CHAPTER 2

Research questions, hypotheses, and clinical questions

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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.
- Discuss the appropriate use of research questions versus hypotheses in a research study.
- Identify the criteria for determining the significance of a research question or hypothesis.
- Discuss how the purpose, research question, and hypothesis suggest the level of evidence to be obtained from the findings of a research study.
- Discuss the purpose of developing a clinical question.
- Discuss the differences between a research question and a clinical question in relation to evidence-based practice.
- Apply critiquing criteria to the evaluation of a research question and hypothesis in a research report.

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

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exercises, and additional research articles for practice in reviewing and critiquing.

At the beginning of this chapter, you will learn about research questions and hypotheses from the perspective of a researcher, which, in the second part of this chapter, will help you generate your own clinical questions that you will use to guide the development of evidence-based practice projects. From a clinician's perspective, you must understand the research question and hypothesis as it aligns with the rest of a study. As a practicing nurse, developing clinical questions (see Chapters 19, 20, and 21) is the first step of the evidence-based practice process for quality improvement programs like those that decrease risk for development of pressure ulcers.

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.

The research question or hypothesis is a key preliminary step in the research process. The **research question** tests a measureable relationship to be examined in a research study. The **hypothesis** predicts the outcome of a study.

Hypotheses can be considered intelligent hunches, guesses, or predictions that provide researchers with direction for the research design and the collection, analysis, and interpretation of data. 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 (see Chapter 4).

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 and retrieving the best available evidence. This evidence, 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.

Often the research questions or hypotheses appear at the beginning of a research article, but may be embedded in the purpose, aims, goals, or even the results section of the research report. This chapter provides you with a working knowledge of quantitative research questions and hypotheses. 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. Research questions or topics are not pulled from thin air. In Table 2.1, you will see that research questions can indicate that practical experience, critical appraisal of the scientific literature, or interest in an untested theory forms the basis for the development 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 identify that the researcher has:

- Defined a specific question area
- Reviewed the relevant literature
- Examined the question's potential significance to nursing
- 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
Clinical experience	Clinical practice provides a wealth of experience from which research problems can be derived. The nurse may observe 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 observe that despite improvements in symptom management for cancer patients receiving chemotherapy, side effects remain highly prevalent. Symptoms such as nausea/vomiting, diarrhea, constipation, and fatigue are common, and patients report that they negatively affect functional status and quality of life, including costly and distressing hospitalizations. A study by Traeger et al. (2015) tested a model integrated into outpatient care for patients with breast cancer, lung cancer, and colorectal cancer, designed to reduce symptom burden to be delivered by each patient's oncology team nurse

		practitioner that included telephone follow-up, symptom assessment, advice, and triage according to actual clinical practice. The aim was to ensure optimal patient-NP management of side effects early in the course of care.
Critical appraisal of the scientific literature	Critical appraisal of studies in journals may indirectly suggest a clinical problem 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 setting.	At a staff meeting with members of an interprofessional team at a cancer center, it was noted that the center did not have a standardized clinical practice guideline for mucositis, a painful chemotherapy side effect involving the oral cavity that has a negative impact on nutrition, oral hygiene, and comfort. The team wanted to identify the most effective approaches for treating adults and children experiencing mucositis. Their search for, and critical appraisal of, existing research studies led the team to develop an interprofessional mucositis guideline that was relevant to their patient population and clinical setting (NYU Langone Medical Center, 2016).
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.	Obesity is a widely recognized risk factor for many conditions treated in primary care settings including type 2 diabetes, cardiovascular disease, hypertension, and osteoarthritis. Although weight and achieving a healthy weight for children and adults is a Healthy People 2020 goal and a national priority, the prevalence of obesity remains high, and there is little research on targeted interventions for weight loss in primary care settings. Therefore, the purpose of a study by Thabault, Burke, and Ades (2015) was to evaluate an NP-led motivational interviewing IBT program implemented in an adult primary care practice with obese patients to determine feasibility and acceptance of the intervention.
Interest in untested theory	Verification of a theory and its concepts provides a relatively uncharted area from which research problems can be derived. Inasmuch as theories themselves are not tested, a researcher may consider investigating a concept or set of concepts related to a nursing theory or a theory from another discipline. The researcher would pose questions like, "If this theory is correct, what kind of behavior would I expect to observe in particular patients and under which conditions?" "If this theory is valid, what kind of supporting evidence will I find?"	Bandura's (1997) health self-efficacy construct, an individual's confidence in the ability to perform a behavior, overcome barriers to that behavior, and exert control over the behavior through self-regulation and goal setting, was used by Richards, Ogata, and Cheng (2016) to investigate whether health-related self-efficacy provides the untested theoretical foundation for behavior change related to increasing physical activity using a dog walking (Dogs PAW) intervention.

IBT, Intensive behavioral therapy.

Defining the research question

Brainstorming with faculty or colleagues may provide valuable feedback that helps the researcher focus on a specific research question area. **Example:** ➤ Suppose a researcher told a colleague that her area of interest was health disparities about the effectiveness of peer coaching or case management in improving health outcomes with challenging patient populations such as those who are homeless. The colleague may have asked, "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 effectiveness of a nursing case management and peer coaching intervention on hepatitis A and B (HAV and HBV) vaccine completion rates among homeless men recently released on parole (Nyamathi et al., 2015) (see Appendix A). Fig. 2.1 illustrates how a broad area of interest (health disparities, nursing case management, peer coaching) was narrowed to a specific research topic (effectiveness of nursing case management and peer coaching on HAV and HBV vaccine completion among homeless men recently released on parole).

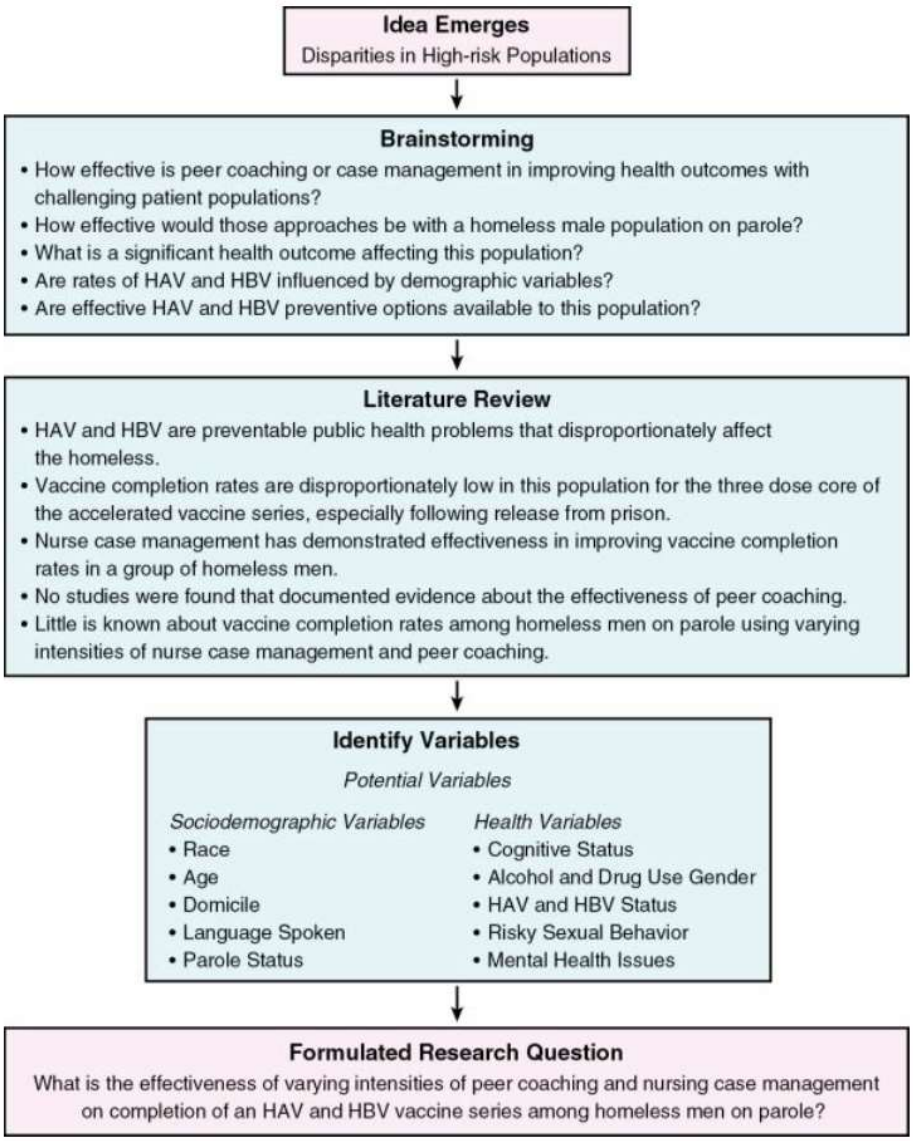


FIG 2.1 Development of a research question.

EVIDENCE-BASED PRACTICE TIP

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

Beginning the literature review

The literature review should reveal a relevant collection of studies and systematic reviews that have been critically examined. Concluding sections in such articles (i.e., the recommendations and implications for practice) often identify remaining gaps in the literature, the need for replication, or the need for additional knowledge about a particular research focus (see Chapter 3). In the previous example, the researcher may have conducted a preliminary review of books and journals for theories and research studies on factors apparently critical to vaccine completion rates for preventable health problems like HAV and HBV, as well as risk factors contributing to the disproportionate impact of HAV and HBV on the homeless, such as risky sexual activity, drug use, substandard living conditions, and older age. These factors, called variables, should be potentially relevant, of interest, and measurable.

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.

Other variables, called *demographic variables,* such as race, ethnicity, gender, age, education, and physical and mental health status, are also suggested as essential to consider. **Example:** ➤ Despite the availability of the HAV and HBV vaccines, there has been a low completion rate for the three-dose core of the accelerated vaccine series, particularly following release from prison. This information can then be used to further define the research question and continue the search of the literature to identify effective intervention strategies reported in other studies with similar high-risk populations (e.g., homeless) that could be applied to this population. **Example:** ➤ One study documented the effectiveness of a nurse case management program in improving vaccine completion rates in a group of homeless adults, but no studies were found about the effectiveness of peer coaching. At this point, the researcher could write the tentative research question: "What is the effectiveness of peer coaching and nursing case management on completion of an HAV and HBV vaccine series among homeless men on parole?" You can envision the interrelatedness of the initial definition of the question area, the literature review, and the refined research question.

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.

Examining significance

When considering a research question, it is crucial that the researcher examine the question's potential significance for nursing. This is sometimes referred to as the "so what" question, because 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.
- Results will be applicable for nursing practice, education, or administration.
- Findings will provide support or lack of support for untested theoretical concepts.
- Findings will extend or challenge existing knowledge by filling a gap or clarifying a conflict in the literature.
- 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, the researcher is wise to extensively revise the question or discard it. **Example:** ➤ In the previously cited research question, the significance of the question includes the following facts:

- HAV and HBV are vaccine preventable.
- Viral hepatitis disproportionately impacts the homeless.
- Despite its availability, vaccine completion rates are low among high-risk and incarcerated populations.
- Accelerated vaccine programs have shown success in RCT studies.
- The use of nurse case management programs in accelerated vaccine programs also provides evidence of effectiveness.
- Little is known about vaccine completion among ex-offender populations on parole using varying

intensities of nurse case management and peer coaches.

- This study sought to fill a gap in the related literature by assessing whether seronegative parolees randomized to one of three intervention conditions were more likely to complete the vaccine series as well as to identify predictors of HAV/HBV vaccine completion.

IPE HIGHLIGHT

It is helpful to collaborate with colleagues from other professions to identify an important clinical question that provides data for a quality improvement on your unit.

The fully developed research question

When a researcher finalizes a research question, the following 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 element is crucial to developing 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.

Variables

Researchers call the properties that they study "variables." Such properties take on different values. Thus a **variable**, as the name suggests, is 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. **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 and frequent oral hygiene are associated with decreasing risk for 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 (see Chapter 9). In nonexperimental research, the independent variable is not manipulated and is assumed to have occurred naturally before or during the study (see Chapter 10).

The **dependent variable**, represented by Y, 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. **Example:** ➤ It might be assumed that the perception of pain intensity (the dependent variable) will vary in relation to a person's gender (the independent variable). In this case, we are trying to explain the perception of pain intensity in relation to gender (i.e., 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.

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.

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?	Are there relationships between socio-demographic (age, willingness to receive HPV vaccination) and professional characteristics (education, belief that cervical cancer can be prevented by HPV vaccination) and overall knowledge about cervical cancer, HPV, and HPV vaccines?
Comparative	Is there a difference in Y (dependent variable) between people who have X characteristic (independent variable) versus those who do not have X characteristic?	Do female caregivers' appraisals of children's behavior differ by family type (level of hardiness and cohesiveness)?
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 attitudes toward cancer pain management, pain intensity, pain relief, functional status, and quality of life in cancer patients who have received an educational intervention versus a coaching intervention versus usual care? (Thomas et al., 2012)
Qualitative		
Phenomenology	What is/was your lived experience of X?	What are parents' perceptions of circumstances influencing their own sleep when living with a severely ill child enrolled in HBHC? (Angelhoff, Edell-Gustafsson, & Morelius, 2015)

HBHC, Hospital-based home care.

Although one independent variable and one dependent variable are used in the examples, there is no restriction on the number of variables that can be included in a research question. 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. **Example:** ➤ A nurse may review an article about depression that identifies depression in adolescents as predictive of risk for suicide. In this case, depression is the independent variable. When another article about the effectiveness of antidepressant medication alone or in combination with cognitive behavioral therapy (CBT) in decreasing depression in adolescents is considered, change in depression is the dependent variable. Whether a variable is independent or dependent is a function of the role it plays in a particular study.

Population

The **population** is a well-defined set that has certain characteristics and is either clearly identified or implied in the research question. **Example:** ➤ In a retrospective cohort study studying the number of ED visits and hospitalizations in two different transition care programs, a research question may ask, "What is the differential effectiveness of nurse-led or physician-led intensive home visiting program providing transition care to patients with complex chronic conditions or receiving palliative care (Morrison, Palumbo, & Rambur, 2016)? Does a relationship exist between type of transition care model (nurse-led focused on chronic disease self-management or physician-led focused on palliative care and managing complex chronic conditions) and the number of ED visits and rehospitalizations 120 days pre- and posttransitional care interventions?" This question suggests that the population includes community-residing adults with complex chronic conditions or receiving palliative care who participated in either a nurse or physician-led transitional care program.

EBP 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**, measurable by either qualitative or quantitative methods. **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 measureable relationship between an independent and a dependent variable. Many interesting and important clinical questions are not valid research questions because they are not amenable to testing.

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.

The question "What are the relationships between vaccine completion rates among the ex-offender population and use of varying intensities of nurse case management and peer coaches?" is a testable research question. It illustrates the relationship between the variables, identifies the independent and dependent variables, and implies the testability of the research question. Table 2.3 illustrates how this research question is congruent with the three research question criteria.

TABLE 2.3

Components of the Research Question and Related Criteria

Variables	Population	Testability
Independent Variable		
• Nurse case management • Peer coaching • Age • Race/ethnicity • Marital and parental status education	• High-risk population of ex-offenders on parole and homeless	• Differential effect of nurse case management and peer coaching on HAV and HBV vaccine completion rates as evidence of health-seeking behavior and coping
Dependent Variable		
• HAV and HBV vaccine completion rates		

This research question was originally derived from a general area of interest: health-seeking behavior and coping (HAV and HBV vaccine completion rates) in a high-risk population (ex-offenders on parole, homeless), factors related to vaccine completion (age, education, race/ethnicity, marital, and parental status), and potential strategies (nurse case management and peer coaching) to improve protective behaviors and health outcomes. The question crystallized further after a preliminary literature review (Nyamathi et al., 2015).

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

The **purpose** of the study encompasses the aims or objectives the investigator hopes to achieve with the research. These three terms are synonymous. The researcher selects verbs to use in the purpose statement that suggest the planned approach to be used when studying the research question as well as 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 hypothesis-testing study for which there is an established knowledge base of the topic.

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 examples of purpose, aims, and objectives.

BOX 2.1

Examples of Purpose Statements

- The purpose of this study was to explore the relationship between future expectations, attitude toward use of violence to solve problems, and self-reported physical and relational bullying perpetration in a sample of seventh grade students (Stoddard, Varela, & Zimmerman, 2015). The aim of this study was to determine knowledge, awareness, and practices of Turkish hospital nurses in relation to cervical cancer, HPV, and HPV (Koc & Cinarli, 2015).

- The purposes of this longitudinal study with a sample composed of Hispanic, Black non-Hispanic, and White non-Hispanic bereaved parents were to test the relationships between spiritual/religious coping strategies and grief, mental health, and personal growth for mothers and fathers at 1 and 3 months after the infant/child's death in the NICU/PICU (Hawthorne et al., 2016). The goals of the current study were to examine psychological functioning and coping in parents and siblings of adolescent cancer survivors (Turner-Sack et al., 2016).

OSEN 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. You 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 figure out the hypotheses and population being tested. **Example:** ➤ In a study by Turner-Sack and colleagues (2016) (see Appendix B), the hypotheses are embedded in the "Data Analysis" and "Results" sections of the article. You must interpret that the statement, "Independent sample t-tests were conducted to compare the survivors, siblings, and parents on measures of psychological distress, life satisfaction, posttraumatic growth (PTG), and that of their matched parents" to understand that it represents hypotheses used to compare psychological functioning, PTG, coping, and cancer-related characteristics of adolescent cancer survivors' parents and siblings.

Hypotheses flow from the study's purpose, literature review, and theoretical framework. Fig. 2.2 illustrates this flow. A **hypothesis** is a declarative statement about the relationship between two or more variables. A hypothesis predicts an expected outcome of a study. Hypotheses are developed before the study is conducted because they provide direction for the collection, analysis, and interpretation of data.

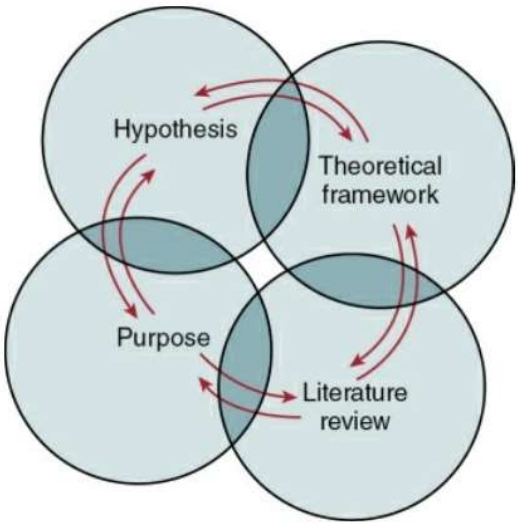


FIG 2.2 Interrelationships of purpose, literature review, theoretical framework, and hypothesis.

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 data analysis, results, or discussion section of a research article.

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: the 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 *difference in* suggest the directionality that is proposed in the hypothesis. The following is an example of a directional hypothesis: "Nurse staff members' perceptions of transformational leadership among their nurse leaders (independent variable) is that it is negatively associated with nurse staff burnout (dependent variable)" (Lewis & Cunningham, 2016). The dependent and independent variables are explicitly identified, and the relational aspect of the prediction in the hypothesis is contained in the phrase "negatively associated with."

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. **Example:** ➤ A researcher might hypothesize selected determinants of the decision-making process, specifically expectation, socio-demographic factors, and decisional conflict would predict postdecision satisfaction and regret about their choice of treatment for breast cancer in Chinese-American women (Lee & Knobf, 2015). It would be difficult for a researcher to predict a cause-and-effect relationship, however, because of the multiple intervening variables (e.g., values, culture, role, support from others, personal resources, language literacy) that might also influence the subject's decision making about treatment for their breast cancer diagnosis.

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. **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.

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

The third characteristic is that the 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. You 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. **Example:** ➤ Nyamathi and colleagues (2015) (see Appendix A) investigated the effectiveness of a nursing case management intervention in comparison to a peer coaching intervention based on the comprehensive health-seeking and coping paradigm developed by Nyamathi in 1989, adapted from a coping model by Lazarus and Folkman (1984), and the health-seeking and coping paradigm by Schlotfeldt (1981), which is a useful theoretical framework for case management, peer coaching interventions, and vaccine completion outcomes.

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 that are described in Tables 2.4 and 2.5. Information about hypotheses may be further clarified in the instruments, sample, or methods sections of a research report (see Chapters 12 and 15).

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	Nondirectional, research	Nonexperimental; Level IV
DV: Self-reported cancer pain		
DV: Symptoms accompanying pain		
DV: Functional status		
2. Individuals Who Participate in UC Plus BP Will Have a Greater Reduction in BP from Baseline to 12-month Follow-up than Individuals Who Receive UC Only.		
IV: TM	Directional, research	Experimental; Level II
IV: UC		
DV: Blood pressure		
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	Directional, research	Experimental; Level II
IV: Standard information		
DV: State anxiety		
4. Participants Randomly Assigned to the Intervention Group (Dog Walking Program) Will Show a Significant Increase in Physical Activity When Compared with Participants in the Control Group (No Dog Walking Program), and These Changes Will Remain 1 Year after the Start of the Intervention.		
IV: Dog walking intervention among dog owners	Directional, research	Experimental; Level II
IV: Control group—usual dog walking		
DV: Physical activity		
5. Nurses with High Social Support from Coworkers Will Have Lower Perceived Job Stress.		
IV: Social support	Directional, research	Nonexperimental; Level IV
DV: Perceived job stress		
6. There Will Be No Difference in Anesthetic Complication Rates Between Hospitals That Use CRNA for Obstetrical Anesthesia Versus Those That Use Anesthesiologists.		
IV: Type of anesthesia provider (CRNA or MD)	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), Compared with 0.5 mL of 0.9% of Normal Saline.		
IV: Heparinized saline	Null	Experimental; Level II
IV: Normal saline		
DV: Duration of patency of intravenous lock		

BP, Blood pressure; *CRNA*, Certified Nurse Anesthetists; *DV*, dependent variable; *IV*, independent variable; *TM*, telemonitoring; *UC*, usual care.

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 ANPs and 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

ANPs, Adult nurse practitioners; *FNPs*, family nurse practitioners; *DV*, dependent variable; *IV*, independent variable.

Statistical versus research hypotheses

You 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. 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.

Directional versus nondirectional hypotheses

Hypotheses can be formulated directionally or nondirectionally. A **directional hypothesis** specifies the expected direction of the relationship between the independent and dependent variables. An example of a directional hypothesis is provided in a study by Parry and colleagues (2015) that investigated a novel noninvasive device to assess sympathetic nervous system functioning in patients with heart failure. The researchers hypothesized that participants with heart failure reduced ejection fraction (HFrEF), who have internal cardiac defibrillators or CRT pacemakers, will have a decrease in pre-ejection period (reflective of increased sympathetic nervous system activity) and decrease in left ventricular ejection time (reflective of an increased heart rate) with a postural change from sitting to standing.

In contrast, a **nondirectional hypothesis** indicates the existence of a relationship between the variables, but does not specify the anticipated direction of the relationship. **Example:** ➤ Rattanawiboon and colleagues (2016) evaluated the effectiveness of fluoride mouthwash delivery methods, swish, spray, or swab application, in raising salivary fluoride in comparison to conventional fluoride mouthwash, but did not predict which form of fluoride delivery would be most effective. Nurses who are learning to critically appraise research studies should be aware that both the directional and the nondirectional forms of hypothesis statements are acceptable.

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, the 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 9 and 10), will influence the wording of the hypothesis. **Example:** ➤ When an experimental design is used, you 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 $\mathbf{X}_2$.

QSEN 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.

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 suggests that the strength of the evidence provided by the results is 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 suggests 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 an example of this concept. The Critical Thinking Decision Path will help you determine the type of hypothesis or research question presented in a study.

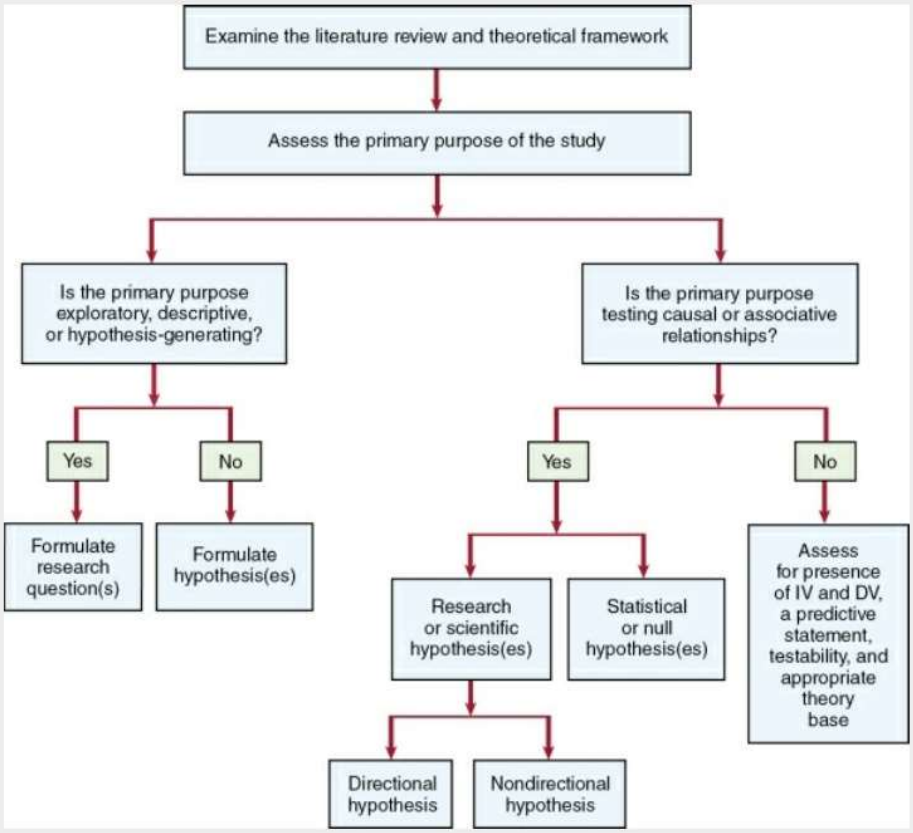
TABLE 2.6
Elements of a Clinical Question

Population	Intervention	Comparison Intervention	Outcome
Older adult hospitalized patients with indwelling urinary catheters	Daily nurse-led catheter rounds	No daily nurse-led catheter rounds	Decreased number of CAUTIs

CAUTIs, Catheter acquired urinary tract infections.

CRITICAL THINKING DECISION PATH

Determining the Use of a Hypothesis or Research Question



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 (see Chapter 20). Practitioners strive to use the current best evidence from research when making clinical and health care decisions. As research consumers, you are not conducting research studies; however, your search for information from clinical practice is converted into focused, structured clinical questions that are the foundation of evidence-based practice and quality improvement projects. 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 form a basis for searching the literature to identify supporting evidence from research. **Clinical questions** have four components:

- Population
- Intervention
- Comparison
- Outcome

These components, known as PICO, provide an effective format for helping nurses develop searchable clinical questions. Box 2.2 presents each component of the clinical question.

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 13–18 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 vs. home care)

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

The significance of the clinical question becomes obvious as research evidence from the literature is critically appraised. Research evidence is used together with clinical expertise and the patient's perspective to confirm, 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 catheter acquired urinary tract infections (CAUTIs), a team of staff nurses working on a medical unit in an acute care setting were reviewing their unit's quarterly quality improvement data and observed that the number of CAUTIs had increased by 25% over the past 3 months. The nursing staff reviewed the unit's standard of care and noted that although nurses were able to discontinue an indwelling catheter, according to a set of criteria and without a physician order, catheters were remaining in place for what they thought was too long and potentially contributing to an increase in the prevalence of CAUTIs. To focus the nursing staff's search of the literature, they developed the following question: Does the use of daily nurse-led catheter rounds in hospitalized older adults with indwelling urinary catheters lead to a decrease in CAUTIs? Sometimes it is helpful for nurses who develop clinical questions from a quality improvement 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 (e.g., hospitalized adults with indwelling urinary catheters).
- The intervention is the dimension of health care interest, and often asks whether a particular intervention is a useful treatment (e.g., daily nurse-led catheter rounds).
- The outcome addresses the effect of the treatment (e.g., intervention) for this patient or patient population in terms of quality and cost (e.g., decreased CAUTIs). 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 provides examples of how to effectively search the literature to find answers to questions posed by researchers and research consumers.

BOX 2.3

Examples of Clinical Questions

- Does using a Discharge Bundle combined with Teachback Methodology reduce pediatric readmissions? (Shermont et al., 2016)
- What is the most effective IV insulin practice guideline for cardiac surgery patients? (Westbrook et al., 2016)
- Does using a structured content and electronic nursing handover reduce patient clinical management errors? (Johnson et al., 2016)
- What is the impact of nursing teamwork on nurse-sensitive quality indicators? (Rahn, 2016)
- Do PCMH access and care coordination measures reflect the contributions of all team members? (Annis et al., 2016)
- Is a patient-family-staff partnership video the most effective approach for preventing falls in hospitalized patients? (Silkworth et al., 2016)
- What is the impact of prompt nutrition care on patient outcomes and health care costs? (Meehan et al., 2016)

PCMH, Patient-centered medical home.

OSEN 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.

Appraisal for evidence-based practice the research question and hypothesis

When you begin to critically appraise a research study, consider the care the researcher takes when developing the research question or hypothesis; it 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. Because this text focuses on you as a research consumer, the following sections will primarily pertain to the evaluation of research questions and hypotheses in published research reports.

Critiquing the research question and hypothesis

The following Critical Appraisal Criteria box provides several criteria for evaluating the initial phase of the research process—the research question or hypothesis. Because the research question or hypothesis guides the study, it is usually introduced at the beginning of the research report to indicate the focus and direction of the study. You can then evaluate whether the rest of the study logically flows from its foundation—the research question or hypothesis. The author will often begin by identifying the background and significance of the issue that led to crystallizing development of the research question or hypothesis. The clinical and scientific background and/or significance will be summarized, and the purpose, aim, or objective of the study is then identified.

Often the research question or hypothesis will be proposed before or after the literature review.

Sometimes you will find that the research question or hypothesis is not specifically stated. In some cases, it is only hinted at or is embedded in the purpose statement, and you are challenged to identify the research question or hypothesis. In other cases, the research question is embedded in the findings toward the end of the article. To some extent, this depends on the style of the journal.

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. 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 or research questions that are not stated objectively. You will find that when there is 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 or research question may be appropriate.

You should recognize that how the proposed relationship of the hypothesis or research question 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. **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 9). If a research question asks if there will be a positive relationship between variables **X** and **Y**, a nonexperimental design (Level IV evidence) is suggested (see Chapter10).

Hypotheses and research questions are never proven beyond the shadow of a doubt. Researchers who claim that their data have "proven" the validity of their hypothesis or research question should be regarded with grave reservation. You should realize that, at best, findings that support a hypothesis or research question 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.

When critically appraising clinical questions, think about the fact that the clinical question should be focused and specify the patient population or clinical 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 that appropriate types of research studies are retrieved in terms of the study design and level of evidence needed to answer the clinical question.

CRITICAL APPRAISAL CRITERIA

Developing Research Questions and Hypotheses

The research question

1. 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?

2. How does the research question specify the nature of the population being studied?

3. How has the research question been supported with adequate experiential and scientific background material?

4. How has the research question been placed within the context of an appropriate theoretical framework?

5. How has the significance of the research question been identified?

6. Have pragmatic issues, such as feasibility, been addressed?

7. How have the purpose, aims, or goals of the study been identified?

The hypothesis

1. Is the hypothesis concisely stated in a declarative form?

2. Are the independent and dependent variables identified in the statement of the hypothesis?

3. Is each hypothesis specific to one relationship so that each hypothesis can be either supported or

not supported?

4. Is the hypothesis stated in such a way that it is testable?

5. Is the hypothesis stated objectively, without value-laden words?

6. Is the direction of the relationship in each hypothesis clearly stated?

7. How is each hypothesis consistent with the literature review?

8. How is the theoretical rationale for the hypothesis made explicit?

9. 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?

2. Does the clinical question address an outcome applicable to practice?

Key points

- Developing 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 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 final research question is 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.
- Research questions that are nondirectional may be used in exploratory, descriptive, or qualitative research studies.
- Research questions can be directional, depending on the type of study design being used.
- Focused clinical questions arise from clinical practice and guide the literature search for the best available evidence to answer the clinical question.
- 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 and be further categorized as either research or statistical hypotheses.
- 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 interrelatedness of the research question or hypothesis and the literature review and the theoretical framework should be apparent.
- The appropriateness of the research design suggested by the research question or hypothesis is also evaluated.

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 by Hawthorne, Youngblut, and Brooten (2016) (see Appendix B), describe how the background, significance, and purpose of the study are linked to the research questions.
- IPE The prevalence of catheter acquired urinary infections (CAUTIs) has increased on your hospital unit by 10% in the last two quarters. As a member of the Quality Improvement (QI) Committee on your unit, collaborate with your committee colleagues from other professions to develop an interprofessional action plan. Deliberate to develop a clinical question to guide the QI project.
- A nurse is in charge of discharge planning for frail older adults with congestive heart failure. The goal of the program is to promote self-care and prevent rehospitalizations. Using the PICO approach, the nurse wants to develop a clinical question for an evidence-based practice project to evaluate the effectiveness of discharge planning for this patient population. How can the nurse accomplish that objective?

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

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