

UNDERSTANDING RESEARCH IN NURSING

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INTRODUCTION

The WHO Expert Committee on Nursing recommended in 1966 "that research into the improvement of nursing care be promoted as an essential part of the planning of health services . . ."1 Understanding Research in Nursing is intended for those nurses who wish to know more about research in nursing that leads to the improvement of nursing care. It is intended for advanced students whose educational programmes include beginning courses in research. It will also be useful to nurses who are participating in nursing care research projects. It is hoped that those nurses who make use of research findings to improve nursing care will find this volume helpful in understanding the research process and its relationship to patient care.

Obviously, all nurses will not, and should not, be researchers. Nurses in leadership positions, however, often use research reports, selecting findings as bases on which to change nursing practices. Some nurses are able to identify researchable problems in the practice area and evaluate the tested results of solutions to the problems in the practice field. According to Brotherson,

"whereas the ability and opportunity to carry out research must be limited to a minority in any profession, an urgent and understanding sense of the need for research should be a part of the mental equipment of every member of any profession worthy of the name."2

Research is sometimes viewed as an appendage to nursing - something someone else does, and something rather unrelated to the real world of nursing. The position taken here, however, is that research as a process is a scientific, systematic way of thinking about nursing care. Research is important to the nurse because from it comes the body of knowledge upon which nursing care is based.

An attempt will be made to illustrate the relationship between nursing care and research in nursing. An exploration of the research process will then be undertaken and key words will be defined and concepts described. Finally, a brief overview of the steps taken to plan and carry out a research project will be suggested, not with the idea that the steps will provide all the knowledge necessary for doing research but because they offer an orderly sequence for describing the main points of the research process.



1. THE RELATIONSHIP BETWEEN NURSING CARE AND RESEARCH
IN NURSING

The WHO Expert Committee on Nursing, Fifth Report, published in 1966, utilizes Virginia Henderson's definition of nursing care as follows:

"In a broad sense nursing care is derived from what has been called the unique function of the nurse ... 'to assist the individual, sick or well, in the performance of those activities contributing to health or its recovery (or to peaceful death) that he would perform unaided if he had the necessary strength, will or knowledge. And to do this in such a way as to help him gain independence as rapidly as possible. This aspect of her work, this part of her function, she initiates and controls; of this she is master."³

In order to assist the patient to achieve his goals, a wide variety of nursing care actions are available to the nurse. Some of the nursing actions are relatively standard techniques and procedures. These are often delegated to others on the health care team. Other nursing actions are more complex and require independent judgements and thoughtful decisions. Some nursing actions call for creativity and innovation on the part of the nurse.

The choice of appropriate nursing care measures is determined by the nurse from a body of nursing knowledge and from factual information about the patient. It is characteristic of nursing, as well as of other service professions, that certain standard principles of practice suggest the appropriate nursing care measures to take. In other words, nursing care should be based upon scientific principles. Hence, nursing curricula usually include anatomy, physiology, sociology, psychology, etc., as well as nursing science. The total body of knowledge called Nursing is composed of many facts, concepts, principles and theories. Much knowledge is borrowed from the medical, biological and social sciences;

nevertheless, it describes and explains nursing problems and nursing care. Scientific principles and theories upon which nursing is based have been derived from research in the general sciences and more recently from beginning efforts of researchers in nursing who apply these principles and theories to nursing care problems.

The following example illustrates the use of factual information, concepts, general principles of nursing care and theories related to a specific nursing care situation:

The nurse caring for a patient admitted to the hospital following an automobile accident would obtain certain factual information from the patient and family. The recording of facts might include: 40 year old male, conscious, no external bleeding; vital signs - blood pressure 90/40, pulse - 100, respiratory rate 20.

She immediately thinks of shock (concept) as she studies the relationship between blood pressure and pulse (facts). She knows that gravity will return the blood to the heart and aid circulation (principle), and she is prepared to elevate the foot of the bed. (Note the principle here suggests the nursing action). Thus, the principle used for nursing care is also supported by theories from physiology and physics.

In the above illustration, the nurse used knowledge that was made up of facts, a concept, a principle and related theories. Facts are events that can be observed and agreed upon by others. Concepts are general ideas made from particular observable events where the events or facts fit together in a meaningful way. That is, when several facts are related to each other in a meaningful way, those facts form an abstract idea or concept. In the above example, the low blood pressure, and elevated pulse rate are related and together they help to form the concept of shock. A principle is a general rule that applies to many situations. In this

case, the principle of gravity was put to work by elevating the foot of the bed so that blood would return to the heart. A theory is a whole set of accepted principles devised to describe, predict and explain a situation. In the example above, the theory which explains the circulatory system and the principle of gravity selected from it formed the basic knowledge from which the nurse made a decision for giving nursing care. These facts, concepts, principles, and theories, and others like them, so basic to giving nursing care, are examples which lend themselves to continued examination through research.

The goal of research in nursing is to confirm and expand the present body of nursing knowledge, which in turn contributes to improved health care. Establishing a scientific base of nursing knowledge will provide nurses with the most relevant nursing care measures and the most current principles of practice. For example, if it could be demonstrated through research that one method of thermometer disinfection proved to be more effective than another, the better method could be adopted. If a study of patient comfort suggested that a relationship between high levels of stress and visiting hours existed, visiting hours could be reduced, and the effectiveness of reduced visiting hours could be further evaluated. A comparative study of different methods of teaching for family planning could aid in the selection of the best method for teaching family planning.

Nursing care and nursing research become a circular process. Nursing problems arise from nursing care situations. Problems may also arise by questioning a known theory. The research findings of nursing studies must be examined in the patient care setting to see if they in fact make a difference in nursing care. New nursing knowledge must be tested in practice, just as nursing care should generate new areas for research.

2. AN APPROACH TO RESEARCH

Research defined

Research broadly defined is the systematic search for answers to questions about facts and the relationships between and among facts. A research study may simply confirm facts which are assumed to exist; some research uncovers or discovers new facts not previously known; some research establishes relationships between and among facts. Thus, findings or outcomes of research may confirm, change or extend what is already known about a problem, or may suggest new knowledge about a problem.

Research can be descriptive or explanatory in nature.⁴ Descriptive research has as its objective the confirmation of facts or the discovery of new facts. For example, the number of pregnant women who attend prenatal clinic and the number who do not attend are descriptive facts. They may be related to programme planning within the clinic. Explanatory research attempts to find relationships between and among facts so that it can offer explanations for what happened and suggests reasons why the relationships exist. An example of such research would be a study designed to determine the relationship between an educational programme and increased attendance at prenatal clinic. Quite often descriptive research precedes explanatory research. Some nursing problems can and should be studied in descriptive ways. Other nursing problems lend themselves to explanatory research when enough descriptive facts already exist so that relationships can be sought among the facts. Explanatory research leads to the organization of concepts, and the derivation of principles and theories. Facts alone may describe nursing situations but they do not provide scientific theories or principles as a basis for nursing practice. The highest goal of nursing research is the establishment of nursing theories and principles to provide sound bases for practice, which in turn improves patient care.

Objectivity is an essential attitude in research. Throughout an entire research project, the highest level of objectivity must be assured. The research problem, methods and findings must be as free of personal prejudice and bias as possible. All of the decisions made in the entire research project are directed toward maximizing objectivity.

The research process

The research process is defined here as a series of interdependent steps consisting of two processes or actions. The two processes constantly interact during the formulation of the research problem and during the time the research is being carried out. Those processes are: (1) conceptual and (2) factual in nature.^a As one moves from a problem area of interest to the formulation of a problem and selects an appropriate design for carrying out the research, one thinks about, reasons about, or conceptualizes the problem. At the same time, attention is given to the factual (observable) information specified in the research problem and the means by which it can be observed. Although each of these processes will be discussed separately in this paper, it is important to recognize that one part does not necessarily precede the other; they are interwoven, the conceptual with the factual. Each must eventually be made explicit throughout the research plan.

^a Some authors use the terms "conceptual" and "theoretical" interchangeably, both referring to the cognitive activity of logical reasoning. The thinking process is the same, with the difference being one of degree. If a specific set of concepts is not sufficiently established to attain theoretical status, a conceptual structure is preferable. In this paper, reference is made to conceptual framework throughout.

The conceptual process

The process of conceptualization is basically a logical, scientific process of reasoning. The goal of conceptualization is to discover or invent relationships between facts which in turn give new meaning to the facts.^a When a person conceptualizes, he uses knowledge he already possesses as it relates to the facts with which he is concerned in the research problem. He freely imagines, invents, creates and finally arrives at a unique conjecture wholly his own. To conceptualize is to speculate. Put another way, to formulate meaningful relationships between facts is speculative. In research, speculation is disciplined because first, the speculation began with hard, real facts. Second, after a relationship between facts is structured into abstract concepts, science requires that the structure be subjected to validation by testing.⁵

Although observable facts are the building-blocks of science, they are isolated and disconnected unless they are joined together in some relationship. Conceptually, we make an effort to put them together in meaningful ways. The outcome of the conceptual process described above may take the form of concepts, principles, or theories or a mixture of all.

Concepts are mental images or ideas relating to phenomena or objects that share common properties. They may be nouns, adjectives, verbs, or adverbs, depending on whether they refer to things, properties of things, events, or properties of events.⁶ "Dog" is an example of a noun concept descriptive of many kinds of animal, each of which has certain properties characteristic of the category "dog". "Large" is an adjectival concept denoting size and contrasted with "small"; the concept "large" may be applied to any number of items, whether

^a Fact is defined as any event or phenomenon that can be observed and on which qualified observers agree.

they be houses, animals, or amounts of money; the concept "large" holds for all. For example, the following research problem names several concepts: does a patient who receives a hot milk drink before bedtime sleep longer than patients who do not receive a hot milk drink as part of their nursing care? "Patient" is a concept because it is an abstract term referring to all clients within the hospital setting. "Drink" is a concept, an abstraction, which stands for orange juice, water or cocoa, etc. "Longer", "hot", "receive", "bedtime", and "nursing care" are also concepts. In the next section, the importance of moving between mental concepts and facts which can be observed about them will be discussed. Suffice it to say here that the variables that will be studied in the research problem are concepts and each must be defined.

Principles state a relationship between two facts that may be used to explain, guide and predict action.⁷ Principles in nursing are commonly used to denote a rule or generalization about two or more facts. They may be derived from several theories, or they may be basic to the formulation of a new theory. Principles serve as rules for giving nursing care, for they predict outcomes for the patient. In an example cited previously, the nurse utilized the principle "fluids flow to the lowest point due to gravity" as a guide for the nursing action of elevating the patient's feet to prevent further shock. Principles have wide applicability to many situations. The above principle is equally applicable to problems of catheter drainage or relieving oedema of the extremities.

A theory is used in the broad sense to refer to an abstraction which summarizes and explains phenomena.⁸ As used here, it is distinguished from a principle in that theory refers to an entire system of interrelated facts. A theory is accepted as true until proven otherwise. Nursing utilizes many theories from the basic sciences such as physiology, anatomy, microbiology as well as from the behavioural sciences such as psychology and sociology.

The conceptual process, then, is that mental activity involving thinking and reasoning whereby concepts, principles, and theories evolve. They represent ways of putting discrete facts together in meaningful ways. In a research study, the concepts may already be related to a specific theory or theories. Conceptually, we select those theories, other facts, perhaps pertinent principles, and organize a framework. This framework provides a kind of structure from which the research problem derives meaning. Assumptions (statements believed to be true) about the research can be added to the framework. Hypotheses to be tested in the research are derived from the framework. In the end, the framework, consisting of concepts, principles, theories, or combination of all three, provides a structure which gives direction to the entire research. The research findings can later be analysed in relation to the stated conceptual framework.

As outlined above the research framework of a study is the selection, arrangement and clarification of concepts, principles and theories basic to the research problem. It may include facts, principles and theories and draw from previous experiences and present knowledge. It becomes the background for the research, the theme which guides the research, the source of direction for the decisions made about the research and, in the end, provides a frame of reference within which the research findings can be interpreted.

Factual processes

A fact is defined as any event or phenomenon that can be observed and on which qualified observers agree. In nursing, blood pressure of 120, pulse of 70, sex and age of patient, and other individual patient observations are all facts. Some are directly observable; others such as blood pressure require an instrument to facilitate observation. The solution of nursing problems requires objective observation of these and other specific facts about the patient. The record of facts must be accurately maintained.

Similarly in the research process, certain specified factual information must be obtained through observation, and it must be systematically and precisely recorded. The facts themselves and the means for recording them must be clearly outlined so that any other person observing the same event would know exactly when the event had occurred and could utilize the same means of recording the event. For example, research which calls for the observations of patient characteristics might call for "age" recorded in years and months; "height" recorded in cm, and "weight" measured in kg. "Intake" might be explicitly defined as all fluids taken orally by the patient, measured in ml and so recorded on an hourly chart.

It was mentioned earlier that concepts stated in the research problem are the variables to be studied. The statement of the problem makes use of concepts. These concepts have been described as abstract names or ideas. Since the concepts, per se, are not observable, certain facts which can be observed in the real world are assigned to represent each concept. For example, if a research problem poses a question about patient intake, the concept of intake needs to be defined according to observable factual information. Intake could be defined as amount of fluid, taken orally, and measured in ml. It can be readily seen that the definition of the concepts presented in the research problem by specifying the observable factual information needed indicates to the researcher what he must do to collect the data, i.e., measure the amount of fluid taken by mouth.

The conceptualization part of the research process might well be called the "thinking" part of the research, while the factual part of the research process is more related to the "doing" aspect. What facts are needed and how they will be collected are major considerations in the research plan. How the factual information will be interpreted depends upon the conceptual frame of reference selected and developed by the researcher. The interdependence of the conceptual process and the factual process are evident.

3. THE RESEARCH PLAN

It has been said that 90% of the total time allotted to research should be devoted to the planning stage. A well-designed study is far easier to carry out than one in which potential problems have not been anticipated. If consultation is required, the consultant should be called in during the planning stages. If the use of a statistician is anticipated, he, too, should be involved during the planning stages. The early involvement of resource people cannot be stressed enough. Too often a consultant is called in after the data have been collected, and after the researcher has spent endless time trying to make sense of the data.

The overall plan for a research project begins with an active interplay between the factual information to be studied and the conceptual scheme into which it fits. Some researchers begin with questions arising from problematic situations, i.e., the observation of new facts relevant to a nursing problem, or a difficult question about a patient that requires factual information not previously observed. An example of such a problem might be: what are the psychological needs of the patient who has had a particular new surgical procedure? Some researchers, on the other hand, question an established concept, principle or theory of nursing care and set out to confirm or refute it. An example of this could be the confirmation of the effectiveness of a particular disinfectant solution for thermometers, a principle taken from microbiology and applied to nursing. Whether one approaches nursing research by the first activity listed above or by the second is not important. The nature of the problem, the current status of nursing knowledge related to the problem, and the individual style of the researcher all influence one's choice.

Planning a research study involves the logical progression from identification of a problem to selecting a research plan. Although it is easier to discuss steps in the research process one by one, it must be remembered that in practice the researcher moves back and forth

between "steps", clarifying the problem, seeing theoretical relevance, finding new literature pertinent to the topic, etc., until he is finally satisfied with the problem and the research plan. The research plan should be completely formalized before the research is begun to avoid problems later which may defeat the entire research effort.

Planning the research project will be discussed according to the following steps: first, conceptualization of the research problem (researchable problems; review of the literature; the development of a conceptual framework; and definition of terms), and secondly (section 4), the research design (planning for data collection; selecting the sample; and data analysis and interpretation). The two-part process of research discussed in section 1 of this paper will be reflected in the following discussion. The conceptual process is evident throughout the conceptualization of the research problem, while the design section emphasizes the factual processes.

Conceptualization of the research problem

A problem is a question posed for solution. The first step in planning a nursing research project is to identify and state the problem. In the beginning, the problem may be no more than a broad area of concern which, when made explicit, becomes a series of questions. For example, one may be interested in studying problems related to the shortage of nurses in a given community. Specific questions might be asked: How many nurses reside in the community? How many nurses work in the community? How many nurses have family responsibilities? The researcher who seeks answers to these kinds of questions is doing a fact-finding study. Earlier in the text, facts were called the building-blocks of science, but unless meaningful relationships are found to exist between facts, knowledge is not extended. A more fruitful question for study in the present example would be: how many nurses who do not work have family responsibilities? Here the tentative relationship between not

working and family responsibilities is suggested in the question. The study problem in descriptive research is often stated in question form.

Sometimes enough is known about the problem for it to be stated in the form of a hypothesis. A hypothesis is a statement about the relationship between facts; it is a guess or a "hunch" about the answer to the question asked in the research. A hypothesis can also be described as a suggestion or a proposition which explains observed facts. "Hypotheses are devised as bridges from the bare facts to an explanatory principle which accounts for them", according to Feibleman.⁹ A hypothesis is tentative in nature. If it is confirmed by the research study, the relationship between one fact and another is established and one can make predictive statements about the facts. The tested hypothesis enables one to say, for example, "If A exists, then B exists". This is a powerful characteristic of the hypothesis, for it does more than simply describe: it tests and confirms (or rejects) relationships between facts. Eventually, the hypothesis joins the rank of principle or theory, depending upon the amount of support it receives. Thus, the testing of hypotheses leads to explanation of relationships between facts. Such research is known as explanatory research.

Researchable problems

Research problems are questions posed for solution, but not all questions are researchable. What makes a problem researchable? First, for a problem to be researchable the concepts it expects to study must be verifiable. A problem which hypothesizes relationships between love and security is not researchable in its present form because the concepts "love" and "security" are not expressed in observable events. Secondly, a researchable problem should not require a value judgement. The question of what constitutes good nursing care is not researchable in its present form because it calls for a value judgement about what is "good". An example of a researchable problem studied by many in recent years is the extent to which cigarette smoking is related to lung

cancer. Here the concepts are verifiable; they can be seen as observable events.

Another characteristic of a researchable problem is the extent to which the research question derives from a conceptual framework. Obviously, a question so derived already has a close relationship to other concepts and study of it is more likely to confirm or modify existing knowledge. For example, findings from a study about patients' reactions to the intensive care unit can be compared with the work of others if each study utilized theories of sensory deprivation in the development of the problem.

Practical questions about whether or not a research project should be undertaken need also to be considered. For example, is the study feasible? If methodology, subjects, and money do not exist to carry out the study, it is not feasible. Another consideration should be the qualifications of the researcher. Since nursing knowledge relies heavily upon the basic sciences, many researchable problems are more the province of physiology or physics than of nursing. The researcher must ask himself whether he is qualified for and prepared to undertake research of a problem which will lead him into new areas of study.

Review of the literature

The purpose of the literature review is to discover what has previously been done about the problem to be studied, what remains to be done, what methods have been employed in other research and how the results of other research in the area can be combined to develop knowledge. Thus, a review of the literature can help to clarify a problem, justify research for the proposed problem, shed light on appropriate (or inappropriate) methodologies and contribute toward the development of a conceptual framework. According to Abdellah & Levine, "the material gathered in the literature review should be treated as an integral part of the research data, since what is found in the literature not only can have an important influence

on the formulation of the problem and the design of the research, but also can provide useful comparative material when the data collected in the research are analysed".¹⁰

Because the review of the pertinent literature contributes to the problem formulation, it is appropriately carried out during the initial stages of research planning. However, as the research plan progresses the researcher will probably return to the literature from time to time to examine methodology and data analysis procedures.

The conceptual framework

It has previously been established that the process of conceptualization utilizes forms of conjecture whereby meaning can be attached to otherwise unrelated facts. The conceptual framework formalizes the thinking processes so that others may read and know the frame of reference basic to the research problem.

One formulates a conceptual framework by creating order out of otherwise disorganized information. One begins by accepting the rather broad frame of reference, nursing. A problem can be studied in relation to a number of fields or disciplines, yet a problem concerned with circulation of the blood, for example, takes on a different meaning and relevance if studied against the background of nursing. A framework relating to a nursing problem for study is derived from available empirical knowledge, findings from the research of others, assumptions, and explanations and delineation of concepts. Often the conceptual framework will utilize a theory already established as a nursing theory, or it will borrow a theory from another discipline. For example, in a study which tests the hypothesis that prior explanation about hospital admission will reduce the amount of anxiety exhibited by patients upon admission, the conceptual framework might utilize psychological theory about anxiety, the research findings of others, assumptions that anxiety can be measured and a selected teaching-

learning theory to support the nurse-patient interaction. The conceptual frame of reference is organized to summarize existing knowledge and to show how the research problem chosen for study fits together with knowledge already known about the subject.

The function of the conceptual framework is twofold. First, concepts, principles and theories serve as tools and their organization into a framework helps the researcher to know what information (data) he needs to collect. In general, the framework gives direction to the entire research. Secondly, a conceptual framework has a goal function; that is, it provides the organizational scheme into which the new findings of the research will fit into broader fields of knowledge.^{11,12} In the example used above about admission of patients, the framework acts as a tool because it helps the researcher to know what specific facts he must look for as outlined in the psychological theory about anxiety which he chose as part of the framework. The goal function is demonstrated because the findings of the research will always be reported in relation to the framework - either confirming or refuting the structure, thereby adding to the existing knowledge.

It is especially worth noting the role played by the theoretical framework in identifying assumptions basic to the study. Assumptions are statements believed to be true. Many are derived from theory selected from the research findings of others. Some assumptions merely reaffirm a general philosophy of nursing, e.g., that patients benefit from nursing care. Although assumptions of this kind probably do not need to be stated explicitly, others which have a direct bearing on the problem should be so stated and incorporated into the conceptual framework.

Definition of terms

The review of the literature and the development of a conceptual framework help the researcher to make the problem to be studied as clear as possible. He may

actually change the problem as he focuses his attention from a broad area to specific aspects. In the end, however, every concept used within the problem must be made explicit enough so that actual facts can be observed and recorded for each concept. Facts were previously defined as events or phenomena closely agreed upon by more than one observer. The concepts now expressed in the research problem must be clearly stated so that they can indeed be observed and verified. The observable events to be studied are called variables.

In an example which hypothesizes a relationship between a specific nursing action and reduction of patient anxiety, several concepts appear which although commonly used by nurses, do not have a standard meaning. "Nursing action" would have to be defined in this case as prescribed intervention consisting of specific behaviours, each of which could be observed. The specific behaviours would have to be written out as well as the conditions (or context) under which these behaviours could be observed. Similarly, "anxiety" has several meanings and would in this case derive meaning from psychological theory chosen for the conceptual framework. It too would require further behavioural and/or physiological descriptions and measurements for determining the presence or absence of anxiety.

The interaction between the observation of facts and the conceptualization process is especially obvious here. Nursing makes use of so many concepts that are presumed to have a common meaning but in reality are insufficiently conceptualized to be observed with accuracy by independent observers. "Team nursing", "comprehensive patient care" and "interpersonal relationships" are a few examples of complex concepts which require careful delineation if meaningful research in nursing is to be done.

The steps enumerated above should lead the researcher to a refined and clearly stated problem which is now seen in the context of the conceptual framework guiding the study. The concepts utilized in the problem statement

become the variables for study. The next step in refinement is to list all the variables of the problem and to indicate precisely which ones will be studied. A variable is a characteristic or attribute of an event or phenomenon to be observed which can be measured. The extent of measurement can be the fluctuation in quality or quantity; it can be measured with a tool already in existence, such as the thermometer to measure temperature, or it can be measured on a scale of "occurring" or "not occurring". In many instances, measurements are taken in the form of the number of times the variable occurs. In cases where variables are not quantifiable, descriptive and narrative data are collected and some scheme of classification must be developed. The variables to be studied and the means for quantifying the data must be made explicit in the research design, which will be discussed in the next section.

Research literature refers to variables by various names. For the sake of simplicity, two general kinds will be considered here: (1) those to be studied and (2) all others which may affect those to be studied. Both kinds must be listed, and what the researcher plans to do about them must be decided. Consider the following hypothesis: patients who receive a hot milk drink before bedtime in addition to usual evening care request fewer sleeping medications than patients who receive no hot milk drink as part of their care. The variables to be studied are (1) hot milk drink and (2) sleeping medications. The first one is called the independent variable. The researcher will control or manipulate it; he will organize and implement a plan whereby patients will be given hot milk drinks. The second variable is called the dependent variable because its outcome (result) depends upon the independent variable. It is not manipulated, but is merely allowed to occur. Many other variables which may influence the two to be studied can be identified, e.g., type of medication, sleeping habits, type of drink, etc. Variables of this kind must be taken into account in the research design.

An important step in the research process is to define clearly and plan for quantification of the dependent variable. Measurements of the extent to which the dependent variable occurs are often called criterion measurements. In the hot drink example mentioned above, a criterion measurement (dependent variable) is the number of times the patient asked for and/or received a sleeping medication. The definition of sleeping medication must be explicit.

Plans for controlling or manipulating the independent variable must be specific. If a hot milk drink is the variable to be studied, the researcher must outline the facts and events that will ensure control of that variable. One tablespoonful of a particular malted preparation dissolved in milk, heated to 120°F, and given 30 min before lights are turned out in the ward is an example of delineating the facts required to study the problem.

Variables not being studied are called extraneous variables. If they are thought to affect the dependent variable (request for medication) just as the independent variable (hot drink) might affect it, some control measure is planned. For example, if visiting hours are believed to have an effect on the dependent variable, the researcher could either control the variable by cancelling visiting hours or recognize it as an important variable that cannot be controlled. If such variables cannot be controlled, they are recognized as part of the limitations of the study. Often variables will be recognized which are thought to be absolutely irrelevant to the study, i.e., the colour of patients' eyes. These are simply ignored.

4. THE RESEARCH DESIGN

Earlier the research process was described as having two components, one concerned with conceptualization and the other concerned with factual information. The interdependence of these two processes is evident throughout the research design. The formulation of the research

problem is primarily conceptual, while the research design focuses on factual information, i.e., the observable facts or data needed to answer the question or test the hypothesis stated in the problem. Earlier, "fact" was defined as an event or phenomenon that can be observed and on which qualified observers agree. The purpose of the research design is to outline what facts (data) are needed to study the variables, how the data can be collected and recorded, how objectivity can be encouraged and bias discouraged, and how the data can be analysed and interpreted.

According to Kerlinger,¹³ a research design tells the researcher what to do and sets forth a mechanism of control. To control is to verify or regulate; to control is also to impose restrictions on observations (data). "Research designs are invented to enable the researcher to answer research questions as validly, objectively, accurately and economically as possible."¹⁴ A research design tells the researcher what data to collect, how to collect the data, and how to analyse the data, and suggests possible conclusions to be drawn from the data. A research design is a total plan which ensures maximum objectivity, a goal to which all research (descriptive as well as explanatory) aspires.

It is beyond the scope of this paper to review the wide range of research designs, methodologies and techniques. Suffice it to say that the selection of methodology and specific design should follow, not precede, the formulation of the problem. Nurse researchers should feel confident about the problem statements and areas of interest for research, for nursing is their area of expertise. Advice on research design, selection of methodologies, and data analysis should be sought by the inexperienced researcher. The importance of involving the consultant in the early planning stages of research cannot be stressed enough.

For the purpose of this volume, research design can be described as a continuum extending from non-experimental research at one end to experimental research at the other. An experimental design calls for the control of as many conditions as possible by the researcher. The classic example of an experiment is that which takes place in a laboratory setting, where maximum control is feasible. The advantage of an experiment is that causal relationships can be established by manipulated variables. Thus, the contribution to knowledge is at once more useful if cause and effect can be demonstrated. For example, the hypothesis that medication was absorbed more slowly intramuscularly from muscles damaged with scar tissue than from normal muscle was tested in a laboratory setting with rabbits. The relationship between absorption rate in damaged and in normal muscle was demonstrated under controlled conditions. The results have theoretical as well as practical relevance for nursing practice.

Obviously, most nursing problems do not lend themselves to controlled experimentation. Much research takes place with patients or in the community setting, where controlled circumstances are difficult. Clearly, there is less control over the study subjects and the setting. Since the control or elimination of bias are a major goal of research, many variations of non-experimental research exist. These are best described as those studies which make use of as much control as possible over subject and setting even though the research may take place in a natural setting. For example, to test the hypothesis that pre-operative instruction to patients will increase the effectiveness of post-operative coughing, some control can be exercised over the patients and setting, while other variables such as the extent of surgery and tolerance to pain cannot be controlled.

At the other end of the continuum are non-experimental designs, which make no attempt to control for other variables which may influence the specific variables under study. Even so, it is important to remember that objectivity and elimination of bias are

basic to all research, and designs for descriptive or exploratory studies ought to include some of the same safeguards.

Whether the research problem is stated as a question or as a hypothesis, whether the study is descriptive or explanatory, non-experimental or experimental, the research design prescribes what data are needed to study the problem, how the data will be collected and recorded, from whom and by whom it will be collected, and where and under what circumstances it will be collected. The sample, or the subjects selected for study, is related to the complexity of design and the methods selected for collecting the data, and will be discussed separately. In addition to indicating what the researcher must do, the research design also contains rules or decisions to ensure objectivity and lessen personal bias.

Planning for data collection

Planning for data collection involves a series of decisions. What data are needed to answer the research question is specified by careful problem delineation. The variables are by now clearly defined so that plans can be made to gather the factual information needed to answer the question posed in the research problem. Decisions about what data to collect are based on the problem, the review of the literature, and the conceptual framework of the research. In many instances, decisions are arbitrary, with advantages outweighing disadvantages, according to the researcher. For example, to test the hypothesis that a nursing intervention which includes a hot drink before bedtime reduces the number of sleeping medications a patient receives, one specifies that among the data to be studied is factual information about the nature of the hot drink. The variable of "hot" may be recognized as important to physiological and psychological theories of relaxation and selected on that basis. On the other hand, the variable of "drink" may be described as cocoa or a malted preparation mixed with milk because the calcium in milk is a relaxant. The variable of requests for sleeping medications must also be described

according to the factual information to be collected. Does the researcher count the number of requests or the number of sedatives given? The preferred one must be specified. To ensure objectivity, certain other decisions are made about the variables. For example, whichever type of hot drink is chosen for use in the study, it should be given to all patients being studied. In fact, the entire nursing action should be precisely defined so the researcher knows exactly what is to be done for each patient.

If there are other variables that could possibly affect the variables being studied, the researcher should specify in the research design what is to be done with regard to those other variables. For example, if sex, age, and diagnosis are believed to have a relationship to the variables being studied, facts such as age, sex and diagnosis could be tabulated for each patient and examined together with the findings. An alternative is to impose some control or regulation of these variables by selecting a sample in which these variables would be kept constant; that is, the sample to be studied could specify that only 50-60-year-old males, three days post-operative from abdominal surgery, would be included in the study. Another decision, that of random assignment, could be made which would deal with these variables by assigning patients on a random basis to the two groups being studied, the group receiving a hot drink and the group not receiving a hot drink. (The concepts of randomization and sample selection will be discussed later.) The best decision, for the beginning researcher, can be made with the assistance of a consultant, for each decision made about data is interrelated in a complex way with other decisions involving methods of data analysis.

How to collect the factual information (data) is again a matter of choice. In the above example, the researcher must decide whether to depend upon the patient's chart for a record of the medication requested or administered. The patient's chart would most likely be the most objective and dependable source of information

if the researcher decided previously to record number of medications received instead of requests made. The influence of one decision (medication received) on a subsequent decision (how to collect information) is especially obvious here. Methods and techniques that are commonly used for data collection include observation, interview, questionnaire, and selected instruments, both pencil and paper types and mechanical or physiological. These will be discussed later.

How to collect the data is intimately involved with when, under what circumstances and by whom the data is to be collected. If a diagnosis of surgery is an important variable, the decision may be made not to collect data on Mondays if Monday is a day when patients are scheduled for surgery. How many days to collect data is an important consideration; the time period must be long enough to ensure adequate observation under differing conditions (e.g., visiting hours on Tuesdays, Thursdays, and Sundays; new admissions on Wednesdays, etc.) and short enough to be manageable. Who should collect the data is often a question of training, although in our example it is easy enough for the nurse researcher to tabulate recorded medications from the patient's chart. When observations and interview techniques are utilized, the observer and the interviewer must be trained and skilled in these techniques. The additional problem of personal bias will be discussed later.

How to collect the data relative to the research problem usually involves the selection of one of a number of methods of data collection - observation, interview, etc. For some problems, appropriate methods do not exist and the researcher must either invent his own or alter the problem. Whatever the method, technique, or instrument, it should possess validity and reliability. Validity is the extent to which the instrument measures what it purports to measure, the extent to which the method yields the data needed to study the problem. Reliability is the extent to which another researcher would record the same data with the same method. Put

another way, reliability is also determined by the subject, who responds the same way to a second exposure of the method or instrument. Sensitivity is another criterion of a method of data collection. The means of collecting data must be sufficiently refined and sensitive to differentiate among subjects.

Whatever method is chosen, even the use of patient records, as in the "hot drink" example, the method employed should be pretested before the research is begun. In the above example, pretesting consists of checking a small number of charts from the institution in which the study will be conducted to see whether medication received by patients is charted regularly and accurately. Pretesting the interview, questionnaire, instrument, etc., familiarizes the researcher with the procedure and setting. Pretesting also enables the researcher to make changes in a procedure that uses an instrument, to add or change questions in the interview, or to clarify the procedures of observation. Pretesting should, of course, be carried out in settings and with subjects similar to, but not identical with, those to be used in the research.

Selecting the sample

The sample consists of the subjects selected for study; they are selected from a larger group of similar persons, referred to as the population. In the "hot drink" example, the population consists of hospitalized patients. The sample may consist of male patients, 50-60 years old, etc., depending upon decisions made in the research design.

An important objective of sampling, the process of selecting a sample, is to create, whenever possible, a miniature version of the total population, with all its characteristics - a randomized sample. For example, if the total population of hospitalized patients included young and old, male and female, medical and surgical, etc., the sample selected from the total population should have the same characteristics in the same proportions.

Thus, a miniature is created with the same characteristics as the total sample. The extent to which this is accomplished determines the extent to which the findings can be generalized to the entire population. The miniature sample is the ideal and if the characteristics of the sample corresponded exactly to the total population, the findings of the research problem could be generalized to the entire population.

Because such an ideal is difficult to achieve, two general types of samples are therefore utilized. One type is used with the aim of enabling the researcher to generalize from the findings. The second is not used with this aim. The first is called random sampling. Random means that each member of the population has an equal chance of being selected. Random sampling is a "technique . . . to equalize the composition of the various groups under study so that they are identical in respect to all pertinent . . . variables. Subjects are allocated to the different study groups according to the laws of chance".¹⁵ After a random start, subjects can be assigned to one group or another, i.e., first one to experimental group, second to control group, etc.; names can be drawn from a hat to determine groups. Statistical techniques can be used to evaluate the extent to which the sample is like the population. Studies using the second type of sample, which cannot be used for the purpose of making statistical generalizations to the larger population, are no less important, but their findings are somewhat limited. Non-random samples are selected for some purpose. Most common in nursing are samples chosen for convenience, i.e., the patients are there to be studied at the researcher's convenience. Subjects may be deliberately chosen according to some criterion important to the study. Subjects may also be recruited as volunteers.

Although random sampling is the approach of choice for truly scientific studies, few nursing problems lend themselves to study by a highly controlled experimental design with subject selection truly representative of the total population. In non-experimental studies and

studies that exercise some degree of control, however, subjects can often be randomly drawn from the population, or randomly assigned to study groups, so that the scope of the research findings is extended.

The size of the sample for study is determined by a number of factors in the research plan. First, the nature of the problem influences the number of subjects. If descriptive data are required about a new event or phenomenon in nursing, a few case histories and nursing care plans may suffice. If the problem calls for complex, possible painful intervention to test an outcome, the sample might be small because of the potential discomfort to the patient. Methodology is often a determining factor of sample size. For example, a questionnaire can almost as easily be sent to a total population (of hospitals, schools) as to a selected number. On the other hand, considerations of time and cost may influence the decision to select a random sample smaller in size. Interviews with subjects or direct observation of data, both time-consuming, may impose limitations on sample size. A tightly controlled experimental design requires fewer subjects than one less controlled. A precise tool or measurement yields findings of greater validity than a crude measurement. Therefore, a smaller sample can be considered for research employing a sensitive tool or measurement. The type of data to be analysed and the method whereby it will be analysed are other factors which determine sample size. Another consideration is the degree of precision required from the results when computed statistically. Consultation with a statistician is recommended early in planning the research design. A general principle applicable to sample size can be stated: a sample is required which is large enough to yield precise results but small enough to be manageable.

Data analysis and interpretation

It has been said throughout that the research process consists of two interrelated parts: (1) factual information and (2) conceptualization of the factual information.

The interaction of the factual with the conceptual has also been seen in the plan of research, i.e., one part of the research plan is concerned mainly with conceptualizing the problem for study, and as the problem becomes clearer the researcher moves closer to the observable factual phenomena needed to study the problem. Thus, the second part of the research plan deals with design or methods for collecting and recording data.

The research plan would not be complete without delineation of the procedures to be used for data analysis and interpretation. Hence, it might be said that a third and most important part of the research plan provides the opportunity to examine the data (factual information) in relation to the conceptual framework; in this way, the research findings become meaningful and useful to nursing. This last part of the research plan, the integration of the empirical facts with the conceptual framework, completes the cycle and at the same time begins a new one as new hypotheses and new questions are identified.

Analysis of data consists of putting all of the individual observations, scores, measures, interview data, etc., into some manageable form. This is sometimes done by counting the number of times a variable occurred. For example, in the study cited previously, the number of sedatives given per evening constitutes the body of data from which findings will be derived. After the original data is summarized according to the variables studied, the data can be tabulated; that is, the frequencies of occurrence can be expressed in numbers, and thereafter, a summary of the data can be made.

Although descriptive data can be expressed in rates, ratios, and percentages, they can also be analysed and expressed as categories or classifications according to some scheme relative to the problem. Through various methods, descriptive data can be categorically organized into a logical scheme which summarizes the individual observations.

If the purpose of a study is "to describe . . .", then meaningful description is called for. True descriptions can sometimes be in the form of a numerical value, as in the case of frequency of observations of phenomena, but one must also be alert to the existence of descriptive data which may not be included in the quantification of data. In other words, qualitative data may lose the richness of their quality when connected to numerical values. Some researchers who do descriptive studies have been known to deliberately avoid reporting any numbers except for sample size, to guarantee that the findings will in fact relate to the purpose of the study, description.

Data that have been quantified can be summarized with numbers indicating the measure of central tendency, common or average value for all the subjects studied. Measures of central tendency include mean (average), median (middle value which has an equal number of observations greater and less than it), and mode (most common value). Other measures of quantifiable data are measures of variation: range (the lowest and highest values), and standard deviation (the average measure of a number of errors or deviations from the central tendency measure). Yet other methods are available for summarizing data; again, it would be wise to involve a consultant or a statistician early in the planning stages to plan the best design to study a particular problem, and to select the appropriate methods for analysing the data.

In general, data should be analysed in terms of the stated problem. If questions were posed, findings should answer those questions. If hypotheses were stated, findings should support or not support them. Tables, graphs and line drawings are helpful to summarize data from which relationships between data can be seen. Hypothetical tables should be constructed as part of the research plan before the project is begun. Summary tables might be made utilizing data about the subjects, settings or environment.

Data can be analysed substantively and/or statistically. To analyse data substantively means to study the information for its relevance for nursing care. Data analysis must take place within the conceptual framework established for the study. The problem for study, it should be remembered, derived its rationale from the framework. The data should be analysed for its practical significance to nursing care. Statistical analysis, on the other hand, refers to arithmetical calculations used to summarize data as discussed above. Data lead to findings. Findings derive meaning from interpretation. The researcher's knowledge and expertise in a particular field enable him to interpret the findings in relation to the conceptual framework developed for the study. The substantive meaning of the findings is especially important for nursing, for it is hoped that out of the substance will come solid, sound, useful, effective guides to nursing practice.

5. IMPLEMENTING THE RESEARCH PLAN

It has been stressed throughout that the total research plan should be organized, and preferably written before the research project is begun. The use of consultants early in the planning stages has also been emphasized for beginning nurse researchers. The amount of time devoted to the written plan for research probably exceeds the amount of time it takes to carry out the research. The reward is obvious. A well-organized research plan prevents or keeps to a minimum the unanticipated problems arising from design, methods and data analysis.

Protection of human rights in research

The nurse researcher, consistent with ethical premises basic to the nursing profession, is responsible for the preservation of patient rights throughout the entire process of the research. In 1968, the American Nurses' Association published a pamphlet which summarizes that responsibility and makes suggestions which guarantee

protection of human rights. An abstract appears here as a guide to others:¹⁷

"Society places certain areas of individual rights in eminent position - privacy; self-determination; conservation of personal resources such as time, dignity, and energy; freedom from arbitrary physical or mental hurt by others; and freedom from intrinsic risk of emotional or physical injury. Nursing stresses these values. The preservation of these rights must be an integral part of nursing research. The participation of human beings as research subjects is based upon trust that these rights will be respected in the development and implementation of the research design . . . The investigator must seek, by every means at his disposal, to ensure that the rights of subjects are rigorously protected throughout all phases of the investigation . . . In studies which ask that subjects surrender one or more of their rights, it is advisable that the investigator obtain written consent from the subject or his agent . . . Since the investigator carries the major responsibility for ensuring the rights of the subject are not violated, he must, throughout the course of the investigation and thereafter, scrupulously adhere to the mutual agreement, oral or written, entered into with each subject."

Resources for research

Resources needed for carrying out the research include a setting, a sample, research personnel and possibly money for supplies and/or instruments. The research plan should be sufficiently shared with administrative personnel from the selected site to gain their approval. It is helpful to communicate some idea of the time schedule for the research to interested personnel. Anticipated costs should have been estimated and funds should be available at the beginning to ensure smooth progress.

Just as it is important to gain the support of the administrative personnel for the research project, so it is important to share the findings of the study with them when the study has been completed. If the findings of the study contribute to improved patient care, better organizational planning, etc., the researcher may wish to participate in the application of the findings.

6. REVIEW OF SELECTED DATA COLLECTION METHODS

Many techniques for gathering data exist. It is beyond the scope of this paper to list or review more than a few. Descriptions of the various techniques can be found in the literature on research methodology.

Some of the common techniques for collecting data are observation, interview, questionnaire and measurement, such as the use of instruments.

Observation

Observation ranges from the documentation of events and phenomena on a scale or specially constructed checklist to unstructured observations allowing maximum freedom in judging the event. The former has the advantage of objectivity; the latter may identify data not included previously in the understanding of the event or phenomena. It is important for the beginning researcher to have a format, with precise definitions and examples, for recording observations clearly.

Interview

Interviews vary from the highly structured to the completely unstructured. In the former, the interviewer reads the questions and records the answers. In the latter, the interviewer must be especially skilful in asking questions and probing for additional information. Here again, the beginning researcher profits from a more structured interview since the data are easier to analyse. Questions which cannot be answered by "yes" or "no" generally yield more useful information.

Questionnaire

A questionnaire is a list of questions usually relating to factual information, but sometimes requiring answers to open-ended questions about opinions and/or impressions. The advantage of the questionnaire is its low cost and wide coverage. In addition, the carefully developed questionnaire can be organized in such a way that it is practically coded when it is returned.

Use of instruments

When instruments are used to collect data, it is imperative that the researcher be thoroughly familiar with their use and with the means of recording data. The thermometer and sphygmomanometer are simple examples; more complex are devices to measure palmar sweat.

Written testing instruments

Psychological and sociological paper-and-pencil tests are commonly used in nursing research. They measure such items as personality characteristics, intelligence, and attitudes. Usually they have been constructed and validated by someone else, and include instructions for use and interpretation by means of comparative scales.

7. SUMMARY

It was Brotherson² who said, in 1960, ". . . an urgent and understanding sense of the need for research should be a part of the mental equipment of every member of any profession worthy of the name". This paper represents one attempt to explain the research process utilizing nursing care examples.

The research process has been described according to two major components: conceptual and factual.

The first part of the process was labelled conceptual, referring to the mental or cognitive acts of thinking,

reasoning and arranging facts into systematic and logical order. Relationships between facts, concepts, principles and theories were explored since they provide the base of knowledge for nursing care.

The second part of the research process was labelled factual. Facts were defined as observations with which other observers agree. Facts are observations made in the real world. In research, the factual information that is collected to answer the research question is called data.

The entire research process is one of interweaving the conceptual or thinking component with the factual or "real world" part of research. One part does not necessarily precede the other; they are integrated, but for purposes of clarity they have been discussed separately.

The main goal of the nursing profession is to provide high-quality nursing care to people of the world. Understanding research in nursing can make us more aware of questions to be asked and more cognizant of the research findings of others. Understanding that research in nursing begins by asking questions and proceeds by collecting information to answer the questions should ultimately improve nursing care.

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