Essential	1	2	3	4	5	6	7	Essential
5) Concise	1	2	3	4	5	6	7	Wordy
6) Simple	1	2	3	4	5	6	7	Complex
7) At Bedside	1	2	3	4	5	6	7	Elsewhere
8) Decorative	1	2	3	4	5	6	7	Functional
9) Therapeutic	1	2	3	4	5	6	7	Harmful
10) Difficult	1	2	3	4	5	6	7	Effortless
11) Conventional	1	2	3	4	5	6	7	Creative
12) Easy to Learn	1	2	3	4	5	6	7	Hard to Learn
13) Saves Time	1	2	3	4	5	6	7	Wastes Time
14) Awkward	1	2	3	4	5	6	7	Handy
15) Diagnostic	1	2	3	4	5	6	7	Uncertain
16) Dangerous	1	2	3	4	5	6	7	Safe
17) Effective	1	2	3	4	5	6	7	Ineffective
18) Bothersome	1	2	3	4	5	6	7	Enjoyable
19) Helpful	1	2	3	4	5	6	7	Hindrance
20) Rigid	1	2	3	4	5	6	7	Flexible
21) Person-Oriented	1	2	3	4	5	6	7	Task-Oriented
22) Portable	1	2	3	4	5	6	7	Fixed
23) Hypocrisy	1	2	3	4	5	6	7	Reality
24) Legal	1	2	3	4	5	6	7	Nursing
25) Weak	1	2	3	4	5	6	7	Powerful
26) Reasonable	1	2	3	4	5	6	7	Ridiculous
27) Heavy	1	2	3	4	5	6	7	Lightweight
28) Logical	1	2	3	4	5	6	7	Illogical
29) Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30) Natural	1	2	3	4	5	6	7	Unnatural

Resident's Chart

The resident's Chart is typically a collection of diagnostic lab work, progress notes, physician orders, multidisciplinary plans and notes, and the resident's face sheet of demographic information.

RC

Please mark the following characteristics as you believe they describe the Resident's Chart:

How frequently do you use a Resident's Chart (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1) Accurate	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Inaccurate
2) Current	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Out of Date
3) Unavailable	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Available
4) Non-Essential	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Essential
5) Concise	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Wordy
6) Simple	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Complex
7) At Bedside	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Elsewhere
8) Decorative	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Functional
9) Therapeutic	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Harmful
10) Difficult	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Effortless
11) Conventional	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Creative
12) Easy to Learn	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Hard to Learn
13) Saves Time	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Wastes Time
14) Awkward	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Handy
15) Diagnostic	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Uncertain
16) Dangerous	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Safe
17) Effective	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Ineffective
18) Bothersome	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Enjoyable
19) Helpful	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Hindrance
20) Rigid	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Flexible
21) Person-Oriented	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Task-Oriented
22) Portable	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Fixed
23) Hypocrisy	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Reality
24) Legal	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Nursing
25) Weak	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Powerful
26) Reasonable	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Ridiculous
27) Heavy	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Lightweight
28) Logical	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Illogical
29) Single Discipline	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Multidiscipline
30) Natural	_1_	_2_	_3_	_4_	_5_	_6_	_7_	Unnatural

Minimum Data Set Assessment

The Minimum Data Set is a federally mandated assessment of the resident's physical, and psycho-social condition. It is required for Medicare reimbursement.

MDS

Please mark the following characteristics as you believe they describe the Minimum Data Set Assessment:

How frequently do you use a Minimum Data Set Assessment (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1)	Accurate	1	2	3	4	5	6	7	Inaccurate
2)	Current	1	2	3	4	5	6	7	Out of Date
3)	Unavailable	1	2	3	4	5	6	7	Available
4)	Non-Essential	1	2	3	4	5	6	7	Essential
5)	Concise	1	2	3	4	5	6	7	Wordy
6)	Simple	1	2	3	4	5	6	7	Complex
7)	At Bedside	1	2	3	4	5	6	7	Elsewhere
8)	Decorative	1	2	3	4	5	6	7	Functional
9)	Therapeutic	1	2	3	4	5	6	7	Harmful
10)	Difficult	1	2	3	4	5	6	7	Effortless
11)	Conventional	1	2	3	4	5	6	7	Creative
12)	Easy to Learn	1	2	3	4	5	6	7	Hard to Learn
13)	Saves Time	1	2	3	4	5	6	7	Wastes Time
14)	Awkward	1	2	3	4	5	6	7	Handy
15)	Diagnostic	1	2	3	4	5	6	7	Uncertain
16)	Dangerous	1	2	3	4	5	6	7	Safe
17)	Effective	1	2	3	4	5	6	7	Ineffective
18)	Bothersome	1	2	3	4	5	6	7	Enjoyable
19)	Helpful	1	2	3	4	5	6	7	Hindrance
20)	Rigid	1	2	3	4	5	6	7	Flexible
21)	Person-Oriented	1	2	3	4	5	6	7	Task-Oriented
22)	Portable	1	2	3	4	5	6	7	Fixed
23)	Hypocrisy	1	2	3	4	5	6	7	Reality
24)	Legal	1	2	3	4	5	6	7	Nursing
25)	Weak	1	2	3	4	5	6	7	Powerful
26)	Reasonable	1	2	3	4	5	6	7	Ridiculous
27)	Heavy	1	2	3	4	5	6	7	Lightweight
28)	Logical	1	2	3	4	5	6	7	Illogical
29)	Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30)	Natural	1	2	3	4	5	6	7	Unnatural

Medication Administration Record

The MAR is the Medication Administration Record. It usually contains the resident's name, room number, diagnosis, allergies, prescribed medications, doses, administration schedule, and nurse's initials.

MAR

Please mark the following characteristics as you believe they describe the Medication Administration Record:

How frequently do you use the MAR (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1) Accurate	1	2	3	4	5	6	7	Inaccurate
2) Current	1	2	3	4	5	6	7	Out of Date
3) Unavailable	1	2	3	4	5	6	7	Available
4) Non-Essential	1	2	3	4	5	6	7	Essential
5) Concise	1	2	3	4	5	6	7	Wordy
6) Simple	1	2	3	4	5	6	7	Complex
7) At Bedside	1	2	3	4	5	6	7	Elsewhere
8) Decorative	1	2	3	4	5	6	7	Functional
9) Therapeutic	1	2	3	4	5	6	7	Harmful
10) Difficult	1	2	3	4	5	6	7	Effortless
11) Conventional	1	2	3	4	5	6	7	Creative
12) Easy to Learn	1	2	3	4	5	6	7	Hard to Learn
13) Saves Time	1	2	3	4	5	6	7	Wastes Time
14) Awkward	1	2	3	4	5	6	7	Handy
15) Diagnostic	1	2	3	4	5	6	7	Uncertain
16) Dangerous	1	2	3	4	5	6	7	Safe
17) Effective	1	2	3	4	5	6	7	Ineffective
18) Bothersome	1	2	3	4	5	6	7	Enjoyable
19) Helpful	1	2	3	4	5	6	7	Hindrance
20) Rigid	1	2	3	4	5	6	7	Flexible
21) Person-Oriented	1	2	3	4	5	6	7	Task-Oriented
22) Portable	1	2	3	4	5	6	7	Fixed
23) Hypocrisy	1	2	3	4	5	6	7	Reality
24) Legal	1	2	3	4	5	6	7	Nursing
25) Weak	1	2	3	4	5	6	7	Powerful
26) Reasonable	1	2	3	4	5	6	7	Ridiculous
27) Heavy	1	2	3	4	5	6	7	Lightweight
28) Logical	1	2	3	4	5	6	7	Illogical
29) Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30) Natural	1	2	3	4	5	6	7	Unnatural

ADL Sheet

The ADL sheet is a record of ADL care (Activities of Daily Living) required and given to the resident.

ADL

Please mark the following characteristics as you believe they describe the ADL Sheet:

How frequently do you use an ADL Sheet (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1) Accurate	1	2	3	4	5	6	7	Inaccurate
2) Current	1	2	3	4	5	6	7	Out of Date
3) Unavailable	1	2	3	4	5	6	7	Available
4) Non-Essential	1	2	3	4	5	6	7	Essential
5) Concise	1	2	3	4	5	6	7	Wordy
6) Simple	1	2	3	4	5	6	7	Complex
7) At Bedside	1	2	3	4	5	6	7	Elsewhere
8) Decorative	1	2	3	4	5	6	7	Functional
9) Therapeutic	1	2	3	4	5	6	7	Harmful
10) Difficult	1	2	3	4	5	6	7	Effortless
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13) Saves Time	1	2	3	4	5	6	7	Wastes Time
14) Awkward	1	2	3	4	5	6	7	Handy
15) Diagnostic	1	2	3	4	5	6	7	Uncertain
16) Dangerous	1	2	3	4	5	6	7	Safe
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19) Helpful	1	2	3	4	5	6	7	Hindrance
20) Rigid	1	2	3	4	5	6	7	Flexible
21) Person-Oriented	1	2	3	4	5	6	7	Task-Oriented
22) Portable	1	2	3	4	5	6	7	Fixed
23) Hypocrisy	1	2	3	4	5	6	7	Reality
24) Legal	1	2	3	4	5	6	7	Nursing
25) Weak	1	2	3	4	5	6	7	Powerful
26) Reasonable	1	2	3	4	5	6	7	Ridiculous
27) Heavy	1	2	3	4	5	6	7	Lightweight
28) Logical	1	2	3	4	5	6	7	Illogical
29) Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30) Natural	1	2	3	4	5	6	7	Unnatural

Bedside Care Information

The Bedside Care Information Sheet contains a resident's personal preference information, allergies, and possibly a schedule of activities.

BCS

Please mark the following characteristics as you believe they describe the Bedside Care Information Sheet:

How frequently do you use a Bedside Care Information Sheet (mark best answer):

1☐ Never 2☐ Hardly Ever 3☐ Occasionally 4☐ Frequently 5☐ All the time

1) Accurate	1	2	3	4	5	6	7	Inaccurate
2) Current	1	2	3	4	5	6	7	Out of Date
3) Unavailable	1	2	3	4	5	6	7	Available
4) Non-Essential	1	2	3	4	5	6	7	Essential
5) Concise	1	2	3	4	5	6	7	Wordy
6) Simple	1	2	3	4	5	6	7	Complex
7) At Bedside	1	2	3	4	5	6	7	Elsewhere
8) Decorative	1	2	3	4	5	6	7	Functional
9) Therapeutic	1	2	3	4	5	6	7	Harmful
10) Difficult	1	2	3	4	5	6	7	Effortless
11) Conventional	1	2	3	4	5	6	7	Creative
12) Easy to Learn	1	2	3	4	5	6	7	Hard to Learn
13) Saves Time	1	2	3	4	5	6	7	Wastes Time
14) Awkward	1	2	3	4	5	6	7	Handy
15) Diagnostic	1	2	3	4	5	6	7	Uncertain
16) Dangerous	1	2	3	4	5	6	7	Safe
17) Effective	1	2	3	4	5	6	7	Ineffective
18) Bothersome	1	2	3	4	5	6	7	Enjoyable
19) Helpful	1	2	3	4	5	6	7	Hindrance
20) Rigid	1	2	3	4	5	6	7	Flexible
21) Person-Oriented	1	2	3	4	5	6	7	Task-Oriented
22) Portable	1	2	3	4	5	6	7	Fixed
23) Hypocrisy	1	2	3	4	5	6	7	Reality
24) Legal	1	2	3	4	5	6	7	Nursing
25) Weak	1	2	3	4	5	6	7	Powerful
26) Reasonable	1	2	3	4	5	6	7	Ridiculous
27) Heavy	1	2	3	4	5	6	7	Lightweight
28) Logical	1	2	3	4	5	6	7	Illogical
29) Single Discipline	1	2	3	4	5	6	7	Multidiscipline
30) Natural	1	2	3	4	5	6	7	Unnatural

Tool Descriptions by Aggregate Name

Aggreg Name : 24 hour report sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
CC	daily report		admissions, discharges, diagnoses, transferred to/from, resident change of condition (name room), return physician calls (Dr. name, resident name, problem/message), employee notes	fill-in tabular and columns, one page per shift	communication book in nursing station
COHC	24 hour report		date, wing, census, sick calls, MD visits, new orders, alert status/reason, RN assessments needed, injuries (staff or residents), new decubiti, behavior change, cond change, physician notified, psychoactive meds	2-column fill-in	nursing station
FL	daily census sheet	name, room	total census, holds, ave census, notes thru the day - will use for end of shift report	3 columns of data, reverse side for notes	med cart
HM	wing 24 hour report	name, room, significant interactions on the shift		table, columns by shift	supervisor's office
KC	24 hour DNS report		admits, discharges, census, date, unit, resident events, accidents, incidents, new orders	tabular list	clipboard at nursing station
PH	24 hour DNS report		date, census, unit, resident movement, ADT log, list of residents requiring: therapies, infection, impaction, abnormal VS, dehydration, change in affect, change in mobility, medication reaction	multiple tables	clipboard with information sheet at nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : 24 hour report sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
VV	24 hour resident rep	room, name, vitals	doctor calls per shift, free text notes (will require chart entry too), charge nurse signature for each shift	tabular	3-ring binder

Aggreg Name : ADL sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	ADL flow sheet	name, room, etc., aides charting	initials, signatures	check table	on back of closet door in resident's room
GV	ADL sheets	nutrition, activity, bowel & bladder function, name	admission date, clinical record number, physician name, physician on call	table, checks, initials	in nurses and aides charting/resident refreshment room
PH	ADLs for CNA		CNA worksheet: bowel care, shower, bath, restraints, glasses, VS, meal monitor, routine care list with instructions	3-ring binder	nursing station
VV	ADL flow sheet	name, room, admission date, sex, scheduled cares: bowel, peri, bladder, shower, oral, remarks on reverse	signature line	monthly table similar to med record, text on rever	ADL book at nursing station

Aggreg Name : CNA worksheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	flow sheet	name, breakfast/replacement, lunch, supper, snack, bath/shower, bowel care, I&O	month, signature line, shift initial grid, marginal notes on codes used and meal policies	double-sided landscape grid by date	bedside

Tool Descriptions by Aggregate Name

Aggreg Name : FAX order sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	FAX order sheet		drug name	table with spaces for peel-off stock drug label	afixed to table form

Aggreg Name : I&O sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
FL	I&O sheet	name, room			clipboard with VS sheet
HM	I&O sheet	name, 8 hour I&O, 24 hour total	cc quantities for example containers	table	taped to mirror in resident's room
VV	I&O	name, date, shift total intake & output	physician	tabular	ADL book at nursing station

Aggreg Name : MAR

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	med book	photograph, MAR sheets, vitals sheets, treatment sheets, stickers indicating swallowing difficulty	physician phone number	3-ring binder	med cart
CC	MAR	name, diagnosis, admission date, birthday, age, room, medication, dose, schedule, snacks, allergies	scheduled VS, signature line, crushing instructions, generic replacement OK'd	2-sided, back PRNs and missed meds, matrix	med cart

Tool Descriptions by Aggregate Name

Aggreg Name : MAR

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
ESNF	MAR	name, room, drug, schedule, route	physician, signature line	grid table, yellow highlights DCs	med book - 3-ring binder on med cart
FL	med record	name, diagnosis, age, sex, SSN, diet, admit date, allergies, med, dose, schedule, vitals schedule, room	physician, signatures, date ordered, date DC'd, side effects, copy of telephone order sheet, some vitals recorded on med sheet - transcribed to VS sheet later	landscape column & gird in 3-ring binder, color	med cart
GV	MAR	time, name, dose	room, dates, monthly tally	spreadsheet	cart
GV	med record	date, time, allergies, medication, dose, age, sex, height, weight, BP	admission date, room number, signature lines, physician name	table in 2 wk blocks, sched face page, PRN back	med cart
HM	MAR	name, date, diagnosis, physician, allergies, phone, effective date, drug, dose, schedule, lab data-coumadin/insulin	signature line, initial, date, time	wide month table, small columns; 3-ring binder	med cart in office

Aggreg Name : MDS assessment

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
KC	MDS/RAP		data entry produces a printed sheet with areas marked that require multidisciplinary staff intervention	entered into computer by med records	chart

Tool Descriptions by Aggregate Name

Aggreg Name : NCP

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	care plan	name, diagnosis, birthdate, age, admit date, physician, phone #, problem, goal, est. date, approach, freq., responsibility, resolved, Ht, Wt, allergies, alert, code status	date, page #, conference date and attendees, nurse signature, review date	3-ring binder, table form, computer print-out	nursing station

Aggreg Name : admission assessment

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
RCC	admission patient as	name, date admitted, room, VS, diagnosis, Ht, Wt, ideal body Wt, Wt gain or loss Hx, appetite, gen appearance, resident feelings about placement, residents disc plan, permanent?/reason, rehab goals, family support, orientation, behavior, socialization, co	med record number	3-page fill-in, green paper	chart

Aggreg Name : admission inquiry

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
HM	admission inquiry	name, ICF/skilled, medicare status, demographics, admit data, how transferred, diagnosis, mentation, physician, rehab services, wt, sight, speech, behavior, skin cond, infection, bladder/bowel, diet, feeding tube, O2, meds, special needs, room	date, day of week, time	fill-in fields	supervisor's office clipboard; kspt in folder with all resident admissions - sort of a Kardex

Tool Descriptions by Aggregate Name

Aggreg Name : admission record

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
RCC	admission record	name, room, date, time, diagnosis, TPR, BP, condition (mobility, continence, feeding, LOC, admit mode), glasses, hearing aid, prothesis, skin and gen appearance	signature line	fill-in form with body representations	chart

Aggreg Name : alert sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	alert charting sheet	name, problem, freq of charting, month	skilled charting needs are colored white, timed charting (falls, infection, etc.) are pink	grid with shifts, color color coded by type	nursing station
HM	24 hour skilled char	name, skin dressing, IVs, neuro assessment, edema, pulses, O2, breathsounds, GI, GU, foley, notes & vital signs, teaching (esp. diabetic) special equipment	date, shift, initial	check off	supervisor's office
PH	information/alert sh		I&O list, q shift alert charting list (date on date off), CBGs list, skilled charting (7-3), daily charting (3-11)	table lists, yellow out DC's alert	clipboard at nursing station

Aggreg Name : assignment sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	assignment sheet	name, special needs	ward, date, charge nurse for each shift, aide assignments, alerts, admit/disch, labs, weekly wts, weekly BPs, bowel care, breaks	multiple tables on clipboard; notes taped to clipb	nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : assignment sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
RCC	assignment sheet	room, name, shower schedule, comments, mobility, chair, restraints, restorative/ADLs, meals, feeding, treatments	vital sign, wts, I&O schedules, breaks, charting and feeding times, responsibilitiy for scheduled activities	landscape rows, one row per resident	aide worksheet

Aggreg Name : bedside info/plan

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	bedside info sheet	name, mobility, positioning, mental status, nutrition, ADLs, safety, personal notes/social services, restorative, pastoral, assistive devices	primary nurse, review date, initials, signatures	3-ring binder	bedside
COHC	bedside care plan	name - addressed by, allergies, mobility, positioning, ADLS, special equipment, safety notes & precautions, nutrition, age, resotrative, activities, personality, social services, personal notes,	plan date, RCM, admit date, bed #	landscape 3-column table with open text areas	on back of closet (for privacy) door in resident's room - used for reference by aides

Aggreg Name : behavior sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	behavior flowsheet	name, drug, diagnosis, narrative	month, on back of sheet are formatted side effects of typical drug groups - sedatives, antipsychotics, antianxiety, antidpressant; initial, date, time	tabbed 3-ring binder, name grid, symptom codes	nursing station
VV	behavior form	name, room, admission, diagnosis, condition, episodes, intervention, outcomes	physician, initials	monthly tabular	3-ring binder - ADL book at nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : bowel care book

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	bowel care book	contain resident's bowel sheets		3-ring binder with room tabs	nursing station

Aggreg Name : bowel care sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	bowel care sheet	name, size, color, texture	month, date, shift	3-ring binder tabbed by room, table	nursing station

Aggreg Name : calendar

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
PH	calendar		doctor appointments, urgetn time delimited cares		on nursing station desk top

Aggreg Name : chart

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	chart	problem list, progress notes, physicians orders, physicians progress notes, rehab, lab/xray, MAR/treatment, history & physical, admission assessment/possession list, legal records/advanced directives, MDS, face sheet		tabbed 3-ring binder	nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : chart

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	chart	assessments - RAP, social service, MDS, psychoactive med assessment; admission data - face sheet, personal contacts, hospice forms, interdisc care plan; history, physician orders, progress notes, vital sign flow sheet, I&O, nurses notes	on outside cover - hospice name, contacts, phone #	tabbed sections	nursing station
GV	chart	sectioned into: care plan, face sheet, physicians orders, prgress notes, advance directives, nurses notes, vitals & wts, lab, history & summaries, MDS, nurses admission assessment, rehab sheet, personal effects, transfer forms		tabs	nursing station
HM	chart	face sheet, care plan, admission, skin at risk eval, MDS, nutrition assessment, MD orders, history & physical, progress notes, interdis-24 hour sheets, xray/lab, physical tx, OT, speech, advanced directives, CNA flow sheets		tabbed 3-ring binder	nursing station

Aggreg Name : chart hardback

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	chart hardback	room, name, doctor's name, allergies, code status		color coded labels	nursing station
COHC	chart back	name, room	doctor, color coded alert status	colors and labels	nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : chart hardback

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
GV	chart hardback	color coded for diagnosis, code status, alert status		colored dots	
HM	chart hardback	code status, allergies, insurer/private pay, name, room			office

Aggreg Name : clipboard

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
FL	personal clipboard		lists: vital signs, census, restraints, time cards, assignments	collected on clipboard	med cart
PH	clipboard		guides to assessment and ICD-9 codes	taped to clipboard	nursing station

Aggreg Name : consultation form

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
KC	consultation form	name, room, medicare no., medicaid no., problems, diagnosis, orders, progress note, new diagnosis, new orders	date and time of next appointment, physician signature, facility name, address, phone number	tabular fill-in	nursing station to physician's office and return

Tool Descriptions by Aggregate Name

Aggreg Name : cork board

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	cork board	name, room, notice on therapy in progress		notes	on doors of resident rooms

Aggreg Name : daily resident refer

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	unit shift book	name, room	general collection of unit specific notifications and operations for each shift, policies, work schedule, assignment schematic, bowel care protocol, aide task assigment sheets	3-ring binder	nursing station

Aggreg Name : daily ward reference

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	day shift daily form		nursing assignment tools, BM worksheet, site injection sheet, charting schedule, CNA rounds	3-ring binder	nursing station

Aggreg Name : dietary communicatio

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	dietary communicatio	name, order, nursing order, family preference, change in mechanical/aspiration status, resident preference, allergies, adaptive equipment, comments, date, time	resident off floor for meals	fill-in fields, duplicate,	nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : interdepartment comm

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
ESNF	interdepartment comm		notes written into discipline area alerting that discipline staff of needed action	3-sections: therapy (PT, OT,SLP), social serv, nurs	clipboard at nursing station

Aggreg Name : maintenance request

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
GV	maintenance request		date, time, location, problem to be fixed, requested by	fill-in fields	nursing station

Aggreg Name : meal monitor

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
FL	meal monitor	name, room, breakfast, lunch, dinner, CCs of intake, % of meals		table for multiple residents	clipboard in clean utility
GV	meal monitor	name, date, diagnosis, age, sex, % of breackfast, lunch, dinner	doctor, admission date, room, bed number, code status	2 wk table recorded in %	nursing station
VV	meal monitor	name, % intake of meals, diet			3-ring binder at nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : med bubble pack

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
CC	bubble pack	name, dose, schedule, brand & generic name of med	meds arranged in monthly dose order, expiration date, fill date, physician	1-month numbered 1-31, one card per med	med cart
COHC	med bubble packs	name, dose, time/schedule	routine meds, one pack per drug per patient per month	card-backed see-thru bubble pack	med cart

Aggreg Name : med cart

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
FL	med cart	name on drawers	drawers labeled by name or stock med type	rolling cart with multiple drawers, table top	med room

Aggreg Name : narcotic sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
GV	narcotic sheet	name, time, reason, result, amount	initial	table	med cart

Aggreg Name : personal worksheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	cheat sheet	name, meds, treatments, special needs, snacks, alerts		table organized by the hour	nursing station, clipped to the assignment sheet

Tool Descriptions by Aggregate Name

Aggreg Name : personal worksheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
GV	cheat sheet	room number, name, diagnosis, special treatments, labs due		2 columns	holding in hand or placed on her med cart; cheat sheet is clipped to hinged box-like clipboard that also contains quick reference cards, small flashlight, tape, etc.
VV	personal worksheet	name, room, code status, vitals, meds, IVs, FSBS, I&O, alert status	some fields highlighted	tabular with time schedule	on person

Aggreg Name : physician call sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
ESNF	physician call sheet	name, date, problem/need, comments	physician, phone number, time called, (whether called back, new order, will call back - not used)	landscape table, yellow highlighted when addressed	clipboard at nursing station
RCC	Dr. call sheet	name, date, room, regarding...	physician, telephone number, date called, time	5-sectioned field groups	clipboard at nursing station - copied to report sheet

Aggreg Name : post-its

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	post-its		free text - attached to report sheet		nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : report worksheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	nursing assignment s	room, name, assessment data text	L side of page is notes from AM report, R side of page is info from aides collected during the shift	blue page folded in half	nursing station
COHC	report sheet	resident name, room	notes made by charge nurse during shift - things our of the ordinary	table	nursing station
ESNF	shift worksheet	room, name, code status, diet, diagnosis, orders	physician, nursing comments	multipage stapled document, 3 column table	on each staff members person, taking notes during report
GV	nursing report book	name, physician, problem and whether it was charted on, I&O totals over multiple days, room number, labs	physician calls made, orders received, shower schedule by room number	3-ring binder with pocket, multiple tables	nursing station
RCC	nurses report sheet			blank tabular format	stock at nursing station, report notes, carried on person
RCC	report sheet	name, diagnosis, room	alert charting by shift,	pre-printed 32 column format,	clipboard at nursing station

Aggreg Name : shower list

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	shower list		room number matrix by day of week for shower rotation	matrix table	nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : sign in sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
HM	sign in sheet		name, title, assignment, hours, midnight census	table	supervisor's office

Aggreg Name : skin sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
GV	skin audit	name, room, skin turgor, abrasions, contusions, skin tears, oral mucosa, scalp, hair, eyes, ears, fingernails, toenails, feet & ankles,	date, wristband present, signature	checksheet, anterior, posterior, and lateral body	nursing station
RCC	pressure sore progre	name, date, site of wound, risk factors, stage description, size, depth, drainage, odor, color, cultured?, response to treatment, notifications, nutrition assessment	signature	body representation, field fill-in and free text	decubitus skin book, referenced by nurses notes

Aggreg Name : telephone order form

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
ESNF	physicians orders	name, medical record number, order, date, type, drug, dose, route, schedule, treatments		computerized entry, tab between view/enter modes	on computer terminal in nursing station; designated terminal for order entry - keyboard is high and fixed
GV	telephone order shee	name, address, physician, orders	date, time, date DC'd, nurse's signature, physician signature	checks & initials on 4 page pressure sensitive for	nursing station
HM	telephone order slip	name, order	signature, date, time	table	nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : textbooks

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	textbooks		dictionary, med dictionary, drug handbook, Merck manual, diagnostic tests, pocket med-surg nursing, IV meds, nursing diagnosis, P&P manual, PDR, phone book		nursing station

Aggreg Name : treatment sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
CC	treatment book			as med book	treatment cart
COHC	treatment sheet	name, room, treatments, nursing orders	aides may chart some treatments, RN initials	similar to MAR	treatment cart
ESNF	treatment sheet	name, room, diagnosis, skilled treatments	physician	grid table similar to MAR	3-ring binder with MAR on med cart
RCC	treatment sheet	name, sex, age, birthdate, LOC, diet, allergies, diagnosis, treatments, date ordered, schedule, (on reverse) nurses notes, skin observations, problem	physician, physician phone number, page, signature lines	2-sided landscape, matrix, tables, body representa	treatment book, med cart
VV	license book	name, room, diagnosis, treatment, scheduled insulin, IV drugs	treatments that require RN license, drug record, BG record, cliding scale coverage AM & PM	monthly matrix like med record	3-ring binder at nursing station

Tool Descriptions by Aggregate Name

Aggreg Name : vital sign sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
COHC	vital sign sheet	name, date, vitals	copied from aides notes on assignment sheet	table	chart at nursing station
FL	vital sign sheet	name, room, TPR, BP, BM cre, Wt		table with X's marking needed VS	clipboard with I&O sheet in clean utility room
HM	vital signs	name, room, vitals by shift		tables	supervisor's office

Aggreg Name : weight sheet

Facility	Local Tool Name	Resident Specific Data	Process/Reference Data	Format	Placement
BNC	weight graph	name, weight	month/date, signature line	X-Y grid - X date, Y wt., in binder	bedside
KC	weight sheet		room numbers and list of patients, marks where wts are required	top down list, fill in where starred	nursing station

Interview Data Summary

12 interviews

<u>Shift</u>
day = 6
evenings = 4
shift change = 1

<u>Size of entire facility</u>
range = 26 to 160 beds
mean = 93.7

<u>No. of residents on ward (7 facilities with SNF beds; 10 facilities with ICF beds; 1 facility with LTC beds only)</u>
range = 26 to 80
mean = 36.4

<u>No. of staff on ward (RCM, RN, LPN, CNA)</u>
range = 4 to 10
mean = 6.2
resident to staff ratio = 5.9

<u>Age of interviewee</u>
mean age = 41.8 years of age

<u>License</u>
RN = 12

<u>Practicing in nursing</u>
range = 1.5 to 27 years
mean = 9.2 years

<u>Practicing in LTC</u>
range = less than 1 year to 10 years
mean = 4 years

<u>Education</u>
ADN = 8
Diploma = 3
BSN = 1

<u>Staff position for this shift</u>
RCM = 3
Charge nurse/lead nurse = 7
Medication nurse = 1
Per diem nurse = 1

Ethnicity = white; 1 part American Indian

Information tool that worked best (may answer more than one):
personal notes or "cheat sheet" = 6
assignment sheet or schedule = 4
medical administration record or treatment record = 3
drug reference = 2
one each of: physician call sheet, alert sheet or 24 hour care sheet, MDS, NCP, pharmacist, stethoscope/self

Best placement:
nursing station = 9
on person = 6
medcart = 3
bedside = 1

Information tools that don't work (may answer more than one):
24 hour care sheet = 2
intershift communication book = 2
CNA or chart audits = 2
ADL sheets = 2
I&O sheets = 2
one each of: mandated text charting, MDS, NCP, functional measures, resident classification tool, dietary intake sheets, procedure book, PDR, MAR

Why doesn't the tool work:
unstructured, unfocused, redundant, wordy, one-way information that only meets guidelines not care needs, makes work, not current

What are some of your goals when using a tool:
backtracking information - following a trail, validating other information, memory aide, decision tool, communication, "getting to know a resident," scheduling resident movements or lab work

What tools are used most frequently:
MAR (medication administration record) = 5
census/assignment sheet/24 hour report = 4
telephone call/orders = 3
nurses notes = 2
cheat sheet = 2
and one each: lab report, NCP, I&O, vital signs, other workers

What tools are used infrequently but are valuable:
care guidelines/MDS = 5
drug reference = 3
bedside care sheet = 3

and one each: doctor's orders, charts, incident reports, CNA evaluation guidelines

How frequently is infrequent:
daily to weekly
weekly
every other week
weekly or monthly

Do you use the MDS?
yes = 5
no = 7

Does the MDS help to focus care?
Helps to guide evaluation but does not help to focus care.
It is multidisciplinary.

What are some of your decision making needs in a day?
Knowing how far to push residents in activities = 5
Should we call...is there a real change = 4
Staffing = 2
Pain medication orders = 1

Is some information more valid than others?
[most responded with "invalid" information instances]
Verbal or resident transfer information = 3

- information from social workers is incomplete.
- form may not be structured too well.

Bowel and bladder training = 2

- is it done, does it really work, is total continence realistic.
- omissions or verbal.

Doctor's notes not too valid = 2

- how do they know the resident if they only see them 5 minutes every 3 months.
- residents take longer to express their concerns.

Resident's emotional state information from family members = 1

- too charged emotionally, guilt feelings, accusatory.

Lack complete primary care physician orders = 1
The duplicity in our information may make some information seem incomplete = 1
Some vital sign and skin assessment data may be fishy = 1
Depends upon who entered the information = 1

Other:
Most communication among staff is verbal = 3
Need to be able to trend "gero data" in the same way we trend physical data = 2
Would like a worksheet that compiles all the data - rather than transfering data from one sheet to another.
Information as to what the resident was like when she/he was young is omitted.
Gerontology care creativity is squashed by regulations.

Use personal notes to get "back on track" after frequent interuptions.
Quick care plan in resident's room assists in giving cares.
Care information flows up but not necessarily down = 1
Need guidelines for CNAs and agency personnel = 1
The RCM makes a bedside care sheet (see quick care plan) after she does the MDS. I use that, so I guess the MDS affects care indirectly.
Uses different colored pens to indicate change; uses visual cues at the nursing station.