Introduction to critical appraisal & reading scientific articles

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Objectives

At the end of this session you will be able to…

1. ...Search for evidence from published medical journals on a specified research topic
2. ...Review and critically appraise the evidence presented in a scientific paper
3. …Present critical appraisal findings to lecturers and peers

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Defining critical appraisal?

What does the term ‘critical appraisal’ mean?

- The process of systematically examining research evidence to assess its validity, results and relevance before using it to inform a decision
- Essential part of evidence-based clinical practice, allowing us to make sense of research evidence and begin to close the gaps between research and practice
- N.B., the quality of study designs is never certain, even if published

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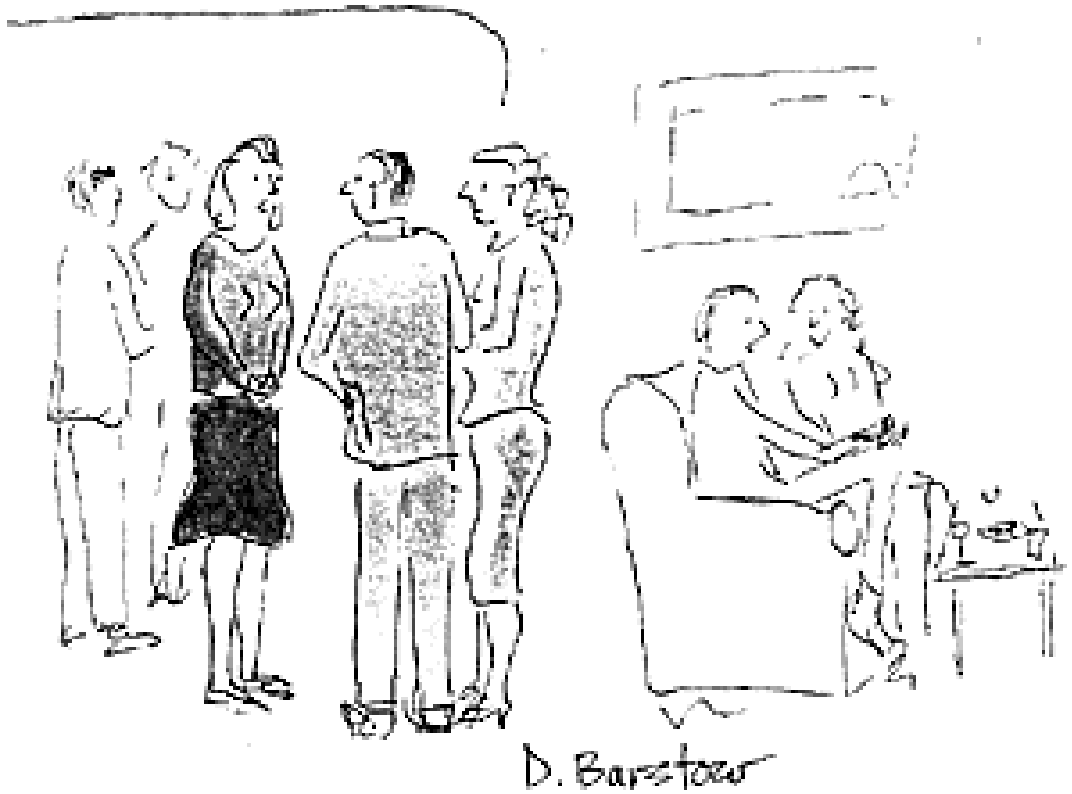
Only reading an excerpt (e.g., abstract) will not enable you to critically review the content of the piece



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Importance of critical appraisal

Core part of clinical practice

- Enables you to find & make sense of, research evidence, and to put newly gained knowledge from research appraisals into practice

Better communication with patients

- Patients increasingly ask whether they should have a new treatment just out (that they've seen on the internet) and if it will increase their survival or not

Just as relevant to students

- PBL
- BSc
- Journal clubs
- Information Literacy workshop 1
- Ward rounds

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Responsibilities of scientists (p10)

On the conduct of science

"The starting point for considering the conduct of science is that all work should be of the highest quality and, in so far as is possible, reported in a way that makes it reproducible and/or verifiable. Poor quality science—no matter how important the field—should not be tolerated and all efforts should be made to ensure the robustness of any information or data that are produced. In the 1940s the American sociologist Robert Merton formulated four principles, which he believed constituted a 'moral consensus' in science. The, so called, CUDOS norms (Communalism, Universalism, Disinterestedness and Organized Scepticism) may no longer be sufficient to fully accommodate the changes that have taken place in science and society since that time. Nevertheless, they remain an important foundation on which to build. …

… All scientists have a responsibility to ensure that they conduct their work with honesty and integrity; to ensure that methods and results are reported in an accurate, orderly, timely and open fashion. …

International Council for Science Freedom, Responsibility and Universality of Science. 2008 http://www.icsu.org/publications/cfrs/freedom-responsibility-booklet/ICSU-CFRS-booklet.pdf (21st November 2012)

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Finding research evidence

Medicine databases / guide:

- http://www3.imperial.ac.uk/library/subjectsandsupport/medicine/eresources
- College's available electronic content: http://www3.imperial.ac.uk/library/find
- Accessing electronic resources at home and in the College**:** http://www3.imperial.ac.uk/library/find/howto

Further help:

- Guides: http://www3.imperial.ac.uk/library/subjectsandsupport/publications
- Online tutorials: http://www3.imperial.ac.uk/library/subjectsandsupport/tutorials
- Training workshops: http://www3.imperial.ac.uk/library/subjectsandsupport/workshops
- The library: http://www3.imperial.ac.uk/library/getintouch

Information received with thanks from Jacqueline Cousins

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Keeping records

RefWorks

- Useful electronic system (index cards are a more classic format)
- Training given in Year 2 (Science and the Patient module)
- Track your reference database online from anywhere

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Approaching your literature review

1. Find models (be guided by others)
2. Problem formulation – which topic is under consideration and what are the constituent issues?
3. Literature search
4. Evaluation of findings
5. Analysis and interpretation of literature

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Approaching your literature review (2)

- Critical and evaluative account
- Summarise, synthesise and analyse
- You should:
  - describe and analyse the existing evidence base
  - detail what gaps you've found
  - reveal similarities and differences, consistencies and inconsistencies and controversies

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Things to avoid...

- Describing what someone else has done
- Writing an annotated reference list

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Hierarchy of study designs

1a (best)	Systematic review of RCT's, meta-analysis
1b	Individual RCT with narrow confidence interval
1c	All or none case series (all patients died before a new therapy introduced, those receiving it now survive)
2a	Systematic review of cohort studies
2b	Individual cohort study or RCT with <80% follow up
2c	Outcomes research / Ecological studies
3a	Systematic review of case-control studies
3b	Individual case control study
4	Case report/series
5 (worst)	Expert opinion

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Ideal design for outcome…

- Therapeutic methods: efficacy, alternative methods etc – RCT
- Diagnosis method: efficacy, reliability etc – Cross sectional study
- Screening: value of tests which enable pre-symptomatic diagnosis – Cross sectional study
- Prognosis: Longitudinal cohort study
- Causation: environmental, lifestyle etc factors and their impact on health – Cohort or case control study (or case reports)

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Review checklists (1)

Comprehensive lists of reporting guidelines:

- Experimental studies:
  - RCT: CONSORT
  - Infection control/intervention studies: ORION
- Observational studies
  - STROBE
  - Genetic association studies: STREGA
  - Anecdotes of suspected drug adverse reactions: PHARMA
  - Tumour marker prognostic studies: REMARK
  - Internet e-Surveys: CHERRIES
- Diagnostic accuracy studies: STARD

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Review checklists (2)

- Reliability and agreement studies: GRRAS
- Systematic reviews: PRISMA / MOOSE
- Qualitative research: COREQ / RATS
- Quality improvement studies: SQUIRE
- Other reporting guidelines:
  - Clinical Guidelines: COGS
  - Anecdotes of suspected drug adverse reactions: PHARMA
  - Evaluation studies in Health Informatics: STARE-HI

http://www.equator-network.org/home/: Resource centre

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Defining your research Q

P	Patients or problem of interest
I	Intervention of interest
C	Control or alternative treatment
O	Outcome of interest

If you refer a patient with mild hypertension for dietetic counselling regarding a low-sodium diet, this would generate the following PICO question:

In patients with mild hypertension (P)...
...does nutritional counselling regarding low sodium intakes (I)
...compared with no dietary advice (C)
...lead to a sustained fall in BP (O)

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Literature search: key points

- What search engine(s)? Year(s)?
- Define your topic
  - Use to guide 'search terms'
- Be systematic in your search methodology
- Use a variety of different information sources
- Ensure all information sources (esp. internet) contain trusted information
- Keep good notes (e.g., using RefWorks)

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Literature review: key points

- Aim: Identify scope and key issues
- Done well:
  - Examines why findings sometimes contradictory
  - Highlights good practice (and things to avoid)
  - Considers what more needs to be done (and why)

NB., To review what you are reading well, you must understand the subject you are researching

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Critically summarising a paper

- Why did they do it?
- What did they do?
  - Was the design appropriate?
  - Is the study original?
  - Who is the study about?
  - Was the study design sensible?
- What did they find?
  - Is bias controlled for?
  - Is the study blinded (if appropriate)?
  - Were the appropriate statistics applied?
- What did they conclude?

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Or use your own headings…

- **Is the study valid?**
  - Randomization?
  - Blinding?
  - Clinically important differences?
  - Were groups treated equally (aside from experimentation)?
- **Are the results important?**
  - How large was the treatment effect?
  - How precise are the results (confidence intervals)
- **Can I apply the results to my patient?**
  - Is my patient too different from those studied?
  - Is the treatment consistent with my patients values/preferences?
  - Is the treatment feasible for use in my setting?

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Example checklist (1)

- **Question:** Is there a hypothesis? Is the question relevant?
- **Design:** Is it cross-sectional, cohort, case-control, ecological, RCT? Hierarchy of studies. Is it appropriate?
- **Population:** Sample size. Are results generalisable to other populations
- **Methods:** Exposure measurements, interview, measure, questionnaire etc.

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Example checklist (2)

- **Analysis:** Appropriate statistical tests. Chance? Confounding?
- **Confounders:** Presence of any confounders and attempts to exclude or adjust
- **Bias:** Measurement/Selection?
- **Ethics:** Is the study ethical?
- **Interpretation:** Do the authors interpret correctly? Do they make a causal inference? Bradford-Hill?

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Tutorial papers

- Lee, *et al.,* (2005) Vitamin E in the Primary Prevention of Cardiovascular Disease and Cancer. The Women's Health Study: A Randomized Controlled Trial *JAMA. 2005;294:56-65*

- Pocobelli *et al.,* (2009) Use of Supplements of Multivitamins, Vitamin C, and Vitamin E in Relation to Mortality Am J Epidemiol; 170:472–483

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Use of Supplements of Multivitamins, Vitamin C, and Vitamin E in Relation to Mortality (Pocobelli *et al.*, 2009)

What thoughts spring to mind when you read the title?

- What are the characteristics of the population?
- How long did the study go on for?
  - Were they waiting for a certain proportion to die?
- How many people were studied?
- How many things in our diet contain vitamins?

Am J Epidemiol 2009;170:472–483

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In this cohort study, the authors evaluated how supplemental use of multivitamins, vitamin C, and vitamin E over a 10-year period was related to 5-year total mortality, cancer mortality, and cardiovascular disease (CVD) mortality. Participants (n = 77,719) were Washington State residents aged 50–76 years who completed a mailed self-administered questionnaire in 2000–2002. Adjusted hazard ratios and 95% confidence intervals were computed using Cox regression. Multivitamin use was not related to total mortality. However, vitamin C and vitamin E use were associated with small decreases in risk. In cause-specific analyses, use of multivitamins and use of vitamin E were associated with decreased risks of CVD mortality. The hazard ratio comparing persons who had a 10-year average frequency of multivitamin use of 6–7 days per week with nonusers was 0.84 (95% confidence interval: 0.70, 0.99); and the hazard ratio comparing persons who had a 10-year average daily dose of vitamin E greater than 215 mg with nonusers was 0.72 (95% confidence interval: 0.59, 0.88). In contrast, vitamin C use was not associated with CVD mortality. Multivitamin and vitamin E use were not associated with cancer mortality. Some of the associations we observed were small and may have been due to unmeasured healthy behaviors that were more common in supplement users.

Am J Epidemiol 2009;170:472–483

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Cohort study: Particular outcome (e.g., death from a heart attack), is compared in groups of people who are alike in most ways but differ by a certain characteristic (e.g., smoking)

Cox regression: Considers whether the effect of a treatment under study has a multiplicative effect on the subject's hazard rate (e.g., taking a statin may halve our immediate probability of having a MI)

Hazard ratio: the effect of an explanatory variable on the risk of an event

95% confidence interval: The range of values within which, 95% of the time, the true value would fall

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Tutorial (4th December)

- Quick appraisal for each paper:
  - Why did they study this?
  - What did the authors do?
  - What did they find?
  - What do they conclude?
- Then consider (p82)
  - Question; Design; Population; Methods; Analysis; Confounding; Bias; Ethics; Interpretation
- Use appropriate evaluation checklist:
  - Lee (2009): CONSORT
  - Pocobelli (2005): STROBE

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Points to remember

Always question content and clarity

- Difficult or badly written articles will be easier to read once you have read around the subject
- Report your findings as a ‘balance of evidence’
- Assimilation of complex ideas/evidence = ideal

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Practicing EBM

- Use of EBM in practice is restricted by time and information resource restraints:
  - do not expect to do this for every case
  - when necessary, this is an extremely empowering skill which can help show your professionalism
  - credibility and value of clinical advice will be directly correlated with your ability to perfect such techniques
  - these skills are consistent with the code of ethics for all medical practitioners

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Final thoughts…

- Available evidence should be used in making patient care decisions, but evidence alone is not enough: it must be combined with clinical judgement and patient preferences
- EBM provides an efficient and systematic way to locate the best evidence to answer clinical questions. Through simultaneous appraisal of that evidence, you can truly chose the most relevant information to answer your question

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Further reading?

- Trisha Greenhalgh (2001) How to Read a Paper: The Basics of Evidence Based Medicine (2nd edition). BMJ Books; London.
- Gray GE & Gray LK (2002) Evidence-based medicine: applications in dietetic practice. *J Am Diet Assoc* **102:** 1263-1272.
- Lang T (2004) Twenty Statistical Errors Even YOU can Find in Biomedical Research Articles Croatian Medical Journal. 45(4): 361-370
- http://www.equator-network.org/home/