2

Research Questions, Hypotheses, and Clinical Questions

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KEY TERMS

clinical question
complex hypothesis
dependent variable
directional hypothesis
hypothesis
independent variable
nondirectional hypothesis
population
purpose
research hypothesis
research question
statistical hypothesis
testability
theory
variable

LEARNING OUTCOMES

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

- Describe how the research question and hypothesis relate to the other components of the research process.
- Describe the process of identifying and refining a research question or hypothesis.
- Identify the criteria for determining the significance of a research question or hypothesis.
- Discuss the purpose of developing a clinical question.
- Discuss the appropriate use of the purpose, aim, or objective of a research study.
- Discuss how the purpose, research question, and hypothesis suggest the level of evidence to be obtained from the findings of a research study.
- Describe the advantages and disadvantages of directional and nondirectional hypotheses.
- Compare and contrast the use of statistical versus research hypotheses.
- Discuss the appropriate use of research questions versus hypotheses in a research study.
- Discuss the differences between a research question and a clinical question in relation to evidence-based practice.
- Identify the criteria used for critiquing a research question and hypothesis.
- Apply the critiquing criteria to the evaluation of a research question and hypothesis in a research report.

STUDY RESOURCES

Evolve

Go to Evolve at http://evolve.elsevier.com/LoBiondo/ for review questions, critiquing exercises, and additional research articles for practice in reviewing and critiquing.

As you read each chapter remember that each step of the research process will be defined and discussed as to how that particular step relates to evidence-based practice. All research studies begin with questions and hypotheses. The first step of the evidence-based practice process also asks a question, but it is a clinical question. The research questions and hypotheses in a research study discussed in the beginning of this chapter have different purposes than the clinical questions found in an evidence-based practice project. In a research study the research question and hypothesis lead to the development of a research study; the clinical question in an evidence-based practice project is the first step in the development of an evidence-based practice project.

At the beginning of this chapter you are going to learn about research questions and hypotheses from the perspective of the researcher, which, in the second part of this chapter, will help you to generate your own clinical questions that you will use to guide the development of evidence-based practice projects. From a clinician's perspective you have to understand the research question and hypothesis as it aligns with the rest of the study. As a practicing nurse, the clinical questions you will develop (see Chapters 17 and 18) represent the first step of the evidence-based practice process.

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 question or hypothesis. Research questions are usually generated by situations that emerge from practice, leading nurses to wonder about the effectiveness of one intervention versus another for a specific patient population.

For an investigator conducting a study, the research question or hypothesis is a key preliminary step in the research process. The **research question** (sometimes called the problem statement) presents the idea that is to be examined in the study and is the foundation of the research study. The **hypothesis** attempts to answer the research question.

Hypotheses can be considered intelligent hunches, guesses, or predictions that help researchers seek a solution or answer a research question. Hypotheses are a vehicle for testing the validity of the theoretical framework assumptions and provide a bridge between **theory** (a set of interrelated concepts, definitions, and propositions) and the real world. In the scientific world, researchers derive hypotheses and research questions 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.

For a clinician making an evidence-informed decision about a patient care issue, a clinical question such as whether chlorhexidine or povidone-iodine is more effective in preventing central line catheter infections, would guide the nurse in searching for and retrieving the best available evidence that, combined with clinical expertise, and patient preferences, would provide an answer on which to base the most effective decision about patient care for this population.

You will often find research questions or hypotheses at the beginning of a research article. However, 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 the producer of research to understand the importance of research questions and hypotheses as the foundational elements of a research study. This chapter provides a working knowledge of quantitative

research questions and hypotheses, as well as the standards for writing them and a set of criteria for evaluating them. It also highlights the importance of clinical questions and how to develop them.

DEVELOPING AND REFINING A RESEARCH QUESTION: STUDY PERSPECTIVE

A researcher spends a great deal of time refining a research idea into a testable research question. Unfortunately, the evaluator of a research study is not privy to this creative process because it occurs during the study's conceptualization. Although this section will not teach you how to formulate a research question, it is important to provide a glimpse of what the process of developing a research question may be like for a researcher.

Research questions or topics are not pulled from thin air. As shown in Table 2-1, research questions should indicate that practical experience, critical appraisal of the scientific literature, or interest in an untested theory was the basis for the generation of a research idea. The research question 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 question area
2. Reviewed the relevant literature
3. Examined the question's potential significance to nursing
4. Pragmatically examined the feasibility of studying the research question

TABLE 2-1 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.	Health professionals, including nurses, frequently advise patients to improve their health by stopping smoking. Nurse practitioners (NPs) working in a primary care practice starting a smoking cessation program want to find out if there are specific brief or intensive smoking cessation interventions led by nurses that are effective in increasing and maintaining the quit rate. Findings from a systematic review "*Nursing interventions for smoking cessation*" indicate that the effect of smoking cessation advice and/or counseling is most effective when interventions are provided by nurses whose main role is health promotion or smoking cessation. The challenge is to incorporate smoking behavior monitoring and cessation interventions as part of standard practice so that all patients are given the opportunity to be asked about their tobacco use and to be given advice and/or counseling to quit along with reinforcement and follow-up (Rice & Stead, 2008).

Continued

TABLE 2-1 How Practical Experience, Scientific Literature, and Untested Theory Influence the Development of a Research Idea—cont'd

Area	Influence	Example
Critical appraisal of the scientific literature	The critical appraisal of research studies that appear in journals may indirectly suggest a clinical 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, quality improvement project, or clinical practice guideline to determine the effectiveness of this intervention in their own practice setting.	At a staff meeting, nurses, physicians, and other members of the interdisciplinary oncology team at a hospital specializing in treatment of cancer were discussing developing an algorithm to serve as an interdisciplinary protocol for the most effective interventions for treating adult cancer pain in specific treatment settings. Their search for and critical appraisal of existing clinical practice guidelines led to development of an interdisciplinary *Cancer Pain Practice Guideline,* based on National Cancer Institute (NCI) and National Cancer Consensus Network (NCCN) practice guidelines, for treatment of adult cancer pain in a variety of settings that were relevant to their patient population and clinical setting (MD Anderson Cancer Center, 2008).
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.	Rural adults have higher rates of chronic illness and physical limitations that might be prevented by increased physical activity, yet few studies have been focused on helping people increase their regular physical activity in rural environments. The study used a telephone-only motivational interviewing (MI) intervention that is different from other MI studies that included one or more in-person MI counseling sessions (Bennet, Lyons, Winter-Stone et al., 2008).
Interest in untested theory	Verification of an untested theory provides a relatively uncharted territory from which research problems can be derived. Inasmuch as theories themselves are not tested, a researcher may consider investigating a particular concept or set of concepts related to a particular nursing theory or a theory from another discipline. The researcher would pose questions such as the following: "If this theory is correct, what kind of behavior will I expect to observe in particular patients and under which conditions?" "If this theory is valid, what kind of supporting evidence will I find?"	Self-regulation theory (Johnson et al., 1997) proposes that individuals cope with illness according to their understanding of the experience. The theory emphasizes that patients need to have adequate information to gain knowledge and understanding of a specific health-related problem or risk (e.g., for breast cancer survivors, a health-related issue is lymphedema risk) and to make decisions and develop preventive or coping strategies (e.g., lymphedema risk reduction behaviors). Accordingly, patient education interventions that provide accurate information may be a critical component of lymphedema risk reduction. The use of self-regulation theory to test the effect of providing breast cancer survivors with lymphedema information on clinical outcomes has not been explored. Using Johnson's self-regulation theory to guide its development, the purpose of this study was to explore the effect of provision of lymphedema information on survivors' symptom experiences and practice of risk reduction behaviors (Fu et al., 2008).

Defining the Research Question

Brainstorming with teachers, advisors, or colleagues may provide valuable feedback that helps the researcher focus on a specific research question area. For example, suppose a researcher told a colleague that her area of interest was pain as a prevalent problem for older adults. The colleague may have said, "What is it about the topic that specifically interests you?" This conversation may have initiated a chain of thought that resulted in a decision to explore the relationship between pain and functional disability in older adults (Horgas et al., 2008) (see Appendix C). Figure 2-1 illustrates how a broad area of interest (pain as a prevalent problem for older adults) was narrowed to a specific research topic (persistent pain and its relationship to functional disability in older adults).

EVIDENCE-BASED PRACTICE TIP

A well-developed research question guides a focused search for scientific evidence about assessing, diagnosing, treating, or assisting patients with understanding of their prognosis related to a specific health problem.

Beginning the Literature Review

The literature review should reveal a relevant collection of individual studies and systematic reviews that have been critically examined. Concluding sections in such articles, that is, 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 3). In the previous example about persistent pain and functional disability in older adults, the researcher may have conducted a preliminary review of books and journals for theories and research studies on factors apparently critical to pain experience such as racial and/or ethnic differences in pain experience, pain treatment, and access to pain medications. These factors, termed *variables* in the language of research, should be potentially relevant, of interest, and measurable.

Possible relevant factors mentioned in the literature begin with an exploration of the relationship between self-reported pain intensity, acute versus chronic pain, pain management effectiveness, and functional disability. Other variables, called *demographic variables,* such as race, ethnicity, gender, age, income, education, and marital status, are also suggested as essential to consider. This information can then be used by the researcher to further define the research question and address a gap in the literature, as well as extend the knowledge base related to relationships among race (black or white), pain, and functional disability (physical and social functioning) in older adults. At this point the researcher could write the following tentative research question: "What are the relationships among race, pain, and disability in older adults?" Readers can envision the interrelatedness of the initial definition of the question area, the literature review, and the refined research question. 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 (Horgas et al., 2008) (see Appendix C).

HELPFUL HINT

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

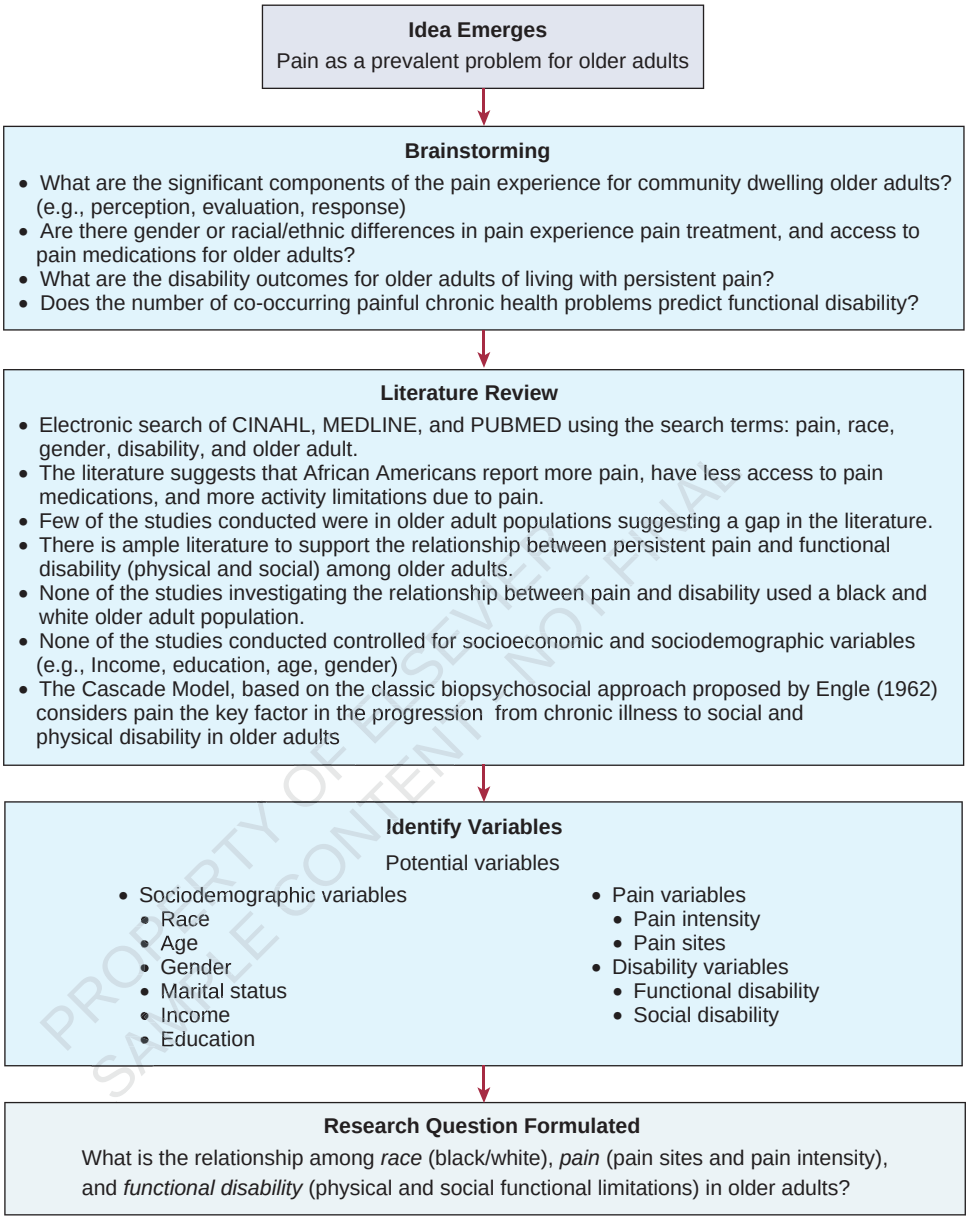


Figure 2-1 Development of a research question.

Examining Significance

When considering a research question, it is crucial that the researcher has examined the question's potential significance to nursing. The research question should have the potential to contribute to and extend the scientific body of nursing knowledge. Guidelines for selecting research questions 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, fill a gap in the literature, or clarify a conflict in the literature.
- The findings will potentially provide evidence that supports developing, retaining, or revising nursing practices or policies.

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

- Pain is a persistent problem in the daily lives of approximately 50% of community-dwelling older adults.
- Pain is due to the high prevalence of acute and chronic health problems in this population.
- Pain from acute and chronic conditions is a key indicator of physical and social functioning and quality of life.
- Data on racial and/or ethnic differences in pain experience indicate that African Americans report more pain, more untreated pain, and have less access to pain medications.
- Few of the studies conducted have been conducted in older adult populations.
- This study sought to fill a gap in the related literature by examining the relationships among race, pain, and functional disability in older adults.
- This study sought to extend the knowledge base about this phenomenon, thereby providing a foundation for the development and testing of interventions.

EVIDENCE-BASED PRACTICE TIP

Without a well-developed research question, the researcher may search for wrong, irrelevant, or unnecessary information. This will be a barrier to identifying the potential significance of the study.

Determining Feasibility

The feasibility of a research question must be pragmatically examined. Regardless of how significant or researchable a question 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 question is inappropriate because it lacks feasibility (see Chapters 4 and 7).

THE FULLY DEVELOPED RESEARCH QUESTION

When a researcher finalizes a research question, the following three characteristics should be evident:

- 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 question, the criteria will be discussed in greater detail. These elements can often be found in the introduction of the published article; they are not always stated in an explicit manner.

HELPFUL HINT

Remember that research questions are used to guide all types of research studies, but are most often used in exploratory, descriptive, qualitative, or hypothesis-generating studies.

EVIDENCE-BASED PRACTICE TIP

The answers to questions generated by qualitative data reflect evidence that may provide the first insights about a phenomenon that has not been previously studied.

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 pneumonia in postoperative patients on ventilators in critical care units. It is a variable because not all critically ill postoperative patients on ventilators have pneumonia. A researcher may also be interested in what other factors can be linked to ventilator-acquired pneumonia (VAP). There is clinical evidence to suggest that elevation of the head of the bed is also associated with VAP. You can see that these factors are also variables that need to be considered in relation to the development of VAP in postoperative patients.

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

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 intensity. The researcher may manipulate the independent variable (i.e., the method of administering pain medication) by using nurse-controlled versus patient-controlled administration of analgesia (see Chapter 8). 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 gender and perception of pain intensity. The independent vari-

TABLE 2-2 Research Question Format

Type	Format	Example
QUANTITATIVE		
Correlational	Is there a relationship between **X** (independent variable) and **Y** (dependent variable) in the specified population?	Is there a relationship between pain and functional disability in black and white older adults? (Horgas et al., 2008)
Comparative	Is there a difference in **Y** (dependent variable) between people who have **X** characteristic (independent variable) and those who do not have **X** characteristic?	Do mothers who received a home-based nursing intervention for infant irritability report less parenting stress than mothers who did not receive the intervention? (Keefe et al., 2006)
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?**	What is the difference in physical, social, and emotional adjustment in women with breast cancer (and their partners) who have received phase-specific standardized education by video vs. phase-specific telephone counseling? (Budin et al., 2008)
QUALITATIVE		
Phenomenological	What is/was it like to have **X?**	What is the meaning of the health care provider (HCP) relationship for women with chronic illness and how they believe it affected their health? (Fox & Chesla, 2008)

able—gender—is not manipulated; it is just presumed to occur and is observed and measured as it naturally happens (see Chapter 9).

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 intensity (i.e., the dependent variable) will vary in relation to a person's gender (i.e., the independent variable). In this case we are trying to explain the perception of pain intensity in relation to gender, that is, male or female. 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 hepatitis C were studied. The researcher discovered that older nurses had a more negative attitude about patients with hepatitis C than younger nurses. The researcher did not conclude that the nurses' negative attitudes toward patients with hepatitis C 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 hepatitis C. That is, as the nurses' ages increase, their attitudes about patients with hepatitis C 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 2-2 presents a number of examples of research questions. Practice substituting other variables for the examples in Table 2-2. You will be surprised at the skill you develop in writing and critiquing research questions with greater ease.

Although one independent variable 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 question. Remember, however, that questions should not be unnecessarily complex or unwieldy, particularly in beginning research efforts. Research questions that include more than one independent or dependent variable may be broken down into subquestions 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 human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (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** (a well-defined set that has certain properties) is either specified or implied in the research question. If the scope of the question 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 question may ask, "What is the effect of a psychoeducational intervention on quality of life (QOL) in breast cancer survivors in posttreatment survivorship?" This question suggests that the population under consideration includes breast cancer survivors who have completed treatment for breast cancer (e.g., surgery, adjuvant therapy, reconstruction). It is also implied that some of the breast cancer survivors were involved in a psychoeducational intervention (consisting of face-to-face sessions and monthly follow-up sessions by telephone and in person) in contrast to other survivors (who received four monthly control telephone calls). The researcher or reader will have an initial idea of the composition of the study population from the outset (see Chapter 10).

EVIDENCE-BASED PRACTICE TIP

Make sure that the population of interest and the setting have been clearly described so that if you were going to replicate the study, you would know exactly who the study population needed to be.

Testability

The research question must imply that it is **testable,** that is, measurable by either qualitative or quantitative methods. For example, the research question "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 research question. A scientific research question 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 clinical questions are not valid research questions because they are not amenable to testing.

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

TABLE 2-3 Components of the Research Question and Related Criteria

Variables	Population	Testability
Independent variable: Pain intensity Pain sites Race Health (number of limiting diagnoses) *Dependent variable:* Management effectiveness Functional status	Black and white older adults	Differential effect of pain intensity and number of painful sites on functional disability (physical and social functioning)

- Is there a relationship between patient-controlled analgesia (PCA) versus 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 question.

Now that the elements of the formal research question have been presented in greater detail, this information can be integrated by formulating a formal research question about whether self-reported pain (pain sites and pain intensity) and disability (physical and social functional limitations) differ between black and white older adults. This research question was originally derived from a general area of interest—pain experiences of older adults of different racial groups. The topic was more specifically defined by delineating a particular research question, self-reported pain and outcomes (e.g., physical and social functional limitations). The question crystallized further after a preliminary literature review (Horgas et al., 2008). Table 2-3 identifies the components of this research question as they relate to and are congruent with the three research question criteria.

HELPFUL HINT

- Remember that research questions are often not explicitly stated. The reader has to infer the research question from the title of the report, the abstract, the introduction, or the purpose.
- Using your focused question, search the literature for the best available answer to your clinical question.

STUDY PURPOSE, AIMS, OR OBJECTIVES

Once the research question is developed and the literature review is critiqued in terms of the level, strength, and quality of evidence available for the particular research question, the purpose, aims, or objectives of the study become focused so that the researcher can decide whether a hypothesis should be tested or a research question answered.

The **purpose** of the study encompasses the aims or objectives the investigator hopes to achieve with the research, not the question to be answered. These three terms are synonymous with each other. For example, a nurse working with rehabilitation patients who have 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

BOX 2-1 Examples of Purpose Statements

- The purpose of this study was to evaluate the short and long-term effects of smoking cessation strategies tailored to the pregnant to attain and maintain abstinence (Albrecht et al., 2006).
- The aim of this study was to explore what patients on hemodialysis perceive concerning choice among three types of renal replacement therapies: transplantation, hemodialysis, and peritoneal dialysis (Landreneau & Ward-Smith, 2007).
- The primary purpose of this prospective randomized controlled trial of 56 cancer survivors was to test whether motivational interviewing (MI) would help long-term cancer survivors increase their participation in self-selected regular physical activities (Bennett et al., 2007).
- The objective of this study was to evaluate patient characteristics to predict selection and maintenance of a complementary therapy and the feasibility of a randomized clinical trial of complementary therapies (Wyatt, Sikorski, Siddiqi et al., 2007).
- The aims of this study were to determine whether a tailored, nurse-delivered adherence intervention program—Client Adherence Profiling and Intervention Tailoring (CAP-IT)—improved adherence to HIV medication compared to standard care (Holzemer et al., 2006).

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 versus a 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 question. Through the researcher's selection of verbs, the purpose statement suggests the manner in which the researcher planned to study the question and the level of evidence to be obtained through the study findings. Verbs such as *discover, explore,* or *describe* suggest an investigation of an infrequently 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. You should remember that when the purpose of a study is to test the effectiveness of an intervention or compare the effectiveness of two or more interventions, the level of evidence is likely to have more strength and rigor than a study whose purpose is to explore or describe phenomena. Box 2-1 provides other examples of purpose, aims, and objectives.

EVIDENCE-BASED PRACTICE TIP

The purpose, aims, or objectives often provide the most information about the intent of the research question and hypotheses and suggest the level of evidence to be obtained from the findings of the study.

DEVELOPING THE RESEARCH HYPOTHESIS

Like the research question, hypotheses are often not stated explicitly in a research article. The evaluator will often find that hypotheses are embedded in the data analysis, results, or discussion section of the research report. Similarly, the population may not be explicitly stated but will have been identified in the background, significance, and literature review. It is then up to you to discern the nature of the hypotheses and population being tested. For example, in

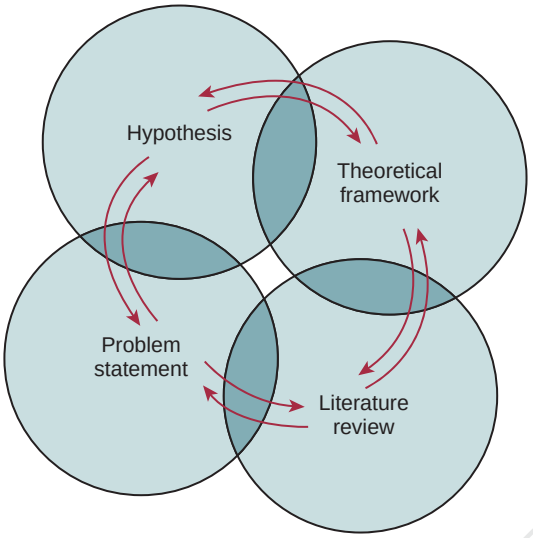


Figure 2-2 Interrelationships of research question, literature review, theoretical framework, and hypothesis.

the study by Meneses and colleagues (2007), the hypotheses are embedded in the Methods section of the article; you must interpret that the statement, "The overall hypotheses are to determine the effect of the breast cancer psychoeducational intervention (BCEI) on overall quality of life (QOL) and on the individual quality of life (QOL) and to examine whether the effects of the intervention were durable over time," represents the hypotheses that test the effect of the BCEI on QOL in female breast cancer survivors. In light of that stylistic reality, it is important for you to be acquainted with the components of hypotheses, how they are developed, and the standards for writing and evaluating them.

Hypotheses flow from the research question, literature review, and theoretical framework. Figure 2-2 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 is 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. Hypotheses are formulated before the study is actually conducted because they provide direction for the collection, analysis, and interpretation of data.

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 section 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 **(X)** and a dependent variable **(Y).** The direction of the predicted relationship is also specified in this statement. Phrases such as *greater than; less than; positively, negatively,* or *curvilinearly related;* and *difference in* connote the directionality that is proposed in the hypothesis. The following is an 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 dependent and independent variables are explicitly identified, and the relational aspect of the prediction in the hypothesis 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 blood pressure telemonitoring plus usual care would lead to a greater reduction in blood pressure than usual care alone from baseline over a 12-month follow-up (Artinian et al., 2007). 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 the variables change in relation to each other. 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 who have been 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.

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.

Theory Base

A sound hypothesis is consistent with an existing body of theory and research findings. Whether a hypothesis is arrived at on the basis of a review of the literature or a clinical observation, it must be based on a sound scientific rationale. Readers should be able to identify the flow of ideas from the research idea to the literature review, to the theoretical framework, and through the research question(s) or hypotheses. For example, Jones and colleagues (2007) (Appendix B) investigated the effectiveness of the Deaf Heart Health Intervention (DHHI), which is an education program taught in sign language by a trained deaf lay heart-health teacher about modifiable cardiovascular disease (CVD) risk factors and principles of health behavior change. The study questioned whether DHHI increased self-efficacy for health behaviors related to risk for CVD among culturally deaf adults. Self-efficacy was a key construct used for the theoretical framework because it is a key factor in understanding and modifying health behaviors.

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 10 and 12).

Statistical versus 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 evaluating the effectiveness of a home-based nursing intervention in reducing parenting stress in three groups of families with irritable infants, the research hypothesis was that "Mothers who received the home-based nursing intervention (REST—reassurance, empathy, support, and time-out) for infant irritability will report less parenting stress than the mothers who did not receive the intervention" (Keefe et al., 2006). Because the findings for this hypothesis were

TABLE 2-4 Examples of How Hypotheses Are Worded

Variables*	Hypothesis	Type of Design; Level of Evidence Suggested
1. THERE ARE SIGNIFICANT DIFFERENCES IN SELF-REPORTED CANCER PAIN, SYMPTOMS ACCOMPANYING PAIN, AND FUNCTIONAL STATUS ACCORDING TO SELF-REPORTED ETHNIC IDENTITY.		
IV: Ethnic identity DV: Self-reported cancer pain DV: Symptoms accompanying pain DV: Functional status	Nondirectional, research	Nonexperimental; Level IV
2. INDIVIDUALS WHO PARTICIPATE IN USUAL CARE (UC) PLUS BLOOD PRESSURE (BP) TELEMONITORING (TM) WILL HAVE A GREATER REDUCTION IN BP FROM BASELINE TO 12-MONTH FOLLOW-UP THAN WOULD INDIVIDUALS WHO RECEIVE UC ONLY.		
IV: Telemonitoring (TM) IV: Usual care (UC) DV: Blood pressure	Directional, research	Experimental; Level II
3. THERE WILL BE A GREATER DECREASE IN STATE ANXIETY SCORES FOR PATIENTS RECEIVING STRUCTURED INFORMATIONAL VIDEOS BEFORE 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; Level II
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; Level II
5. NURSES WITH HIGH SOCIAL SUPPORT FROM CO-WORKERS HAVE LOW PERCEIVED JOB STRESS.		
IV: Social support DV: Perceived job stress	Directional, research	Nonexperimental; Level IV
6. THERE WILL BE NO DIFFERENCE IN ANESTHETIC COMPLICATION RATES BETWEEN HOSPITALS THAT RELY PRIMARILY ON CERTIFIED REGISTERED NURSE ANESTHETIST (CRNA) OBSTETRICAL ANESTHESIA VERSUS THOSE THAT RELY PRIMARILY ON ANESTHESIOLOGISTS.		
IV: Type of anesthesia provider (CRNA or MD) DV: Anesthesia complication rates	Nondirectional; null	Nonexperimental; Level IV
7. THERE WILL BE NO SIGNIFICANT DIFFERENCE IN THE DURATION OF PATENCY OF A 24-GAUGE INTRAVENOUS LOCK IN A NEONATAL PATIENT WHEN FLUSHED WITH 0.5 ml OF HEPARINIZED SALINE (2 U/ml), STANDARD PRACTICE, COMPARED WITH 0.5 ml OF 0.9% NORMAL SALINE.		
IV: Heparinized saline IV: Normal saline DV: Duration of patency of intravenous lock	Nondirectional; null	Experimental; Level II

*Abbreviations: *IV*, independent variable; *DV*, dependent variable.

TABLE 2-5 Examples of Statistical Hypotheses

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; null	Experimental
There will be no difference in the performance accuracy of adult nurse practitioners (ANPs) and family nurse practitioners (FNPs) in formulating accurate diagnoses and acceptable interventions for suspected cases of domestic violence.	IV: Nurse practitioner (ANP or FNP) category DV: Diagnosis and intervention performance accuracy	Statistical; null	Nonexperimental

*Abbreviations: *IV*, independent variable; *DV*, dependent variable.

not statistically significant, the hypothesis was not supported, thereby indicating that the REST intervention did not significantly reduce parenting stress for parents with irritable infants. The examples in Table 2-4 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 2-5 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, a study by Simonson and colleagues (2007) that sought to identify differences in the rates of anesthetic complications in hospitals whose obstetrical anesthesia is provided solely by certified registered nurse anesthetists (CRNAs) compared to hospitals with only anesthesiologists. The null hypothesis, that there would be no differences in anesthetic complication rates between the hospitals that rely primarily on CRNA obstetrical anesthesia versus those that rely primarily on anesthesiologists, was supported, thereby indicating that there were no differences in anesthesia-related complications according to the type of provider, nurse anesthetist or physician. Because the difference in outcomes was not greater than expected by chance, the null hypothesis was accepted (see Chapter 18).

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. You 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.

Directional versus 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 variables. The reader of a directional hypothesis may observe not only the proposal of a relationship but also the nature or direction of that relationship. The following is an example of a directional hypothesis: "Culturally deaf adults who receive the DHHI would demonstrate greater self-efficacy for targeted health-related behaviors than deaf adults who do not receive the DHHI" (Jones et al., 2007) (see Appendix B). Examples of directional hypotheses can also be found in examples 2 through 7 in Table 2-4.

Whereas a **nondirectional hypothesis** indicates the existence of a relationship between the variables, it does not specify the anticipated direction of the relationship. For example, in a study to determine if proteins expressed in nipple aspirate fluid (NAF) serve to detect inflammatory or premalignant states, the following nondirectional hypothesis was used: "A relation exists between women's reproductive, nutritional, and body composition, and activity factors and the amount of C-reactive protein (CRP) in NAF" (Lithgow, Nyamathi, & Elashoff et al., 2006). Nurses who are learning to critique research studies should be aware that both the directional and the nondirectional forms of hypothesis 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 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 question. The literature review and the conceptual framework provide the theoretical foundation for deriving the hypothesis. For example, the theory (e.g., self-efficacy 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. As you read research articles, you will note that directional hypotheses are much more commonly used than nondirectional hypotheses.

In summary, when you evaluate a hypothesis you 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 that a theory base has been used to derive the hypotheses and that the phenomena under investigation have been critically examined and interrelated. You should realize that nondirectional hypotheses may also be deduced from a theory base. Because of the exploratory nature of many studies using nondirectional hypotheses, however, the theory base may not be as developed.
- They provide you with a specific theoretical frame of reference, within which the study is being conducted.
- They suggest to 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 you 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.

TABLE 2-6 Elements of a Clinical Question

Population	Intervention	Comparison Intervention	Outcome
People with advanced cancer	Pain diaries	No pain diaries	Increased pain control

RELATIONSHIP BETWEEN THE HYPOTHESIS, THE RESEARCH QUESTION, AND THE RESEARCH DESIGN

Regardless of whether the researcher uses a statistical or a research hypothesis, there is a suggested relationship between the hypothesis, the research design of the study, and the level of evidence provided by the results of the study. The type of design, experimental or nonexperimental (see Chapters 8 and 9), 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**). This would suggest that the strength of the evidence provided by the results would be Level II (experimental design) or Level III (quasi-experimental design).

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.**

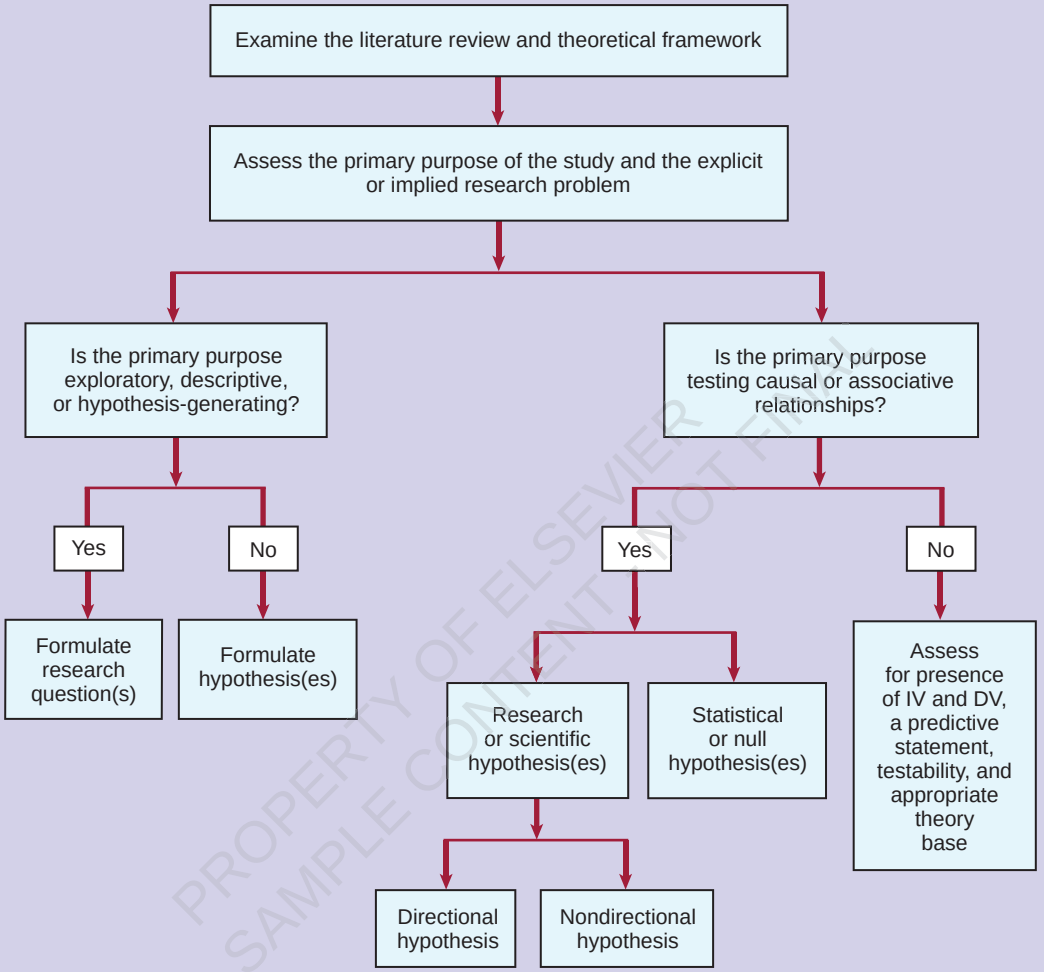
This would suggest that the strength of the evidence provided by the results of a study that examined hypotheses with associative relationship statements would be at Level IV (nonexperimental design).

Table 2-6 provides additional examples of this concept. The Critical Thinking Decision Path shown in the following diagram will help you determine the type of hypothesis presented in a study, as well as the study's readiness for a hypothesis-testing design.

EVIDENCE-BASED PRACTICE TIP

Think about the relationship between the wording of the hypothesis, the type of research design suggested, and the level of evidence provided by the findings of a study using each kind of hypothesis. You may want to consider which type of hypothesis potentially will yield the strongest results applicable to practice.

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



BOX 2-2 Components of a Clinical Question Using the PICO Format

Population: The individual patient or group of patients with a particular condition or health care problem (e.g., adolescents age 13 to 18 with type 1 insulin-dependent diabetes)

Intervention: The particular aspect of health care that is of interest to the nurse or the health team (e.g., a therapeutic [inhaler or nebulizer for treatment of asthma], a preventive [pneumonia vaccine], a diagnostic [measurement of blood pressure], or an organizational [implementation of a bar coding system to reduce medication errors] intervention)

Comparison intervention: Standard care or no intervention (e.g., antibiotic in comparison to ibuprofen for children with otitis media); a comparison of two treatment settings (e.g., rehabilitation center or home care)

Outcome: More effective outcome (e.g., improved glycemic control, decreased hospitalizations, decreased medication errors)

DEVELOPING AND REFINING A CLINICAL QUESTION: A CONSUMER'S PERSPECTIVE

Practicing nurses, as well as students, are challenged to keep their practice up-to-date by searching for, retrieving, and critiquing research articles that apply to practice issues that are encountered in their clinical setting (Cullum, 2000). Practitioners strive to use the current best evidence from research in making clinical and health care decisions. Although research consumers are not conducting research studies, their search for information from practice is also converted into focused, structured clinical questions that are the foundation of evidence-based practice. **Clinical questions** often arise from clinical situations for which there are no ready answers. You have probably had the experience of asking, *What is the most effective treatment for … ?* or *Why do we still do it this way?*

Using similar criteria related to framing a research question, focused clinical questions are used as a basis for searching the literature to identify supporting evidence from research. **Clinical questions** have four components:

- Population
- Intervention
- Comparison
- Outcome

The four components, known as PICO, a format that is effective in helping nurses develop searchable clinical questions. Box 2-2 presents each component of the clinical question.

The significance of the clinical question becomes obvious as the research evidence from the literature is critiqued. The research evidence is used side by side with clinical expertise and the patient's perspective to develop or revise nursing standards, protocols, and policies that are used to plan and implement patient care (Cullum, 2000; Sackett et al., 2000; Thompson et al., 2004). Issues or questions can arise from multiple clinical and managerial situations. Using the example of pain, albeit from a different perspective, a nurse working in a palliative care setting wondered whether completing pain diaries was a useful thing in the palliative care of patients with advanced cancer. She wondered whether time was being spent developing something that had previously been shown to be useless or even harmful. After all, it is conceivable that monitoring one's pain in a diary actually heightens one's awareness and experience

BOX 2-3 Examples of Clinical Questions

- What are the most effective decision aids to support oncology patients' participation in clinical decision making? (Stacey et al., 2008)
- In overweight or obese people with type 2 diabetes, does an intensive lifestyle intervention reduce weight and cardiovascular disease risk factors? (Pi-Sunyer et al., 2007)
- Are diet and/or exercise effective for weight reduction in postpartum women? (Amorim et al., 2007)
- In patients with multiple behavioral risk factors for cardiovascular disease, is sequential counseling (SQC) that targets one behavior at a time more effective than simultaneous counseling that targets multiple behaviors? (Hyman et al., 2007)
- In patients requiring mechanical ventilation for greater than 48 hours, is oral decontamination with chlorhexidene (CHX) or CHX plus colistin (COL) effective for reducing ventilator-associated pneumonia (VAP)? (Koeman et al., 2006)
- What is the effect of arch supports on balance, functional mobility, and back pain and lower extremity joint pain in older adults? (Mulford et al., 2008)
- Is there a significant difference in the effect of different body positions on blood pressure in healthy young adults? (Eser et al., 2007)
- In people with impaired glucose tolerance, do lifestyle or pharmacological interventions prevent or delay onset of type 2 diabetes? (Gillies et al., 2007)
- What are the experiences of middle-aged people living with chronic heart failure? (Nordgren et al., 2007)

of pain. To focus the nurse's search of the literature, she developed the following question: *Does the use of pain diaries in the palliative care of patients with cancer lead to improved pain control?* Sometimes it is helpful for nurses who develop clinical questions from a consumer perspective to consider three elements as they frame their focused question: (1) the situation, (2) the intervention, and (3) the outcome:

- The situation is the patient or problem being addressed. This can be a single patient or a group of patients with a particular health problem (palliative care of patients with cancer).
- The intervention is the dimension of health care interest and often asks whether a particular intervention is a useful treatment (pain diaries).
- The outcome addresses the effect of the treatment (intervention) for this patient or patient population in terms of quality and cost (decreased pain perception/low cost). It essentially answers whether the intervention makes a difference for the patient population.

The individual parts of the question are vital pieces of information to remember when it comes to searching for evidence in the literature. One of the easiest ways to do this is to use a table as illustrated in Table 2-6. Examples of clinical questions are highlighted in Box 2-3. Chapter 3 will provide examples of how to effectively search the literature to find answers to questions posed by researchers and research consumers.

EVIDENCE-BASED PRACTICE TIP

You should be formulating clinical questions that arise from your clinical practice. Once you have developed a focused clinical question using the PICO format, you will search the literature for the best available evidence to answer your clinical question.

The Research Question and Hypothesis

The care that the researcher takes when developing the research question or hypothesis is often representative of the overall conceptualization and design of the study. In a quantitative research study, the remainder of a study revolves around answering the research question or testing the hypothesis. 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 questions and hypotheses in published research reports.

CRITIQUING THE RESEARCH QUESTION

The following Critiquing Criteria box provides several criteria for evaluating the initial phase of the research process—the research question. Because the research question 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. You will then be in a position to evaluate whether the rest of the study logically flows from its foundation—the research question(s). The author will often begin by identifying the background and significance of the issue that led to crystallizing development of the unanswered question. The clinical and scientific background and/or significance will be summarized, and the purpose, aim, or objective of the study is identified. Finally, the research question and any related subquestions will be proposed before or after the literature review.

The purpose of the introductory summary of the theoretical and scientific background is to provide the reader with a glimpse of how the author critically thought about the research question's development. The introduction to the research question 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 a study by Holzemer and colleagues (2006) that tested a tailored nurse-delivered HIV/AIDS medication adherence intervention program compared with standard care, the significance of the research question was related to the known relationship between patient adherence and treatment outcomes across chronic health conditions and the ongoing challenge of improving patient adherence to HIV/AIDS therapeutic medication regimens and, thereby, improving patient outcomes.

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

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

You will use these three elements as criteria for judging the soundness of a stated research question. It is likely that if the question 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 question. A restatement of the question might be as follows:

$$(\mathbf{Y}_1)(\mathbf{X}_1, \mathbf{X}_2, \mathbf{X}_3)$$

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. You will have a clear idea of what the report should convey and can knowledgeably evaluate the material that follows. When critically appraising clinical questions, think about the fact that they should be focused and specify the patient or problem being addressed, the intervention, and the outcome for a particular patient population. There should be evidence that the clinical question guided the literature search and suggests the design and level of evidence to be obtained from the study findings.

CRITIQUING THE HYPOTHESIS

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

1. When reading a research study, you 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. In cases such as that, you must infer the hypotheses from the purpose statement and the type of analysis used. You should not assume that if 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.
2. If a hypothesis or set of hypotheses are presented, the data analysis should directly answer the hypotheses. 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.

3. Although a hypothesis can legitimately be nondirectional, it is preferable, and more common, for the researcher to indicate the direction of the relationship between the variables in the hypothesis. You will find that when there are a lack of data available for the literature review (i.e., the researcher has chosen to study a relatively undefined area of interest), a 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, you will 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. You 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.
5. Another point about testability 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, or related convey the idea of objectivity and testability. You should immediately be suspicious of hypotheses that are not stated objectively.
6. You should recognize that how the proposed relationship of the hypothesis is phrased suggests the type of research design that will be appropriate for the study, as well as the level of evidence to be derived from the findings. 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 (Level II evidence) or quasi-experimental design (Level III evidence) is suggested (see Chapter 8). If a hypothesis proposes that there will be a positive relationship between variables **X** and **Y,** a nonexperimental design (Level IV evidence) is suggested (see Chapter 9). A review of Table 2-4 provides you with additional examples of hypotheses, the type of research design, and the level of evidence that is suggested by each 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.
7. If the research report contains research questions rather than hypotheses, you will want to evaluate whether this is appropriate to the study. One criterion for making this decision, as presented earlier in this chapter, is whether the study is of an exploratory, a descriptive, or a qualitative nature. If it is, then it is appropriate to have research questions rather than hypotheses.

CRITIQUING CRITERIA: *Developing Research Questions and Hypotheses*

The Research Question

1. Was the research question introduced promptly?
2. Is the research question stated clearly and unambiguously?
3. Does the research question express a relationship between two or more variables or at least between an independent and a dependent variable, implying empirical testability?
4. How does the research question specify the nature of the population being studied?
5. How has the research question been substantiated with adequate experiential and scientific background material?
6. How has the research question been placed within the context of an appropriate theoretical framework?
7. How has the significance of the research question been identified?
8. Have pragmatic issues, such as feasibility, been addressed?
9. How have the purpose, aims, or goals of the study been identified?
10. Are research questions appropriately used (i.e., exploratory, descriptive, or qualitative study or in relation to ancillary data analyses)?

The Hypothesis

1. How does the hypothesis 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. How are the variables measurable or potentially measurable?
5. Is each hypothesis 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. How is each hypothesis consistent with the literature review?
10. How is the theoretical rationale for the hypothesis made explicit?
11. Given the level of evidence suggested by the research question, hypothesis, and design, what is the potential applicability to practice?

The Clinical Question

1. Does the clinical question specify the patient population, intervention, comparison intervention, and outcome?

CRITICAL THINKING CHALLENGES

- Discuss how the wording of a research question or hypothesis suggests the type of research design and level of evidence that will be provided.
- Using the study about breast cancer survivors by Meneses et al. in Appendix A, diagram how the hypotheses flow from the theoretical framework and literature review.
- Using the Horgas study in Appendix C, describe how the significance of the research problem and purpose of the study are linked to the research questions.
- A nurse is caring for patients in a clinical situation that produces a clinical question having no ready answer. The nurse wants to develop and refine this clinical question using the PICO approach so that it becomes the basis for an evidence-based practice project. How can the nurse accomplish that objective?

KEY POINTS

- Formulation of the research question and stating the hypothesis are key preliminary steps in the research process.
- The research question 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 question.
- The significance of the research question must be identified in terms of its potential contribution to patients, nurses, the medical community in general, and society. Applicability of the question 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 question 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 question 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.
- Focused clinical questions arise from clinical practice and guide the literature search for the best available evidence to answer the clinical question.
- A hypothesis attempts to answer the question posed by the research question. When testing the validity of the theoretical frameworks' 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 purpose, research question, or hypothesis provides information about the intent of the research question and hypothesis and suggests the level of evidence to be obtained from the study findings.
- 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 question, as well as the related subquestions, the specificity of the population, and the implications for testability.
- The interrelatedness of the research question, the literature review, the theoretical framework, and the hypotheses should be apparent.
- The appropriateness of the research design suggested by the research question is also evaluated.
- The purpose of the study (i.e., why the researcher is doing the study) should be differentiated from 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 and level of evidence 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.

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