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CHAPTER 1

Evidence-based neurology in health education

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Clinical neurology trainees undergo a lengthy and complex process requiring integration of many fundamental skills that coalesce into sound diagnosis and decision making. Beyond the core knowledge of anatomy, physiology, biochemistry, pathology, and the medical sciences, there is an essential requirement for the clinical student, in the arena of evidence-based clinical practice, to acquire skills and expertise in the principles and practice of critical appraisal and to have a working knowledge of the best evidence from the diverse multiple subspecialties that comprise neurology today. Maintaining competence in the current best evidence over a neurologist's career is essential to making accurate diagnoses, providing high-quality neurological care, and selecting appropriate tests and therapies.

Developing the skills necessary for critical appraisal is a difficult process, particularly when competing with the rigorous demands of a residency training program. An evidence-based curriculum in neurology education provides the opportunity for teaching the fundamentals of critical appraisal and engaging in discussion of current clinical questions, hot topics, and continued controversies. Fostering an understanding of what comprises an appropriately comprehensive rigorous literature search, the levels of evidence, the different types of studies, and the methodologies are difficult to consolidate outside of a formalized curriculum or graduate-level training in evidence-based medicine, health research methodology, and clinical epidemiology.

In this chapter, we discuss the development of an evidence-based neurology (EBN) curriculum in health education.

Objectives

Teaching and acquisition of critical appraisal skills is the primary objective of an evidence-based clinical practice

curriculum. Fundamental critical appraisal skills include the following: awareness of a clinical knowledge gap, formulation of answerable questions based on clinical uncertainty, performance of a literature search, identification of the highest quality evidence from the search yield, and critical appraisal of the studies to address the original clinical question. Students should become familiar with the different classifications of clinical studies (e.g. prognosis, diagnosis, therapy or harm) and the main methodological and statistical questions that must be addressed in each type of study. The students should also be able to determine whether or not the study findings are worth considering given the methodological quality of the study and its generalizability in reference to the patient population in question.

Students should develop an understanding of both the importance and the limitations of clinical evidence. Emphasis should remain on high-quality patient care and the use of the current best evidence to guide clinical practice within the context of the patient's wishes and the clinician's judgment and reasoning. It must be emphasized that lack of evidence for efficacy does not necessarily mean lack of benefit with treatment, and vice versa for lack of evidence against certain therapies or diagnostic tests.

As a result of the evidence-based medicine, curriculum knowledge about best current evidence practices is accumulated and stored for future use. Owing to the discussion of common clinical scenarios and review of the relevant best evidence, the students develop a working knowledge of the current evidence (Table 1.1).

The following sections describe an example of an EBN curriculum based on two longstanding, mature, and successful programs targeting clinical neurology residents: the EBN curriculum from the Western University (WU) in London, Canada [1–4]; and the Mayo Clinic Evidence-Based Clinical Practice, Research, Informatics, and Training (MERIT)

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Table 1.1 Objectives of evidence-based neurology curriculum.

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| <p>1 Students of neurology should develop critical appraisal skills to</p> <ul style="list-style-type: none">(a) formulate answerable questions based on clinical uncertainty(b) perform an appropriate literature search(c) identify the best quality evidence from the studies identified(d) critically appraise the identified studies to answer the original clinical question(e) be familiar with prognostic, diagnostic, and therapeutic clinical studies and the key methodological and statistical questions that should be addressed in each type of study(f) determine whether the study findings are valid and useful, considering the methodological quality of the study and the applicability to a particular patient population <p>2 Students of neurology should develop a working understanding of the importance of high-quality evidence and also realize its limitations</p> <p>3 Students should accumulate knowledge about best current evidence practices in neurology</p> |
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Curriculum, Mayo Clinic, Phoenix, AZ [5,6]. Another third valuable resource designed to help educators teach students of neurology to understand and use evidence-based medicine is the web-based American Academy of Neurology (AAN) Evidence-Based Medicine Curriculum [7].

Topic selection

Generating the clinical questions

Once annually EBN curriculum facilitators survey all neurology students and faculty members to generate a list of neurological questions for potential review. These clinical questions are then rank ordered by the trainees and facilitators according to multiple factors including clinical importance, relevance, frequency of occurrence, and interest. The most highly ranked questions are reviewed in the upcoming year. The topics are screened to ensure that they are congruent with the educational recommendations of the training program (post-graduate education committee): Royal College of Physicians and Surgeons of Canada Advisory Committee and/or Accreditation Council for Graduate Medical Education – Neurology Residency and American Board of Psychiatry and Neurology [1–6].

Preparing for the tutorial session

Students each select one or two clinical questions per academic year and prepare their critically appraised topic for general discussion with the group. For each clinical topic, a clinical scenario and a focused clinical question are formulated. A focused clinical question should include considerations of the specific patient group, the intervention or exposure, the method of comparison, and the outcome measures. The acronym PICO can serve as a helpful reminder [8] (Table 1.2).

Table 1.2 PICO acronym [8].

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| <p>Patient or population</p> <p>Intervention, prognostic factor or exposure</p> <p>Comparison intervention</p> <p>Outcome to measure or achieve</p> |
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For a given clinical question, the presenting trainee performs a literature search and identifies studies representing the highest level of evidence [9]. Expert librarians and informatics specialists can be called upon to assist in efficient and comprehensive literature searching. Studies are evaluated according to the generally accepted hierarchy of clinical evidence. High-quality meta-analyses, systematic reviews, and randomized clinic trials are preferred over observational studies and case reports. One to four studies are selected for critical appraisal and discussion. A summary of this information is prepared in advance of the discussion in the form of a critically appraised topic (CAT) as described later. One week prior to the session, the presenting trainee circulates copies of the clinical scenario, focusing clinical question, search strategy, and articles for review to the participants. The pre-tutorial process is supervised by one of the facilitators. The faculty often provides instruction and advice on the search strategy and reasons for inclusion or exclusion of studies. Trainees are introduced to different search engines (e.g. PubMed [10], SUMSearch [11], Cochrane Library [12]). Discussions on Medical Subject Headings (MeSH headings), keywords, and their uses are helpful.

Flexibility is available to adjust the clinical topics to suit the needs and training level of the trainees. Semi-annual meetings of the curriculum trainees and facilitators allow for appropriate curriculum content changes and adjustment of group discussion objectives to cover specific epidemiological or biostatistical topics.

Tutorial

Each tutorial session focuses on a trainee presenting one clinical question. The session begins with a 5-min description of the clinical scenario and focused clinical question. This is followed by a 10-min presentation of the background topic including clinical information about the condition, treatment, or diagnostic test. The trainee then presents and discusses the search strategy for 5 min.

The following 45 min is dedicated to critical appraisal of the evidence.

The study type is identified (e.g. prognosis, diagnosis, therapy, or harm), and the appropriate rating scale or worksheet is utilized to assist the presenting trainee and faculty members guide the group through the critical appraisal process. Sample worksheets are available through the Western University Evidence-Based Neurology website [4].

These worksheets were derived from the *Users' Guide to the Medical Literature* [13] and relevant articles contained therein. The rating scales are generally divided into three sections: (1) analysis of the study methodology to determine its validity, (2) assessment of the final results including accuracy and clinical importance, and (3) appraisal of the applicability of these results to the target patient or patient population.

To engage the audience, it is helpful to divide into smaller groups of three or more participants (depending on number of trainees) to each completely assigned portions of a worksheet. For example, for a therapeutic article one group can determine whether the study addressed a focused clinical question, whether treatment allocation was randomized, and whether the randomization list was concealed. A second group could discuss the length of patient follow-up and whether an intention-to-treat analysis was employed. The whole group then discusses the interpretation of results and their applicability to the focus clinical question (5 min). The final conclusions of the group are summarized as “clinical bottom lines” (5 min). The presenting trainee’s draft CAT is then reviewed, discussed, and edited. The final CAT reflects the opinion of the entire group.

Post-tutorial

The presenting trainee completes final revisions of the CAT based on the suggestions of the group at the tutorial and submits it for final review to the facilitators. The final CAT is collected and made available for review either in hard copy format, posted to a central repository on the intranet or Internet, or published in peer-reviewed journals.

All trainees are encouraged to utilize their evidence-based skills during their clinical rotations and in teaching sessions. Trainees are encouraged to ask about the evidence underlying their supervising faculty’s medical decisions in a collegial manner and to review the literature as appropriate to enhance everyone’s knowledge base.

The critically appraised topic (CAT)

The CAT begins with a short summary of the clinical scenario and focused clinical question. The literature search is briefly outlined. The clinical bottom lines are highlighted followed by the most relevant data, typically in table form, and the relevant references. The objective of the CAT is to summarize the tutorial topic and conclusions in a concise manner for future reference. The WU EBN Program maintains an online archive of CATs that assist in clinical decision making and implementation of evidence-based clinical practice [4]. Both the Mayo Clinic MERIT and WU EBN programs have published CATs in peer-reviewed print journals [6,14–26].

Resources

Faculty

Most programs have two full-time neurologists with expertise in evidence-based medicine, clinical epidemiology, and biostatistics who are responsible for coordinating the tutorials and teaching evidence-based care principles and practice. All neurology and neurosurgery faculty are invited to attend tutorials, and special invitations are sometimes extended to other medical and surgical faculty, outside neurology, with particular interest or expertise on the topic of discussion at a given session. Teaching faculty from other departments or other academic institutions are occasionally invited to participate or teach on specific evidence-based medicine topics. Neurosurgery residents attend EBN tutorials when topics relevant to neurosurgical practice are discussed. Neurology residents have graded responsibilities and assume a greater teaching role as they gain experience and skill in EBN. Neurology trainees, residents, and fellows vary in total number from 10 to 14 per year, depending on the institution.

Medical librarians and informatics experts

If available, expert evidence-based medicine librarians and informatics specialists serve as valuable faculty additions and can be called upon to assist in the literature search. They may identify more useful or encompassing search terms, suggest additional specialized databases to search, and help finalize a list of relevant articles.

Time

EBN tutorial sessions range from 60 to 90 min in duration, depending on the program, and are held monthly throughout the typical 4- or 5-year neurology residency training program. Sessions are scheduled into protected educational time for neurology students, thus ensuring mandatory participation. Topics for discussion are generally decided upon early in the academic year, thus allowing ample informal research and preparatory time.

Space

EBN tutorials are generally held in an available university or hospital auditorium. Reference material on evidence-based medicine is made available in the departmental library. Computers, smartphones, and tablets with links to electronic databases are readily available.

Educational resource material

It is helpful to provide an introductory reference book on evidence-based medicine to each new student [27]. Other evidence-based references and educational material can be located in the departmental library. A compilation of all critically appraised topics reviewed is made available in print format (published, peer reviewed, or unpublished) or as a web-based searchable database for intra- or extra-institutional use [4].

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Informatics

Students use smartphones, tablets, laptop computers, and digital projection units for presentations and tutorials. With Internet access and links to the commonly used searchable databases of the evidence-based literature, the departmental library based on the real and virtual neurology remains a focal point of the EBN curriculum.

The evidence to support an evidence-based health curriculum

An increasing number of medical residency training programs devote formal educational time to developing evidence-based clinical practice knowledge and skills. One of the core competencies on graduate medical education is *Practice-based learning and improvement*. This requires the clinical student to investigate and evaluate their care of patients, to appraise and assimilate scientific evidence, and to continuously improve patient care based on constant self-evaluation and lifelong learning. Residents/fellows are expected to develop skills and habits to be able to

- Locate, appraise, and assimilate evidence from scientific studies related to their patients' health problems;
- Use information technology to optimize learning.

Other than simply fulfilling a core competency, the question is, "Do these curricula improve knowledge of evidence-based neurology concepts and critical appraisal skills?" "Do they result in a change in clinical practice and patient health outcomes?" Several primarily nonrandomized or quasirandomized studies conducted over the past decade have attempted to address these questions. High-quality evidence is limited as a result of heterogeneity of the teaching method or intervention assessed, small sample sizes, heterogeneity of the outcome instruments or measures, and variability in the duration of the study or timing of the outcome assessment [28–30]. Systematic reviews of the available evidence suggest that post-graduate evidence-based medicine education results in significant improvements in a student's knowledge base but data are lacking, which significantly alter clinical decision making or patient outcomes [28–30].

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