



## CRITICAL APPRAISAL OF SCIENTIFIC ARTICLES

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Key Words: What Do They Mean To  
You?



- Publication
- Critical Appraisal
- Decision Making
- Quality Assurance
- Study



## Learning Objectives

- Foster a desire to read scientific research.
- Hone the ability to analyze scientific literature critically.
- Introduce the principles of critical reading of scientific articles in medicine.
- Assess & adequately synthesize the essential principles of the evaluation of scientific publications.



## Decision Making

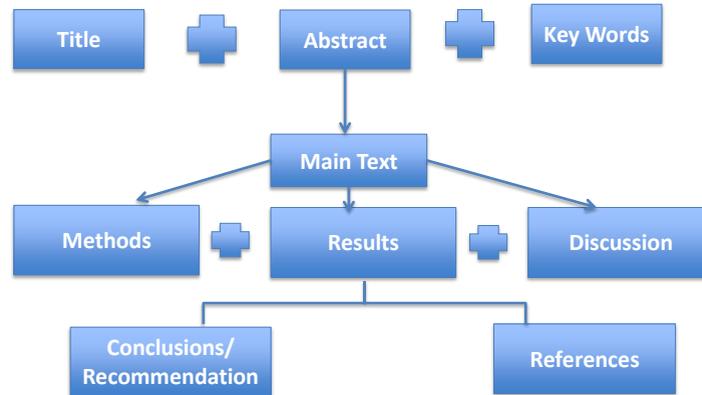
- Before starting a scientific article, a reader must be clear as to his/her intentions:
  - Is this a quick-read?
    - If so, would a review article best meet his/her needs?
  - Is one looking for more in-depth analysis?
    - If so, should one follow the article's references for more detailed information?

*What do you hope to achieve by reading a scientific article?*



# Structure of a Scientific Publication

- Essentially always the same:



## Content & Purpose of Sections

- Introduction
  - Familiarizes the reader with the subject matter of the investigation- General to the specific
  - Cites necessity of study & references current literature.
  - Avoids inexact phrases.
  - Segues from general to specific.
  - Explains clearly what question the study is intended to answer; knowledge gap



## Content & Purpose of Sections

- Methods
  - Presents the essential data that permit appraisal of the study's validity.
  - Describes:
    - All stages of planning
    - The composition of study- population (patients, animals, etc)
    - The execution of the study
    - Statistical methods – choice of statistical tool



## Questions on Methodology

- Is the study designed to fulfill the aims of the study?
- Is it stated whether the study is confirmatory or descriptive in nature?
- What type of study was chosen, and does it permit the aims of the study to be addressed?
- Is the study's endpoint precisely described?



## Questions on Methodology (cont'd)

- What statistical measure is employed to characterize the endpoint?
- Are the geographic area, population, study period, and the intervals between investigation described in detail?



## Study Design

***The most important element of a scientific investigation is the study design.***

- The choice of study design must be explained in clear terms.
- Statistical methods should be explicitly outlined.
- Statistical parameters & procedures should be describe clearly with references to special research.



## Study Design (cont'd)

- In experimental studies, precise description of the design & execution is vital.
- The accuracy of a method, i.e. its reliability and validity must be articulated.
- The explanatory power of the results is improved by the inclusion of a control group and randomized assignments of patients.



## Study Design (cont'd)

- Is it explained how measurements were conducted?
- Are instruments and techniques described in sufficient detail?
- Were measurements made under standardized conditions?
- What kind of scale were variables measured (e.g. eye color, nominal; tumor stage, ordinal; bodyweight, metric); biochemical indices etc.



## Study Design (cont'd)

- Was there a careful power calculation before the study started?
  - If the number of cases is too low, a real differences (e.g. between the effects of two medications) may not be detected.
- Statistical advice should be sought



## Results

- In this section the findings should be presented clearly and *objectively*, i.e. **without interpretation**.
  - The interpretation of results belongs discussion section.
- Result Section should address directly the aims of the study and be presented in a well-structured, readily understandable and consistent manner.



## Results (cont'd)

- Findings should be formulated descriptively; outstanding features should be noted
- Important to outline:
  - statistical parameters such as case numbers
  - mean values
  - and confidence intervals.
- Section should include a comprehensive description of the study population.



## Results (cont'd)

- Aside from information on statistical significance in the form of p - values, the results section should contain:
  - A comprehensive description of the data.
  - Details on confidence intervals and effect sizes.
  - Traditionally, tables and figures are recommended to enhance clarity- duplication to be avoided.



## Discussion

- Investigator discusses results frankly and openly- scientific integrity important
  - Regardless of the study type, there are essentially two goals:
    - Comparison of the findings with the status quo (existing body of knowledge)
    - Critical analysis of the study's limitations.



## Current Findings vs Existing Literature

- Discussion should answer the following questions:
  - How has the study added to the body of knowledge on the given subject
  - What conclusions can be drawn from the data
  - Will the findings of the study lead the author to change his/her professional behavior, e.g. modify diagnostic attributes or a type of treatment?



## Current Findings vs. Existing Literature

- What is your own interpretation of the data?
- Do the findings suggest further investigations?
- Does the study raise new questions?
- What are the implications of the results?
- Are the findings in accord with those of the majority of earlier studies?
- Do the results appear plausible?



## Critical Analysis of the Study's Limitations

- Might sources of bias have affected the results?
- Was there a high rate of loss to follow-up (e.g. patients refusing to participate further in the study)?
- Methods- adequate?



## Critical Analysis of the Study's Limitations

- **Problems with experimental approach:**
  - Too much unnecessary experimental detail
  - Not enough detail on approaches, especially untested ones
  - Not enough preliminary data to establish feasibility
  - Feasibility of each aim not shown
  - Little or no expertise with approach
  - Lack of appropriate controls
  - Ethical boards may share some light



## Conclusions

- Authors should concentrate on most important findings.
- Avoid unsubstantiated conclusions; padding
- Do not refer to exploratory data analysis as proof.
- One's own conclusions should be should be considered in light of other investigator's findings.



## Conclusions (cont'd)

- IN concluding, weaknesses of the study must be considered.
- Study can attain objectivity only if the possibility of erroneous or chance results is admitted; do not be too rigid
- Avoid including nonsignificant results in your conclusion.
- “Significant results” must be considered from the perspective of biological and medical plausibility.



## References

- Present references in the journal's standard style.
- Reference list must include all sources cited in the text, tables and figures of the article.
- Reference must be up to date in order to make it clear whether the publication incorporates new knowledge.
- References should help the reader explore the topic further.



## Acknowledgements and Conflict of Interest Statement

- Investigators must provide information on any sponsors of the study.
- Any potential conflicts of interest, financial or otherwise, must be revealed in full.



## Critical Questions and Quality Checklist

- Does the study pose scientifically interesting questions?
- Are statements and numerical data supported by literature citations?
- Is the topic of the study medically relevant?
- Is the study innovative?
- Does the study investigate the predefined study goals?



## Critical Questions and Quality Checklist

- Is the study design apt to address the aims and/or hypotheses?
- Did practical difficulties lead to major compromises in study implementation compared with the study protocol?
- Was the number of missing values too large to permit meaningful analysis?
- Was the number of cases too small and thus the statistical power of the study too low?



## Critical Questions and Quality Checklist

- Was the course of the study poorly or inadequately monitored (missing values, confounding, time infringements?)
- Do the data support the authors' conclusions?
- Do the authors and/or the sponsor of the study have irreconcilable financial or ideological conflicts of interest?



## Group Activity

- Review the article by Aakech et al, Crit Care Med 2010 OR a research article of your choice.
  - Identify components of the article (summary, method, conclusion). Explain how each of these components function in the article.
  - Assess the article using the *Critical Questions*.
  - Identify the critical analysis of your study's limitations. How would you strengthen the same study so as to minimize those limitations?



## Questions & Discussion

