EDUCATION

Teaching and learning evidence based medicine skills in accident and emergency medicine

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It seems likely that the earlier application of the findings of high quality research may have reduced mortality and morbidity (a commonly cited example is the delay in implementing thrombolysis for acute myocardial infarction).¹ Evidence based practice seeks to improve the process and outcome of care by using high quality evidence *together with* clinical expertise and patient values and preferences.²

The purpose of this paper is to suggest a curriculum that is suitable for accident and emergency (A&E) medicine, and ways to teach, learn, and assess the skills of evidence based medicine (EBM). The following areas are discussed:

- What is the EBM process?
- Why are EBM skills necessary?
- What should be learned?
- How should this be taught?
- How should this be assessed?

What is EBM and why do we need to be able to practise it?

One needs an understanding of the processes involved in the practice of EBM before planning a curriculum to teach it. EBM is "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients".² Its practice creates a need for clinically important information and thus requires clinicians to perform a number of actions (box 1).

Box 1: The process of EBM

1. Convert information needs into answerable questions.
2. Track down with maximum efficiency, the best evidence with which to answer questions (whether from the clinical examination, the diagnostic laboratory, from research evidence, or other sources).
3. Critically appraise that evidence for its validity (closeness to the truth) and usefulness (clinical applicability).
4. Integrate this appraisal with clinical expertise and apply the result in clinical practice.
5. Evaluate one's performance.

The successful application of the principles of EBM entails all these steps; they are interde-

pendent. A&E doctors are familiar with the Advanced Life Support "chain of survival" in which the weakest link governs the strength of the system. In the same way, a weakness in any one of these steps will detract from the overall result.

There are two main aims in providing these skills. The first is to improve the clinical care (and thus the clinical outcomes) of individual patients. The second, relevant to some senior staff whose decisions affect the care received by populations rather than individuals, is to improve health services planning and the use of resources.³ Many of the skills needed to practise EBM are also needed for effective continuing medical education and for independent practice. Their acquisition may improve future learning in other areas.

What EBM skills do A&E doctors need?

Being able to appraise literature critically is a prerequisite for the practice of EBM. Alone, though, this skill is not sufficient. It should be stressed that other skills are needed. The skills needed for the practice of EBM are listed in the appendix.

FORMULATING QUESTIONS

Researchers can waste time and other resources if the aims of their research are not clearly determined at the outset. As a parallel, time can be wasted searching literature if a question is not formulated with sufficient clarity. Shortage of time is a commonly cited barrier to the practice of EBM. Making a question as specific as possible helps to reduce the time taken for the search and limits the yield of irrelevant information. Answers to the "wrong" question are unlikely to be helpful to either clinician or patient.

SEARCHING FOR ANSWERS

If one is unable to find research evidence that is relevant to a particular problem the skills of critical appraisal are of no value. Not only must clinicians be proficient at searching using MEDLINE, they should also be aware that this has limitations and that there are additional sources of evidence.

APPRAISING THE "ANSWERS"

The independent practice of consultants cannot be guided by research evidence if they do

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not have the skills to critically appraise published papers.

IMPLEMENTING FINDINGS (WHEN APPROPRIATE) AND EVALUATING THE EFFECTS OF THIS

Acting on the results of an “answer” will often require change. Though the management of change is a skill that is vital to successful management, it is beyond the scope of this report to consider if and how this should be taught in A&E medicine. The ability to evaluate the process and the outcome of care is also essential.

Teaching EBM

Work is needed to establish the best way(s) to teach and learn each part of the curriculum. The acronym CRISIS has been suggested as a way of remembering the characteristics of successful continuing medical education⁴:

- Convenient.
- Relevant.
- Individualised.
- Self assessed.
- Interesting.
- Speculative and systematic.

If one is hoping to cultivate the attitude that lifelong learning is both normal and helpful, it seems prudent to ensure that the teaching of EBM satisfies these criteria.

The most convenient way of learning about EBM is “on the job”. This requires facilities that may not yet be present in every A&E department (particularly the facility to perform electronic searches 24 hours a day). The smaller the distinction between clinical practice and the learning of EBM the better; this will enhance relevance. Ways to achieve this include seniors ensuring that when they are asked questions they are phrased in the three or four part format of EBM (these could then be turned into “educational prescriptions”⁵ if the need for an answer is not clinically urgent), or integrating the assessment of trainees’ ability to elicit a specific clinical sign with a discussion of the value of that sign in making or excluding a diagnosis.

Other ways of increasing the relevance of EBM include:

- Emphasising to the learner the clinical uses to which they may put the knowledge or skills acquired. A particularly powerful tool is using the results of a learner’s question, search, and appraisal as the basis for clinical management.
- Establishing which skills or knowledge a trainee has and which they lack (doing this will also contribute towards the goal of self assessment). Unintentional duplication of previous teaching should be avoided as should the omission of important areas. Individualising the teaching and learning in this way is valuable in its own right.
- Using clinical topics as a basis for EBM teaching that the learner(s) have identified as high priority or ones that are⁶:

1. Frequent, important, or serious illnesses amenable to medical care.
2. Conditions for which management methods have recently improved.

3. Conditions where education can improve previously poor management.

Didactic teaching in lectures is often inefficient and demotivating (for teacher and learner alike!). When this format is used this should be coupled with opportunities for both teachers and learners to ask questions and to gain “feedback”. Much could be replaced by required reading, relevant to each part of the curriculum, coupled with tutorials to allow learners as well as teachers to check that important ideas have been understood.

Groups must be sufficiently small that discussions are relevant to and of interest to all members, that all members can actively participate, and that they do not become mini-lectures. Active participation is a more interesting and more effective way to learn than being a passive recipient of teaching.

An element of speculation can be achieved by asking learners (and teachers) how they would manage a particular problem before answers are sought. Discovering one’s instincts are not always correct may provide some motivation to practise in an evidence based way. Although not strictly part of the process of EBM, motivated learners may use questions for which a valid answer cannot be located as a springboard to discussing the design of original research. If the topic is of sufficient importance and the study feasible primary research may be stimulated.

A curriculum helps learners and teachers to be systematic. Without one it is difficult to ensure that all important EBM skills and knowledge will be acquired. The same curriculum should be used for learning and for assessment (otherwise learners will concentrate on the one upon which assessment is based). The schedule for learning should ensure that all “core” knowledge is gained within the first year with other knowledge being added through the remainder of higher training.

“Provided” exercises and “personal” exercises (questions based on clinical scenarios) provide opportunities for trying out the EBM approach:

- Formulating questions.
- Conducting literature searches.
- Appraising papers.

The difference between the two is that in a “provided” exercise the clinical problem is provided by the teacher and in a “personal” exercise by the learner (from their clinical experience). The former (which can be tackled by more than one learner at a time) will provide an opportunity to compare learners. The latter, which would be generated from the experiences of individual learners, maximises the relevance, interest, and individuality of the learning. “Provided” exercises should cover an area in which a diligent search will generate at least one relevant article from a mainstream journal (the expense and inconvenience of interlibrary loans is a hurdle to avoid whenever possible). Debate may be particularly lively if there are papers giving conflicting answers. An example of a provided exercise is given in box 2.

Box 2: Example of a provided exercise

A 24 year old is brought to A&E "breathless", disorientated, and uncooperative. An observant medical student notes a smell of ketones. Laboratory investigations confirm the diagnosis of diabetic ketoacidosis with a venous bicarbonate of 4 mmol/l. You start treatment with fluid and insulin but the physician to whom you refer the patient is scathing about your failure to administer intravenous sodium bicarbonate. The diabetologist in the hospital where you were house physician taught you that bicarbonate was not needed and you have followed her advice subsequently. Should you change your practice?

Running a journal club in an evidence based way⁵ is useful way of practising EBM skills. It can be highly relevant if the problems considered are important to learners and if the conclusions reached are seen to influence practice.

Assessing competence

The importance of informal appraisal has been stressed elsewhere.⁷ Assessment methods should be valid, reliable, and practicable. The ideal would be to assess trainees using EBM skills in "real time" to deal with genuine problems (that is, to assess performance rather than competence). This may prove very difficult to achieve. There may be no alternative but to assess learners' competence in other circumstances (though these should minimise artificiality).

Provided and personal exercises could be used for assessment as well as for teaching. It would probably be more realistic to require these to be conducted and submitted before the FFAEM examination, to allow access to electronic databases and journals. The current "topic review" element of the examination could also be used to assess trainees' ability to perform a literature search and to appraise the papers identified. The literature appraisal element of the examination should endeavour to be as objective and consistent as possible. To this end it may be necessary to include only methodologically perfect papers or those that have one or more "fatal flaws"; people argue about the importance of minor methodological shortcomings. This part of the examination would be less abstract if built upon a clinical scenario. Similar exercises could form part of the annual assessment of specialist registrars. If an examination is thought necessary this could be of the "open book" type, with trainees having access to resources that they normally use to enhance critical literature appraisal.

Conclusions

A&E medicine has the potential to build on the strength of the FFAEM examination and the interest of an increasing number of clinicians to become the first specialty in which all trainees will acquire the skills needed to practise

EBM. To achieve this the following are needed (in the order presented):

1. Agreement about the reasons for teaching and assessing EBM skills.
2. Development of a curriculum.
3. Development of appropriate teaching and assessment methods.

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- 1 Antman EM, Lau J, Kupelnick B, *et al.* A comparison of the results of meta-analyses of randomised controlled trials and recommendations of clinical experts: treatments for myocardial infarction. *JAMA* 1992;268:240-8.
- 2 Sackett DL, Rosenberg WMC, Gray JAM, *et al.* Evidence based medicine: what it is and what it isn't. *BMJ* 1996;312:71-2.
- 3 Muir Gray JA. *Evidence-based healthcare*. London: Churchill Livingstone, 1997.
- 4 Harden RM, Laidlaw JM. Effective continuing education: the CRISIS criteria. *Med Educ* 1992;26:408-22.
- 5 Sackett DL, Richardson WS, Rosenberg WMC, Haynes RB. *Evidence-based medicine: how to practice and teach EBM*. London: Churchill Livingstone, 1997: 33.
- 6 Laxdal OE. Needs assessment in continuing medical education: a practical guide. *Journal of Medical Education* 1982;57:827-34.
- 7 Reynard K, McGowan A. Assessment of specialist registrars in A&E—opportunities for change. *J Accid Emerg Med* 1997;14:107-9.

Appendix: An EBM curriculum for A&E trainees
Fundamental areas of EBM are highlighted in bold.

Topics are cross referenced to the curriculum for higher specialist training in A&E medicine (in parentheses).

FORMULATING QUESTIONS

(teaching skills: self directed learning and research skills: literature survey)

- **How? (the four part approach).**
- **Why use this approach?**
- Examples from practice.

SEARCHING FOR ANSWERS

(research skills: literature survey and use of information technology)

Conducting a MEDLINE search:

● **Using a search strategy that is appropriate for the type of question** (therapy, diagnosis, harm, aetiology, prognosis, and systematic reviews and meta-analyses).

- Medical subject heading (MeSH) and textwords.
- Truncation.
- Combining and limiting sets.
- Publication types.
- **Sensitivity and specificity of search strategies.**

Understanding limitations of and alternatives to MEDLINE searches.**ASSESSING THE "ANSWERS" FOUND**

(research skills: literature appraisal, data evaluation and statistics, and scientific study design)

The framework for appraisal:

- Valid.
- Important.
- Applicable.

Critical appraisal of review articles and meta-analyses:

- Roles of the Cochrane Collaboration and Centre for Reviews and Dissemination.
- Systematic *v* traditional reviews.
- Understanding of confidence intervals, odds ratio, and relative risk (as used in meta-analyses).

Critical appraisal of therapy articles:
 ● “Number needed to treat” statistic and the difference between relative and absolute risk reduction.

- Statistical “power”.

Descriptive statistics:

- Different forms of “average”.
- Confidence intervals for means and proportions.

Critical appraisal of diagnosis articles:
 ● Likelihood ratios, pretest and post-test probabilities.

- Sensitivity and specificity, receiver operating characteristic curves.
- Measuring agreement with the κ statistic.

Critical appraisal of prognosis articles:

Critical appraisal of articles about aetiology and harm:

- Relative risk and odds ratios.

- Association *v* cause, hypothesis generation *v* testing.

Critical appraisal of practice guidelines:

Appraising other types of article:

- Clinical decision analysis.
- Health economic papers.
- Case-control studies.

APPLICATION OF ANSWERS THAT ARE VALID, IMPORTANT, AND APPLICABLE

(managerial skills: department policies and teaching skills: medical postgraduates)

Implementing the findings of high quality research: barriers and ways around these.

Teaching EBM, what approaches work?

EVALUATING THE IMPACT OF USING EBM

(managerial skills: clinical audit/quality monitoring)

The role of audit.