

## Evidence-Based Decision Making in Action: Part 2 – Evaluating and Applying the Clinical Evidence

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### Abstract

This is the second of a two-part series addressing the use of evidence-based decision making (EBDM) in the use of home bleaching. In Part 1, a case scenario demonstrated the skills involved in (1) structuring a clinical question and (2) conducting an online search using PubMed. Part 2 demonstrates the third and fourth steps in the EBDM process, i.e., (3) critical appraisal to assess the validity of a study and (4) applying that information to clinical decision making. This 4-step approach to EBDM recognizes that clinicians can never be completely current with all conditions, medications, materials, and products. Thus, EBDM provides a mechanism for addressing these gaps in knowledge in order to provide the best care possible.

**Keywords:** Evidence-based decision making, EBDM, evidence-based practice, critical appraisal

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## Introduction

As society gains greater access to healthcare information, clinicians must be armed with the skills to find and evaluate the scientific evidence in order to answer patient questions and provide up-to-date care. This has become increasingly difficult considering the amount of information available via the Internet and media. Just keeping up with the scientific literature in our own professional journals is overwhelming and, unfortunately, "less than 15% of all articles published on a particular topic are useful {for patient care}. Most articles are not peer-reviewed, are sponsored by those with commercial interests, or arrive free in the mail. Even articles published in prestigious journals are far from perfect."<sup>2,3</sup> Because of the flaws that can be found in published research and the conclusions drawn that may not be supported by the data, clinicians need to be responsible for judging the validity and clinical importance of the scientific literature.

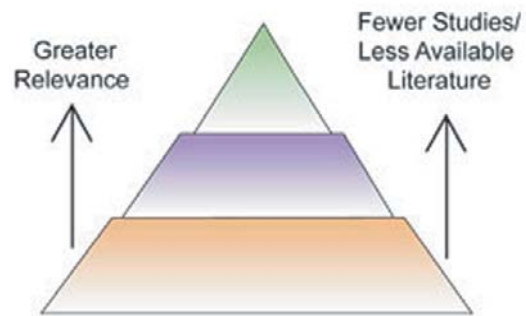
Once you have found the most current evidence, the next step in the EBDM process is to understand what you have and its relevance to your patient. Fortunately, the tools to critically appraise papers based on the type of question being asked have been developed by the evidence-based medicine group at McMaster University and adapted by other evidence-based groups worldwide.<sup>4-6</sup> These tools consist of a structured series of questions that help you determine the strengths and weaknesses of how a study was conducted, how information was collected, and how useful and applicable the evidence is to the specific patient problem or question being asked.<sup>4,7,8</sup>

## Key Questions in Appraising the Scientific Literature

The purpose of the third step in the evidence-based decision making (EBDM) process is to determine the validity and usefulness of the study, keeping in mind that scientific evidence is the product of well-designed and well-controlled research investigations and the hierarchy of evidence is based on the notion of causation and the need to control bias.<sup>9</sup> Although each level of the hierarchy may contribute to the total body of knowledge, "...not all levels are equally useful for making patient care decisions."<sup>10</sup> As you progress

up the pyramid, the number of studies and correspondingly, the amount of available literature decreases, while at the same time their relevance to answering clinical questions increases.

Conceptually there are three key questions that need to be asked:<sup>4,5,11</sup> (<http://www.cche.net/usersguides>; <http://www.cebm.utoronto.ca/teach/materials/caworksheets.htm>)



1. Are the results of the study valid?
2. What are the results?
3. Will the results help in caring for my patient?

The first question focuses your analysis on the research design, methods, and manner in which the study was conducted. It's difficult to place confidence in the results if the study was not appropriately conducted, so by answering the first question one can determine if there is bias that affects the ability to demonstrate causality and whether or not to continue reading that particular article. The second question addresses the size of the affect, while the third engages the patient in determining whether the size of this affect meets the patient's needs.

A subset of more detailed questions exists for each of the three key questions. These questions further help determine the validity, results, and applicability of the evidence. In addition to the subset of questions, most of the checklists include helpful hints as to what the questions mean. Table 1 provides an example of a Critical Appraisal Form and illustrates how it can be used to analyze a research article.

Table 1.

Table 1. Critical Appraisal Form for the Gerlach RW, Gibb RD, Sagel PA Article	
<b>A. Are the results of the trial valid?</b>	
<p><b>1. Did the trial address a clearly focused issue?</b> Hint: An issue can be 'focused' in terms of:</p> <ul style="list-style-type: none"> <li>• The population studied</li> <li>• The intervention given</li> <li>• The outcomes considered</li> </ul>	<p>Yes, a clearly focused issue was stated in both the abstract and the body of the article; to compare the efficacy of the whitening strip to 3 tray-based bleaching systems.</p>
<p><b>2. Was the assignment of patients to treatment randomized?</b></p>	<p>Yes, although it is not clear why the number assigned to using 20% carbamide peroxide is almost half the number of participants in the other 3 groups.</p>
<p><b>3. Were all the patients who entered the trial properly accounted for at the end?</b> Hint:</p> <ul style="list-style-type: none"> <li>• Was follow-up complete?</li> <li>• Were patients analyzed in the groups to which they were randomized (intention to treat analysis)?</li> </ul>	<p>Yes, although reasons for why 4 of the 36 participants were absent from the final assessment is not presented, nor is any follow-up on those 4 presented.</p>
<p><b>Is it worth continuing?</b> Although there are concerns about the potential for bias, the low number of actual participants, and the reason why four participants did not complete the 2-week trial, this randomized controlled trial (RCT) research is directly related to Mr. Logan's question.</p>	
<p><b>4. Were patients, therapists, and examiners "blinded" to treatment?</b></p>	<p>Yes, for examiners. The article doesn't state if the subjects using custom trays were blinded.</p>
<p><b>5. Were the groups similar at the start of the trial?</b> Hint:</p> <ul style="list-style-type: none"> <li>• Similar in terms of factors that might affect the outcome of the trial, e.g., severity of their disease, age, smoking status, etc.</li> <li>• Baseline prognostic factors (demographics, co-morbidity, disease severity, other confounders) balanced?</li> <li>• If different, were these adjusted for?</li> </ul>	<p>Yes, participants were healthy adult volunteers without existing sensitivity, past tooth-whitening, or restorative dentistry involving facial surfaces of anterior teeth. Source of volunteers not given. Exclusion criteria given, but not inclusion criteria.</p>
<p><b>6. Apart from the experimental treatment, were the groups otherwise treated equally?</b> Hint:</p> <ul style="list-style-type: none"> <li>• Was follow-up of the same frequency?</li> <li>• Was the only difference between groups the test intervention?</li> <li>• Co-intervention? Contamination? Compliance?</li> </ul>	<p>Yes</p>
<b>B. What are the results?</b>	
<p><b>7. How large was the treatment effect?</b> Hint:</p> <ul style="list-style-type: none"> <li>• Absolute risk reduction</li> <li>• Relative risk reduction</li> </ul>	<p>Stated in terms of yellow, brightness, composite color change, and mean unit improvement. All achieved 1 unit, but doesn't state if &gt;1 unit was achieved by any of the groups. Risk reduction not given.</p>
<p><b>8. How precise was the estimate of the treatment effect?</b> Hint:</p> <ul style="list-style-type: none"> <li>• Look for the confidence intervals</li> </ul>	<p>P value stated without Confidence Intervals. Change in yellow, brightness, and composite color given.</p>

Table 1. (continued)

C. Will the results help me in caring for my patient(s)?	
<p><b>9. Can the results be applied to my patient care?</b> Hint: Consider whether:</p> <ul style="list-style-type: none"> <li>• The patients covered by the review could be sufficiently different from your patients to cause concern.</li> <li>• The treatment is applied in such a way that it cannot reasonably be performed in your setting.</li> <li>• There is a compelling reason why the results should not be applied.</li> </ul>	<p>Although the majority of participants were women, gender does not seem to be a major concern.</p>
<p><b>10. Were all important outcomes considered?</b> Hint:</p> <ul style="list-style-type: none"> <li>• Are substitute endpoints valid?</li> </ul>	<p>Yes. Yellow, brightness, and composite color changes. Whitening strips did achieve at least the change in 1 unit.</p>
<p><b>11. Are the likely treatment benefits worth the harms and costs?</b> Hint:</p> <ul style="list-style-type: none"> <li>• Have adverse effects/costs been considered?</li> <li>• Are the numbers needed to treat (NNT) available for different outcomes?</li> <li>• If not stated, what do you think?</li> </ul>	<p>Yes, appears to be a benefit without any harm. Cost is lower than alternatives considered.</p>
D. Application of findings?	
<p><b>12. Based on the results of this study and discussion about the findings from previous studies, what are you going to recommend to your patient and why?</b></p> <p><b>Recommendation(s):</b> I would explain to Mr. Logan the research findings regarding the efficacy of the whitening strips. The research reports the strips were comparable to the 10% carbamide peroxide tray-based system. It may be easier and more cost-effective for Mr. Logan to use the whitening strips to achieve a brighter smile for his class reunion. However, if he wanted more significant improvements within the time frame of his initial office visit and his class reunion, I would recommend using a 15-20% of carbamide peroxide bleaching tray.</p> <p><b>Why:</b> The whitening strips yielded "a highly significant (<math>P &lt; 0.001</math>) improvement in color vs. baseline" and did as well as 10% carbamide peroxide. However, since the dose response increases, using a product that has 15-20% carbamide peroxide will produce even greater reduction in yellow, increased brightness, and composite color change, a response and closer to the desired result.</p> <p>(Adapted from: Guyatt, et. al. User's guide to the Medical Literature, II How to use an article about therapy JAMA 1993; 270: 2598-2601)</p>	

### Case Example

Your new patient, Mr. Jim Logan, is a 48-year old marketing executive. His chief complaint is the discoloration of his front teeth, which he feels is getting worse as he gets older. He would like them to be as white as they were when he was 25, and even brought in a picture to show you. He would like them whitened within three weeks before he attends his 30-year high school reunion. When reviewing his health history and behaviors, you learn that Mr. Logan is a coffee drinker and former smoker. Upon examination you determine his only treatment needs are preventive care and suggest that you re-evaluate the discoloration

after the appointment since the stain could be due to both intrinsic and extrinsic factors. If additional treatment is needed, you can provide vital bleaching in the office or make him custom trays for use with an at-home whitening/bleaching system.

You present the bleaching procedure options and related fees to Jim. He questions you about the differences between them and the new whitening strips that don't require a tray and can be purchased at the local grocery store. Jim insists the whitening strips are just as effective and cost considerably less.

You are not familiar with the scientific literature on the whitening strips to answer Mr. Logan's questions thoroughly. You tell him you know the bleaching procedures you have suggested are safe, effective, and produce the desired outcomes in a relatively short period of time. However, you tell him you will be glad to investigate the whitening strips option so each of you are fully informed about the pros and cons of each method before selecting a treatment. With the popularity of these treatment options and new products introduced quite frequently, this information will be a valuable addition to the evidence-based "library" you are creating in your office.

In Evidence-Based Decision Making in Action: Part 1- Finding the Best Clinical Evidence (<http://www.thejcdp.com/issue011/index.htm>), a search was conducted to identify articles to answer Mr. Logan's question. By using the PubMed 'Limit' features to find the highest level of evidence, several articles were identified. (Figure 1) However, for practical purposes, this article only will appraise one of those studies, *A Randomized Clinical Trial Comparing a Novel 5.3% Hydrogen Peroxide Whitening Strip to 10%, 15%, and 20% Carbamide Peroxide Tray-Based Bleaching Systems*, by Gerlach, Gibb, and Sagel.<sup>12</sup>

In selecting this article, you notice the publishing company says it is a peer-reviewed journal, however, no editorial review board is listed. This particular publication is a supplement that focuses on continuing dental education and states those universities who are awarding the credit have representatives that have reviewed the articles for acceptance. Also, it is clear this research study was funded and conducted by Procter & Gamble, the company that manufactures the whitening strips being tested, and the company is the sponsor of this particular issue of the journal. Despite these questionable factors, this article may directly answer Mr. Logan's question since it is the only published research you found that tests the product on an adult population and directly compares the whitening strip effectiveness with tray-bleaching systems. You recognize this is a new product on the market and the research is limited to that funded by the manufacturer. For these reasons, you decide to continue to analyze the article.

To be sure your analysis is thorough, you use a Critical Appraisal Form from an article on Therapy adapted from the *Users' Guides to the Medical Literature* as a guide in your evaluation. Table 1 is a summary of our evaluation and demonstrates the use of this form.

**Figure 1. Results of Limit to RCT, English, Human**

for Whitening Strips AND Tooth Bleaching

Limits

Limits: English, Randomized Controlled Trial, Human

Display:

Show:  Items 1-5 of 5

1: [Kugel G, Aboushale A, Zhou X, Gerlach RW](#) Related  
 Daily use of whitening strips on tetracycline-stained teeth: comparative results after 2 months.  
 Comp Dent. 2002 Jan;23(1A):29-34; quiz 50.  
 PMID: 11913291 [PubMed - indexed for MEDLINE]

2: [Donly KJ, Donly AS, Beharion L, Rojas-Candelas E, Garcia-Godoy F, Zhou X, Gerlach RW](#) Related  
 Tooth whitening in children.  
 Comp Dent. 2002 Jan;23(1A):22-8; quiz 49.  
 PMID: 11913290 [PubMed - indexed for MEDLINE]

3: [Gerlach RW, Gibb RD, Sagel PA](#) Related  
 A randomized clinical trial comparing a novel 5.3% hydrogen peroxide whitening strip to 10%, 15%, and 20% carbamide peroxide tray-based bleaching systems.  
 Comp Dent. 2000 Jun;21(29):S22-8; quiz S42-3.  
 PMID: 11908406 [PubMed - indexed for MEDLINE]

**Figure 2. Four Additional Articles Selected from PubMed to Review**

Display Summary Pub Date Save Text Clip Add Order

Show: 20 Items 1-5 of 5

- 1: [Donly KJ, Gerlach RW](#) Re  
Clinical trials on the use of whitening strips in children and adolescents.  
Gen Dent. 2002 May-Jun;50(3):242-5.  
PMID: 12116511 [PubMed - in process]
- 2: [Gerlach RW, Gbb RD, Sagel PA](#) Re  
Initial color change and color retention with a hydrogen peroxide bleaching strip.  
Am J Dent. 2002 Feb;15(1):3-7.  
PMID: 12074226 [PubMed - in process]
- 3: [Gerlach RW, Zhou X](#) Re  
Comparative clinical efficacy of two professional bleaching systems.  
Compend Contin Educ Dent. 2002 Jan;23(1A):35-41; quiz 50.  
PMID: 11913292 [PubMed - indexed for MEDLINE]
- 4: [Gerlach RW, Barker ML, Sagel PA](#) Re  
Comparative efficacy and tolerability of two direct-to-consumer tooth whitening systems  
Am J Dent. 2001 Oct;14(5):267-72.  
PMID: 11803987 [PubMed - indexed for MEDLINE]

Understanding that one research study does not constitute the full-body of evidence, you also chose to read four other research studies that tested the efficacy of whitening strips: two that studied the 6.0% hydrogen peroxide Crest? Professional Whitening Strips; one that compares the 5.3% hydrogen peroxide strip to a placebo strip; and one that used whitening strips to treat tooth discoloration on children and adolescents. These articles add to the evidence and give a broader understanding of the efficacy of whitening strips. (Figure 2)

In presenting the research findings and your conclusions to Mr. Logan, he decides to try the whitening strips. He feels it is more cost-effective and purchasing the strips on his way home means he doesn't have to take time out of his busy schedule to have custom bleaching trays made for him. He feels the whitening strips will provide the extra boost of "white" his smile needs at a fraction of the cost and at his convenience. He leaves the office grateful for the extra time you took to research his options and values the patient-centered care.

### Common Ways of Presenting Data

As you can see, the structured series of questions provides a guide for an initial appraisal of whether

the results are valid (the first key question) and if the results or potential benefits (harms) are important and applicable. Sackett et al. have identified clinically useful measures for each type of study, i.e., therapy or prevention, diagnosis, prognosis, harm/etiology, and systematic reviews.<sup>13</sup> For example, in determining the magnitude of therapy results, the control event rate (CER), the experimental event rate (EER), the absolute and relative risk reduction (ARR or RRR), and numbers needed to treat (NNT) should be reported to help the reader decide whether a treatment should be used. Unfortunately, these values are rarely reported,<sup>14</sup> although the Consolidated Standards of Reporting Trials (CONSORT) standards statement encourages reporting absolute values and NNT as clinically useful measures of treatment effect.<sup>15</sup> NNT tells us the number of patients (surfaces, periodontal pockets) that would need to be treated with the experimental treatment or intervention to achieve



one additional patient (surfaces, periodontal pockets) who has a favorable response. In *Evidence-Based Principles and Practice*, McKibbin et al. walks the reader through easy to understand examples using each of these measures and how they relate to NNT and odds ratios.<sup>10</sup> A summary of the critical analysis key questions related to each type of study is presented in Table 2, while terms used to report outcomes and their calculations are defined in a glossary at the end of this article, Appendix A.

### Practice Tips

There are several ways to incorporate an EBDM approach into a practice or curriculum, beginning with learning evidence-based principles and the skills related to formulating good clinical questions and searching for the best current evidence. Once you have found the most relevant evidence, the next step in the EBDM process is to understand what you have found. Critical appraisal checklists are especially helpful in guiding the initial review.

Evidence-based terms and how related statistics are derived are defined in the *Glossary of Evidence-Based Terms* {Appendix A}. In addition, *Sources of Evidence and Other Online Healthcare Related Resources* can be found in Table 3 in the previous issue {Part 1, of this series}.<sup>1</sup>

Just as it was suggested in Part 1, each private practice, educational program, or specific department can build an “evidence-based library” by having clinicians, staff, and/or students contribute to it. As patient problems or questions arise, these would be documented along with the PICO question, search strategy, selected citations and abstracts, and an appraisal of the literature found that assisted in addressing the problem. Faculty can reinforce the



Table 3.

Evidence Based Sources of Evidence	
PubMed- Free public version of Medline	<a href="http://pubmed.gov">http://pubmed.gov</a>
SUMSearch is a "meta-search" engine for evidence-based medicine resources.	<a href="http://SUMSearch.uthscsa.edu">http://SUMSearch.uthscsa.edu</a> University of Texas Health Science Center at San Antonio
COCHRANE COLLABORATION	<a href="http://www.cochrane.de/">http://www.cochrane.de/</a>
COCHRANE Oral Health Group Abstracts of Systematic Reviews	<a href="http://www.cochrane-oral.man.ac.uk/abstracts.htm">http://www.cochrane-oral.man.ac.uk/abstracts.htm</a>
DARE [Database of Abstracts of Reviews of Effectiveness]	<a href="http://nhscrd.york.ac.uk/darehp.htm">http://nhscrd.york.ac.uk/darehp.htm</a>
DARE listing of Dental systematic reviews	<a href="http://www.cochrane-oral.man.ac.uk/dental_systematic_reviews.htm">http://www.cochrane-oral.man.ac.uk/dental_systematic_reviews.htm</a>
Bandolier - Dental and Oral Health	<a href="http://www.jr2.ox.ac.uk/bandolier/booth/booths/dental.html">http://www.jr2.ox.ac.uk/bandolier/booth/booths/dental.html</a>
Evidence-based Dentistry Journal	<a href="http://www.naturesj.com/ebd">http://www.naturesj.com/ebd</a>
Journal of Evidence-based Dentistry	<a href="http://www.us.elsevierhealth.com/JEBDP/">http://www.us.elsevierhealth.com/JEBDP/</a>
ADA Guidelines	<a href="http://www.ada.org/prof/prac/issues/statements/index.html">http://www.ada.org/prof/prac/issues/statements/index.html</a>
National Guideline Clearinghouse	<a href="http://www.guideline.gov">http://www.guideline.gov</a>

Table 3. (continued)

<b>Evidence-based Tutorials:</b>	
Evidence Based Clinical Practice Tutorial	<a href="http://www.urmc.rochester.edu/miner/guides/ebhctut1.html">http://www.urmc.rochester.edu/miner/guides/ebhctut1.html</a>
Introduction to EBM, Duke University/UNC	<a href="http://www.hsl.unc.edu/lm/ebm/index.htm">http://www.hsl.unc.edu/lm/ebm/index.htm</a>
SUNY Health Sciences Evidence based Medicine Course from SUNY Downstate Medical Center	<a href="http://servers.medlib.hscbklyn.edu/ebm/toc.html">http://servers.medlib.hscbklyn.edu/ebm/toc.html</a>
PubMed Tutorial, National Library of Medicine	<a href="http://www.nlm.nih.gov/bsd/pubmed_tutorial/m2017.html">http://www.nlm.nih.gov/bsd/pubmed_tutorial/m2017.html</a>

<b>Research Design &amp; Statistical Terms and Concepts</b>	
Guide to Research Methods, The Evidence Pyramid	<a href="http://servers.medlib.hscbklyn.edu/ebm/2100.htm">http://servers.medlib.hscbklyn.edu/ebm/2100.htm</a>
Critical Appraisal Skills Programme (CASP)	<a href="http://www.phru.org.uk/%7Ecasp/index.htm">http://www.phru.org.uk/%7Ecasp/index.htm</a>

<b>Evidence Based Centers</b>	
Agency for Healthcare Research and Quality (AHRQ)	<a href="http://www.ahrq.gov/">http://www.ahrq.gov/</a>
Centre for Evidence-based Dentistry	<a href="http://www.ihs.ox.ac.uk/cebd/index.htm">http://www.ihs.ox.ac.uk/cebd/index.htm</a>
Centre for Evidence Based Medicine	<a href="http://cebm.jr2.ox.ac.uk/">http://cebm.jr2.ox.ac.uk/</a>
Center for Evidence Based Medicine- U. Toronto	<a href="http://www.cebm.utoronto.ca">http://www.cebm.utoronto.ca</a>
Centres for Health Evidence	<a href="http://www.cche.net">http://www.cche.net</a>
The Cochrane Collaboration	<a href="http://www.cochrane.de/">http://www.cochrane.de/</a>
Evidence-Based Informatics, HIRU at McMaster	<a href="http://hiru.mcmaster.ca/">http://hiru.mcmaster.ca/</a>
Evidence Based News, National Center for Dental Hygiene Research	<a href="http://www.usc.edu/ebnet">http://www.usc.edu/ebnet</a>

Table 3. (continued)

Databases	
<b>The Trip Database</b> , searches over 61 sites of high-quality medical information on the web.	<a href="http://www.tripdatabase.com/">http://www.tripdatabase.com/</a>
<b>CHID Combined Health Information Database</b>	<a href="http://chid.nih.gov/">http://chid.nih.gov/</a>
<b>Netting the Evidence</b> access to helpful organizations and useful learning resources	<a href="http://www.nettingtheevidence.org.uk">http://www.nettingtheevidence.org.uk</a> <a href="http://www.shef.ac.uk/~scharr/ir/netting">http://www.shef.ac.uk/~scharr/ir/netting</a>
<b>Drug Databases</b> Corey Nahman.com updated Daily	<a href="http://www.coreynahman.com/druginfopage.html">http://www.coreynahman.com/druginfopage.html</a> <a href="http://www.rxlist.com/">http://www.rxlist.com/</a> <a href="http://www.nlm.nih.gov/medlineplus/druginformation.html">http://www.nlm.nih.gov/medlineplus/druginformation.html</a>
<ul style="list-style-type: none"><li>• RxList</li><li>• MEDLINEplus Health Information</li></ul>	

development of critical appraisal by incorporating clinical problems into case studies and having students evaluate the evidence needed for their clinical decision-making.

### Conclusions

In order to appropriately appraise the literature, it is important to have a basic foundation of research methodology and an understanding of the principles of a well-grounded, valid research study. To assist with the process, tools to critically appraise papers based on the type of question have been developed by the evidence-based groups. These tools consist of a structured series of questions that help you determine the strengths and weaknesses of how a study was conducted, how the information was collected, and how useful and applicable the evidence is to the specific patient problem or question being asked. As you gain experience with the critical analysis process using an appraisal checklist, the next step is to gain a greater understanding of the type of statistical analysis needed to determine if the valid result you have found are important and, if so, are they feasible to implement with your patient.

### Appendix A: Glossary of Evidence-Based Terms

**Absolute Risk Difference:** The arithmetic difference between the rates of events in the experimental group and the control group.

**Absolute Risk Reduction (ARR):** The difference in the event rate between the control group (CER) and the experimental group (EER):  $ARR = CER - EER$ . For example, in a study investigating the use of a new treatment in remineralizing enamel surfaces, the ARR would be the absolute difference between the proportion of decalcified enamel surfaces in the control group and those in the experimental group.

**Case Control Studies:** Studies in which patients who already have a certain condition are compared with people who do not. Case control studies are less reliable than either randomized controlled trials or cohort studies. Just because there is a statistical relationship between two conditions does not mean that one condition actually caused the other.

**Case Series and Case Reports:** Consists either of collections of reports on the treatment of individual patients or reports on a single patient. Case series and case reports, since they use no control group with which to compare outcomes, have no statistical validity.

**Cochrane Collaboration:** Cochrane Collaboration is an international endeavor in which people from many different countries systematically find, appraise, and review available evidence from randomized controlled trials

(RCTs). The Cochrane Collaboration's aims are to develop and maintain systematic, up-to-date reviews of RCTs of all forms of healthcare and to make this information readily available to clinicians and other decision-makers at all levels of healthcare systems, <http://www.cochrane.org/>. The **Cochrane Oral Health Review Group** aims to produce systematic reviews that primarily include all RCTs of oral health. Oral health is broadly conceived to include the prevention, treatment, and rehabilitation of oral, dental, and craniofacial diseases and disorders, <http://www.cochrane-oral.man.ac.uk/>.

**Cohort Study:** A study in which patients who presently have a certain condition and/or receive a particular treatment are followed over time and compared with another group who are not affected by the condition under investigation. The disadvantage of cohort studies is they can take a very long time waiting for the conditions of interest to develop.

**Critical Appraisal:** The process of assessing and interpreting evidence by systematically considering its validity, results, and relevance to your own work.

**Cross-Sectional Study:** An observational study that examines a characteristic (or set of characteristics) and a health outcome in a sample of people at one point in time.

**Double Blind Study:** A double blind study is one in which neither the patient nor the physician knows whether the patient is receiving the treatment of interest or the control treatment. A double blind study is the most rigorous clinical research design because, in addition to the randomization of subjects that reduces the risk of bias, it can eliminate the placebo effect that is a further challenge to the validity of a study.

**Evidence-Based Decision Making (EBDM):** The use of current best evidence in making decisions about individual patient care. Evidence provides another dimension to the decision-making process that includes the clinical skills, judgment, and experience of the individual practitioner along with the patient's preferences.

**Evidence-Based Practice (formerly Medicine):**

The integration of best research evidence with clinical expertise and patient values. *Best research evidence* refers to clinically relevant research, especially from patient-centered clinical research. *Clinical expertise* means the ability to use clinical skills and past experience to rapidly identify each patient's unique health state and diagnosis, individual risks and benefits of potential interventions, and personal values and expectations. *Patient values* refers to the unique preferences, concerns, and expectations that each patient brings to a clinical encounter which must be integrated into clinical decisions if they are to serve the patient. (Sackett D, Straus S, Richardson W, 2000)

**Event Rate:** The proportion of patients in a group in whom the event is observed. Thus, if out of 100 patients, the event is observed in 27, the event rate is 0.27. **Control Event Rate (CER)** and **Experimental Event Rate (EER)** are used to refer to this in control and experimental groups of patients respectively.

**Gold Standard:** A method, procedure, or measurement that is widely accepted as being the best available, e.g., used with studies when measuring the reliability of a particular diagnostic measure for a disease against the accepted measure as being the best for the same disease.

**Limits [for searching]:** Broad restrictions applicable to existing search sets; limits searches to specific fields such as language, human or animal publication types (clinical trial, meta-analysis, randomized controlled trial, practice guideline, reviews), age groups, gender, type of study, publication date, a specific language, types of articles, or subsets. Limits will differ among databases.

**Literature or Narrative Reviews:** Deals with a broad range of issues on a given topic rather than answering a specific question in depth as found in a systematic review. Narrative reviews can be a subjective assessment in that the literature can be selected to support a desired conclusion.

**MeSH (Medical Subject Headings):** The thesaurus for MEDLINE, a controlled vocabulary used

as the indexing language, providing consistent terminology for concepts covered in the database.

**Numbers Needed to Treat (NNT):** The number of patients one would need to treat with the experimental treatment or intervention to achieve one additional patient who has a favorable response or outcome. For example, if a drug has an NNT of 15, it means 15 people would need to be treated with the drug to prevent one additional bad outcome. **NNT** is calculated as  $100/\text{absolute difference}$ ,  $\text{NNT} = 1/\text{ARR}$ .

**MEDLINE:** Produced by the U.S. National Library of Medicine, the MEDLINE database is widely recognized as the premier source for bibliographic and abstract coverage of biomedical literature. MEDLINE encompasses information from Index Medicus, Index to Dental Literature, and International Nursing, as well as other sources of coverage in the areas of allied health, biological and physical sciences, humanities, and information science as they relate to medicine and healthcare, communication disorders, population biology, and reproductive biology. More than 12 million records from more than 4,600 journals are indexed, plus selected monographs of congresses and symposia (1976-1981). Abstracts are included for about 67% of the records. [http://www.ovid.com/documentation/user/field\\_guide/](http://www.ovid.com/documentation/user/field_guide/)

**Meta-analysis:** A statistical process commonly used with systematic reviews. It involves combining the statistical analyses and summarizing the results of several individual studies into one analysis. When data from multiple studies are pooled, the sample size and power usually increase.

**Odds:** A ratio of events to non-events. If the event rate for a disease is 0.1 (10%), its non-event rate is 0.9 and, therefore, its odds are 1:9, or 0.111.

**Odds Ratio:** Describes the odds of an experimental patient suffering an adverse event relative to a control patient. To calculate the odds ratio, you need to know the odds for disease in each group. Odds are derived by dividing the event rate by the non-event rate for each group:  
**OR = (EER/(1-EER)) / (CER/(1-CER))**

**PICO:** systematic process for converting information needs/problems into questions so they

can be answered. A “well-built” question includes four parts that identify the patient problem or population (P), intervention (I), comparison (C), and outcome(s) (O), referred to as PICO, <http://cebm.jr2.ox.ac.uk/docs/focusquest.html>.

**PubMed:** PubMed was developed by the National Center for Biotechnology Information (NCBI) at the National Library of Medicine (NLM), located at the National Institutes of Health (NIH). It was developed in conjunction with publishers of biomedical literature as a search tool for accessing literature citations and linking to full-text journals at web sites of participating publishers. <http://www.ncbi.nlm.nih.gov/PubMed/>

**Randomized Controlled Trial (RCT):** A trial in which subjects are randomly assigned to two groups: one (the experimental group) receiving the intervention being tested and the other (the comparison group or controls) receiving an alternative treatment. The two groups are then followed up to see if any differences between them result.

**Relative Risk Difference:** The proportional difference between the rates of events in the experimental group and the control group, taking into account the control group rate. Relative differences are always bigger than absolute differences and often tend to inflate perceptions of what the results of the study truly are. The RRD is calculated by dividing the absolute difference by the control rate,  $(\text{experimental rate} - \text{control rate}) / \text{control rate}$ .

**Relative Risk Reduction (RRR):** The percent reduction in events in the treated group event rate (EER) compared to the control group event rate (CER):  $\text{RRR} = (\text{CER} - \text{EER}) / \text{CER} * 100$ .

**Risk Ratio:** The ratio of risk in the treated group (EER) to the risk in the control group (CER): **RR = EER/CER**. RR is used in randomized trials and cohort studies.

**Sensitivity:** Proportion of all the documents that are relevant that your search manages to find or the likelihood of retrieving relevant items (precision). Increase sensitivity if not retrieving enough by broadening the question, use “OR” with synonyms and related concepts. Find more search terms from relevant records

using truncation, relevant items. Sensitivity of a diagnostic test refers to the proportion of truly diseased persons, as measured by the gold standard, who are identified as diseased by the test under study, <http://cebm.jr2.ox.ac.uk/docs/searching.html#senspec>

**Specificity:** Likelihood of excluding irrelevant items. Increase specificity if retrieving too much by narrowing the question and using more specific terms. Specificity of a diagnostic test refers to the proportion of truly non-diseased persons, as measured by the gold standard, who are so identified by the diagnostic test under study, <http://cebm.jr2.ox.ac.uk/docs/searching.html#senspec>

	Disease Positive	Disease Negative
Test Positive	a	b
Test Negative	c	d

**Sensitivity:** The proportion of people with disease who have a positive test.  
Sensitivity =  $a/(a+c)$

**Specificity:** The proportion of people free of a disease who have a negative test.  
Specificity =  $d/(b+d)$

**Likelihood Ratio:** The likelihood a given test result would be expected in a patient with the target disorder compared to the likelihood the same result would be expected in a patient without that disorder.

$$LR+ = \text{Sensitivity}/(1-\text{specificity}) = [a/(a+c)] / b/(b+d)$$

$$LR- = (1 - \text{sensitivity}) / \text{specificity} = [c / (a+c)] / [d/(b+d)]$$

**Positive Predictive Value (+PV):** The proportion of people with a positive test who have the target disorder =  $a/(a + b)$

**Negative Predictive Value (-PV):** The proportion of people with a negative test who do not have the target disorder =  $d/(c + d)$

**Systematic Reviews:** Considered the gold standard for evidence, these reviews provide a summary of individual research studies that have investigated the same phenomenon or question. This scientific technique uses explicit criteria for retrieval, assessment, and synthesis of evidence from individual RCTs and other well-controlled methods. Systematic reviews provide a way of managing large quantities of information.

**Validity:** Validity refers to the soundness or rigor of a study. A study is valid if the way it is designed and carried out means the results are unbiased; that is, it gives you a 'true' estimate of clinical effectiveness.

**Definitions Compiled from Several Sources:** Sackett D, Straus S, Richardson W. Evidence-Based Medicine: How to Practice & Teach EBM. 2000; London, England: Churchill Livingstone.

CEBM, Evidence-Based Medicine Glossary, <http://cebm.jr2.ox.ac.uk/docs/glossary.html>

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