

Evidence in Exotic Animal Practice: A “How-To Guide”

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Abstract

Evidence-based veterinary medicine is a process used to guide clinical decision making, thereby allowing veterinarians to find, appraise, and integrate current best evidence with individual clinical expertise, client wishes, and patient needs. Although the concept of using research evidence to guide clinical decisions is not new, a structured approach to integrating these aspects of veterinary practice opens the door to allow the overwhelming amount of available published evidence to flow into the veterinary examination room. The goal of this article is to demystify evidence-based veterinary medicine and explain how the techniques are used in exotic animal practice. Copyright 2009 Elsevier Inc. All rights reserved.

Key words: amphibian; avian; evidence-based veterinary medicine; exotic animal; exotic companion mammal; reptile

Evidence-based veterinary medicine (EBVM) is a tool for practitioners that was introduced through a medical article published in 1992 describing a process that guides clinical decisions by de-emphasizing intuition, unsystematically recorded clinical experiences, and pathophysiological rationale.¹ At first glance this may seem to devalue a clinician's expertise and reasoning, but “evidence-based medicine (EBM) requires the integration of the best research evidence with our clinical expertise and our patient's unique values and circumstances.”² Veterinarians have modified the definition slightly because animal patients cannot communicate their values to us: “EBVM is a process of clinical decision-making that allows veterinarians to find, appraise, and integrate current best evidence with individual clinical expertise, clients' wishes, and patients' needs.”³ Some authors suggest it is simply the repackaging and marketing of the same medicine veterinarians have always practiced.⁴ It is quite useful, however, because it is a systematic, well-defined set of guidelines that help formulate clinical decisions. It is an effort to recognize the science of medicine while honoring

the art. The fundamental premise of EBVM recognizes that veterinarians are subject to an array of influences (biases) on our clinical decisions. Consequently, a protocol for describing exactly what evidence we use to guide our decisions is reassuring and more likely to give confidence in our medical decisions and/or to be defensible in a court of law. When we question the reliability of the source of our knowledge, we create an opportunity to quantify these sources of evidence. The “conscientious, judicious, explicit” application of clinical research evi-

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dence is directed toward avoiding harm while providing the best possible treatment to the patient.⁵

In practical terms, research evidence is increasing at such a rapid pace that no one is able to remain current in all disciplines for every companion exotic animal species. Therefore, it is inappropriate to tell a client that “nobody knows anything” about a specific disease or treatment in an exotic companion animal patient until after a thorough literature search has been performed on the subject. It is likely that an article, possibly from a nonscientific source, has been published on most of the diseases and treatments of companion birds, reptiles, and exotic mammals. The challenge is locating and assessing the publications before making a clinical decision. Many articles are published in languages other than English, and numerous publications are either out of print, not listed by familiar Internet search engines, or found within the recesses of university library shelves. In addition, an overwhelming quantity of scientific information is published in biological or human medical journals instead of the veterinary literature. It is difficult enough for veterinarians to read the current veterinary information; therefore, if articles are published elsewhere, the likelihood of reaching practicing veterinarians is remote. In short, it is rarely a true lack of evidence that precludes exotic animal veterinarians from practicing EBM; rather, it is a perceived lack of readily accessible, clinically applicable scientific evidence. The goal of this article is to help lower the barriers in obtaining, assessing, and applying the best-available evidence in clinical exotic animal practice.

Evidence-based Veterinary Medicine in Exotic Animal Practice

Veterinary practitioners may believe that there is not enough time to search for science-based veterinary medical information while managing cases, but these perceptions often change after experiencing the effect this new-found knowledge has on treatment response by the patient.⁶ Veterinarians who regularly practice problem-oriented medicine are well prepared to begin practicing EBVM because of the development of succinct case-based questions. For EBVM to be applied to exotic animal practice, it is simply a matter of learning how to efficiently find and assess information. The process starts by composing a focused clinical question, as one does through the problem-oriented approach, then answering that medical uncertainty through the use of critically appraising evidence. Once the best-available science-based research evidence is learned, the information is inte-

grated with clinical expertise, client wishes, and patient needs to determine a treatment plan for disease resolution, if possible. The crucial step comes later, after the case outcome has been determined. This final step of EBVM calls on clinicians to honestly evaluate their effectiveness and efficiency to incorporate published scientific information in the decision-making process on each case. This crucial step in the EBVM process takes place after the case outcome has been determined to improve one’s veterinary medical expertise. Self-directed criticism is difficult to accept for many veterinarians, but it can be rewarding when a retrospective review of similar case presentations is compared with current practice methods using EBVM. Self-improvement is gratifying and can motivate continued dedication to EBVM. Figure 1 depicts the steps in the process of evidence-based practice.⁷

Step 1: Asking a Focused Clinical Question

“Ignorance may not be bliss, but it is the beginning of all learning.”

—Richard Smith, Editor of British Medical Journal

“I don’t know” are the three most important words in medicine.⁸ EBVM begins with learning to recognize what information is needed but not yet known. This recognition creates an opportunity to state a focused clinical question (Fig 1).^{2,9,10} Many veterinarians fill an information gap with an educated guess, but such guesswork is likely to be

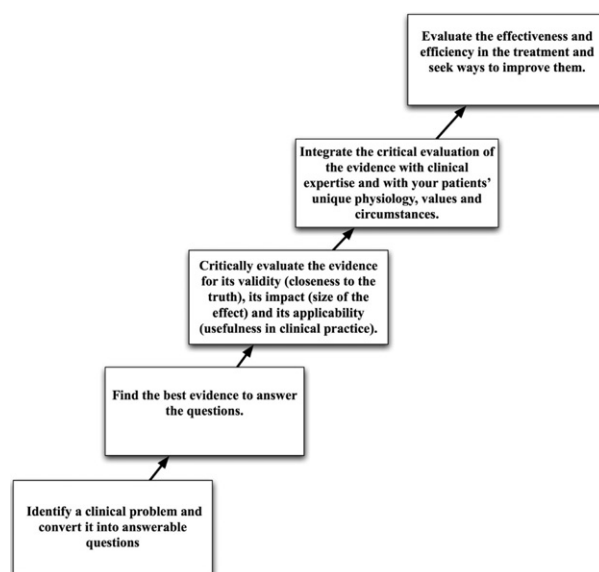


Figure 1. Evidence-based veterinary medicine: 5 simple steps to evaluate and improve one’s level of medicine.

suspect; therefore, it is better to state a need for information and begin an earnest search. A focused clinical question can be introduced into problem-oriented veterinary medicine at several points in the patient evaluation process and incorporates specific case information such as species, age, sex, and environmental (husbandry) parameters. Questions about background information on species' normal anatomy, physiology, pharmacology, pathology, natural history, or husbandry are identified during information gathering and problem assessment, including background questions (e.g., (1): What are normal complete blood count parameters of an adult, female, recently wild-caught *Corytophanes cristatus*?, (2) What are the thermal needs of a hatchling *C. cristatus*?).

Initial questions to research through EBVM arise from clinical findings, etiology, manifestations of disease, differential diagnoses, diagnostic tests (e.g., sensitivity, specificity, prevalence), therapy (e.g., dosage, safety, effectiveness), prevention, and how long a specific patient is likely to survive with or without treatment. Each question should specify: (1) the specific patient or problem; (2) the intervention; (3) the control group (e.g., one drug vs another drug vs doing nothing); and (4) the clinical outcome of a case.¹¹ A focused question asked after the initial patient assessment might be written thus, "In an adult, recently wild-caught *Corytophanes cristatus* with fungus-associated increased respiratory effort, would administration of amphotericin B in the ventral caudal vein reduce morbidity or mortality enough to be worth amphotericin B's inconveniences and potentially harmful effects?" Take time to write down the questions in a systematic manner that arise at each point during case management, and write yourself a reminder to search for published evidence at an opportune time.²

Step 2: Finding Evidence to Answer the Question

"Half of what you are taught as medical students will in 10 years have been shown to be wrong. And the trouble is, none of your teachers knows which half."

—Sydney Burwell, Dean of Harvard Medical School

Background questions about species normal anatomy, physiology, pharmacology, pathology, natural history, or husbandry can often be addressed with textbooks and narrative review articles such as those published in the *Journal of Exotic Pet Medicine* or *Veterinary Clinics of North America Exotic Animal Prac-*

tice. The *Journal of Avian Medicine and Surgery* and the *Journal of Herpetological Medicine and Surgery* should also be searched for birds, reptiles, and/or amphibians, respectively. In addition, natural history information is located in biological journals or textbooks for unusual species or to supplement information that is not peer reviewed.

The key to finding research evidence is to input terminology from the focused clinical question to an Internet-based search engine. Google Scholar (<http://scholar.google.com>), Web of Knowledge (<http://www.isiwebofknowledge.com>), PubMed (<http://www.ncbi.nlm.nih.gov/pubmed>), BioONE (<http://www.bioone.org>), Veterinary Information Network (<http://www.vin.com>), and the International Veterinary Information Service (<http://www.ivis.org>) are all useful search engines with various methods of access to full-text articles for practitioners. Search strategies to find veterinary research evidence have been described.^{10,12} Visit the Evidence-Based Veterinary Medical Association website (<http://www.ebvma.org>) and the Centre for Evidence-Based Medicine website (<http://www.cebm.net>) for ideas and guidance on locating the desired referenced information. One can locate other articles within this issue of the *Journal of Exotic Pet Medicine* for detailed descriptions on how other authors recommend information searches. In general, if too few articles are found with very specific search terms, then the use of broader terms is required (e.g., if the term "iguana" produces few results, try the term "lizard" or "reptile"). Some search engines also use "wildcard" characters such as an asterisk, so the search term "reptil*" would be more inclusive than "reptile" because it would also search for "reptiles" and "reptilian." Search term input is usually a process of trial and error to find just the right combination of words to retrieve a manageable list of relevant articles. Veterinarians who treat exotic animal species can improve the speed and ease of access to research evidence by taking time to learn effective search strategies by reading the cited sources,^{10,12} attending EBVM workshops, and experiencing the retrieval of information.

Step 3: Appraising the Available Evidence

Many authors rank the validity and value of scientifically substantiated information as evidence of an evidence hierarchy (Fig 2).^{2,13,14} This structural ranking is only useful in general terms, because no meta-analysis has been published for exotic animal medicine and few review articles approach the criteria as a "systematic" review. Instead, almost all exotic animal medicine review articles are "narrative," citing

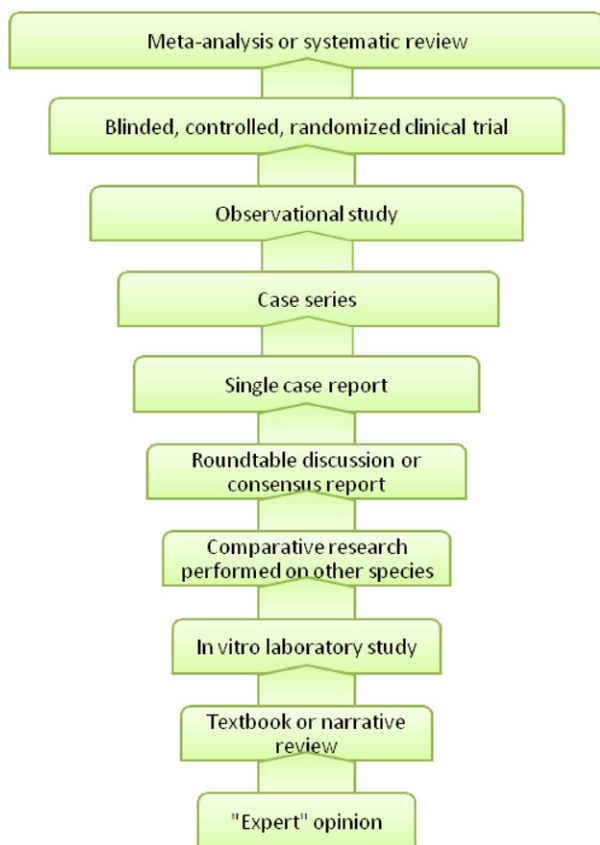


Figure 2. Hierarchy ladder of the relative value and validity of the different forms of evidence that may be used to influence veterinary clinical decisions. Evidence is most compelling at the top of the ladder and lessens progressively toward the bottom.

published literature in support of the authors' opinions. So, rather than relying on a "hierarchy," it is more useful to evaluate each piece of evidence on its own scientific merit. Science is a search for truth and knowledge that recognizes natural human tendencies.¹⁵ People naturally tend to use rhetoric (persuasive language) to support strongly held opinions, therefore it is essential to assess sources of information for bias, random chance, and false assumptions of knowledge. Bias is often noted in scientific articles because of an author's tendency to remember events that support investigative assumptions while disregarding events that may refute the hypothesis. The best evidence clearly states the probability that it is correct (i.e., not due to random chance) and does not imply absolutism. Many firmly established principles have been refuted by scientific research, so it is important to remain open minded about the veracity of human "knowledge" (e.g., *Helicobacter pylori* was eventually proven to be a contributing factor in human gastric ulcers after decades of strong consensus that infection was not a component of the disease process).

Guidelines for assessment of evidence have been published and should be used to guide the process.^{11,15} These guidelines are useful in exotic animal medicine, but it is important to also keep taxonomic relationships¹⁶ in mind because research on a more closely related species is more compelling than that performed on a distantly related species. As an example, if the case in question is a Bearded Dragon (*Pogona vitticeps*), then pathophysiological evidence from other species is most reliable in the following descending order: (1) green iguana (*Iguana iguana*), (2) kingsnake (*Lampropeltis getula*), (3) leopard gecko (*Eublepharis macularius*), (4) leopard frog (*Rana pipiens*), (5) domestic chicken (*Gallus domesticus*), and (6) guinea pig (*Cavia porcellus*). Keep in mind that no source of evidence is perfect, and the practice of EBVM relies on evidence that is "best available." One must read the entire article because abstracts frequently contain information that is inconsistent with or absent from the article.¹⁷ Always read the methods first, because if the research methods are not valid, then the information in the article is not worth using for case evaluation. Learn about statistical methodology and how tests are used to state the probability and that all results are verified. By reading the results section second, it allows the veterinarian to draw their own conclusions about the information rather than relying on an author's interpretation, which may be biased. The discussion section should evaluate the data generated against that found in other similar studies. This section is valuable because it raises new questions about the topic of investigation by comparing previous work with the new information. One should always critically analyze an author's conclusions because they may not be supported by the actual results.

A critically appraised topic (CAT) is an excellent way to record the effort invested in finding and appraising available scientific evidence.² This standardized report can be filed for future in-house reference, shared with colleagues, or published either in a journal or on an association website.^{18,19} The Cochrane Collaboration Cochrane Reviews (<http://www.cochrane.org/reviews>) is one source of CAT for the human medical profession and serves as a template veterinarians may want to use. The Association of Avian Veterinarians (<http://www.aav.org>), Association of Exotic Animal Veterinarians (<http://www.aemv.org>), and the Association of Reptilian and Amphibian Veterinarians (<http://www.arav.org>) would all benefit by hosting databases of CAT. General guidelines for a standardized CAT include a statement of the clinical presentation, the specific clinical question, the literature citation, a 2-line summary of

Table 1. Sources of evidence available to veterinarians who practice exotic animal medicine, rated according to how relevant the information is to a clinical case, how scientifically valid a source is likely to be, and how easy a source is for a practitioner to access. These ratings are totaled to obtain an “overall usefulness score”

Information Source	Relevance to Case	Scientific Validity	Ease of Access	Overall Usefulness
Reference textbooks	3	1	3	7
E-B drug formulary	3	1	3	7
Online E-B journal articles	2	3	1	6
Filed E-B journal articles	1	3	2	6
Consensus statements & roundtables	2	2	2	6
Consultation with an “expert”	2	1	3	6
Narrative review articles	3	1	2	6
Library E-B journal articles	2	3	0	5
Continuing education seminars	2	1	2	5
General Internet search	2	0	3	5
Unsystematic journal articles	2	0	2	4
Drug company representative	2	0	2	4

Abbreviation: E-B, evidence based.

the study methods, a brief table or summary of the results, the name of the person who did the appraisal, and the date the appraisal was performed.² This can be structured into a form that is used for all CATs, which simplifies referring back to them on future cases.

Step 4: Integrating the Best-available Evidence

“There are some patients that we cannot help; there are none we cannot harm.”

—Arthur L. Bloomfield, 1888-1962, Professor of Medicine, Stanford University School of Medicine

Now that the focused clinical question has been answered by evidence that is known to be the best available, it can be applied to the case for which it was gathered. This evidence can influence interpretation of clinical signs, the understanding of pathophysiology, selection and interpretation of diagnostic tests, treatment options, surgical intervention, prognosis, and client education information. The evidence should be integrated with the client’s wishes, the specific patient’s needs, and the expertise and judgment of the attending veterinarian (Fig 3). It is very easy to focus on only one of these components during case management and to shift attention away from the important aspects of case management. For instance, an academician might prioritize

research evidence, whereas practitioners may concentrate on personal clinical expertise. Alternatively, the “animal lover” may focus primarily on the emotional value of the pet, often without taking clinical experience or research evidence into consideration. For example, if a rabbit has been diagnosed with a

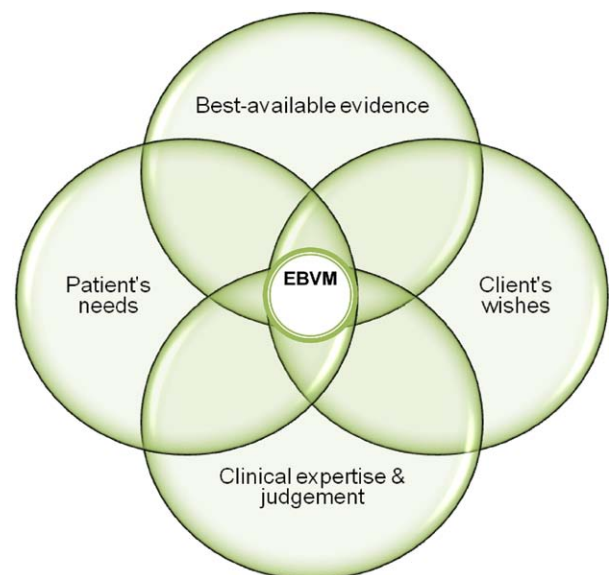


Figure 3. Evidence-based veterinary medical decisions integrate the best-available clinical research evidence; client preferences, values, or beliefs; individual patient circumstances and needs; and the clinical judgment and expertise of the attending veterinarian.

thymoma and the owner is not able or willing to choose the best-available treatment (e.g., surgery, chemotherapy, radiation treatment), it could be considered inappropriate to withhold oral steroid therapy in an attempt to provide short-term relief in the face of potential side effects. If the rabbit experiences an improved quality of life, as might reasonably be expected with corticosteroid therapy, then this treatment should be offered, knowing what its effect will have on the patient and the underlying disease process. Therefore, while attempting to keep a balance between the pillars of EBM, it is important to remain flexible. It would not serve the patient to withhold an alternative, less successful, or less researched treatment, but it is important to educate the owners about side effects or a less favorable prognosis when choosing among the various less substantiated therapeutic options. Focusing on only one of the components of EBVM rather than considering them equally is unlikely to bring about a successful clinical outcome.

Consider the individual patient's needs and circumstances. Veterinary intervention may completely resolve some disease and physical problems but not others. Many patients have multiple problems; as a result, even the best-available treatment for one disease condition might not improve the patient's quality or length of life. Referral to discipline specialists, such as surgeons or oncologists, is ideal, but most of these specialists lack background knowledge about exotic animal species. Consequently, a veterinarian with species-specific expertise may need to work as a team with a discipline specialist to bring about a successful case outcome.

Step 5: Evaluating Success

Using the information gathered through EBVM to evaluate a patient's response to therapeutic measures is a powerful learning tool. Veterinary practitioners seek to satisfy the needs of clients and bring about excellent quality of life and health care for their patients. Motivation to improve one's clinical ability arises when patient health care diminishes and owners are not satisfied. The motivation to improve one's veterinary medical skills can be a driving force to keep systematic case records of results in an effort to improve the outcome of similar presentations in the future. Self-evaluation requires specific questions to be asked of oneself, and is based on how well the first 4 steps of EBVM are being used: (1) "Am I writing down my clinical questions?", (2) "Are my questions focused and well formulated?", (3) "Am I searching for answers?", (4) "Am I able to find

useful evidence to answer my questions?", (5) "Is critical appraisal becoming easier for me?", (6) "Am I writing summaries of my critical appraisals?", (7) "Am I making the best use of clinical expertise by referring cases or working together with discipline specialists?" Recognizing a deficiency in the EBVM process creates the motivation to focus on doing better when treating future cases. Clinical effectiveness can improve by identifying evidence that affects patient care and improves the outcome of therapy. Efficiency can improve by using time management techniques that allow "down time" to be used for case-based learning and recording what was learned.

Conclusion

It is true that rigorous research evidence is more limited in exotic companion animal medicine than in other fields; however, the body of evidence is expanding daily, requiring the exotic animal practitioner to regularly seek out new evidence through the myriad of information sources available. Veterinary clinicians already feel overwhelmed by the daily tasks of balancing personal life with all aspects of working in practice; therefore, learning the skills necessary to keep up with new evidence requires motivation. Even though much of the newly published literature may not apply to the case at hand, look for any helpful information that may relate to the patient's condition. The expertise required to search, assess, and integrate new information rapidly improves with practice, and the evidence-based clinical practice learning becomes more rewarding over time. Application of new scientifically validated information and observing practical benefits is gratifying, while discussing new information collected from these cases with colleagues is enriching. Ultimately, it will become beneficial to use experts and specialists when interpreting new evidence, rather than simply serving as sources of secondhand information. Exotic animal veterinarians who rely on their own ability to identify personal knowledge gaps, find information, assess its validity, and integrate it together with clinical judgment and expertise, client wishes, and individual patient needs can feel tremendous satisfaction knowing they have done their best to relieve animal suffering while supporting the human-animal bond and, above all, avoiding harm.

References

1. Evidence-based Medicine Working Group: Evidence-based medicine. A new approach to teaching the

- practice of medicine. *J Am Med Assoc* 268:2420-2425, 1992
2. Straus SE, Richardson WS, Glasziou P, et al: Evidence-Based Medicine: How to Practice and Teach EBM (ed 3). Philadelphia, Elsevier, 2005
 3. Schmidt PL: Preface. *Vet Clin North Am (Small Anim Pract)* 37:xi-xii, 2007
 4. Pion PD: Using internet resources for making evidence-based treatment decisions. American College of Veterinary Internal Medicine Forum Proceedings, 2002
 5. Sackett DL, Straus SE, Richardson WS, et al: Evidence-based Medicine: How to Practice and Teach EBM (ed 2). Edinburgh, Churchill Livingstone, 2000
 6. Magrabi F, Westbrook JI, Coiera EW: What factors are associated with the integration of evidence retrieval technology into routine general practice settings? *Int J Med Inform* 76:701-709, 2007
 7. Albert E: Lecture Notes: Evidence Based Practice. Tasmania, Australia, University of Tasmania Hobart, 2001
 8. Smith R: Thoughts for new medical students at a new medical school. *BMJ* 327:1430-1433, 2003
 9. Robertson SR: Refining the clinical question: the first step in evidence-based veterinary medicine. *Vet Clin North Am (Small Anim Pract)* 37:419-431, 2007
 10. Cockcroft PD, Holmes MA: Handbook of Evidence-based Veterinary Medicine. Malden, MA, Blackwell Publishing, Inc., 2003
 11. Kastelic JP: Critical evaluation of scientific articles and other sources of information: an introduction to evidence-based veterinary medicine. *Therio* 66:534-542, 2006
 12. Murphy SA: Searching for veterinary evidence: strategies and resources for locating clinical research. *Vet Clin North Am (Small Anim Pract)* 37:433-445, 2007
 13. Schmidt PL: Evidence-based veterinary medicine: evolution, revolution, or repackaging of veterinary practice? *Vet Clin North Am (Small Anim Pract)* 37:409-417, 2007
 14. Sutter MC: The ranking and reliability of evidence. *B C Med J* 48:16-19, 2006
 15. Holmes MA: Evaluation of the evidence. *Vet Clin North Am (Small Anim Pract)* 37:447-462, 2007
 16. Fry BG, Vidal N, Norman JA, et al: Early evolution of the venom system in lizards and snakes. *Nature* 439:584-588, 2006
 17. Pitkin RM, Branagan MA, Burmeister LF: Accuracy of data in abstracts of published research articles. *J Am Med Assoc* 281:1110-1111, 1999
 18. Rosser W: Bringing important research evidence into practice: Canadian developments. *Fam Pract* 25(Suppl 1):i38-i43, 2008
 19. Bigby M: Evidence-based dermatology section welcomes a new feature: critically appraised topic. *Arch Dermatol* 143:1185-1186, 2007