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PROFESSIONAL DEVELOPMENT

How to Critically Read a Surgical Scientific Article

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Introduction

Reading a scientific paper is very different from reading a novel or newspaper. The content is denser and its full understanding may require more than one reading or sometimes even referral to other publications cited in the article to be clearly understood.

There are also different degrees of commitment that the reader gives when reading a scientific paper. Generally there are two grades of reading; relaxed and critical reading. Although, they differ totally in technique, a reader tends to shift from one to other. Relaxed reading is frequent and aims at increasing ones knowledge, on the other hand, critical reading is less frequent and aims at assessing the importance and validity of the results and conclusions mentioned in the scientific paper.

Table 1 summarizes the difference between relaxed and critical reading. This article will concentrate on critical reading and appraisal in general. The articles that will follow in this volume of the EJS will concentrate on critical appraisal of different types of research papers.

Table 1 Function of each part of a scientific paper according to type of reading

Part	Function	Relaxed reading	Critical reading
Title	Tells what the paper is about	Helps decision to read article or not	Helps decision to read article or not
Authors	Tells who did the work	Important: some authors are consistently good writers	Not important
Abstract	Summarizes the results of the paper	Not important	Important: key to read the full text
Introduction	Sets the paper's aim and background	Important	Not important
Patients (materials) and methods	Gives details of patients or materials used and of experimental methods	Important only when reader is unfamiliar with subject	Given detailed attention. Main area to look for strengths and weaknesses
Results	Reports the research outcomes in tables, graphs, photographs	Important	The most important part of the paper
Discussion	Discusses adequacy of methodology and results to other published work	Helps understand authors' views	Not important
References	Lists research used in writing the article	Source of further information	Allows to find detail of methods used

General advice

Don't try to read the entire article all at once, from start to finish. Instead, take a step-by-step approach.

1. Is it of interest? An immediate guide to whether to read a scientific paper comes from its title. This will indicate to the relevance of the content of the paper to your desired target from reading.

2. Read the abstract. The abstract is a brief summary of the article. It should give you an overview of what the paper is about and what the authors' research accomplished. If the content of the abstract does not seem to meet your expectations and will not help you answer your questions, you may want to choose another article.

3. Skim the article. Look at the section headings and any figures or tables, taking time to read the captions.

4. Go back and carefully read the entire article, section by section. Write down any questions you have about the article while you're reading it; that way, you can see if the authors answer your questions later in the article.

Before embarking on how to critically read a paper we would like to remind you of the basic structure and aim of each section of a scientific paper. The basic structure of a scientific paper is summarized by the acronym IMRAD which stands for:

Introduction	Why?
Methods	How?
Results	What?
And	
Discussion	However.....Therefore

10 questions to ask when reading a paper

1. Are the aims clear
2. Is the study design appropriate
3. Are the methods and statistics well described
4. Was the sample size calculated
5. Are the statistics appropriate to the study design
6. Are the basic data well-described
7. Do the number add up
8. What is the main finding
9. How do the results compare to previous work
10. What implications does this work have on practice

1. Are the aims clear?

This question should arise when you are reading the introduction. A specific and measurable aim suggests that the research work has been planned in advance and that it was set to answer a specific research question. On the other hand, vague aims are indicative of data dredging (mining, fishing) which is the deliberate search for “statistical difference” in the available data followed by research question formulation based on these differences.

2. Are the methods sound enough to yield valid and reliable results?

A valid measure is one that measures what it is supposed to measure; and a reliable measure is one that gives similar result when applied on more than one occasion. The answer to this question lies in the methods section. First, was the study design suitable to the research question (aim) set in the introduction? Box 1 and 2 illustrate examples for research questions and their impact on study design. Second, was the quality of the study design in accordance with established guidelines e.g. CONSORT, QUORUM, etc. (see forthcoming issues of EJS). Third, were there an appropriate number of patients or samples included in the study and was the sample size calculated beforehand. Studies with inadequate sample size are incapable of detecting real differences between study population and their control.

Box 1. Types of research questions

Diagnosis: how to select and interpret diagnostic tests, in order to confirm or exclude a diagnosis, based on considering their precision, accuracy, acceptability, expense, safety, etc.

Prevention: how to identify primary and secondary risk factors, leading to therapy or behavioural change.

Therapy: how to select treatments based on efficacy, cost and your patient's values.

Prognosis: how to estimate the probable course of disease over time and predict likely outcomes.

Harm / Aetiology: how to identify causes of diseases and their modes of operation (including iatrogenic forms).

Box 2. Relation between research question and design

Diagnosis: prospective cohort study with good quality validation against "gold standard".

Therapy or prevention: prospective, randomized controlled trial (RCT).

Prognosis: prospective cohort study.

Harm / Aetiology: RCT, cohort or case control study (probably retrospective).

3. Are the results important?

Are the basic data properly described and do the numbers add up. Missing data and inconsistencies in numbers indicate sloppiness not only in writing the paper but also in its execution. Are the result clearly presented and was every effort done to present them in maximum numerical clarity accompanied by statistical comparison. What are the main findings of the study and is their magnitude large enough to be of clinical significance or is it only a statistical phenomena?

4. How do the results compare to others and what is their impact on practice

The answer lies in the discussion where the authors should compare their research results with published data in a balanced manner. Beware of papers that champion the same opinion by citing only supportive data. The second half of the question is crucial as the ultimate goal of research, whether basic or applied, is to have a potential for improving the medical care offered to patients.