CHAPTER 3

Informatics and Evidence-Based Practice

Heather Carter-Templeton, PhD, RN, NI-BC, FAAN
Janie T. Best, DNP, RN, ACNS-BC, CNL
Karen H. Frith, PhD, RN, NEA-BC, CNE
Ron Schwertfeger, MLIS

LEARNING OBJECTIVES

1. Distinguish between the hardware and software components of computer systems.
2. Search electronic resources for evidence-based practice (EBP), including databases, journals, and professional organizations, efficiently to find current nursing research, systematic reviews, and clinical practice guidelines.
3. Discuss methods of integrating EBP into electronic health records or other health information technology.
4. Apply knowledge of EBP to patient care.
5. Discuss the role of health information technology standards in EBP.

KEY TERMS

Agency for Healthcare Research and Quality (AHRQ)
Boolean operators
Centers for Disease Control and Prevention (CDC)
Clinical decision-support systems (CDSS)
Cochrane Databases
Cumulative Index to Nursing and Allied Health Literature (CINAHL)
Directory of Open Access Journals (DOAJ)
Evidence-based practice (EBP)
Google Scholar
Interlibrary loan
Literature search
Medical Subject Headings (MeSH)
National Center for Biotechnology Information (NCBI)
National Guideline Clearinghouse
National Library of Medicine (NLM)
Open access
Plan-Do-Study-Act (PDSA)
PubMed
PubMed Advanced Search Builder
PubMed Clinical Queries
PubMed LinkOut
PubMed sidebar filters
Reference Management Software
Rich Site Summary (RSS feeds)

Chapter Overview

Nurses at all levels must be able to operate within our information-rich, high-tech healthcare environments. Informatics competencies will continue to grow and advance based on emerging technologies and the needs of our clinical environments and the patients we serve.

Information literacy is considered a baseline competency required of all nurses, including entry-level RNs (Diploma, ADN/ASN, BSN, 2nd Degree BSN, and Pre-licensure MSN) (American Nurses Association, 2022).

Information literacy has been well understood within the information sciences discipline; it is less known in the nursing field. Competencies associated with information literacy influence a wide range of knowledge and information-seeking behavior. Those unfamiliar with information literacy may describe it as activities used when engaged in evidence-based practice (Cantwell et al., 2021). Yet, some would argue that information literacy is a prerequisite to evidence-based practice (Shorten, Wallace, & Crookes, 2001). Regardless, the nursing workforce operating in the 21st century must be data and information literate and they must be able to manage and apply data to inform practice (Bergren & Maughn, 2020).

Since the passage of the Affordable Care Act in 2009, and with the opportunity to capture incentive monies from the Centers for Medicare and Medicaid Services (CMS), the use of technology has exploded as healthcare organizations have accepted the challenge to convert their paper records to electronic health records (EHRs) (Duffy, 2015). Nursing is the largest healthcare profession, with 3,130,600 jobs available in the field (U.S. Bureau of Labor Statistics, 2024) and nurses are constantly using technology in an effort to improve the quality and safety of care provided (Strudwick et al., 2019, JONA).

Successful use of technology by nurses to implement evidence-based practice and understanding of computer architecture, computer terminology, and data and file management (Cheeseman, 2012). Developing the skill of finding and appraising current evidence from research, systematic reviews of literature, and clinical practice guidelines may be difficult as the nurse moves from academic to practice settings. However, **evidence-based practice (EBP)** is a core skill necessary to improve nursing care and enhance the safety of patients. This chapter provides basic computer information, a synopsis of EBP, describes the major steps associated with EBP, and supplies readers with resources to conduct literature searches for evidence. Finally, this chapter gives an overview of health information management technology standards as they apply to clinical practice.

Introduction to Information and Computer Science

Computer Architecture

Computers are used to find, manipulate, and store data in an electronic format. In recent years, computers have become more complex and mobile, and they are increasingly essential to individuals in their personal and professional lives (Kaminski, 2015). Desktop devices, laptops, tablets, cell or smartphones, and a wide variety of medical and household equipment use computer software to perform their functions (Dainow, 2016). A basic understanding of how computers operate provides the nurse with the first step to exploring the evidence as it relates to clinical practice (Cheeseman, 2012).

A computer system has four main functions—collection, processing, storage, and retrieval of data (Cheeseman, 2011)—and consists of input devices, the central processing unit (CPU), memory, and output devices (Sipes, 2019). The physical components

two main components of a computer. Physical components include the casing (desktop, laptop, or mobile) and the internal mechanisms (CPU, motherboard, power supply, hard disc, and memory). External hardware includes touch screens, keyboards, a mouse to control screen position, and a monitor that displays information on a screen. Additional hardware is available to help the user print information or enhance listening (Kaminski, 2015).

Computers are further categorized on the basis of size and use. Supercomputers are large and only run a few programs at a high processing speed. Their specific uses range from animations and simulations for training to weather forecasting. Mainframe computers have large memory capacity, work at a high speed, and have the ability for many users to operate the computer system at the same time. Healthcare and university computer systems are examples of mainframe computers. The smallest computers, microcomputers or personal computers, are designed for single users, can be connected as a network, and are small and affordable to most individuals (Cheeseman, 2011).

Data Organization, Representation and Structure

A computer's work begins with input of information via an external or touch-screen keyboard to a CPU where a processor chip collects data and makes decisions based on the software's program code (instructions). The memory of a computer is divided into random-access (RAM) and read-only (ROM). RAM provides temporary storage of data during the creation of work before it is stored in a more permanent location, either in the computer's hard drive or other storage location. Unless saved to a more permanent location, RAM storage is lost when the program is closed or the computer is turned off. ROM is located in the motherboard (circuit boards) the computer is turned off. During work, data are uploaded in the RAM and, when directed by the user, stored in ROM on the hard drive, on a USB flash drive, or in other external locations (Cheeseman, 2011; Kaminski, 2015; Sipes 2019).

The ability to store information is based on the capacity of the device. The basic (smallest) unit of memory is a bit; a byte consists of eight bits of data. From these small units, storage can be expanded in increments of 1,000 to kilobytes (KB), megabytes (MB), gigabytes (GB), and terabytes (TB). Decisions about the amount of storage needed in a computer system is based on the amount of data to be processed and stored, and on estimated storage time. Data can be collected, organized, and stored in a database where it can be retrieved easily and in a way that is meaningful to the user. Commonly used databases in health care include electronic medical records, databases that support mobile applications, and many more, which are described in the chapters that follow. In academic settings, bibliographic and citation databases are commonly used. Synthesized databases allow the user to search for information from practice guidelines, systematic reviews, and meta-analysis documents (Cheeseman, 2011). Directions for how to conduct a literature search using large databases are discussed later in this chapter.

Software applications are internal programs that can be modified without changes to the external hardware of the computer (Dainow, 2016). These applications are categorized as productivity, creative, or communication programs. Productivity software includes a variety of programs such as databases, email, presentations, spreadsheets, and word-processing applications to support a wide variety of information-processing needs. Creative software can be used to create drawings, music, or digital photography/videos. Communication software includes email programs, Internet browsers, instant messaging, and a variety of conferencing programs

Networking and Data Communication

Computer networks are formed when two or more computers are linked in a way that allows them to share information. A local area network (LAN) is confined to a single site, a metropolitan area network (MAN) connects regional areas, and a wide area network (WAN) reaches far beyond the single location to connect many LANs together. Connections to the Internet are available through cable or digital subscriber lines (DSL) or through dial-up telephone services (Cheeseman, 2011; Dainow, 2016). To connect to the Internet, the computer has to be connected to an Internet service provider (ISP) through a modem and a unique Internet protocol (IP) address (Dainow, 2016). Each website is identified by a unique uniform resource locator (URL) protocol. Two types of URL addresses are commonly used to reach web resources: hypertext transfer protocol (HTTP) or hypertext transfer protocol—secure (HTTPS). There are also URL addresses for email and file transfers (FTP) (Cheeseman, 2011; Dainow, 2016).

Computer networks allow knowledge to be shared in multiple ways. The World Wide Web (www) is a network program that is familiar to most Internet users. A collection of documents, images, and web pages, the World Wide Web makes it possible to gather information from many resources, as well as to share information around the globe. Smart devices add another layer of information gathering and storage via telephone and global positioning system (GPS) technology, preserving the ability to access and disseminate information, no matter where we are, 24 hours a day (Cheeseman, 2011; Dainow, 2016; Kaminski, 2015).

Another use of the Internet is to store large amounts of information in a *cloud.* This method of storage allows an organization to achieve cost savings in many areas (maintenance, infrastructure, use of less expensive computers). For an organization that requires loss of, or a slow, Internet service connection will be a disadvantage of this method of data storage (Cheeseman, 2011).

Health care has benefited from recent computer advances in software programming, including educational packages for online instruction through courses, simulation experiences (avatars, high-fidelity mannequins, simulated electronic medical records, and online student resources), artificial intelligence/robotics to improve life for individuals with disabilities, and research (e.g., the Human Genome Project to map DNA). Additionally, social networking applications (also known as social media), software programs that encourage communication with others, hold great potential for growing professional networks and providing evidence-based information to healthcare providers and consumers (Carter-Templeton, Krishnamurthy, & Nelson, 2016). Individuals can set up blogs or join social media networks to share information with friends, family, or others with similar health conditions (Dainow, 2016). Social media has become a way that patients, families, and caregivers gain information and support from one another, particularly with chronic illnesses or life-limiting illnesses (Rupert et al., 2016). Preparing both patients and nurses carefully for using social media can provide meaningful benefits (Carter-Templeton, Krishnamurthy, & Nelson, 2016).

Basic Terminology of Computing

Understanding basic computer terminology is the first step to effective computer use. Many Internet sites have compiled comprehensive lists of computer terms and definitions that can be easily accessed and used for teaching and learning basic computer language.

Standardized terminologies became necessary in nursing with the introduction of the electronic medical record. Having a common terminology is essential to the effective use of retrieval of essential nursing-related data to im-

Jannson, 2017). Nurses must be able to capture their work in a way that is meaningful and allows for evaluation of the effectiveness of nursing interventions (Rutherford, 2008). The American Nurses Association (2018) published 12 approved standardized terminologies that support nursing work. The International Council of Nurses (2015) developed a framework for nursing practice that allows for inclusion of different terminologies that support the work of nurses. The goals of these two documents are similar and support the use of common nursing language to raise awareness of nursing work, communication within the healthcare team, ease of data retrieval and analysis for evaluation of nursing work, and an increased ability to incorporate and adhere to evidence-based standards of care (Rutherford, 2008). Use of standard terminologies ensures that communications are understood and interpreted in the same way by all members of the healthcare team (Halley, Sensmeier, & Brokel, 2009).

Integrating Evidence-Based Practice

Introduction

EBP is a problem-solving approach to healthcare delivery, integrating evidence, the expertise of the clinician, and the preferences and values of a patient (Melnyk & Fineout-Overholt, 2019). Practices found in healthcare systems and organizations are often steeped in tradition which may make it challenging to implement new procedures, even those based on evidence. In recent years, we have seen an information explosion. Much of this information and evidence is available to support clinicians. However, evidence-based care is often not the norm (Caramanica & Gallagher-Ford, 2022). Information literacy skills which may be learned and refined during educational experiences are of great benefit to work done in the clinical setting supporting EBP. The EBP nursing, is the practice of using best evidence to support patient care as governed by research. We have many opportunities to search, evaluate, and possibly apply evidence as we engage in this process (Badke, 2018). Converse to finding evidence, nurses have a role to play in dispelling misinformation by helping patients and colleagues access and assess trusted sources. In fact, the Code of Ethics for Nurses includes information about this duty to others. Nurses must work to ensure others understand the information they are receiving to make informed consent and decision making possible (Villarruel & James, 2022).

The components of EBP include a systematic and critical evaluation of the current literature, the nurse's clinical expertise and available resources, and patients' values and preferences. This information is used to make deliberate clinical decisions based on theory and relevant research that guide patient care (Ahrens & Johnson, 2013; Ingersoll, 2000; Melnyk & Fineout-Overholt, 2011). The expected results of these carefully considered decisions are improved outcomes for patients, efficiency, and cost-effective care delivery for organizations (Melnyk & Fineout-Overholt, 2011; Salmond, 2007). The translation of research evidence into the clinical setting remains delayed, often lasting years or even over a decade. In fact, Balas & Boren referred to the 17-year research practice time gap in their study. While recent work (Khan, Chambers, & Neta, 2021) suggests this timeframe may be a bit less, it is apparent it remains challenging to translate research findings into the clinical setting. Through the study of dissemination, adoption, implementation, and evidence-based practice sustainability, implementation science aspires to reduce this gap (Nelson-Brantley & Chipps, 2021).

Cultivating a Spirit of Inquiry

The process of EBP is best learned in sequence with distinct steps. The preliminary

Fineout-Overholt, Stillwell, & Williamson, 2010, p. 51), means to be curious about the effectiveness of nursing interventions, to take interest in changing nursing practice or questioning practice, and to try new approaches. This is the practice of continual questioning of procedures and operations (Melnyk, Gallaher-Ford, & Fineout-Overholt, 2016). Nurses with a spirit of inquiry understand EBP as a way of thinking, not an additional burden to their practice. Nurses who are passionate about EBP will likely become informal leaders, or be promoted to leadership positions, and can influence others to grow support for EBP. Those who have a spirit of inquiry will have questions and a desire to find the best evidence to support their practice (Melnyk, Fineout-Overholt, Stillwell, & Williamson, 2009).

Writing the Question

Those working in the clinical setting may be inundated by a constant flow of new evidence in the form of articles. In order to clarify our clinical questions, we must work to interpret our clinical questions in a format that helps facilitate a searchable query (Seguin, Haynes, Carballo, Iorio, Perrier, & Agoritsas, 2020). Nurses who use the steps of EBP to formalize their questions about practice should use the PICOT format. The term PICOT identifies the patient or population (P), issue or intervention (I), what will be compared (C), the expected outcome (O), and the time (T) it will take to achieve and evaluate the outcome (O). The PICOT format is a systematic method of question writing and helps formulate a search strategy potentially yielding the most relevant and appropriate evidence from existing scientific literature. Using a correct and appropriate PICOT question for a search allows for a more manageable amount of relevant studies to be discovered (Gallagher Ford & Melnyk, 2019). Consistently using a specific format to write the question ensures that all components of the question are addressed before the **literature search** begins

It takes time and practice to learn how to write questions in the PICOT format. Melnyk and Fineout-Overholt (2011) suggest that it takes "practice, practice, practice" to become proficient in writing PICOT questions (p. 31). Librarians may be helpful when developing and using a PICOT question (Gallagher Ford & Melnyk, 2019). Questions may be written following a template and may focus on interventions, predictions, or prognosis of outcomes for a specific patient population, comparison of diagnosis or diagnostic tests, etiology and associated risk factors for a specific condition, or meaning within a situation (Melnyk & Fineout-Overholt, 2011; Stillwell et al., 2010).

Nurses who embrace EBP may find support in forming groups interested in certain topics. Lawson (2005) suggests that getting other nurses involved helps to clarify clinical issues and to write clear and specific clinical questions. Once a group is assembled and the individuals are comfortable in identifying issues and writing questions, the second step, searching for evidence, can begin. If a clinical problem generates multiple questions, those with significant consequences or those that are most frequently managed should be given priority (Melnyk & Fineout-Overholt, 2023).

Finding the Evidence Using Library Sources

In order to use evidence in EBP, a nurse must locate and review the evidence found in research articles as published in reliable sources. The search strategy used to gain access to information begins with consideration of the elements identified in the PICOT question. Once a search strategy is established, the strategy and terms are used throughout the search process among all databases used (Melnyk & Fineout-Overholt, 2023). This process begins with using appropriate electronic databases and performing effective online searches. Using appropriate databases can be easier for nursing students during their coursework and

clinics, with their many research database subscriptions, but other options are available.

Nurses should use databases and websites that have valid and reliable information. **PubMed** and **Cumulative Index to Nursing and Allied Health Literature (CINAHL)** are two databases that index a comprehensive body of healthcare literature. The **Cochrane Databases** and the **National Guideline Clearinghouse** support EBP by including systematic reviews and current practice guidelines. Government sources for reliable information include the **Centers for Disease Control and Prevention (CDC)** and the **Agency for Healthcare Research and Quality (AHRQ)**. Many professional organizations have their journals and evidence-based guidelines available electronically for members or individuals who have subscribed online. Information about additional resources is addressed later in this chapter.

Searching for Evidence in Research Literature

Searching the literature may seem like a daunting task, and overwhelming to those who have not had experience with electronic databases. While lack of access to an onsite library or computer database applications can be a major barrier to conducting a search for evidence, the inability of a nurse to effectively use the computer to search the literature adds an additional barrier to embracing EBP (Hoss & Hanson, 2008; Wells, Free, & Adams, 2007). Nurses without computer skills or experience in data searches can seek assistance from a university or hospital librarian, or other experienced professionals (Fain, 2009). Time spent with a librarian who loves to teach others how to find these treasure troves of information is priceless, and will return a lifetime of information power. Links to tutorials and videos for using commonly accessed databases can be found in the companion website for this book. However, many functioning in the clin-

a recent study (Hines, Ramsbotham, & Coyer, 2021), it was found that a lack of access to evidence-based literature and research led to feeling unsupported and remains a perceived primary barrier to providing evidence-based care according to nurses (Storey, Wagnes, LaMothe, Pittman, Cohee, & Newhouse, 2019).

One of the greatest skills that nurses learn in their academic program is the ability to find relevant research on clinical topics. To begin the search in one of these research databases, nurses should select key terms from the PICOT question. These terms are entered using **Boolean operators** (*and*, *or*, *not*) to combine multiple search terms. In addition, many databases allow the use of quotation marks to search for phrases of multiple words. A good search technique is to set limits on the search, to narrow down the results to articles that are more suitable. For example, limiting a search to English-language, peer-reviewed journals and articles published within the last 5 years can help in the selection of valid findings that may be applicable to the topic (Hoss & Hanson, 2008; Melnyk & Fineout-Overholt, 2011).

Systematic Reviews and Clinical Practice Guidelines

Systematic reviews are literature reviews that follow a certain methodology to standardize the critique of research findings. Two excellent sources of systematic reviews are McMaster Plus Nursing+ and the Cochrane Collaboration. McMaster Plus has three functions: (1) it serves as a database of peer-reviewed articles that have been rated by nursing professionals, (2) it contains an email alert system for selected topics of interest, and (3) it provides links to abstracts of systematic reviews of research literature. The Cochrane Collaboration is a library built by healthcare professionals who author Cochrane Reviews, which are the gold standard for pre-appraised research evidence. Only a few Cochrane reviews are free; most are contained in the Cochrane Database of System-

Table 3-1 Resources to Learn About EBP

Tutorials	Internet Address
Appraising the Evidence	http://nursingworld.org/MainMenuCategories/ThePracticeofProfessionalNursing/Improving-Your-Practice/Research-Toolkit/Appraising-the-Evidence
American Nurses Association (ANA) list of online tutorials about EBP	http://ana.nursingworld.org/research-toolkit/Education
University of North Carolina EBP tutorials	https://hsl.lib.unc.edu/services
Academic Center for Evidence-Based Practice at the University of Texas Health Science Center at San Antonio	https://uthscsa.edu/nursing/research/resources-scholarly-support/star-model
Evidence-Based Practice: Step-By-Step: The Seven Steps of Evidence (from the *American Journal of Nursing*)	https://journals.lww.com/ajnonline/Fulltext/2010/01000/Evidence_Based_Practice__Step_by_Step__The_Seven.30.aspx

Nurses can join the Cochrane Journal Club and other electronic notifications of systematic reviews and clinical practice guidelines at no cost. **Table 3-1** provides a list of resources and Internet addresses for these sites.

Clinical guidelines are valuable because they contain pre-appraised research. Authors of clinical practice guidelines rate the research for the quality of evidence and the strength of making a recommendation for change based on the findings. The federal government provides at least three sources of free clinical practice guidelines at the Agency for Healthcare Quality and Research, the National Guidelines Clearing House, and the **PubMed Clinical Queries**. **Table 3-2** provides the Internet addresses for the free resources for clinical practice guidelines.

Using Free Resources

After students leave their colleges and universities, access to subscription databases, such as CINAHL, depends on resources available in their places of employment. For those in academic medical centers, access to databases may be assured; those in community hospitals themselves disconnected from the very lifeline of evidence-based practice—a library.

There are ways to access libraries free or at low costs for individual nurses. The best place to start is PubMed, which is freely available online. Some of the research journals published online are available as open access journals—if those journals are indexed in PubMed, then those results will link to the article. Google Scholar can also be a useful tool.

PubMed

As a service of the **National Center for Biotechnology Information (NCBI)** at the U.S. **National Library of Medicine (NLM)**, PubMed is an extensive index of published medical literature with over 22 million citations. Nursing literature is indexed in this service, too. However, unlike CINAHL and other subscription databases, it does not provide full-text access to those articles. While articles can be accessed with the LinkOut functionality, they may not be housed within the PubMed database.

PubMed offers several noteworthy features. Rather than using keywords, the most

Table 3-2 PubMed Tutorials and Videos: Learn How to Search Efficiently for Articles

Tutorials	Internet Address
PubMed Tutorial	http://www.nlm.nih.gov/bsd/disted /pubmedtutorial/
Medical Subject Headings (MeSH) in MEDLINE/PubMed: A Tutorial	http://www.nlm.nih.gov/bsd/disted /meshtutorial /introduction/index.html
Branching Out: The MeSH Vocabulary	http://www.nlm.nih.gov/bsd/disted/video/
Videos	
My NCBI—National Center for Biotechnology Information	http://www.youtube.com/watch?v=ks46w3mNAQE
PubMed YouTube Playlist	https://www.youtube.com/playlist?list =PL7dF9e2qSW0YkmxDTsUG6p4hJjYOPT0Uj
PubMed Learning Resources Database	https://learn.nlm.nih.gov/documentation /training-packets/T0042010P/
PubMed Search	https://pubmed.ncbi.nlm.nih.gov/help/#author-search
Pub Med Advanced Search Builder	https://youtube/IHhTDqiNQK8

Medical Subject Headings (MeSH). MeSH is a thesaurus of controlled-vocabulary terms. Once MeSH terms are found for the topic, a more fruitful yield will result from searches of PubMed. **Figure 3-1** shows a MeSH tree for obstructive sleep apnea. Other features of PubMed are the PubMed Advanced Search Builder, sidebar filters, LinkOut, and My NCBI.

The MeSH terms selected are entered into the **PubMed Advanced Search Builder**, the open boxes in PubMed. The drop-down menus are then set to MeSH terms, and Boolean operators (*and*, *or*, *not*) should be used as needed. If the yield is too high for a reasonable review of articles, then the **sidebar filters** can be added including article types (clinical trials, systematic reviews, practice guidelines, to name a few), text availability (abstract available, free full text available, or full text available), and publication dates. The filters will limit the search to a number that is more manageable. When the desired articles are selected, some full-text articles may be freely available using the **LinkOut** service. LinkOut the screen. To find the desired reference material, the LinkOut icon should be clicked. Icons change depending on the source of the reference material. If full text is not available, nurses can order the articles from their hospitals or from public libraries using **interlibrary loan** services. Typically, a public library will have a nominal charge for an interlibrary loan.

Searches of PubMed should be managed such that the MeSH terms and the yields from searches can be retrieved if needed. PubMed provides a cloud-based folder called *My NCBI* (My National Center for Biotechnology Information) for searching and storing the history of searches. Up to 6 months of search histories can be stored in My NCBI. Registration and use is free. Written tutorials and short videos provide excellent help for nurses who are new to PubMed. Some of the most helpful tutorials and videos are listed in **Table 3-3**.

Google Scholar

Google Scholar is a web-based search engine

Previous indexing:

- Apnea (1966–1979)
- Sleep (1966–1979)
- Sleep apnea syndromes (1980–1999)

All MeSH categories

Diseases category

Respiratory tract diseases

Respiration disorders

Apnea

Sleep apnea syndromes

Sleep apnea, obstructive

Obesity hypoventilation syndrome

All MeSH categories

Diseases category

Nervous system diseases

Sleep disorders

Dyssomnias

Sleep disorders, intrinsic

Sleep apnea syndromes

Sleep apnea, obstructive

Obesity hypoventilation syndrome

Figure 3-1 MeSH tree for obstructive sleep apnea produced from a search of PubMed.

Courtesy of National Center for Biotechnology Information. Available at http://www.ncbi.nlm.nih.gov/pubmed

Table 3-3 Electronic Alerts for Systematic Reviews and Clinical Practice Guidelines

Resource	Internet Address
McMaster Plus, *British Medical Journal* Updates	https://plus.mcmaster.ca/EvidenceAlerts/
PubMed	https://www.ncbi.nlm.nih.gov/pubmed/
National Library of Medicine Resources for Healthcare Professionals	https://www.nlm.nih.gov/portals/healthcare.html
Cochrane Library Journal Club	https://www.cochranelibrary.com/cdsr/journal-club/
National Guideline Clearinghouse Email Alerts	http://www.guideline.gov/subscribe.aspx

disciplines and it is an easy way to search a wide range of scholarly works. Its index includes literature from both free and paid repositories, professional societies, academic publishers, and other sources across the web. The primary focus is to index all academic papers on the web (Google). While there is no doubt of the value of the service for researchers of all kinds, it also has its shortcomings. Google takes articles from everywhere it can access on the web, and users must be careful to vet the articles they find using Google Scholar, because the articles may or may not be peer reviewed, and in fact may include articles from predatory publishers (Oermann et al., 2022). One particularly celebrated and useful feature of Google Scholar is the "cited by" feature. The "cited by" feature allows users to view a list of later works that have cited the original paper. This ability to connect literature through citations has historically only been available through paid services. A particularly pervasive shortcoming of the service is that it strengthens the Matthew Effect, a term coined by sociologist Robert Merton to refer to the way in which starting advantages tend to build on themselves (Rigney, 2010). With Google Scholar, this is seen in the way that articles with more citations are more likely to be at the top of the search results, and newer articles with fewer citations are more likely to be lower on the page and thus less likely to be read and used (Beel & Gipp, 2009). Google Scholar is a valuable resource for researchers of all kinds, but, as is true with all research tools, it is the responsibility of researchers to verify the veracity of any sources they use.

Open Access Journals

Freely available articles are provided by publishers who offer **open access**. The rationale for providing free, online access to scholarly articles and research is to advance scientific thought, particularly for individuals in developing countries who cannot afford the high The cost of publication is shifted to the authors, rather than the readers. While this makes research available, nurses must ensure they are selecting articles from peer-reviewed journals. Journals that are open access can be found by searching online for the **Directory of Open Access Journals (DOAJ)**. A particular advantage of the DOAJ is that it gives smaller publications a way to expand their reach. Nurses should always be vigilant about the quality of their sources, but they should not neglect open-access journals, as they often have research from more varied sources and in smaller research niches. Predatory publishing has unfortunately resulted from open-access publishing (Beall, 2016). These publishers operate under questionable practices, such as limited or no peer-review. They may also be in business for the purposes of collecting fees from authors (Oermann et al., 2016).

Analyzing the Literature

Not all evidence is equal; nor will all evidence be applicable to a particular clinical setting. When searching for evidence, it is prudent to look for clinical practice guidelines, systematic reviews, meta-analyses of evidence, or randomized controlled trials relevant to the particular clinical question. Single studies or case studies can be used to demonstrate how evidence is put into practice, and textbooks can be used as resources for information on a particular condition. Most nursing research and evidence-based practice textbooks will have guides to help evaluate the quality of quantitative and qualitative research studies (Levin, 2013; Fineout-Overholt et al., 2011).

The evaluation or critical appraisal of the information offers a bridge between evidence and the application of it in clinical practice. This process is often not clearly understood by nurses who often rely on their colleagues for information (Carter-Templeton, 2013). Melnyk & Fineout-Overholt (2023) suggest four phases of critical appraisal, an essential

is a rapid critical appraisal, where the validity, reliability, and applicability of a study or article is assessed. Phase 2 is that of evaluation. In this phase, the study designs are carefully reviewed. The third phase is called synthesis. Patterns among the literature are identified with the previous phase (evaluation phase) and typically placed into an organizing table to illustrate and demonstrate what is known about a topic and outline information about how it has been explored. From this synthesis, conclusions are developed that lead to recommendations for practice (Phase 4).

Information appraisal can be complex. Many recommend specific approaches to evaluation such as checklists or scales to help nurses evaluate the quality of research studies. These tools address the validity of the study, reliability of the results, and the applicability to the particular patient care setting (see Table 3-1).

Putting the EBP Process Into Practice

Once the literature is analyzed using a systematic approach, nurses working on an EBP project will need to decide if a change in practice is needed. If so, then creating enthusiasm for the project and soliciting input from all stakeholders early in the planning stages will be critical. Early and frequent communication by email or other innovative strategies such as Twitter, Facebook, or blogging can keep stakeholders involved.

As with any change, a plan needs to be prepared. A theoretical model or process, such as **Plan-Do-Study-Act (PDSA)**, can be used as a framework to plan and implement the project. A timeline for the project is essential to keep it on track. The PDSA cycle is a common tool used to support change and continuous improvement evaluation. This cycle is a framework consisting of a four-step systematic process used to plan a change, implement a change, observe the results, and create an action based on the findings (Institute of Health Improvement, 2016). Even strategies to overbe included. Selecting an evaluation strategy as part of the initial project plan is also necessary (Melnyk & Fineout-Overholt, 2011). The plan must address any ethical issues and protected health information issues by seeking Institutional Review Board approval for the project (Levin, 2013).

Communicating the Findings

Once the practice change is stable, the final step of EBP is to share the results with others. Failure to disseminate the outcomes of EBP projects may lead to unwarranted duplication and delay in getting evidence into practice throughout the practice setting and beyond. Results can be disseminated in the organization at staff meetings, in a nursing newsletter, as a blog posting, or as a poster presentation. Findings should be presented at local specialty group meetings or at regional or national conferences (Melnyk et al., 2010). Nurses can also partner with local schools or colleges of nursing to create an Evidence-Based Practice Day, in which nurses from various clinical settings can share the results of their projects.

Evaluating EBP

Standardized computer terminology and databases provide the opportunity to evaluate EBP. Outcome data are available from the EHR, disease-specific registries, and other quality care databases. In order for these data to be useful, they must be entered correctly, processed in a meaningful way, and retrieved and analyzed using appropriate statistical tools (Tymkow, 2016).

Using Reference Manager Software to Store and Use Sources

Nurses who plan to carry out formal EBP projects need to learn how to manage the results of

critical if the nurse plans to communicate findings in poster sessions or in published articles. Without software, the research articles, systematic reviews of literature, and clinical practice guidelines (see **Table 3-4** for Repositories of Clinical Practice Guidelines) can become stacks of paper with little or no organization. Fortunately, there are **reference management software** solutions such as Zotero, EndNote, Refworks, and Mendeley, among others. These applications allow authors to search online bibliographic databases, store articles, and arrange citation information, as well as create reference lists. These programs can assist with reference formatting with regard to reference style and ordering of references (Oermann, 2016). Each of these citation management programs has different computer requirements and installation instructions, as well as pricing structures and storage capability. Some of these applications are free, while others must be paid for prior to use.

Staying Current in Nursing Practice and Specialty Areas

Email Notifications

It is impossible to read enough journals to stay current with the short shelf-life of most research. Using technology to stay current is a smart decision. With registration at journal publisher websites, email notifications will be sent when new content is available. Publishers send a table of contents with every issue of the journal. Links from the table of contents often provide an abstract. If an interesting journal article is in the table of contents, then the nurse can order the article using an interlibrary loan if it is not available from other sources. **Table 3-5** lists journal publishers who provide free email notifications.

Table 3-4 Repositories of Clinical Practice Guidelines

Resource	Internet Address
Agency for Healthcare Research and Quality (AHRQ)	http://www.ahrq.gov/clinic/cpgsix.htm
AHRQ Innovations Exchange	https://innovations.ahrq.gov/
National Guideline Clearinghouse	http://www.guideline.gov/
PubMed Clinical Queries	https://www.ncbi.nlm.nih.gov/pubmed/clinical
National Institute for Health and Care Excellence (NICE) Organization	http://www.nice.org.uk/

Table 3-5 Electronic Subscriptions to Journal Email Notifications

Resource	Internet Address
Mobile CINAHL	https://health.ebsco.com/products/the-cinahl-database
Lippincott Williams & Wilkins Email Alerts	http://journals.lww.com/pages/login.aspx?ContextUrl=%2fsecure%2fpages%2myaccount.aspx
Sage Publishers Email Alerts	http://www.sagepub.com/emailAlerts.sp?_DARGS=/common/components/extras_big.jsp.1_A&_DAV=Dummy&_dynSess-Conf=1994759084613409176

Rich Site Summary

Rich Site Summaries (RSS), often called **RSS feeds**, are simplified summaries of the information provided on whole websites. For example, an RSS feed of the CNN website would show a list of all the stories on the page. RSS feeds provide a clear and easy way of tracking information from a large number of sources, and nurses should be aware of the wealth of information available to them through RSS feeds. Some notable sources of feeds include the National Institutes of Health, the Food and Drug Administration, the CDC, and the AHRQ.

Social Media

Social media includes Facebook, Twitter, LinkedIn, and all the other similar services. In health care, social media has not been a widely used tool, but that may be changing. Social media services help people to connect, share their experiences, develop groups, and communicate more effectively. For a healthcare provider (HCP) that might mean instant-messaging services between patients and nurses or doctors, or video-conference-based appointments. It could also mean social networks specific to nurses and doctors where opportunities, research, and wisdom could be shared. A free EHR system called Hello Health is used by a Brooklyn-based practice that provides a model for this type of integration (Hawn, 2009). The practice has developed a patient management platform where patients can communicate with their HCP via private instant messaging, schedule video-chat appointments, renew prescriptions, and access their own personal health record (Hawn, 2009). As the landscape continues to develop and these tools evolve, nurses must adapt. By focusing on the improved communication enabled by social media, nurses will be able to build communities and share their experiences

Webinars and Teleconferences

Communication technology, particularly Internet-based communications, have opened up new ways for nurses to engage with one another to learn about the best practices in patient care. Technologies such as Skype, Google Hangouts, and join.me offer low-cost or free services to connect multiple people with audio, video, and desktop sharing. When used as continuing education or webinars, nurses can participate with experts on clinical topics anywhere Internet service is available. Sortedahl (2012) developed an online journal club for school nurses and assessed nurses' satisfaction with the method after 3 months. Sortedahl found that the nurses valued three key elements: having well-informed knowledgeable moderators, getting research articles in advance, and discussing the application of findings to nursing practice. The researcher also found that using Internet-based technology allowed the journal club to invite the author of a research article to the club meeting, which benefited the researcher and nurses. There were issues with slow Internet connections, firewalls and other security measures, and operating system incompatibilities. Despite the technical issues, the nurses liked the method and wanted even more interaction with each other between journal club meetings (Sortedahl, 2012).

Evidence-Based Practice Integrated in Clinical Decision-Support Systems

The most efficient means for integrating EBP in clinical processes is to have a **clinical decision-support system (CDSS)** embedded in health information technology (health IT). Clinical decision-support systems, introduced

are computer systems designed to impact clinical decision making about individual patients at the moment those decisions are made (Berner & La Jande, 2007) by presenting contextually appropriate information. Integrating CDSS with EHR technology has been a method used to improve decision making in the clinical setting which can ensure quality care and safety (Dunn-Lopez, Gephart, Rascewski, Sousa, Shehorn, & Abraham, 2016). CDSSs bring the available, applicable knowledge and research together into systems that clinicians can use throughout the decision-making process. The key aspect is that the usefulness comes from the interaction of the human and the computer. Modern CDSSs are not designed as black boxes that interpret information and deliver concrete answers, but as tools that provide the clinician with the best possible evidence relevant to the patient's assessment data and laboratory results to ensure the patient receives the best possible care (Berner & La Jande, 2007).

Most CDSSs are made up of three essential components: the knowledge base, the reasoning engine, and a mechanism to communicate with the user (Berner & La Jande, 2007). The knowledge base contains all the relevant knowledge expressed as if-then rules. The reasoning engine contains a set of instructions that tell the computer how to apply the rules to real patient data. The communication mechanism provides the means for patient data to be entered into the system and for any pertinent findings to be relayed to the user. Many CDSSs rely on the user to input data manually, but the continued acceptance of EHRs and improved interoperability among systems will enable more systems to input data automatically from multidisciplinary team members (Berner & La Jande, 2007).

Commercially available EHRs typically have CDSSs, but the system may need to be customized for use in the particular healthcare setting. Nurses and other HCPs need to be involved in the development of the CDSS *clinical* decisions, and HCPs are equipped to translate clinical research into clinical processes through a reasoning engine in the EHR (Brokel, 2009). In a very basic way, order sets and nursing plans of care in EHRs represent clinical decision support because the predetermined orders are used to simplify the cognitive processes necessary for planning care. When order sets and nursing plans of care are developed, nurses can influence the process by serving on a task force to develop the CDSS by bringing research evidence and clinical practice guidelines to this decision-making group. In this way, nurses contribute to the implementation of evidence-based practice (Brokel, 2009).

Health Information Technology and EBP

Health information includes all the information related to the interactions of patients, HCPs, and the health information management (HIM) team. Beginning with the registration process, health information is captured, categorized, stored, and retrieved to use in making decisions related to the delivery of health care. Managing health information through the life span of EHRs is the responsibility of HIM professionals (ITI Planning Committee, 2015).

As outlined in the ITI Planning Committee white paper (2015), responsibilities and requirements for HIM professionals include ensuring the integrity, protection, and availability of health information. HIM professionals work in a variety of roles to capture, validate, maintain, and analyze data, as well as providing decision support for health professionals. HIM practice by these professionals supports the life cycle of health information from capture or input of data into the computer system to the disposal of health information data. Principles governing health information have been developed by the American Health Information Management Association (AHIMA) and are focused on integrity, protection, transparency,

availability, retention, and disposition of health information (ITI Planning Committee, 2015). Standards governing the use of health information are focused on the interoperability of information technology systems to support distribution of patient information by authorized users (Halley et al., 2009). Incorporation of clinical practice guidelines and nursing terminology into the EHR provides a common language and interventions that support data collection and evaluation of clinical outcomes (Barey, Mastrian, & McGonigle, 2016).

Box 3-1 Case Study: Searching for, Evaluating, and Managing Research Articles

Beth works at the OB/GYN clinic in a medium-sized hospital. She has noticed that many of her patients develop diabetes during their pregnancy, even though they do not have a previous history of diabetes. Beth wants to use EBP to help improve the care these patients receive.

As her first step, Beth wants to look in a reputable online resource for evidence-based research in medicine and nursing. She decides to use PubMed.

When Beth begins her research in PubMed, she searches for "diabetes" but finds a lot of the results do not seem relevant; many of the research articles describe older patients, or teenagers, or males. In order to perform a more effective search for evidence-based research on her topic, Beth uses the MeSH database option within PubMed. When she searches in the MeSH database for diabetes and pregnancy, she finds the term "Diabetes, Gestational."

When Beth adds the MeSH term "Diabetes, Gestational" to her search in PubMed, she finds thousands of articles specific to diabetes during pregnancy. After beginning to scan through the articles in this list, she uses filters to narrow down her search to articles from the last 5 years that are about clinical trials. She still finds hundreds of articles, so she starts reading the following article:

Karamali, M., Heidarzadeh, Z., Seifati, S. M., Samimi, M., Tabassi, Z., Hajijafari, M., . . . Esmaillzadeh, A. (2015). Zinc supplementation and the effects on metabolic status in gestational diabetes: A randomized, double-blind, placebo-controlled trial. *J Diabetes Complications, 29*(8), 1314–1319.

Beth decides to start with this article, because the citation indicates this research article is relevant to her area of research, it is recent, and it reports on clinical trials with human patients. After she reviews this article and saves it, she continues looking for other similar articles.

As Beth continues her research for recent articles about clinical trials with human patients, she begins to save the article citations into a personal "library." In order to easily review these articles, she begins to use Zotero, saving her articles on her laptop and online. This has several added benefits: She can save citations from PubMed, as well as articles she finds in other research databases; she can access those citations from other computers; she can share her library of references with her colleagues; and she can build a bibliography from these articles, if she wants to document the EBP at her clinic.

Check Your Understanding

1. When Beth started her research, she decided to start in PubMed. For what possible reasons might she have started in PubMed (over another medical database, such as CINAHL)? What advantages would PubMed have over another resource, such as Google Scholar?
2. In Beth's first PubMed search, she found a lot of results for older patients or males. What benefits does she gain from using a MeSH term?
3. In the results Beth found, she started with the 2015 article "Zinc supplementation and the effects on metabolic status in gestational diabetes." Why would she choose this article? What information in this citation indicates it might meet her needs?
4. When Beth starts to save a personal library of her references, she has several reasons to use Zotero. How can a citation manager like Zotero (or Mendeley, or EndNote, etc.) help you with your research?

The use of a sophisticated CDSS, developed by multidisciplinary teams, is an efficient way to translate research evidence into everyday practice. However, the steps involved in the appraisal of evidence cannot be missed. It would be irresponsible to take current practice and automate the clinical decisions based on status quo. Likewise, it would be imprudent to base care on a single research article. Nurses and other HCPs need to take the time to examine their current practices with respect to best practices when EHRs or other health IT are implemented.

Summary

While moving from academia to nursing practice based on evidence may seem daunting, nurses should transform traditional practices into ones supported by the best scientific evidence. Nurses can get access to primary research, systematic reviews, and clinical practice guidelines by using information technology effectively. Information management strategies are essential, including subscribing to RSS feeds, registering for email alerts from journal publishers and from government resources, and purchasing subscriptions to services that provide EBP support. Finally, nurses should advocate for the selection of health information technology that has best practices as an integrated feature. Technology can make the practice of EBP more seamless for nurses and fulfill the need to improve patient care.

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