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3 Research Problems and Hypotheses

Key Terms

conceptual definitions
dependent variable
directional hypothesis
hypothesis
independent variable
nondirectional hypothesis
operational definitions
population
problem statement
research hypothesis
research problem
research question
statistical hypothesis
testability
theory
variables

Learning Outcomes

After reading this chapter, the student should be able to do the following:

- Describe how the problem statement and hypothesis relate to the other components of the research process.
- Describe the process of identifying and refining a research problem.
- Identify the criteria for determining the significance of a research problem.
- Identify the characteristics of research problems and hypotheses.
- Describe the advantages and disadvantages of directional and nondirectional hypotheses.
- Compare and contrast the use of statistical vs. research hypotheses.
- Discuss the appropriate use of research questions vs. hypotheses in a research study.
- Identify the criteria used for critiquing a research problem and hypothesis.
- Apply the critiquing criteria to the evaluation of a research problem and hypothesis in a research report.

When nurses ask questions such as, "Why are things done this way?", "I wonder what would happen if. . . ?", "What characteristics are associated with. . . ?", or "What is the effect of . . . on patient outcomes?", they are often well on their way to developing a research problem, question, or hypothesis.

Formulating the research problem and developing the **research question** or hypotheses are key preliminary steps in the research process. The **research problem,** often called a **problem statement,** presents the question that is to be asked in the study and is the foundation of the research study. The **hypothesis** attempts to answer the question posed by the research problem.

Hypotheses can be considered intelligent hunches, guesses, or predictions that help researchers seek the solution or answer to the research question. Hypotheses are a vehicle for testing the validity of the theoretical framework assumptions and provide a bridge between **theory** and the real world. In the scientific world, researchers derive hypotheses from theories and subject them to empirical testing. A theory's validity is not directly examined. Instead, it is through the hypotheses that the merit of a theory can be evaluated.

Research consumers rarely see a formal statement of the research problem in a research article because this is part of the "groundwork" involved in developing the research study. More commonly, readers find research questions or hypotheses in a research article, but because of space constraints or stylistic considerations in such publications, they may be embedded in the purpose, aims, goals, or even in the results section of the research report. Nevertheless, it is equally important for both the consumer and producer of research to understand the importance of the research problem, research questions, and hypotheses as the foundational elements of the research study. This chapter provides a working knowledge of quantitative research problems, research questions, and hypotheses, as well as the standards for writing them and a set of criteria for evaluating them.

DEVELOPING AND REFINING A RESEARCH PROBLEM

A researcher spends a great deal of time refining a research idea into a testable research problem. Unfortunately, the evaluator of a research study is not privy to this creative process because it occurs during the study's conceptualization. The final problem statement usually does not appear in the research article unless the study is qualitative rather than quantitative (see Chapters 6, 7, and 8). Although this section will not teach you how to formulate a research problem, it is important to provide a glimpse of what the process of developing a research problem may be like for a researcher.

As illustrated in Table 3-1, research problems or topics are not pulled from thin air. Research problems should indicate that practical experience, critical appraisal of the scientific literature, or interest in an untested theory has provided the basis for the generation of a research idea. The problem statement should reflect a refinement of the researcher's initial thinking. The evaluator of a research study should be able to discern that the researcher has done the following:

1. Defined a specific problem area.
2. Reviewed the relevant scientific literature.
3. Examined the problem's potential significance to nursing.
4. Pragmatically examined the feasibility of studying the research problem.

DEFINING THE PROBLEM AREA

Brainstorming with teachers, advisors, or colleagues may provide valuable feedback that helps the researcher focus on a specific problem area. For example, suppose a researcher told a colleague that the area of interest was adaptation of children faced with stressful experiences. The colleague may have said, "What is it about the topic that specifically interests you?" Such a conversation may have initiated a chain of thought that resulted in a decision to explore the adaptation processes of families faced with stressful

TABLE **3-1** How Practical Experience, Scientific Literature, and Untested Theory Influence the Development of a Research Idea

AREA	INFLUENCE	EXAMPLE
Practical experience	Clinical practice provides a wealth of experience from which research problems can be derived. The nurse may observe the occurrence of a particular event or pattern and become curious about why it occurs, as well as its relationship to other factors in the patient's environment.	Although breast self-examination (BSE) has long been recommended by nurses and other health care providers as a complement to mammography and clinical breast examination, only a small percentage of U.S. women report doing a monthly BSE, and nurses observe that an even smaller percentage of women perform this health-promotion self-care procedure proficiently. Nurses working in a women's health center speculate about the effect of a structured training protocol on improving thoroughness of search using two dimensions of BSE technique (i.e., depth of palpation and duration of the BSE examination in each of two search patterns [vertical strip and concentric circle]) using biomedical instrumentation (Leight et al, 2000).
Critical appraisal of the scientific literature	The critical appraisal of research studies that appears in journals may indirectly suggest a problem area by stimulating the reader's thinking. The nurse may observe the outcome data from a single study or a group of related studies that provide the basis for developing a pilot study or quality improvement project to determine the effectiveness of this intervention in their own practice setting.	At a staff meeting where cost-effectiveness was being discussed, a nurse reported that she had read an article indicating that comprehensive discharge planning and home follow-up for hospitalized elders at risk for readmission by advanced practice nurses have demonstrated short-term reductions in readmissions of elderly patients. At 24 weeks after discharge, Medicare reimbursements for health services were about $1.2 million in the control group vs. about $0.6 million for the intervention group. There were no significant differences in post-discharge acute care visits, functional status, depression, or patient satisfaction. Another nurse said that other articles on file indicated that this model had been studied using other patient populations (i.e., very–low-birthweight babies, women having hysterectomies and unplanned cesarean births) with similar quality and cost-effectiveness outcomes (Naylor et al, 1999). The group agreed that there was a sufficient body of related research findings to use in defining their own problem focus.

Continued

TABLE **3-1** How Practical Experience, Scientific Literature, and Untested Theory Influence the Development of a Research Idea—cont'd

AREA	INFLUENCE	EXAMPLE
Gaps in the literature	A research idea may also be suggested by a critical appraisal of the literature that identifies gaps in the literature and suggests areas for future study. Research ideas also can be generated by research reports that suggest the value of replicating a particular study to extend or refine the existing scientific knowledge base.	A nurse who had just begun working in an obstetrics clinic observed that the impact of miscarriage on the well-being of women was not a focus of attention after the miscarriage was over. She wondered whether the partners' emotional concerns (especially those related to loss, depression, and anxiety) and feelings of well-being had even been examined. Where the literature is reviewed relative to this topic, no controlled research studies are identified that demonstrated the significant effects of counseling with women who miscarry to provide a scientific basis for determining the value of caring-based counseling (early or delayed) on the integration of loss and women's emotional well-being (i.e., self-esteem and moods) in the first year subsequent to miscarrying (Swanson, 1999).
Interest in untested theory	Verification of an untested nursing theory provides a relatively uncharted territory from which research problems can be derived. Inasmuch as theories themselves are not tested, a researcher may think about investigating a particular concept or set of concepts related to a particular nursing theory. The deductive process would be used to generate the research problem. The researcher would pose questions such as, "If this theory is correct, what kind of behavior will I expect to observe in particular patients and under which conditions?" or "If this theory is valid, what kind of supporting evidence will I find?"	Development of theoretical models that are derived from nursing and related literature are conducted to provide empirical support for the accuracy of a specific theoretical model that examines the fit between the hypothesized model and the data. Using social cognitive theory, a nurse researcher sought to understand how social cognitive constructs operate together to explain condom use behavior among college students. This understanding would be useful in developing HIV and sexually transmitted disease (STD) prevention programs for college students. An estimated structural model of condom use behavior developed from the literature was tested. Overall, the findings lend support to a condom use model based on social cognitive theory, which suggests that interventions focusing on self-efficacy and reducing anxiety related to condom use increases positive perceptions about condoms and the likelihood of adopting condom use behaviors (Dilorio et al, 2000).

health care experiences (e.g., their child's need for organ transplantation). Figure 3-1 illustrates how a broad area of interest (adaptation of families faced with stressful health care experiences) was narrowed to a specific research topic (adaptation of families faced with stressful health care experiences such as their child's need for organ transplantation).

BEGINNING THE LITERATURE REVIEW

The literature review should reveal that the literature relevant to the problem area has been critically examined. Concluding sections on the recommendations and implications for practice often identify remaining gaps in the literature, the need for replication, or the need for extension of the knowledge base about a particular research focus (see Chapter 4). In the previous example about family adaptation to a child's having an organ transplant, the researcher may have conducted a preliminary review of books and journals for theories and research studies on factors apparently critical to how families adapt to the process of their child having an organ transplant. These factors, called **variables** in research language, should be potentially relevant, of interest, and measurable.

Possible relevant factors mentioned in the literature begin with an exploration of the relationship between family variables of stress, perception of stress, coping, social support, and adaptation. Other variables, such as demographical characteristics of children and their parents, the transplant process, and the phase of the transplant process, are also suggested as essential to consider. This information can then be used by the researcher to further define the research problem, address a gap in the literature, as well as extend the knowledge base related to the impact of a child's organ transplant on family adjustment. At this point, the researcher could write the following tentative research problem: What is the impact of a child's organ transplant on family adaptation? Although the research problem is not yet in its final form, readers can envision the interrelatedness of the initial definition of the problem area, the literature review, and the

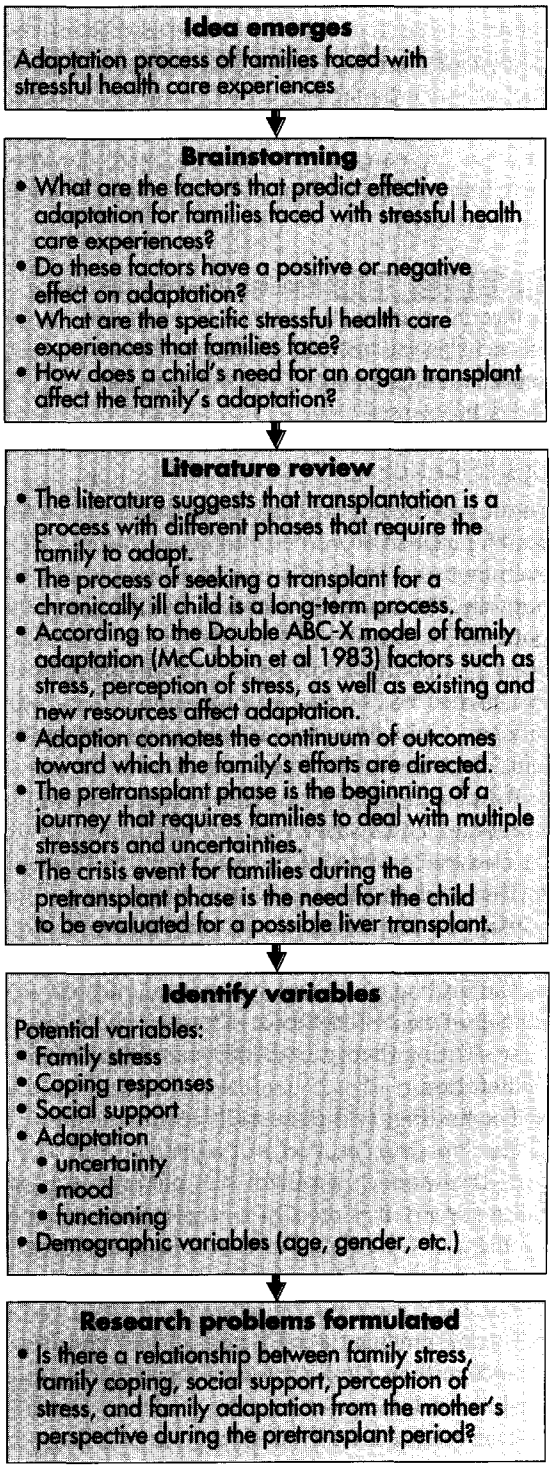


Figure 3-1 Development of a research problem.

refined research problem. Readers of research reports examine the end product of this process in the form of a research question and/or hypothesis, so it is important to have an appreciation of how the researcher gets to that point in constructing a study (LoBiondo-Wood et al, 2000; see Appendix D).

HELPFUL HINT **Reading the literature review or theoretical framework section of a research article helps you trace the development of the implied research problem, research question, and/or hypothesis.**

SIGNIFICANCE

Before proceeding to a final development of the research problem, it is crucial that the researcher has examined the problem's potential significance to nursing. The research problem should have the potential to contribute to and extend the scientific body of nursing knowledge. The problem does not have to be of prize-winning caliber to be significant. Guidelines for selecting research problems should meet the following criteria:

- Patients, nurses, the medical community in general, and society will potentially benefit from the knowledge derived from the study.
- The results will be applicable for nursing practice, education, or administration.
- The results will be theoretically relevant.
- The findings will lend support to untested theoretical assumptions, extend or challenge an existing theory, or clarify a conflict in the literature.
- The findings will potentially formulate or alter nursing practices or policies.

If the research problem has not met any of these criteria, it is wise to extensively revise the problem or discard it. For example, in the previously cited research problem, the significance of the problem includes the following facts:

- Organ transplantation is stressful for children and/or their families, taxing their coping skills and resources.
- Transplantation affects all aspects of individual and family life and requires families to deal with multiple stressors and uncertainties.
- Health care providers do not assess the needs of families coping with the organ transplantation process effectively.
- The perception of stress, coping, and social support may be of prime importance in family adaptational outcomes.
- This study sought to fill a gap in the related literature by beginning the exploration of the relationship between family variables of stress, perception of stress, coping, social support, and family adaptation from the mother's perspective during the pretransplantation period.
- This study sought to extend the knowledge base about this phenomenon, thereby providing a foundation for the development and testing of interventions.

FEASIBILITY

The feasibility of a research problem must be pragmatically examined. Regardless of how significant or researchable a problem may be, pragmatic considerations such as time; availability of subjects, facilities, equipment, and money; experience of the researcher; and any ethical considerations may cause the researcher to decide that the problem is inappropriate because it lacks feasibility (see Chapters 6, 9, and 13).

THE FULLY DEVELOPED RESEARCH PROBLEM

A research problem may be written in declarative or interrogative form (Table 3-2). Both are acceptable formats. The style chosen is largely a function of the researcher's preference. A good research problem exhibits the following three characteristics:

- It clearly identifies the variables under consideration.
- It specifies the population being studied.
- It implies the possibility of empirical testing.

Because each of these elements is crucial to the formulation of a satisfactory research problem, the criteria will be discussed in greater detail.

TABLE **3-2** Components of the Research Problem and Related Criteria

VARIABLES	POPULATION	TESTABILITY
Independent variable: • Family stress • Coping responses • Social support Dependent variable: Adaptation	Mothers faced with their child's liver transplant during the pretransplant period	Differential effect of stress, coping, and social support on adaptation

VARIABLES

Researchers call the properties that they study **variables.** Such properties take on different values. Thus a variable is, as the name suggests, something that varies. Properties that differ from each other, such as age, weight, height, religion, and ethnicity, are examples of variables. Researchers attempt to understand how and why differences in one variable relate to differences in another variable. For example, a researcher may be concerned about the variable of pain in postoperative patients. It is a variable because not all postoperative patients have the same amount of pain—or any pain at all. A researcher may also be interested in what other factors can be linked to postoperative pain. It has been discovered that anxiety is associated with pain. Thus anxiety is also a variable, because not all postoperative patients have the same amount of anxiety—or any anxiety at all.

When speaking of variables, the researcher is essentially asking, "Is **X** related to **Y**? What is the effect of **X** on **Y**? How are $\mathbf{X}_1$ and $\mathbf{X}_2$ related to **Y**?" The researcher is asking a question about the relationship between one or more independent variables and a dependent variable.*

An **independent variable,** usually symbolized by **X**, is the variable that has the presumed effect on the dependent variable. In experimental research studies, the researcher manipulates the independent variable. For example, a nurse may study how different methods of administering pain medication affect the patient's perception of pain. The researcher may manipulate the independent variable (i.e, the method of administering pain medication) by using nurse- vs. patient-controlled administration of analgesia (see Chapter 10). In nonexperimental research, the independent variable is not manipulated and is assumed to have occurred naturally before or during the study. For example, the researcher may be studying the relationship between the level of anxiety and the perception of pain. The independent variable—the level of anxiety—is not manipulated; it is just presumed to occur and is observed and measured as it naturally happens (see Chapter 11).

The **dependent variable,** represented by **Y**, is often referred to as the consequence or the presumed effect that varies with a change in the independent variable. The dependent variable is not manipulated. It is observed and assumed to vary with changes in the independent variable. Predictions are made from the independent variable to the dependent variable. It is the dependent variable that the researcher is interested in understanding, explaining, or predicting. For example, it might be assumed that the perception of pain (i.e., the dependent variable) will vary with changes in the level of anxiety (i.e., the independent variable). In this case, we are trying to explain the perception of pain in relation to the level of anxiety.

Although variability in the dependent variable is assumed to depend on changes in the independent variable, this does not imply that there is a causal relationship between **X** and **Y** or that changes in variable **X** cause variable **Y** to change. Let us look at an example in which nurses' attitudes toward patients with tuberculosis were

*In cases in which multiple independent or dependent variables are present, subscripts are used to indicate the number of variables under consideration.

TABLE **3-3** Research Problem Format

TYPE	FORMAT	EXAMPLE
QUANTITATIVE EXPERIMENTAL		
Correlational	Is there a relationship between **X** (independent variable) and **Y** (dependent variable) in the specified population?	Is there a correlation between trait anger and adolescent general well-being?
Comparative nonexperimental	Is there a difference in **Y** (dependent variable) between people who have **X** characteristic (independent variable) and those who do not have **X** characteristic?	Is there a difference in family adaptation between families facing their child's organ transplant who have fewer coping skills compared with those who have more coping skills?
Quantitative experimental	Is there a difference in **Y** (dependent variable) between Group A who received **X** (independent variable) and Group B who did not receive **X**?	Is there a difference in perception of pain for patients using patient-controlled analgesia (PCA) and those receiving nurse-administered analgesia?
QUALITATIVE		
Phenomenological	What is/was it like to have **X**?	What was it like to have a bone marrow transplant?

studied. The researcher discovered that older nurses had a more negative attitude about patients with tuberculosis than younger nurses. The researcher did not conclude that the nurses' negative attitudes toward patients with tuberculosis were because of their age, but at the same time it is apparent that there is a directional relationship between age and negative attitudes about patients with tuberculosis. That is, as the nurses' ages increase, their attitudes about patients with tuberculosis become more negative. This example highlights the fact that causal relationships are not necessarily implied by the independent and dependent variables; rather, only a relational statement with possible directionality is proposed. Table 3-3 presents a number of examples to help you learn how to write research problems. Practice substituting other variables for the examples in Table 3-3. You will be surprised at the skill you develop in writing and critiquing research problems with greater ease.

Although one independent and one dependent variable are used in the examples just given, there is no restriction on the number of variables that can be included in a research problem. Remember, however, that problems should not be unnecessarily complex or unwieldly, particularly in beginning research efforts. Research problems that include more than one independent or dependent variable may be broken down into subproblems that are more concise.

Finally, it should be noted that variables are not inherently independent or dependent. A variable that is classified as independent in one study may be considered dependent in another study. For example, a nurse may review an article about sexual behaviors that are predictive of risk for HIV/AIDS. In this case, HIV/AIDS is the dependent variable. When another article about the relationship between HIV/AIDS and maternal parenting practices is considered, HIV/AIDS status is the independent variable. Whether a variable is independent or dependent is a function of the role it plays in a particular study.

POPULATION

The **population** being studied must be specified in the research problem. If the scope of the problem has been narrowed to a specific focus and the variables have been clearly identified, the nature of the population will be evident to the reader of a research report. For example, a research problem that poses the question, "Is there a relationship between the type of dis-

charge planning for elders hospitalized with heart failure and the caregivers?" suggests that the population under consideration includes elders hospitalized for heart failure and their caregivers. It is also implied that some of the elders and their caregivers were involved in a professional-patient partnership model of discharge planning in contrast to other elders who received the usual discharge planning. The researcher or reader will have an initial idea of the composition of the study population from the outset (see Chapter 12).

TESTABILITY

The statement of the research problem must imply that the problem is **testable;** that is, measurable by either qualitative or quantitative methods. For example, the research problem "Should postoperative patients control how much pain medication they receive?" is stated incorrectly for a variety of reasons. One reason is that it is not testable; it represents a value statement rather than a relational problem statement. A scientific or relational problem must propose a relationship between an independent and a dependent variable and do this in such a way that it indicates that the variables of the relationship can somehow be measured. Many interesting and important questions are not valid research problems because they are not amenable to testing.

The question "Should postoperative patients control how much pain medication they receive?" could be revised from a philosophic question to a research question that implies testability. Two examples of the revised research problem might be the following:

- Is there a relationship between patient-controlled analgesia (PCA) vs. nurse-administered analgesia and perception of postoperative pain?
- What is the effect of PCA on pain ratings by postoperative patients?

These examples illustrate the relationship between the variables, identify the independent and dependent variables, and imply the testability of the research problem.

Now that the elements of the formal research problem have been presented in greater detail, this information can be integrated by formulating a formal research problem about the adaptation of families faced with stressful health care experiences (e.g., their child's need for organ transplantation). Earlier in this chapter, the following unrefined research problem was formulated: What is the effect of a child's organ transplant on family adaptation? This problem statement was originally derived from a general area of interest—the adaptation of families faced with stressful health care experiences. The topic was more specifically defined by delineating a particular problem area—the adaptation of families facing stressful health care experiences (e.g., their child's need for organ transplantation). The problem crystallized further after a preliminary literature review and emerged in the unrefined form just given. With the four criteria inherent in a satisfactory research problem, it is now possible to propose a refined research problem; that is, one that specifically states the problem in question form and specifies the relationship of the key variables in the study, the population being studied, and the empirical testability of the problem. Congruent with these three criteria, the following research problem can then be formulated: Is there a relationship between family stress, family coping, social support, perception of stress, and family adaptation from the mother's perspective during the pretransplant period (LoBiondo-Wood et al, 2000)? Table 3-2 identifies the components of this research problem as they relate to and are congruent with the three research problem criteria.

STATEMENT OF THE PROBLEM IN PUBLISHED RESEARCH

A formal research problem is not included in most current research articles. Formal research problems are used in developing grant proposals, theses, and dissertations when greater detail is required. A statement of purpose, which is usually stated in the introductory paragraph or at the beginning or end of the literature review section,

is used more commonly in articles. As such, it is important for research consumers to be clear about the difference between these two components of the research process.

HELPFUL HINT **Remember that research problems are often not explicitly stated. The reader has to infer the research problem from the title of the report, the abstract, the introduction, or the purpose.**

PURPOSE STATEMENT

The purpose of the study encompasses the aims or goals the investigator hopes to achieve with the research, not the problem to be solved. For example, a nurse working with rehabilitation patients with bladder dysfunction may be disturbed by the high incidence of urinary tract infections. The nurse may propose the following research question: "What is the optimum frequency of changing urinary drainage bags in patients with bladder dysfunction to reduce the incidence of urinary tract infection?" If this nurse were to design a study, its purpose might be to determine the differential effect of a 1-week and 4-week urinary drainage bag change schedule on the incidence of urinary tract infections in patients with bladder dysfunction. The purpose communicates more than just the nature of the problem. Through the researcher's selection of verbs, the purpose statement suggests the manner in which the researcher sought to study the problem. Verbs like *discover, explore,* or *describe* suggest an investigation of a little researched topic that might appropriately be guided by research questions rather than hypotheses. In contrast, verb statements indicating that the purpose is to test the effectiveness of an intervention or compare two alternative nursing strategies suggest a study with a better-established knowledge base that is hypothesis testing in nature. Box 3-1 provides other examples of purpose statements.

HELPFUL HINT **The purpose statement often provides the most information about the intent of the research problem and hypotheses.**

BOX 3-1 Examples of Purpose Statements

- The purpose of this study was to examine outcomes of the existing brief psychiatric treatment program (Tucker, Moore, and Luedtke, 2000).
- The aim of this study was to determine whether a nursing intervention could reduce the transfer anxiety experienced by parents when they are faced with the imminent transfer of their child from the PICU to the general pediatric floor (Bouve, Rozmus, and Giordano, 1999).
- The purpose of this study was to examine women's concerns about recovery from CABG and about living with CAD (King, Rowe, and Zerwic, 2000).
- The objective of the present study was to examine the effectiveness of an advanced practice nurse-centered discharge planning and home follow-up intervention for elders at risk for hospital readmission (Naylor et al, 1999).
- The purpose of this study was to test an intervention to help postpartum women avoid or manage smoking lapses, thereby enhancing their likelihood of maintaining continuous smoking abstinence and reducing their risk of daily smoking after the birth of their babies (Johnson et al, 2000).

DEVELOPING THE RESEARCH HYPOTHESES

Like the research problem, hypotheses are often not stated explicitly in a research article. The evaluator will often find that the hypotheses are embedded in the data analysis, results, or discussion section of the research report. It is then up to the reader to discern the nature of the hypotheses being tested. For example, in the study by LoBiondo-Wood and associates (2000), the hypotheses are embedded in the *Results* section of the article; the reader must interpret that the statement, "Coping as measured by the CHIP was negatively and significantly related to family adaptation," represents the hypothesis that tests the relationship between coping and adaptation in families facing their child's organ transplantation. In light of that stylistic reality, it is important to be acquainted with the components of hypotheses, how they are developed, and the standards for writing and evaluating them.

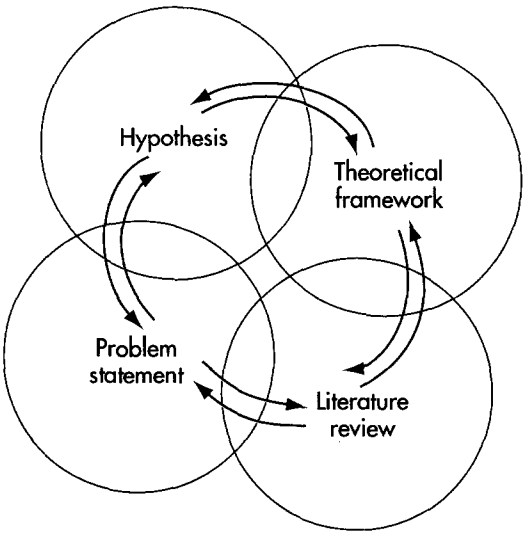


Figure 3-2 Interrelationships of problem statement, literature review, theoretical framework, and hypothesis.

Hypotheses flow from the research problem, literature review, and theoretical framework. Figure 3-2 illustrates this flow. A **hypothesis** is a statement about the relationship between two or more variables that suggests an answer to the research question. A hypothesis converts the question posed by the research problem into a declarative statement that predicts an expected outcome. It explains or predicts the relationship or differences between two or more variables in terms of expected results or outcomes of a study.

Each hypothesis represents a unit or subset of the research problem. For example, a research problem might pose the question "What is the effect of psychological distress on the initial onset/exacerbation of gastrointestinal symptoms in individuals with irritable bowel syndrome?" (Jarrett et al, 1998). This problem can be broken down into the following two subproblems:

1. What is the effect of psychological distress on the onset of gastrointestinal symptoms in individuals with irritable bowel syndrome?
2. What is the effect of psychological distress on the exacerbation of gastrointestinal symptoms in individuals with irritable bowel syndrome?

A hypothesis can then be generated for each unit of the research problem (i.e., the subproblems). The hypotheses of the research problem already mentioned might be stated in the following way:

Hypothesis 1: There will be a positive relationship between measures of recalled psychological distress and gastrointestinal symptom distress.

Hypothesis 2: There will be a positive relationship between daily psychological distress and gastrointestinal symptom distress.

The critiquer of a research report will want to evaluate whether the hypotheses of the study represent subsets of the main research problem as illustrated by the examples just given.

Hypotheses are formulated before the study is actually conducted because they provide direction for the collection, analysis, and interpretation of data. Hypotheses have the following three purposes:

1. To provide a bridge between theory and reality, in this sense, unifying the two domains.
2. To be powerful tools for the advancement of knowledge because they enable the researcher to objectively enter new areas of discovery.
3. To provide direction for any research endeavor by tentatively identifying the anticipated outcome.

HELPFUL HINT **When hypotheses are not explicitly stated by the author at the end of the *Introduction* section or just before the *Methods* section, they will be embedded or implied in the *Results* or *Discussion* sections of a research article.**

CHARACTERISTICS

Nurses who are conducting research or critiquing published research studies must have a working knowledge about what constitutes a "good" hypothesis. Such knowledge will enable them to have a standard for evaluating their own

work or the work of others. The following discussion about the characteristics of hypotheses presents criteria to be used when formulating or evaluating a hypothesis.

RELATIONSHIP STATEMENT

The first characteristic of a hypothesis is that it is a declarative statement that identifies the predicted relationship between two or more variables. This implies that there is a systematic relationship between an independent variable and a dependent variable. The direction of the predicted relationship is also specified in this statement. Phrases such as *greater than; less than; positively, negatively,* or *curvilinearly related* (i.e., shaped like ∩ or ∪); and *difference in* connote the directionality that is proposed in the hypothesis. In the following example of a directional hypothesis, "The rate of continuous smoking abstinence (dependent variable) at 6 months postpartum, based on self-report and biochemical validation, will be significantly higher in the treatment group (postpartum counseling intervention) than in the control group (independent variable)." The two variables are explicitly identified, and the relational aspect of the prediction is contained in the phrase ***significantly higher than.***

The nature of the relationship, either causal or associative, is also implied by the hypothesis. A causal relationship is one in which the researcher can predict that the independent variable **(X)** causes a change in the dependent variable **(Y).** In research, it is rare that one is in a firm enough position to take a definitive stand about a cause-and-effect relationship. For example, a researcher might hypothesize that relaxation training would have a significant effect on the physical and psychological health status of patients who have suffered myocardial infarction. It would be difficult for a researcher to predict a strong cause-and-effect relationship, however, because of the multiple intervening variables (e.g., age, medication, and lifestyle changes) that might also influence the subject's health status.

Variables are more commonly related in noncausal ways; that is, the variables are systematically related but in an associative way. This means that there is a systematic movement in the associated values of the two phenomena. For example, there is strong evidence that asbestos exposure is related to lung cancer. It is tempting to state that there is a causal relationship between asbestos exposure and lung cancer. Do not overlook the fact, however, that not all of those exposed to asbestos will have lung cancer and not all of those who have lung cancer have had asbestos exposure. Consequently, it would be scientifically unsound to take a position advocating the presence of a causal relationship between these two variables. Rather, one can say only that there is an associative relationship between the variables of asbestos exposure and lung cancer, a relationship in which there is a strong systematic association between the two phenomena.

TESTABILITY

The second characteristic of a hypothesis is its **testability.** This means that the variables of the study must lend themselves to observation, measurement, and analysis. The hypothesis is either supported or not supported after the data have been collected and analyzed. The predicted outcome proposed by the hypothesis will or will not be congruent with the actual outcome when the hypothesis is tested. Hypotheses advance scientific knowledge by confirming or refuting theories.

Hypotheses may fail to meet the criteria of testability because the researcher has not made a prediction about the anticipated outcome, the variables are not observable or measurable, or the hypothesis is couched in terms that are value-laden. Table 3-4 illustrates each of these points and provides a remedy for each problem.

HELPFUL HINT **When a hypothesis is complex (i.e., it contains more than one independent or dependent variable), it is difficult for the findings to indicate unequivocally that the hypothesis is supported or not supported. In such cases, the reader must infer which relationships are significant in the predicted direction from the *Findings* or *Discussion* section.**

TABLE **3-4** Hypotheses that Fail to Meet Criteria of Testability

PROBLEMATIC HYPOTHESIS	PROBLEMATIC ISSUE	REVISED HYPOTHESIS
Social support related to adaptation.	No predictive statement about the relationship is made; so the relationship is not verifiable.	Social support is positively related to adaptation.
Patients who receive preoperative instruction have less postoperative stress than have patients who do not.	The "postoperative stress" variable must be specifically defined so that it is observable or measurable, or the relationship is not testable.	Patients who attend preoperative education classes have less postoperative emotional stress than patients who do not attend.
Small-group teaching will be better than individualized teaching for dietary compliance in patients with coronary artery disease (CAD).	"Better than" is a value-laden phrase that is not objective. Moral and ethical questions containing words such as *should, ought, better than,* and *bad for* are not scientifically testable.	Dietary compliance will be greater in patients with CAD receiving diet instruction in small groups than in CAD patients receiving individualized diet instruction.
Nurses' attitudes toward patients with AIDS cause changes in the patients' mood state.	Causal relationships are proposed without sufficient evidence.	Nurses' attitudes toward AIDS patients will be positively related to the emotional status of the AIDS patient.

THEORY BASE

A sound hypothesis is consistent with an existing body of theory and research findings. Whether a hypothesis is arrived at inductively or deductively (see Chapter 5), it must be based on a sound scientific rationale. Readers should be able to identify the flow of ideas from the research problem to the literature review, to the theoretical framework, and through the research question(s) or hypotheses (see Chapters 4 and 5). Table 3-5 illustrates this process in relation to the research problem, "What is the effect of a child's need for organ transplantation on family adapatation?" (LoBiondo-Wood et al, 2000; see Appendix D). In this example, it is clear that there is an explicitly developed, relevant body of scientific data that provides the theoretical grounding for the study. The hypotheses, as stated in Table 3-5, are logically derived from the theoretical framework. The research consumer, however, should be cautioned about assuming that the theory-hypothesis link will always be present.

WORDING THE HYPOTHESIS

As you read the scientific literature and become more familiar with it, you will observe that there are a variety of ways to word a hypothesis. Regardless of the specific format used to state the hypothesis, the statement should be worded in clear, simple, and concise terms. If this criterion is met, the reader will understand the following:

- The variables of the hypothesis.
- The population being studied.
- The predicted outcome of the hypothesis.

Information about hypotheses may be further clarified in the *Instruments, Sample,* or *Methods* sections of a research report (see Chapters 12, 14, and 15).

DIRECTIONAL VS. NONDIRECTIONAL HYPOTHESES

Hypotheses can be formulated directionally or nondirectionally. A **directional hypothesis** is one that specifies the expected direction of the relationship between the independent and dependent

TABLE **3-5** Flow of Data among Problem Statement, Literature Review, Theoretical Framework, and Hypotheses

PROBLEM	LITERATURE REVIEW	THEORETICAL FRAMEWORK	HYPOTHESES
What is the effect on family adaptation of a child's need for organ transplantation?	1. Studies related to the impact of the child's liver transplant on the mother during the post operative period as a significant variable influencing adaptation. 2. A study related to the description of the feelings of parents whose children had or were awaiting a heart or liver transplant that contribute to understanding the family coping process related to this phenomenon. 3. The Double ABC-X Model of Family Adaptation proposes that factors such as stress, perception of stress, resources, and coping responses would be variables that contribute to family adaptation. 4. The pretransplant phase has not been studied in relation to these variables.	1. Gap in the literature related to the impact of a child's organ transplant during the preoperative stage. 2. The process of seeking a transplant for a chronically ill child is a long-term process that has identifiable phases. 3. The definition of stress and stressors is a perceptual experience derived from the meaning that family members give. Stress is evidenced by uncertainty, mood, and functioning. 4. Existing and new resources include social support as manifested by the family's ability to meet its demands and needs, as well as include existing and expanded family support and resources. 5. How family members cope is related to their adaptation. 6. Family adaptation is the component of the ABC-X framework that denotes the continuum of outcomes toward which the family's efforts are directed.	1. Coping was predicted to be positively related to adaptation. 2. Overall family stress was predicted to be negatively related to adaptation. 3. Resources were predicted to be positively related to adaptation. 4. Perception of stress, as evidenced by mood state, was predicted to be negatively related to adaptation. 5. Perception of stress, as evidenced by uncertainty, was predicted to be negatively related to adaptation.

variables. The reader of a directional hypothesis may observe not only that a relationship is proposed but also the nature or direction of that relationship. The following is an example of a directional hypothesis: "Trait anger and state anger each are positively related to change in early adolescents"(Mahon, Yarcheski, and Yarcheski, 2000). Examples of directional hypotheses can also be found in examples 2 to 5, 6, and 7 in Table 3-6.

Whereas a **nondirectional hypothesis** indicates the existence of a relationship between the variables, it does not specify the anticipated direction of the relationship. The following is an example of a nondirectional hypothesis: "Client satisfaction with discharge planning, perceptions of care continuity, and preparedness, as well as difficulties managing care will differ for the intervention and control cohorts" (Bull, Hansen, and Gross, 2000). Other examples of nondirectional hypotheses are illustrated in examples 1 and 8 in Table 3-6.

Nurses who are learning to critique research studies should be aware that both the directional and nondirectional forms of hypotheses statements are acceptable. They should also be aware that there are definite pros and cons pertaining to each one.

Proponents of the nondirectional hypothesis state that this format is more objective and impartial than the directional hypothesis. It is argued that the directional hypothesis is potentially biased, because the researcher, in stating an

TABLE **3-6** Examples of How Hypotheses Are Worded

HYPOTHESIS	VARIABLES*	TYPE OF HYPOTHESIS	TYPE OF DESIGN SUGGESTED
1. There will be a difference in fatigue between two groups of caregivers of preterm infants (i.e., on vs. not on apnea monitors) during three time periods (i.e., prior to discharge, 1 week post-discharge, and 1 month post-discharge).	IV: Apnea monitor DV: Fatigue	Nondirectional, research	Nonexperimental
2. There will be a positive relationship between phase-specific telephone counseling and emotional adjustment in women with breast cancer and their partners.	IV: Telephone counseling DV: Emotional adjustment	Directional, research	Experimental
3. There will be a greater decrease in state anxiety scores for patients receiving structured informational videos prior to abdominal or chest tube removal than for patients receiving standard information.	IV: Preprocedure structured videotape information IV: Standard information DV: State anxiety	Directional, research	Experimental
4. The incidence and degree of severity of subject discomfort will be less after administration of medications by the Z-track intramuscular injection technique than after administration of medications by the standard intramuscular injection technique.	IV: Z-track intramuscular injection technique IV: Standard intramuscular injection technique DV: Subject discomfort	Directional, research	Experimental
5. Specialized oncology home care services provided to terminally ill patients will have a positive effect on bereavement psychological distress among survivors compared with other models of care.	IV: Specialized oncology home care services IV: Other models of care DV: Bereavement psychological distress	Directional, research	Experimental
6. Hospitals with higher registered nurse-to-patient ratios will have fewer adverse patient events.	IV: Registered nurse-to-patient ratio DV: Adverse patient events	Directional, research	Nonexperimental
7. There will be a positive effect from a social support, boosting intervention on levels of stress, coping and social support among caregivers of children with HIV/AIDs.	IV: Social support boosting intervention DV: Stress DV: Coping DV: Social support	Directional, research	Experimental
8. There will be a difference in posttest state anxiety scores in subjects treated with noncontact therapeutic touch than in subjects treated with contact therapeutic touch.	IV: Noncontact therapeutic touch IV: Contact therapeutic touch DV: State anxiety	Nondirectional, research	Experimental

*IV, Independent variable: DV, dependent variable

anticipated outcome, has demonstrated a commitment to a particular position.

On the other side of the coin, proponents of the directional hypothesis argue that researchers naturally have hunches, guesses, or expectations about the outcome of their research. It is the hunch, the curiosity, or the guess that initially leads them to speculate about the problem. The literature review and the conceptual framework provide the theoretical foundation for deriving the hypothesis. Consequently, it might be said that a deductive hypothesis derived from a theory is most always directional (see Chapter 5). The theory will provide a critical rationale for proposing that relationships between variables will have particular outcomes. When there is no theory or related research to draw on for rationale or when findings in previous research studies are ambivalent, a nondirectional hypothesis may be appropriate.

In summary, the evaluator of a hypothesis should know that there are several advantages to directional hypotheses, making them appropriate for use in most studies. The advantages are as follows:

- Directional hypotheses indicate to the reader that a theory base has been used to derive the hypotheses and that the phenomena under investigation have been critically thought about and interrelated. The reader should realize that nondirectional hypotheses may also be deduced from a theory base. Because of the exploratory nature of many studies utilizing nondirectional hypotheses, however, the theory base may not be as developed.
- They provide the reader with a specific theoretical frame of reference, within which the study is being conducted.
- They suggest to the reader that the researcher is not sitting on a theoretical fence, and as a result, the analyses of data can be accomplished in a statistically more sensitive way.

The important point for the critiquer to keep in mind about the directionality of the hypotheses is whether there is a sound rationale for the choice the researcher has proposed regarding directionality.

STATISTICAL VS. RESEARCH HYPOTHESES

Readers of research reports may observe that a hypothesis is further categorized as either a research or a statistical hypothesis. A **research hypothesis,** also known as a scientific hypothesis, consists of a statement about the expected relationship of the variables. A research hypothesis indicates what the outcome of the study is expected to be. A research hypothesis is also either directional or nondirectional. If the researcher obtains statistically significant findings for a research hypothesis, the hypothesis is supported. For example, in a study exploring the relative effectiveness of one intervention, Coping Skills Training (CST), Grey and associates (1999) hypothesized that diabetic adolescents who participated in CST would have better metabolic control and psychosocial outcomes than adolescents who received routine intensive management. The authors reported that after 6 months, subjects who had received CST combined with intensive management had significantly better metabolic control (HbA1c) and general self-efficacy than subjects who received intensive therapy alone. Subjects reported significantly less negative impact from diabetes on their quality of life and had fewer worries about diabetes. As such, the hypothesis is supported; that is, the study findings supported the predicted outcome. The examples in Table 3-6 represent research hypotheses.

A **statistical hypothesis,** also known as a null hypothesis, states that there is no relationship between the independent and dependent variables. The examples in Table 3-7 illustrate statistical hypotheses. If, in the data analysis, a statistically significant relationship emerges between the variables at a specified level of significance, the null hypothesis is rejected. Rejection of the statistical hypothesis is equivalent to acceptance of the research hypothesis. For example, in the study by Swanson (1999), the effects of caring-based counseling, measurement, and time on the integration of loss (i.e., miscarriage loss) and women's emotional well-being (i.e., moods and self-esteem) were tested using a statistical or null hypothesis. One example of a null hypothesis is "There will be

TABLE **3-7** Examples of Statistical Hypostheses

HYPOTHESIS	VARIABLES*	TYPE OF HYPOTHESIS	TYPE OF DESIGN SUGGESTED
Oxygen inhalation by nasal cannula of up to 6 L/min does not affect oral temperature measurement taken with an electronic thermometer.	IV: Oxygen inhalation by nasal cannula DV: Oral temperature	Statistical	Experimental
There will be no difference in the performace accuracy of adult nurse practitioners (ANP) and family nurse practitioners (FNP) in formulating accurate diagnoses and acceptable interventions for suspected cases of domestic violence.	IV: Nurse Practitioner (ANP or FNP) category DV: Diagnosis and intervention performace accuracy	Statistical	Non-experimental

**IV,* Independent variable; *DV,* dependent variable.

no difference in miscarriage impact, disturbed moods, or self-esteem at 4 months and 1 year after the loss." Swanson (1999) reported that there were significant differences in patient outcomes in relation to these variables. Because the difference in outcomes was greater than expected by chance, the null hypothesis was rejected (see Chapter 17).

Some researchers refer to the null hypothesis as a statistical contrivance that obscures a straightforward prediction of the outcome. Others state that it is more exact and conservative statistically, and that failure to reject the null hypothesis implies that there is insufficient evidence to support the idea of a real difference. Readers of research reports will note that when hypotheses are stated, research hypotheses are generally used more often than statistical hypotheses because they are more desirable to state the researcher's expectation. Readers then have a more precise idea of the proposed outcome. In any study that involves statistical analysis, the underlying null hypothesis is usually assumed without being explicitly stated.

RELATIONSHIP BETWEEN THE HYPOTHESIS AND THE RESEARCH DESIGN

Regardless of whether the researcher uses a statistical or a research hypothesis, there is a suggested relationship between the hypothesis and the research design of the study. The type of design, experimental or nonexperimental (see Chapters 10 and 11), will influence the wording of the hypothesis. For example, when an experimental design is used, the research consumer would expect to see hypotheses that reflect relationship statements, such as the following:

- $\mathbf{X_1}$ is more effective than $\mathbf{X_2}$ on **Y**.
- The effect of $\mathbf{X_1}$ on **Y** is greater than that of $\mathbf{X_2}$ on **Y**.
- The incidence of **Y** will not differ in subjects receiving $\mathbf{X_1}$ and $\mathbf{X_2}$ treatments.
- The incidence of **Y** will be greater in subjects after $\mathbf{X_1}$ than after $\mathbf{X_2}$.

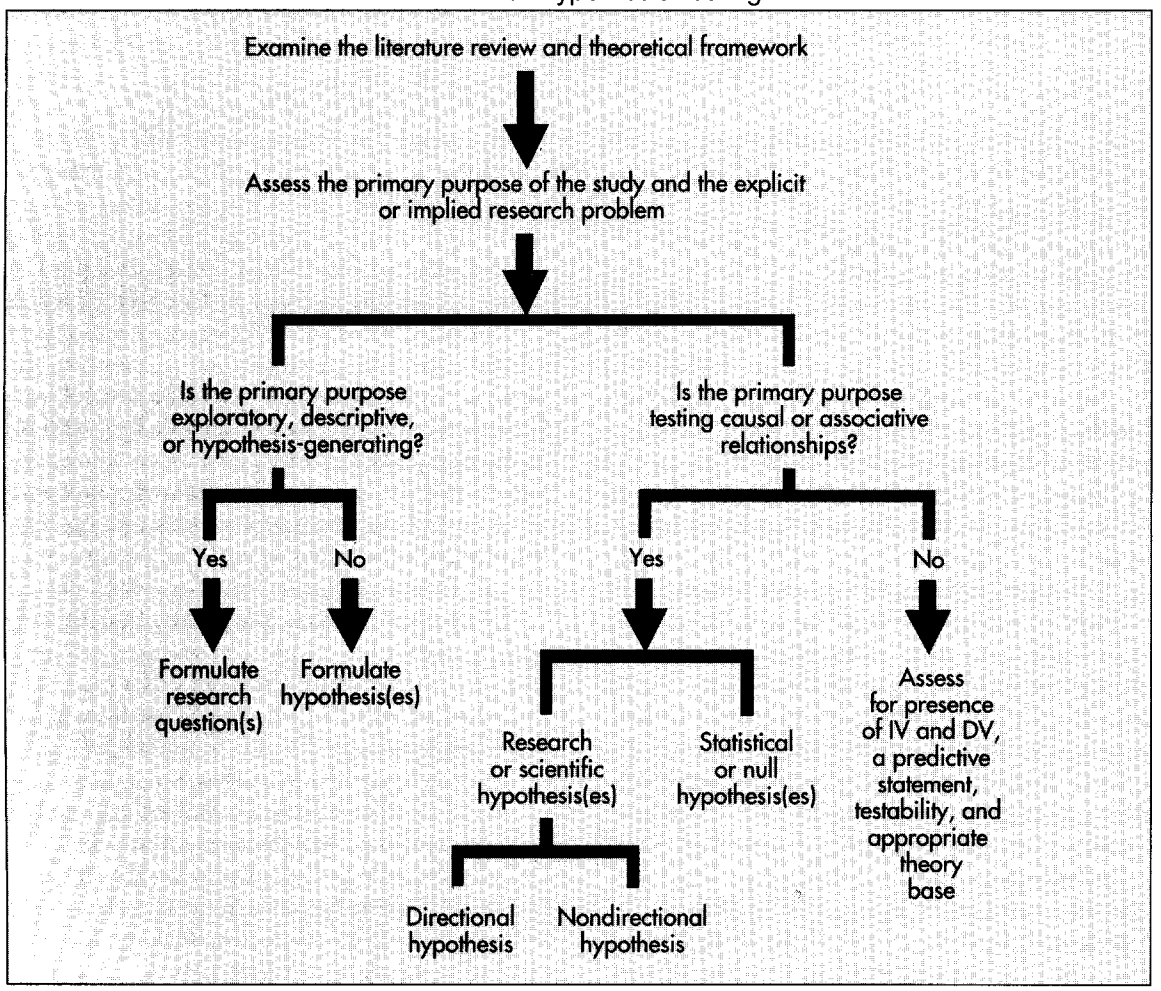
Such hypotheses indicate that an experimental treatment (i.e., independent variable **X**), will be used and that two groups of subjects, experimental and control groups, are being used to test whether the difference in the outcome (i.e., dependent variable **Y**) predicted by the hypothesis actually exists. Hypotheses reflecting experimental designs also test the effect of the experimental treatment (i.e., independent variable **X**) on the outcome (i.e., dependent variable **Y**).

In contrast, hypotheses related to nonexperimental designs reflect associative relationship statements, such as the following:

- **X** will be negatively related to **Y**.
- There will be a positive relationship between **X** and **Y**.

Table 3-7 provides additional examples of this concept. The Critical Thinking Decision Path will help you determine the type of hypothesis

CRITICAL THINKING DECISION PATH Determining the Type of Hypothesis or Readiness for Hypothesis Testing



presented in a study, as well as the study's readiness for a hypothesis-testing design.

RESEARCH QUESTIONS

Research studies do not always contain hypotheses. As you become more familiar with the scientific literature, you will notice that exploratory studies usually do not have hypotheses. This is particularly common when there is a dearth of literature or related research studies in a particular area that is of interest to the researcher. The researcher, interested in finding out more about a particular phenomenon, may engage in a fact- or relationship-finding mission, guided only by research questions. The outcome of the exploratory study may be that data about the phenomenon are amassed, so the researcher can then formulate hypotheses for a future study. This is sometimes called a hypothesis-generating study.

A study by McDonald and associates (2000) examined how patients communicate their pain and pain-management needs after surgery. The research question, which includes the following vari-

BOX 3-2 Examples of Research Questions

- Do nurses with greater empathy have patients experiencing less pain and receiving adequate analgesia (Watt-Watson et al, 2000)?
- To what extent do women engage in risk factor modification activities after CABG surgery (King, Rowe, and Zerwic, 2000)?
- What are nurses' perceptions of people who are homeless (Minick et al, 1998)?
- What are the self-care strategies used by patients with heart failure to manage their symptoms (Bennett et al, 2000)?
- Do gender, race, or both affect the relationship between patterns of anger expression as measured by the Jacobs Pediatric Anger Expression Scale and blood pressure readings (BPR) (Hauber et al, 1998)?
- Does continuous light or very light handrail support reduce oxygen uptake and/or heart rate compared with no handrail support in women during submaximal step treadmill exercise (Christman et al, 2000)?
- Is the incidence of depression greater among adolescents who are legally blind than among adolescents who are sighted (Koenes and Karshmer, 2000)?

ables, pain (independent variable *X*) and postoperative caregiver pain communication (dependent variable *Y*), illustrates how an investigation designed to generate relationships and fill a gap in the literature was guided by research questions.

- How do postoperative patients communicate their pain and pain-management needs to their health care providers?
- How are demographical variables (e.g., race and gender) related to pain and the communication of pain-management needs to health care providers?

Because there has been little research on the effectiveness of postoperative communication of pain, research questions—rather than hypotheses—are appropriate for this baseline phase of a study. The findings of the study highlighted the importance of effective patient communication of pain as a variable related to effective pain management by health care providers. Reasons for decreased pain communication include the following:

- Not wanting to complain.
- Not wanting to take the provider away from other patients.
- Avoiding unpleasant analgesic side effects.
- Not wanting to take "drugs."

The problems in the communication of pain management identified in this study could be used to design nursing-intervention studies to improve pain communication and the consequent pain relief in postoperative patients.

Qualitative research studies also are guided by research questions rather than hypotheses. The descriptive findings of qualitative studies also can provide the basis for future hypothesis-testing studies. "What is it like to go through depression as a Black West-Indian Canadian woman" is an example of a research question from a qualitative study by Schreiber and associates (2000) that sought to enrich understanding about how women from a nondominant cultural background (i.e., West Indian) experience and manage depression (see Chapters 6, 7, and 8).

As you can see, research questions tend to be more specific than the research problems discussed in the research problem section of this chapter. The more specific research questions are, however, the more they provide direction for the study.

In other studies, research questions are formulated in addition to hypotheses to answer questions related to ancillary data. Such questions do not directly pertain to the proposed outcomes of the hypotheses. Rather, they may provide additional and sometimes serendipitous findings that enrich the study and provide direction for further study. Sometimes they are the kernels of new or future hypotheses. The evaluator of a research study must determine whether it was appropriate to formulate a research question rather than a hypothesis given the nature and context of the study. Box 3-2 provides examples of research questions.

HELPFUL HINT **Remember that research questions are most often used in exploratory, descriptive, qualitative, or hypothesis-generating studies.**

CRITIQUING the Research Problem and Hypotheses

The care that a researcher takes when developing the research problem, the research question, or the hypotheses is often representative of the overall conceptualization and design of the study. A methodically formulated research problem or question provides the basis for hypothesis development. In a quantitative research study, the remainder of a study revolves around testing the hypotheses or, in some cases, the research questions. In a qualitative research study, the objective is to answer the research question. This may be a time-consuming, sometimes frustrating endeavor for the researcher, but in the final analysis, the product, as evaluated by the consumer is most often worth the struggle. Because this text focuses on the nurse as a critical consumer of research, the following sections will primarily pertain to the evaluation of research problems, research questions, and hypotheses in published research reports.

CRITIQUING THE RESEARCH PROBLEM

The Critiquing Criteria box provides several criteria for evaluating this initial phase of the research process—the research problem. Because the research problem represents the basis for the study, it is usually introduced at the beginning of the research report to indicate the focus and direction of the study to the readers. Readers will then be in a position to evaluate whether the rest of the study logically flows from its base. The author will often begin by identifying the general problem area that originally represented some vague discontent or question about an unsolved problem. The experimental and scientific background that led to the specific problem is briefly summarized; and the purpose, aim, or goal of the study is identified. Finally, the research problem and any related subproblems are proposed in the same places as they are used in an article.

CRITIQUING CRITERIA

The Research Problem

1. Was the research problem introduced promptly?
2. Is the problem stated clearly and unambiguously in declarative or question form?
3. Does the research problem express a relationship between two or more variables or at least between an independent and a dependent variable, implying empirical testability?
4. Does the research problem specify the nature of the population being studied?
5. Has the research problem been substantiated with adequate experiential and scientific background material?
6. Has the research problem been placed within the context of an appropriate theoretical framework?
7. Has the significance of the research problem been identified?
8. Have pragmatic issues, such as feasibility, been addressed?
9. Have the purpose, aims, or goals of the study been identified?

The Hypotheses

1. Does the hypothesis directly relate to the research problem?
2. Is the hypothesis concisely stated in a declarative form?
3. Are the independent and dependent variables identified in the statement of the hypothesis?
4. Are the variables measurable or potentially measurable?
5. Is each of the hypotheses specific to one relationship so that each hypothesis can be either supported or not supported?
6. Is the hypothesis stated in such a way that it is testable?
7. Is the hypothesis stated objectively, without value-laden words?
8. Is the direction of the relationship in each hypothesis clearly stated?
9. Is each hypothesis consistent with the literature review?
10. Is the theoretical rationale for the hypothesis explicit?
11. Are research questions appropriately used (i.e., exploratory, descriptive or qualitative study or in relation to ancillary data analyses)?

The purpose of the introductory summary of the theoretical and scientific background is to provide the reader with a contextual glimpse of how the author critically thought about the research problem's development. The introduction to the research problem places the study within an appropriate theoretical framework and sets the stage for the unfolding of the study. This introductory section should also include the significance of the study (i.e., why the investigator is doing the study). For example, the significance may be to solve a problem encountered in the clinical area and thereby improve patient care, to resolve a conflict in the literature regarding a clinical issue, or to provide data supporting an innovative form of nursing intervention that is of equal or better quality and is also cost-effective.

In reality, readers often find that the research problem is not clearly stated at the conclusion of this section. In some cases, it is only hinted at, and the reader is challenged to identify the research problem under consideration. In other cases, the research problem is embedded in the introductory text or purpose statement. To some extent, this depends on the style of the journal. Nevertheless, the evaluator must remember that the main research problem should be implied if it is not clearly identified in the introductory section—even if the subproblems are not stated or implied.

The reader looks for the presence of three key elements that are described and illustrated in an earlier section of this chapter. They are the following:

- Does the research problem express a relationship between two or more variables, or at least between an independent and a dependent variable?
- Does the research problem specify the nature of the population being studied?
- Does the research problem imply the possibility of empiric testing?

The reader uses these three elements as criteria for judging the soundness of a stated research problem. It is likely that if the problem is unclear in terms of the variables, the population, and the implications for testability, then the remainder of the study is going to falter. For example, a research study contained introductory material on anxiety in general, anxiety as it relates to the perioperative period, and the potentially beneficial influence of nursing care in relation to anxiety reduction. The author concluded that the purpose of the study was to determine whether selected measures of patient anxiety could be shown to differ when different approaches to nursing care were used during the perioperative period. The author did not go on to state the research problems. A restatement of the problem in question form might be as follows:

$$(Y_1) \qquad (X_1, X_2, X_3)$$

What is the difference in patient anxiety level in relation to different approaches to nursing care during the perioperative period?

If this process is clarified at the outset of a research study, all that follows in terms of the design can be logically developed. Readers will have a clear idea of what the report should convey and can knowledgeably evaluate the material that follows.

CRITIQUING THE HYPOTHESIS

As illustrated in the Critiquing Criteria box, several criteria for critiquing the hypotheses should be used as a standard for evaluating the strengths and weaknesses of the hypotheses in a research report.

1. When reading a research study, research consumers may find the hypotheses clearly delineated in a separate hypothesis section of the research article (i.e., after the literature review or theoretical framework section[s]). In many cases, the hypotheses are not explicitly stated and are only implied in the *Results* or *Discussion* section of the article. As such, readers must infer the hypotheses from the purpose statement and the type of analysis used. Readers must also be cognizant of this variation and not think that because hypotheses do not appear at the beginning of the article, they do not exist in the particular study. Even when hypotheses are stated at the beginning of an article, they are reexamined in the *Results* or *Discussion* section as the findings are presented and discussed. Readers should expect hypotheses to be appropriately reflected depending on the purpose of the study and format of the article.
2. If a research problem was posed at the beginning of the report, the hypothesis should directly answer it. Its placement in the research report logically follows the literature review, and the theoretical framework, because the hypothesis should reflect the culmination and expression of this conceptual process. It should be consistent with both the literature

review and the theoretical framework. The flow of this process, as depicted in Table 3-7, should be explicit and apparent to the reader. If this criterion is met, the reader feels reasonably assured that the basis for the hypothesis is theoretically sound.

3. As readers examine the actual hypothesis, several aspects of the statement should be critically appraised. First, the hypothesis should consist of a declarative statement that objectively and succinctly expresses the relationship between an independent and a dependent variable. In wording a complex vs. a simple hypothesis, there may be more than one independent and dependent variable.

Second, readers can expect that there may be more than one hypothesis, particularly if there is more than one independent and dependent variable. This is a function of the type of study being conducted.

Third, the variables of the hypothesis should be understandable to the reader. In the interest of formulating a succinct hypothesis statement, the complete meaning of the variables is often not apparent. Readers must realize that sometimes a researcher is caught between the "devil and the deep blue sea" on that issue. It may be a choice between having a complete but verbose hypothesis paragraph or a less complete but concise hypothesis. The solution to this dilemma is for the researcher to have a definition section in the research report. The inclusion of **conceptual definitions** and **operational definitions** (see Chapter 5) provides the complete explication of the variables. Readers can then examine the hypothesis alongside the definitions and determine the exact nature of the variables under consideration. An excellent example of this process appears in a research article by Mahon, Yarcheski, and Yarcheski (2000), who hypothesized the following:

> Trait anger and state anger each are positively related to change in early adolescents.
>
> and
>
> Trait anger has a direct effect on state anger.
>
> and
>
> Both trait anger and state anger have a direct effect on vigor and inclination to change

These are appropriately worded hypotheses. It is not completely clear, however, what the variables "Trait anger," "State anger," "Vigor," or "Inclination to change" imply. It is only upon examination of the definitions of these variables, which are included in the literature review section, that the exact nature of the variables becomes clear to readers. (See Appendix C.)

- Trait Anger: "The disposition of individuals to perceive a wide range of situations as annoying, tending to respond to such situations with elevations in state anger."
- State Anger: "An emotional state marked by subjective feelings that vary in intensity from mild annoyance or irritation to intense fury and rage."
- Vigor: "A mood of vigorousness, ebullience, and high energy."
- Inclination to Change: "Seeking new and different, readily changing opinions or values in different circumstances, and adapting readily to change in the environment."

The context of the variables is now revealed to the evaluator.

Fourth, although a hypothesis can legitimately be nondirectional, it is preferable to indicate the direction of the relationship between the variables in the hypothesis. Readers will find that when there is a dearth of data available for the literature review (i.e., the researcher has chosen to study a relatively undefined area of interest), the nondirectional hypothesis may be appropriate. There simply may not be enough information available to make a sound judgment about the direction of the proposed relationship. All that could be proposed is that there will be a relationship between two variables. Essentially, readers want to determine the appropriateness of the researcher's choice regarding directionality of the hypothesis.

4. The notion of testability is central to the soundness of a hypothesis. One criterion related to testability is that the hypothesis should be stated in such a way that it can be clearly supported or not supported. Although the previous statement is very important to keep in mind, readers should also understand that ultimately theories or hypotheses are never proven beyond the shadow of a doubt through hypothesis testing. Researchers who claim that their data have "proven" the validity of their hypothesis should be regarded with grave

reservation. Readers should realize that, at best, findings that support a hypothesis are considered tentative. If repeated replication of a study yields the same results, more confidence can be placed in the conclusions advanced by the researchers. An important thing to remember about testability is that although hypotheses are more likely to be accepted with increasing evidence, they are ultimately never proven.

Another point about testability for research consumers to consider is that the hypothesis should be objectively stated and devoid of any value-laden words. Value-laden hypotheses are not empirically testable. Quantifiable words such as greater than; less than; decrease; increase; and positively, negatively, and curvilinearly related convey the idea of objectivity and testability. Readers should immediately be suspicious of hypotheses that are not stated objectively.

5. The evaluator of a research study should be cognizant of the fact that how the proposed relationship of the hypothesis is phrased suggests the type of research design that will be appropriate for the study. For example, if a hypothesis proposes that treatment $\mathbf{X_1}$ will have a greater effect on **Y** than treatment $\mathbf{X_2}$, an experimental or quasiexperimental design is suggested (see Chapter 10). If a hypothesis proposes that there will be a positive relationship between variables **X** and **Y**, a nonexperimental design is suggested (see Chapter 11). A review of Table 3-6 provides you with additional examples of hypotheses and the type of research design that is suggested by each hypothesis. The reader of a research report should evaluate whether the selected research design is congruent with the hypothesis. This factor has important implications for the remainder of the study in terms of the appropriateness of sample selection, data collection, data analysis, interpretation of findings, and—ultimately—the conclusions advanced by the researcher.
6. If the research report contains research questions rather than hypotheses, the reader will want to evaluate whether this is appropriate to the study. The criterion for making this decision, as presented earlier in this chapter, is whether the study is of an exploratory, descriptive, or qualitative nature. If it is, then it is appropriate to have research questions rather than hypotheses. Ancillary research questions should be evaluated as to whether they answer additional questions secondary to the hypotheses. Sometimes, the substance of an additional research question is more appropriately posed as another hypothesis in that it relates in a major way to the original research problem.

Critical Thinking Challenges

Barbara Krainovich-Miller

- Do you agree or disagree with the following statement: A research study published in a journal does not clearly state the research problem, then it fails to meet the critiquing criteria for problem statements as presented in this chapter. Justify your answer.
- Is it possible for "level of anxiety" to be the independent variable in one study and the dependent variable in another study? Support your position.
- Is it possible for a research hypothesis not to be theory derived? Support your answer with examples.
- What is the difference between your friend predicting that students who don't study will not do well on a test and a research study's hypothesis on the topic? Justify your answer.

Key Points

- Formulation of the research problem, research question, and stating the hypothesis are key preliminary steps in the research process.
- The research problem is refined through a process that proceeds from the identification of a general idea of interest to the definition of a more specific and circumscribed topic.

- A preliminary literature review reveals related factors that appear critical to the research topic of interest and helps to further define the research problem.
- The significance of the research problem must be identified in terms of its potential contribution to patients, nurses, the medical community in general, and society. Applicability of the problem for nursing practice, as well as its theoretical relevance, must be established. The findings should also have the potential for formulating or altering nursing practices or policies.
- The feasibility of a research problem must be examined in light of pragmatic considerations (e.g., time); availability of subjects, money, facilities, and equipment; experience of the researcher; and ethical issues.
- The final research problem consists of a statement about the relationship of two or more variables. It clearly identifies the relationship between the independent and dependent variables; specifies the nature of the population being studied; and implies the possibility of empirical testing.
- A hypothesis attempts to answer the question posed by the research problem. When testing the validity of the theoretical framework's assumptions, the hypothesis bridges the theoretical and real worlds.
- A hypothesis is a declarative statement about the relationship between two or more variables that predicts an expected outcome. Characteristics of a hypothesis include a relationship statement, implications regarding testability, and consistency with a defined theory base.
- Hypotheses can be formulated in a directional or a nondirectional manner. Hypotheses can be further categorized as either research or statistical hypotheses.
- Research questions may be used instead of hypotheses in exploratory, descriptive, or qualitative research studies. Research questions may also be formulated in addition to hypotheses to answer questions related to ancillary data.
- The critiquing criteria provide a set of guidelines for evaluating the strengths and weaknesses of the problem statement and hypotheses as they appear in a research report.
- The critiquer assesses the clarity of the research problem, as well as the related subproblems, the specificity of the population, and the implications for testability.
- The interrelatedness of the research problem, the literature review, the theoretical framework, and the hypotheses should be apparent.
- The appropriateness of the research design suggested by the research problem is also evaluated.
- The purpose of the study (i.e., why the researcher is doing the study) should be differentiated from the research problem or the research question.
- The reader evaluates the wording of the hypothesis in terms of the clarity of the relational statement, its implications for testability, and its congruence with a theory base. The appropriateness of the hypothesis in relation to the type of research design suggested by the design is also examined. In addition, the appropriate use of research questions is evaluated in relation to the type of study conducted.

REFERENCES

Bennett SJ et al: Self-care strategies for symptom management in patients with chronic heart failure, *Nurs Res* 49(3):139-145, 2000.

Bouve LR, Rozmus CL, and Giordano P: Preparing parents for their child's transfer from the PICU to the pediatric floor, *Appl Nurs Res* 12(3):114-120, 1999.

Bull MJ, Hansen HE, and Gross CR: Professional-patient partnership model of discharge planning with elders hospitalized with heart failure, *Appl Nurs Res* 13(1): 19-28, 2000.

Christman SK et al: Continuous handrail support, oxygen uptake, and heart rate in women during submaximal step treadmill exercise, *Res Nurs Health* 23:35-42, 2000.

Dilorio C et al: A social cognitive-based model for condom use among college students, *Nurs Res* 49(4): 208-214, 2000.

Grey M et al: Coping skills training for youths with diabetes on intensive therapy, *Appl Nurs Res* 12(1): 3-12, 1999.

Hauber RP et al: Anger and blood pressure readings in children, *Appl Nurs Res* 11(1):2-11, 1998.

Jarrett M et al: The relationship between psychological distress and gastrointestinal symptoms in women with irritable bowel syndrome, *Nurs Res* 47(3):154-161, 1998.

Johnson JL et al: Preventing smoking relapse in postpartum women, *Nurs Res* 49(1): 44-52, 2000.

King K, Rowe M, and Zerwic J: Concerns and risk factor modification in women during the year after coronary artery surgery, *Nurs Res* 49(3): 167-172, 2000.

Koenes SG and Karshmer JF: Depression: a comparison study between blind and sighted adolescents, *Iss Mental Health Nurs* 21(2):269-279, 2000.

Leight SB et al: The effect of structured training on breast self-examination search behaviors as measured using biomedical instrumentation, *Nurs Res* 49(5):283-289, 2000.

LoBiondo-Wood G et al: Family adaptation to a child's transplant: pretransplant phase, *Progress in Transplantation* 10(2):1-8, 2000.

Mahon NF, Yarcheski A, and Yarcheski TJ: Positive and negative outcomes of anger in early adolescents, *Res Nurs Health* 23(1):17-24, 2000.

McDonald DD et al: Communicating pain and pain management needs after surgery, *Appl Nurs Res* 13(2):70-75, 2000.

Minick P et al: Nurses' perceptions of people who are homeless, *Western J Nurs Res* 20(3):356-369, 1998.

Naylor MD et al: Comprehensive discharge planning and home follow-up of hospitalized elders: a randomized clinical trial, *JAMA* 281(7):999-1000, 1999.

Schreiber R, Noerager-Stern P and Wilson C: *Being strong: how Black West-Indian Canadian women manage depression and its stigma, J Nurs Scholarship* 32(1): 39-45, 2000.

Swanson KM: Effects of caring measurement, and time on miscarriage impact and women's well-being, *Nurs Res* 48(6):288-298, 1999.

Tucker S, Moore W, and Luedtke C: Outcomes of a brief inpatient treatment program for mood and anxiety disorders, *Outcomes Management for Nursing Practice* 4(3):117-123, 2000.

Watt-Watson J et al: The impact of nurses' empathic responses on patients' pain management in acute care, *Nurs Res* 49(4):191-200, 2000.

ADDITIONAL READINGS

Campbell DT and Stanley JC: *Experimental and quasi-experimental designs for research,* Chicago, 1963, Rand-McNally.

Kerlinger FN: *Foundations of behavioral research,* New York, 1986, Holt, Rinehart, and Winston.

Pedhazur EJ and Schmelkin LP: *Measurement, design, and analysis: an integrated approach,* Hillsdale, NJ, 1991, Lawrence Erlbaum Associates.

Van Dalen DB: *Understanding educational research,* New York, 1979, McGraw-Hill.