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The Iowa Model of Evidence-Based Practice to Promote Quality Care

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Research utilization began with Florence Nightingale, who used data to change practices that contributed to high mortality.[38, 39] In spite of Nightingale's efforts, a critical gap developed and grew between the conduct and use of research.[51]

In the 1970s, 1980s, and early 1990s, as nursing science became available to guide practice, use of research in practice was promoted by demonstration projects and programs such as the Conduct and Utilization of Research in Nursing project,[19, 22] Western Interstate Commission for Higher Education in Nursing regional program in nursing research development,[20-28] Nursing Child Assessment Satellite Training Project,[25] Moving New Knowledge into Practice Project,[8, 12, 13] and Orange County Research Utilization in Nursing Project.[42, 50] Findings from these projects demonstrated that research utilization (RU) encompassed dissemination of scientific knowledge, critique of studies, synthesis of research findings, determination of the applicability of findings for practice, development and institution of research-based practice (RBP) guidelines, and evaluation of practice changes.

Parallel to nursing efforts, physicians have focused on evidence-based practices (EBPs) in medicine to promote synthesis and use of research findings from randomized trials. EBP has been defined by some experts as the synthesis and use of scientific information from randomized clinical trials (RCTs) only.[30, 35, 41] Others have defined EBP more broadly to include use of evidence from other types of scientific investigations (descriptive studies) and knowledge (e.g., case reports, expert opinion) as well as findings from RCTs.[7, 50] Sackett and colleagues[44] define evidence-based medicine as "the integration of best research evidence with clinical expertise and patient values."

The term *evidence-based practice* has become widely adopted in recent years by the

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nursing profession[11] and is sometimes used interchangeably with RU.[52, 57] Although these two terms are related, they are not "one and the same."[57] Adopting the definition of EBP as the conscientious and judicious use of the "best evidence" to guide delivery of health care services, RU is a subset of EBP—a process and product encompassed within EBP. Importantly, RU is the application of findings from studies that use qualitative or quantitative methods and is not limited to the use of findings from randomized trials. As Cook[7] notes, "enthusiasm about the primacy of randomized trials to answer all clinically important questions is regressive." In comparison, EBP is a broader concept that encompasses RU as well as evidence from case reports and expert opinion in making decisions about health care practices.

The Iowa Model of Research-Based Practice to Promote Quality Care (Fig. 1), developed and originally implemented at the University of Iowa Hospitals and Clinics (UIHC),[58] serves as a guide for nurses and other health care providers to use research findings for improvement of patient care. Since its inception, the model has been used in numerous academic and clinical settings. More importantly, users of the model have provided important feedback on how to improve it. This article discusses the utility of the original model, explains the impetus for changing the model, and presents the revised Iowa Model of Evidence-Based Practice to Promote Quality Care (Fig. 2).

Utility of the Original Model

The utility of the 1994 model[58] is evident from the more than 93 written requests we have received to use it for publications, presentations, graduate and undergraduate research courses, clinical research programs, and practice. It has been cited in 28 nursing journal articles,[48] and the originators of the model were awarded the 1997 Sigma Theta Tau International Research Utilization Award.

Staff nurses have used the 1994 model to identify areas of clinical inquiry (problem- and knowledge-focused triggers) that may be addressed through synthesis and application of research findings. For example, critical care nurses from a 100-bed private hospital in Hong Kong used the model to guide changes in practice regarding normal saline instillation before suctioning ventilated patients.[53] No adverse outcomes arose from withholding normal saline instillation before suctioning. A decrease in nosocomial respiratory infection and improvement in patient comfort were noted, staff were satisfied with the change in practice, and a significant cost savings was realized.[53] The model also has been used to guide practitioners in reducing restraint use in the acute care setting[9] and to promote earlier ambulation after cardiac catheterization, resulting in improved patient comfort, improved patient satisfaction, and significant cost savings without adverse outcomes.[31]

Feedback from nurses at numerous community-based agencies and health care institutions has indicated that the process is easy to follow and provides three options to choose from if there is not enough research to guide practice. Other aspects of the model that have been reported as helpful include the following:

- Provision of a decision point regarding sufficient research to guide practice,
- Emphasis on pilot testing the practice change with a smaller group of patients before instituting the change throughout designated patient care areas, and
- Evaluation of the change to determine if the outcomes identified in the research actually occur in practice

Use of the 1994 model is facilitated when it is incorporated into the work of existing committee structures such as quality management or research committees. This approach makes use of an established reporting channel within the existing organizational structure. Members of an existing committee or team, having worked through the group process, know each other's talents and can divide the workload in a manner to maximize the strengths of each member. Individuals knowledgeable about quality management and research are usually experienced in data acquisition, data management, and transformation of data into information, which are all important components of evaluating research-based changes in practice.

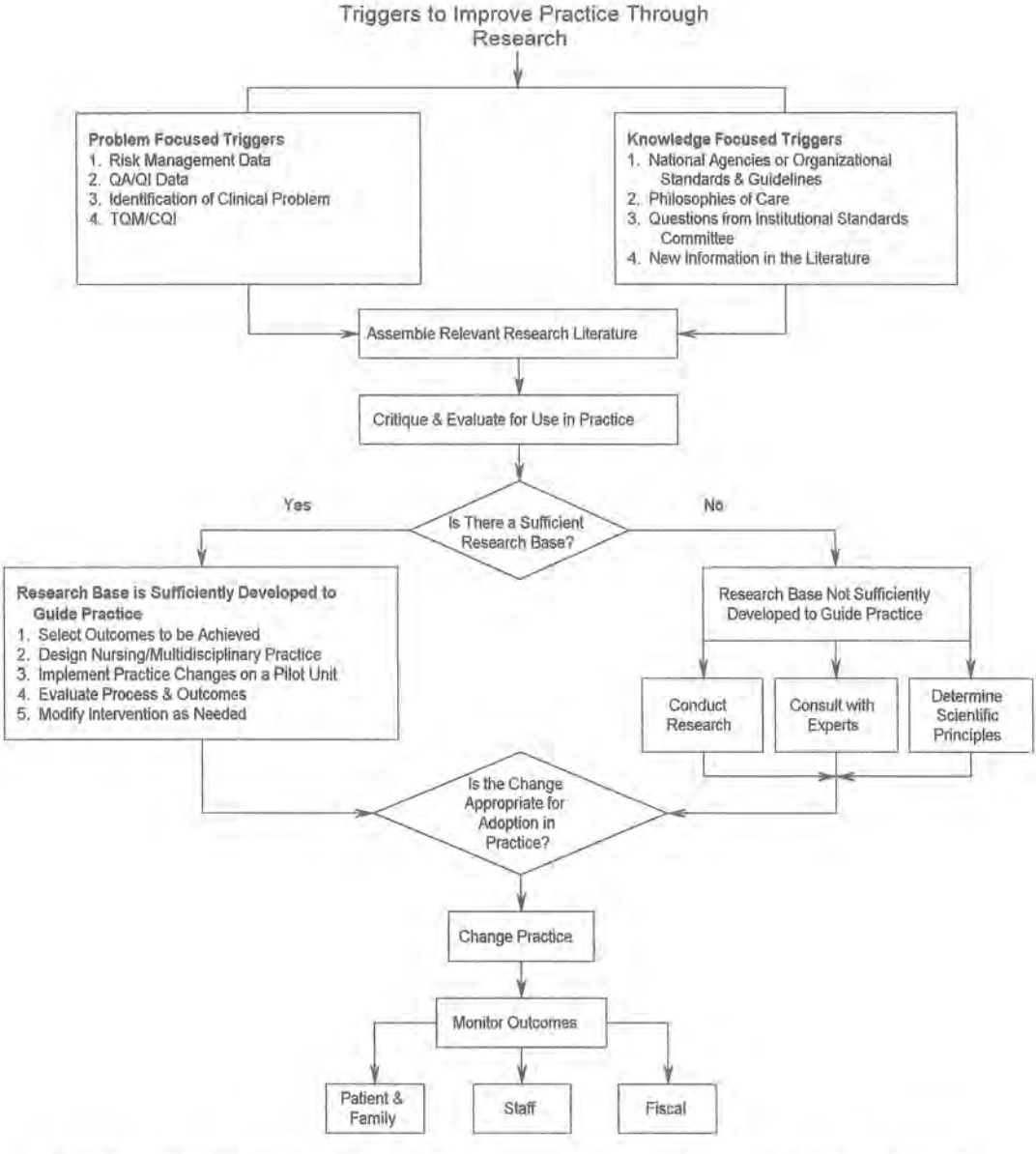

Figure 1 The Iowa model of evidence-based practice to promote quality care. QA/Q1 = quality assessment and improvement. TQM/CQ1 = total quality management and continuous quality improvement. Diamond = A decision point. (*From* Titler MG, Kleiber C, Steelman V, et al: Infusing research into practice to promote quality care. Nursing Research 43:307–313; with permission.)

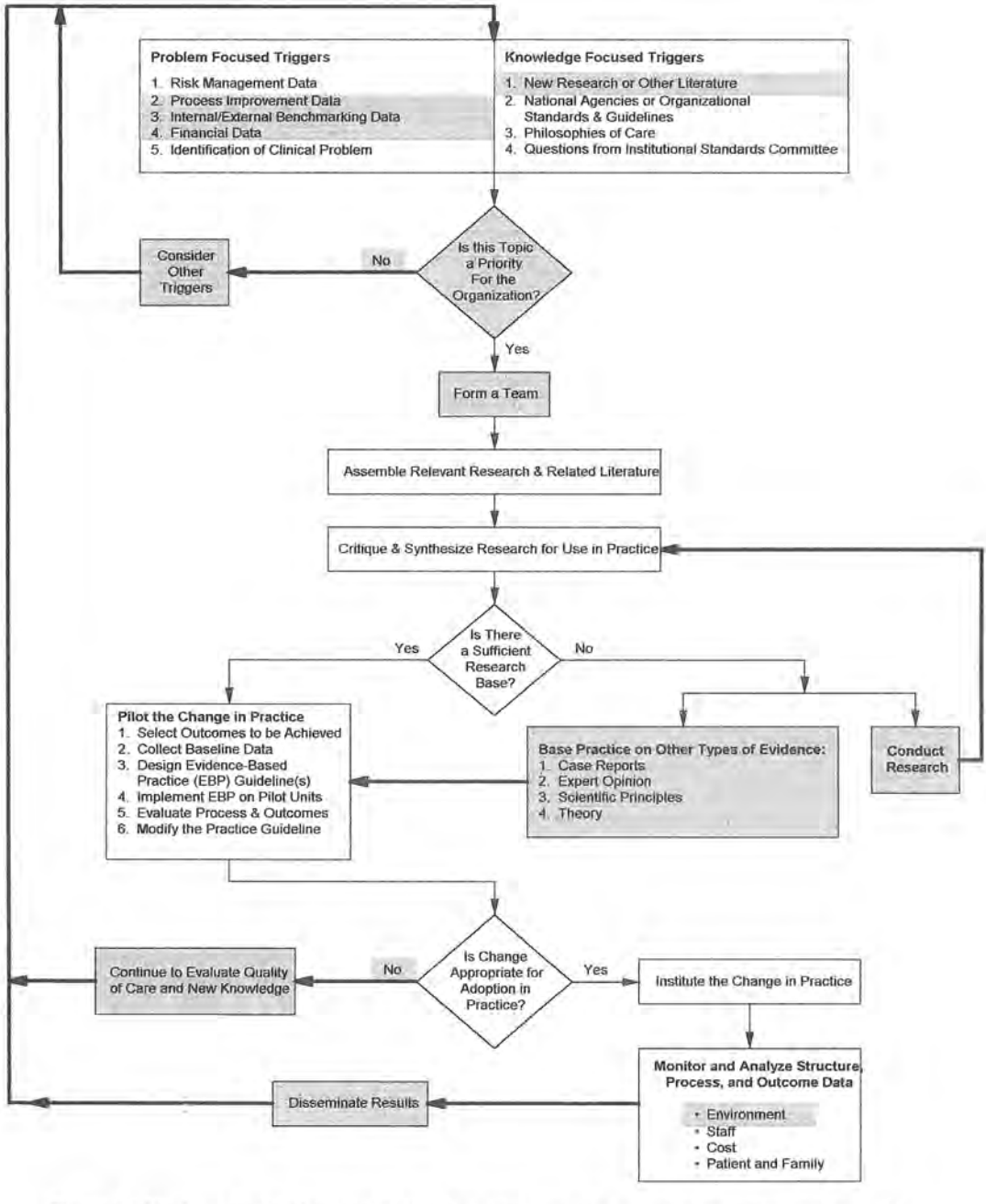

Figure 2 The Iowa model of research-based practice to promote quality care. Diamond = decision point; heavy lines = new feedback loop; shaded areas = new terminology and action steps. (Courtesy of Marita Titler, PhD, RN, FAAN)

Implementation of the model at the UIHC provides an environment for nurses from other agencies to learn experientially about RU. The UIHC provides on-site educational opportunities in research utilization for nurses from a variety of geographic locations and types of agencies. A formal residency program is funded for up to two master's-prepared nurses per year as a part of the Research Dissemination Core of the Gerontological Nursing Interventions Research Center (National Institute of Nursing Research [NINR] grant 2P30 NR03979). Individualized educational programs are also available for nurses from other national and international acute care, long-term care, and home health agencies.

Impetus for Revisions

Based on recent developments in the health care market and feedback from users, the original model was revised to (1) incorporate new terminology and feedback loops, (2) address changes in the health care market, and (3) encourage use of other types of evidence (e.g., case reports) when research findings are unavailable to guide practice.

User Feedback and Terminology

Users of the 1994 model have commented on the need for feedback loops to illustrate that RU is an ongoing process of continually improving care throughout the implementation of research findings in practice. Accordingly, several feedback loops were incorporated into the model, terms used to describe problem- and knowledge-focused triggers were revised, and additional decision points were added.

Changes in the Health Care Market

The changing social and economic environment of health care provides new incentives for RBP. The current health care arena is highly competitive, with institutions trying new initiatives to increase customer satisfaction and implementing highly visible customer-focused programs. These goals, ultimately aimed at protecting or expanding market shares, also may serve as catalysts for adopting RBPs. For example, if a strategic goal of a health care agency is to increase the market share of pediatric critical care services, research-based protocols for promoting family-centered care may be given priority over other potential projects. Customer satisfaction can also serve as a catalyst for projects such as pain management, prevention of postoperative nausea, music therapy, or stress reduction.

Likewise, cost savings has become a common impetus for RBP changes. For example, a change in our clean-catch urinalysis technique was initiated to save money associated with supplies without affecting contamination rates of urine cultures.[3] Similarly, a project evaluating urinary catheters was undertaken to determine if the additional cost of a more expensive catheter could be offset by a reduction in urinary tract infections (M. Wagner et al, unpublished data).

Evidence-Based Practice

The decision to change the name of the Iowa Model from "Research-Based Practice" to "Evidence-Based Practice" arose from our experiences in using the original model, the recent use of the term *evidence-based practice* in the nursing literature,[11] and the need to clarify the application of research findings in relation to use of other types of evidence. Although the scientific basis of nursing practice has grown over the past 30 years, some practices are not "research based," because findings are inconclusive or the practices have not yet been investigated. Nurses need a framework for making decisions about day-to-day nursing practices. When research is either unavailable or inconclusive, several additional sources of evidence such as theory, case reports, consensus of experts, and scientific principles can be used to guide practice. For example, a series of published case reports noting morbidity and mortality of children after aspiration of latex balloons led our nursing department to institute a policy prohibiting latex balloons in pediatric areas of the hospital.

The definition of "evidence" is still actively debated in the interdisciplinary and international scientific community. Groups such as the Cochrane Collaboration (originating in England) and the Evidence-Based Medicine

Working Group (based in Canada) promote strict criteria for evaluating the strength of the research before accepting any conclusions on which to base medical practice.[6, 18, 24, 46] The RCT is most often still regarded as the gold standard for research,[7, 29, 55] and other forms of research (cohort designs or case studies) are viewed by some to be of lesser value in guiding clinical practice.[29] It must be remembered, however, that the work of medicine is different from the work of nursing. Although RCTs are well established for testing the efficacy of drug therapies or medical treatments, nursing intervention testing may not lend itself to this approach.

Others have proposed a broad definition of evidence.[7, 44] For example, the Agency for Healthcare Policy and Research, now the Agency for Healthcare Research and Quality, has categorized evidence into five levels, with the strongest level being meta-analysis of multiple studies and the weakest level including case reports and clinical examples. The Guideline for Management of Cancer Pain[25] made use of this last level of evidence when evaluating the practice of applying heat for comfort. Based on the recommendation of a 1940 study of rats and several other studies of fetal tissue, texts and articles in peer-reviewed journals had labeled the presence of a malignancy as a contraindication to the application of heat. The authors of the guideline acknowledged the physiologically based theory that warmth increases blood flow and might enhance tumor growth if applied to a cancerous region of the body. Nevertheless, the guideline panel concluded that in the absence of research showing that superficial heat is harmful and in the presence of the clinical evidence that heat seems to help relieve pain, superficial heat is recommended for cancer pain.

A variety of other definitions and methods to grade evidence are used when EBP guidelines are developed.[1, 2, 5, 18, 29, 50, 59] There is no consensus regarding the definition of EBP and grading schemas used in development of evidence-based guidelines.[15, 29, 50–52, 55] After careful review of existing definitions, philosophies, and evidence-based guideline grading schemas to use in our revision of the 1994 model, we adopted the definition of EBP as "the conscientious and judicious use of current best evidence to guide health care decisions."[43] Research evidence includes findings from meta-analyses, RCTs, observational studies, and qualitative research; other types of evidence include case reports, expert opinion, scientific principles, and theory.

The Revised Model

As noted previously, several revisions were made to the 1994 model based on feedback from users of the model, analysis of the EBP literature, and consideration of emerging social and environmental factors in the health care market. Major revisions are described in the following sections and are highlighted in Figure 2.

Triggers

Problem- and knowledge-focused triggers are catalysts for nurses to think critically about clinical and operational efficiency and effectiveness and thus to seek scientific knowledge for use in decision making. The term *process improvement data* replaces the term *quality assessment/improvement* and *total quality management/continuous quality improvement*," because process improvement is a more inclusive term that encompasses improvements in clinical and operational systems of health care.

"Internal/external benchmarking data" and "financial data" were added as "problem-focused triggers" to reflect the use of financial consortium benchmarking and internal benchmarking data by organizations when making clinical and operational decisions. As health systems and networks respond to market forces, it has become possible for individual institutions to gauge their progress toward organizational goals using system-wide outcomes, taking into consideration factors such as facility size, patient mix, and severity of illness. Certainly, deviations from expressed goals and target indicators within and outside the health care setting can serve as important triggers to the conduct and utilization of research. Finally, American health care has become a "largely for-profit, market-driven model of managed care."[47] In today's health

care environment, in which many health care agencies are struggling to survive, failure to consider financial data as a problem-focused trigger is shortsighted. Now more than ever, research must be compatible with the realities of the health care marketplace.

The term *new information in the literature* (knowledge-focused trigger) was replaced with the term *new research or other literature* to reflect the importance of clinical- and theory-based publications as information sources that stimulate questioning of current practice. This trigger was listed first to emphasize the importance of new knowledge in stimulating critical thinking.

Priority of the Topic

"Is this topic a priority for the organization?" is a new decision point in the model. Nurses must consider where the topic (e.g., pain, urinary tract infections) fits in relation to organization-, department-, and unit-specific priorities. This is a critical question to ask, because, as noted by Blumenthal,[4] one way to maintain the interest and support of members of health care agencies is to increase investment in research and development that is relevant to the needs of that enterprise. Higher priority may be given to EBP projects that address high-volume or high-cost procedures, those that are closely aligned with the institution's strategic plan, or those that are driven by institutional or market forces. One example of a new priority at the University of Iowa that meets such criteria is macular degeneration, which is the most common cause of legal blindness in the United States and affects about 10% of people over the age of 65 years. The huge cost in terms of human suffering and economic loss has made interdisciplinary collaborative research efforts on diagnosis, treatment, and formulation of guidelines for laser treatment a high priority for the University's newly established Center for Macular Degeneration.

Consideration of how the topic fits into organizational priorities can be important to garner the support of nurse managers, nursing leaders, administrators, and physicians as well as the resources necessary to carry out the change in practice. Equally as important, the topic selected should excite the staff who are responsible for making the change in practice. A topic that is embraced by staff and aligned with the strategic goals of the organization has a high likelihood of being adopted by those providing care.[56]

It is possible that several topics meet these "top priority" criteria and that nurses may be confronted with selecting one topic to pursue from a list of several. Issues to consider when selecting a topic are summarized in Box 1.

If the topic is not a priority for the organization, other topics are considered ("consider other triggers"). This feedback loop is new in the revised model.

Forming a Team

The next step in the model is new. A team is responsible for development, implementation, and evaluation of the EBP. An existing team or subgroup of an existing committee may do the work, or it may be necessary to form a new team. The composition of the team is directed by the topic selected and should include interested interdisciplinary stakeholders in the delivery of care. For example, a team focusing on pain management would ideally be composed of pharmacists, nurses, physicians, and psychologists. In contrast, a team working on the EBP of bathing might consist of nurses, assistive personnel, and experts in skin care.

Assemble Relevant Research and Related Literature

Once a topic is selected and a team is formed, the relevant research and related literature

Box 1 ISSUES TO CONSIDER WHEN SELECTING A TOPIC FOR EVIDENCE-BASED PRACTICE

Fit with the strategic goals of the organization
Magnitude of the problem
Number of people interested in the topic
Interdisciplinary support
Support of nurse leaders
Cost implications
Potential barriers to change

are retrieved. Particular attention is given to including evidence-based guidelines, systematic research reviews, meta-analyses, and clinical studies on the topic.

In addition to using traditional methods of finding published literature (e.g., health indexes), other sources of information should be reviewed, including bibliographies of integrative reviews, abstracts published as part of conference proceedings, master's theses and doctoral dissertations, and direct written or verbal communication with scientists investigating the topic and with others who have completed a research utilization project on the same topic. A number of health care indexes such as the Cumulative Index to Nursing and Allied Health Literature have electronic databases available to assist with the search process. Electronic journals such as the *On-Line Journal of Knowledge Synthesis for Nursing* and the *Evidence-based Nursing Journal* are particularly helpful for research utilization projects, because articles provide a synthesis of the research and an annotated bibliography for selected references or summarize findings from published research. Other databases such as the Best Evidence Database and Cochrane Database of Systematic Review provide access to evidence-based health care reviews. In using all these sources, it is important to identify key search terms and to use the expertise of librarians in locating publications relevant to the subject.

Critique and Synthesis of Research

The critique process is a shared responsibility, and leadership from advanced practice nurses is an integral component of critiquing and synthesizing research for practice.[51] It is helpful for one individual to serve as the leader for the project; this individual should have skills in research critique. A group approach to critique of research is recommended because it distributes the workload, helps those responsible for implementing the changes to understand the scientific base for the change in practice, arms nurses with citations and research-based sound bites to use in effecting practice changes with peers and other disciplines, and provides novices with an environment for learning how to critique and apply research findings in practice.

Once the literature is located, it is helpful to group the articles as clinical (nonresearch), systematic research reviews, theory articles, and research articles. It is important for individuals doing critiques to initially read the clinical and systematic review articles to understand the state of practice and science, respectively. Reading theory articles before undertaking the critiques provides an understanding of the various theoretical principles and concepts that may be encountered in reading and critiquing the research. Numerous aids are available to assist with the critique process.[5, 10, 17, 21, 55] The following methods can make the critique process productive, fun, and interesting:

- Using a journal club to discuss critiques done by each member of the group
- Pairing a novice with an expert to do critiques
- Partnering with faculty or students from a local nursing school who may be interested in the topic and want experience doing critiques
- Assigning the critique process to graduate students interested in the topic
- Making a class project of the critique and synthesis of research for a given topic

Once studies are critiqued, a decision is made regarding use of each study in the synthesis of research findings. Factors that are considered for inclusion of studies in the synthesis process include (1) the overall scientific merit of the study, (2) the type (e.g., age, gender, pathologic findings) of subjects enrolled in the study and their similarity to the patient population to which the findings are to be applied, and (3) the clinical relevance of the study. For example, if the focus of the project is prevention of deep venous thrombosis in postoperative patients, a descriptive study using a heterogeneous population of medical patients is not appropriate for inclusion in the synthesis of findings.

Synthesis of available research can involve a variety of techniques. The most common strategy is the systematic research review. This strategy pulls together research findings through analysis of the studies by one or more reviewers. The process of systematic reviews is facilitated by the use of a summary table, in which critical information from studies can be documented.[5, 56] If the research

provides a clear and consistent message, this approach can be reliable, yielding similar conclusions among reviewers. If the research is unclear and does not easily identify a superior treatment, this type of research synthesis may not provide needed guidance for practice.

Meta-analytic techniques use a quantitative approach to help solve this problem. These methods lift the information-processing burden from the reviewer by quantitatively integrating findings across studies while simultaneously correcting for the effects of statistical and measurement artifacts. They apply the same statistical methods that are routinely used for analyzing data within a study to the problem of integrating findings across studies.[14] Although still imperfect and subject to methodologic pitfalls, the results of a meta-analysis usually provide the closest possible estimate to the effect in the true population because they rely on all available evidence (both published and unpublished). An example of a practice change driven by meta-analysis is the use of saline versus heparin for maintaining the patency of peripheral intravenous locks. A meta-analysis of 17 studies showed that effect sizes for clotting, phlebitis, and duration of the lock were close to zero, indicating that neither agent (heparin or saline) was favored for these three outcomes. Because use of heparin poses additional risks for patients (e.g., thrombocytopenia), the results indicated a need to change practice to the use of saline for flushing. This practice change had the added benefits of eliminating the extra nursing time required to flush between heparin and incompatible drugs (e.g., certain antibiotics) and decreasing supply costs, which were estimated to reach as high as $109,100,000 to $218,200,000 annually in US health care dollars.[16]

Is There Sufficient Research to Guide Practice?

Determining if there is enough research to guide practice is a critical decision point. The synthesis methods described here are important means of making this decision. The following criteria are also helpful: (1) the consistency of findings across studies, (2) the type and quality of the studies, (3) the clinical relevance of the findings for practice, (4) the number of studies with sample characteristics similar to those to which the findings are to be applied, (5) the feasibility of the findings for use in practice, and (6) the risk:benefit ratio. When there is sufficient research to guide practice, major or minor practice modifications may be warranted.[56]

Insufficient Research to Guide Practice

When there is insufficient research on which to base practice, one option for the clinician is to conduct a study. When the study has been completed, the results should be systematically integrated with findings from other research as indicated by the feedback loop to "critique and synthesize research for use in practice." For example, a group of nurses were interested in using saline rather than heparin solution to flush "locked" peripheral intravenous (IV) catheters in our neonatal intensive care units. The research in this area was inconclusive, with one study demonstrating that saline extended the life of intravenous (IV) catheters, one study demonstrating heparin to be superior to saline, and one study demonstrating no difference between heparin and saline. All the studies had small sample sizes, lacking power for conclusive results. The nurses at our hospital conducted a randomized trial of saline and heparin for IV locks in neonates and found no statistically significant differences between groups. Our sample size was also small, however, and lacked statistical power. Insufficient funding and human resource issues made the continuation of the research study impractical. The next step in the process was to critically evaluate all the available evidence. The hospital neonatologists and neonatal nurses decided that there was enough evidence to proceed with an RU project. Baseline data were collected on infiltration rates, with heparin solution as the standard flush solution; those data were compared with infiltration rates collected after changing the practice to use of saline flush. Survival curve analysis revealed no statistically or clinically significant differences between groups, with a power of 0.8. This methodical examination of a nurse-driven practice change prevented disagreements among clinical team members

and enhanced the reputation of nursing as a science-driven profession.[20]

If there is not enough research evidence, an alternative to conducting a study is using other types of evidence (e.g., case reports, expert opinion, scientific principles, theory) to guide practice. Published case reports can provide valuable evidence for untoward outcomes. For example, case reports regarding the transmission of Creutzfeldt-Jakob disease provided evidence of how the fatal disease can be transmitted iatrogenically. This evidence was used to develop an infection control protocol at the UIHC.[49] Expert opinion can also provide a valuable source of knowledge for a practice change when there is insufficient research to guide practice. For example, expert opinion provided by the American Academy of Allergy, Asthma, and Immunology supported the implementation of latex avoidance practices with spina bifida patients beginning at birth.

New to this model is combining other types of evidence such as scientific principles of infection control with available research findings to develop an EBP guideline. This is designated by the arrow between the box "base practice on other types of evidence" and "pilot the change in practice." Components of the EBP guideline may be research based, although other steps in the guideline rely on evidence from expert opinion, case reports, scientific principles, and theory.

In the revised model, the term *evidence-based practice* is used to denote a practice developed from research findings in combination with other types of evidence. Priority is given to projects in which a high proportion of a practice guideline is developed from research evidence. In reality, most practice guidelines are developed using several types of evidence. For example, methods of endotracheal suctioning are based on research evidence, expert opinion, and scientific principles. We suggest using the term *evidence-based practice* guideline rather than *research-based practice* guideline.

In writing EBP guidelines, it is important to designate which components are based on research evidence and which parts are supported by other types of evidence. It is also important to indicate clearly the type and strength of research used in formulation of the guideline.[55]

Pilot the Change in Practice

The change in practice is piloted before adoption, which entails the following steps: (1) selecting outcomes to be achieved, (2) collecting baseline data, (3) developing a written EBP guideline, (4) trying the guideline on one or more units or with a small number of patients, (5) evaluating the process and outcomes of the trial, and (6) modifying the guideline based on process and outcome data. The pilot indicates the feasibility and effectiveness of using the guideline in various practice settings such as acute care, long-term care, or home health care. It is important to know if the guideline can be carried out as intended and if outcomes noted in the research can be achieved in a practice setting, where multiple caregivers deliver the practice to a more heterogeneous patient population.

Piloting a research–based change in clinical settings takes the intervention away from the controlled environment of a research study and puts it into an environment where the effects of extraneous variables influence the results. Consequently, it is possible to obtain different results than those demonstrated by the research on which the guideline is based. An example of this occurred when piloting the effectiveness of using aspirate pH and color to determine nasoenteral tube placement at the bedside. The research showed that this technique could identify correct placement of the tube 85% to 87% of the time.[34] When this method was piloted on four inpatient units at a large academic medical center, this technique yielded only a 50% accuracy rate. Medications and aspirates containing tube feedings adversely influenced the reliability of pH interpretations by nurses.[40,57]

Adoption in Practice

After the EBP has been piloted, a decision is made about adopting the practice for all appropriate patient populations. When outcomes from the practice change are not achieved as expected, adopting the new practice is not supported, and the answer to "is change appropriate for adoption in practice?" is "no." In this case, efforts are refocused to ongoing monitoring of quality of care and evaluation of new knowledge from

recently reported research. This evaluation can result in new information that stimulates the process to begin again as illustrated in the model by a feedback loop (arrow) to the "problem- and knowledge-focused triggers" (see Fig. 2).

If quality improvement monitoring continues to show a problem with current practice and no further research evidence exists to support an alternative approach to the method piloted, other types of evidence such as expert opinion, scientific principles, or theory can be used to determine the best practice. In piloting the use of pH aspirate to determine nasoenteral tube placement, the answer to the decision point on the Iowa Model, "is change appropriate for adoption in practice?," was "no." The use of pH aspirate for determining placement of nasoenteral tubes was not feasible or effective when piloted. Nevertheless, there is strong research evidence to suggest that traditional practice of air insufflation through the nasoenteral tube and auscultation at the abdomen is not reliable and puts patients at risk for complications, especially when small-bore feeding tubes are placed.[55] The EBP team responsible for this project obtained expert opinion and used scientific principles to revise the guideline for determining nasoenteral tube placement. Because of the lack of a good bedside method for determining tube placement, the use of radiography on initial placement was recommended. This change in practice was realistic for our setting and was endorsed by staff.

Institute the Change in Practice

If the pilot reveals positive outcomes and feasibility for carrying out the EBP, the practice change is adopted and integrated into practice throughout a patient population or organization. Adoption can be facilitated through (1) organizational support, (2) education of staff with regard to the knowledge and skills necessary to carry out the EBP, (3) ownership of the new practice by nurses and all affected disciplines, (4) perception by staff that the change improves the quality of care, and (5) time to carry out the EBP as intended. If EBPs are to move from "the book" to the beside, user-friendly prompts are needed in the care environment to help staff practice according to the evidence base. For example, this may require revising patient care documentation systems, developing beside algorithms to guide practitioners in decision making, or removing certain equipment (e.g., certain types of Foley catheters) from the care environment.[57, 56, 58]

Monitor and Analyze Structure, Process, and Outcome Data

The original model emphasized evaluation of patient (e.g., less pain), staff (e.g., increased nursing knowledge), and fiscal (e.g., cost avoidance) outcomes. Evaluation of environmental variables has been added to the revised model based on our experiences and continued work in EBP. For example, the effectiveness of a change in infection control practices for resistant organisms was measured by environmental cultures. Adding environment to structure, process, and outcome data provides another dimension to consider when evaluating EBP changes.

Evaluation of an EBP, whether it involves a change or supports current practice, provides important information for other care providers, administrators, and policy makers. It is imperative that evaluation data from implementation of EBPs be shared with these constituents through presentations and publications as illustrated in the feedback loop from "disseminate results" to "problem- and knowledge-focused triggers" (see Fig. 2). Evaluation provides insights into the outcomes of the practice change and frequently includes structural and cost information beyond what is available in the research literature. Evaluation data lend support to the usefulness of the intervention in practice settings by demonstrating the ability of multiple care providers to use the EBP and the reality of achieving expected outcomes.

Reporting structural, process, and outcome data to internal networks illustrates the value of EBP activities to administrators, peers, and other disciplines. When care is improved, cost reductions and positive outcomes of the practice change are frequently realized. It is important to capture these data through evaluation and include them during the budget process, quality improvement efforts, and other institutional initiatives.

SUMMARY

The UIHC Department of Nursing is nationally known for its work on use of research to improve patient care. This reputation is attributable to staff members who continue to question "how can we improve practice?" or "what does the latest evidence tell us about this patient problem?" and to administrators who support, value, and reward EBP. The revisions made in the original Iowa Model[59] are based on suggestions from staff at UIHC and other practitioners across the country who have implemented the model. We value their feedback and have set forth this revised model for evaluation and adoption by others.

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REFERENCES

1. AACN: AACN Protocols for Practice: Creating a Healing Environment. Aliso Viejo, CA, American Association of Critical-Care Nurses, 1998
2. AACP/AACVPR: Pulmonary rehabilitation. Joint AACP/AACVPR evidence-based guidelines. Chest 112:1363–1396, 1997
3. Alpen M: Cost containment through research utilization. Presented at the Third National Research Utilization Conference, Iowa City, April 1996
4. Blumenthal D: The research mission of academic health centers. *In* Rubin ER (ed): Mission Management: A New Synthesis. Washington, DC, Association of Academic Health Centers, 1998, pp 235–261
5. Brown SJ: Knowledge for Health Care Practice: A Guide to Using Research Evidence. Philadelphia, WB Saunders, 1999
6. Cochrane Collaboration: The Cochrane Collaboration Handbook. Oxford, The Cochrane Collaboration, 1994
7. Cook D: Evidence-based critical care medicine: A potential tool for change. New Horiz 6:20–25, 1998
8. Cronenwett LR: Effective methods for disseminating research findings to nurses in practice. Nurs Clin North Am 30:429–438, 1995
9. Cruz V, Abdul-Hamid M, Heater B: Research-based practice: Reducing restraints in an acute care setting—phase 1. Journal of Gerontological Nursing 23:31–40, 1997
10. Davies B, Logan J: Reading research: A User-Friendly Guide for Nurses and Other Health Professionals. Ottawa, Canadian Nurses Association, 1993
11. Estabrooks CA: Will evidence-based nursing practice make practice perfect? Canadian Journal of Nursing Research 30:15–36, 1998
12. Funk SG, Tornquist EM, Champagne MT: Barriers and facilitators of research utilization: An integrative review. Nurs Clin North Am 30:395–408, 1995b
13. Funk SG, Champagne MT, Tornquist EM, et al: Administrators' views on barriers to research utilization. Appl Nurs Res 8:44–49, 1995a
14. Glass GV: Primary, secondary, and meta-analysis of research. Educational Researcher 5:3–8, 1976
15. Goode CJ: What constitutes the "evidence" in evidence-based practice? Appl Nurs Res 13:222–225, 2000
16. Goode CJ, Titler M, Rakel B, et al: A meta-analysis of effects of heparin flush and saline flush: Quality and cost implications. Nurs Res 40:324–330, 1991
17. Goode CJ, Butcher LA, Cipperley JA, et al: Research Utilization: A Study Guide, ed 2. Ida Grove, IA, Horn Video Productions, 1996
18. Guyatt G, Sackett D, Sinclair J, et al: Users' guides to the medical literature. IX. A method for grading health care recommendations. JAMA 274:1800–1804, 1995
19. Haller KB, Reynolds MA, Horsley JA: Developing research-based innovation protocols: Process, criteria, and issues. Res Nurs Health 2:45–51, 1979
20. Hanrahan K, Kleiber C, Berends S: Saline for peripheral intravenous locks in neonates: Evaluating a change in practice. Neonatal Network 19:19–24, 2000
21. Horn Video Productions: Critiquing Research for Use in Nursing Practice. Ida Grove, IA, Horn Video Productions, 1996
22. Horsley J, Crane J, Crabtree MK: Using Research to Improve Nursing Practice: A Guide. Philadelphia, WB Saunders, 1983
23. Jacox A, Carr DB, Payne R, et al: Management of Cancer Pain. Clinical Practice Guideline, no 9. AHCPR Publication 94-0592. Rockville, MD, US Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research, 1994
24. Jadad AR, Haynes RB: The Cochrane Collaboration: Advances and challenges in improving evidence-based decision making. Med Decis Making 18:2–9, 1998
25. King D, Barnard KE, Hoehn R: Disseminating the results of nursing research. Nurs Outlook 29:164–169, 1981
26. Kreuger JC: Utilization of nursing research: The planning process. J Nurs Adm 8:6–9, 1978
27. Kreuger JC, Nelson AH, Wolanin MO: Nursing Research: Development, Collaboration, and Utilization. Germantown, MD, Aspen, 1978
28. Lindeman CA, Krueger JC: Increasing the quality, quantity, and use of nursing research. Nurs Outlook 25:450–454, 1977

29. Lohr KN, Carey TS: Assessing "best evidence": Issues in grading the quality of studies for systematic reviews. The Joint Commission Journal on Quality Improvement 25:470–479, 1999
30. Long A, Harrison S, Cole A: Evidence-based decision making. Health Service Journal 106(5485) Supp:1–12, 1996
31. Lundin L, Sargent T, Burke LJ: Research utilization and improvement in outcomes after diagnostic cardiac catheterization. Critical Care Nurse 18:30–39, 1998
32. Mast M: What it is, what it isn't. Oncology Nursing Society (ONS) News 15:4–5, 2000
33. Metheny N, Titler MG: Assessing placement of feeding tubes: Evidence-based practices. Am J Nurs 101:36–47, 2001
34. Metheny N, Reed L, Wiersema L, et al: Effectiveness of pH measurements in predicting feeding tube placement: An update. Nurs Res 42:324–331, 1993
35. Mion LC: Evidence-based health care practice. Journal of Gerontological Nursing 24:5–6, 1998
36. Mitchell GJ: Questioning evidence-based practice for nursing. Nursing Science Quarterly 10:154–155, 1997
37. Montgomery LA, Budreau GK: Implementing a clinical practice guideline to improve pediatric intravenous infiltration outcomes. AACN Clinical Issues 7:411–424, 1996
38. Nightingale F: Notes on Matters Affecting the Health, Efficiency, and Hospital Administration of the British Army. London, Harrison & Sons, 1858
39. Nightingale F: Observation on the Evidence Contained in the Statistical Reports Submitted by Her to the Royal Commission on the Sanitary State of the Army in India. London, Edward Standford, 1863
40. Rakel BA, Titler MG, Goode C, et al: Nasogastric and nasointestinal feeding tube placement: An integrative review of research. AACN Clinical Issues in Critical Care Nursing 5:194–206, 1994
41. Rochon PA, Dikinson E, Gordon M: The Cochrane field in health care of older people: Geriatric medicine's role in the collaboration. J Am Geriatr Soc 45:241–243, 1997
42. Rutledge DN, Donaldson NE: Building organizational capacity to engage in research utilization. J Nurs Admin 25:12–16, 1995
43. Sackett DL, Rosenberg WMC, Gray JAM, et al: Evidence based medicine: What it is and what it isn't. BMJ 312:71–72, 1996
44. Sackett DL, Straus SE, Richardson WS, et al: Evidence-based Medicine: How to Practice and Teach EBM. London, Churchill Livingstone, 2000
45. Schmidt FL: Meta-analysis: Implications for cumulative knowledge in the behavioral and social sciences. Presented at the 92nd Annual APA Convention, Toronto, August 1984
46. Sibbald WJ, Kossuth JD: The Ontario health care evaluation network and the critical care research network as vehicles for research transfer. Medical Decis Making 18:9–16, 1998
47. Snyderman R: Restructuring the research enterprise for the future. *In* Rubin ER (ed): Mission Management: A New Synthesis. Washington, DC, Association of Academic Health Centers, 1998, pp 263–280
48. Social Sciences Citations: Social Sciences Citation Index. Philadelphia, Institute for Scientific Information, 1998
49. Steelman V: Prior diseases: An evidence-based protocol for infection control. AORN J 69:946–954, 956–967, 1999
50. Stetler CB, Brunell M, Giuliano KK, et al: Evidence-based practice and the role of nursing leadership. J Nurs Adm 28:45–53, 1998a
51. Stetler CB, Morsi D, Rucki S, et al: Utilization-focused integrative reviews in a nursing service. Appl Nurs Res 11:195–206, 1998b
52. Strohschein S, Schaffer MA, Lia-Hoagberg B: Evidence-based guidelines for public health nursing practice. Nurs Outlook 47:84–89, 1999
53. Taylor-Piliae RE: Utilization of the Iowa Model in establishing evidence-based nursing practice. Intensive and Critical Care Nursing 15:357–362, 1999
54. Titler MG: Critical analysis of research utilization (RU): An historical perspective. Am J Crit Care 2:264, 1993
55. Titler MG: Evidence-based practice. *In* LoBiondo-Wood G, Haber J (eds): Nursing Research, ed 5. St Louis, Mosby–Year Book, in press
56. Titler MG: Use of research in practice. *In* LoBiondo-Wood G, Haber J (eds): Nursing Research, ed 4. St Louis, Mosby–Year Book, 1998, pp 467–498
57. Titler MG, Mentes JC, Rakel BA, et al: From book to bedside: Putting evidence to use in the care of the elderly. Joint Commission Journal on Quality Improvement 25:545–556, 1999
58. Titler MG, Kleiber C, Steelman V, et al: Research-based practice to promote the quality of care. Nurs Res 43:307–313, 1994
59. US Preventive Services Task Force: Guide to Clinical Preventive Services, ed 2. Washington, DC, US Department of Health and Human Services, 1996

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