How to Write A Research Paper

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Disclosure: No Conflicts.
Currently Editor-in-Chief Emeritus, *SHOCK*

What are the reasons to publish – Publishing allows us to:

- Share knowledge with other investigators.
- Add to the emerging body of knowledge.
- Contribute to the growth of the profession.
- Advance career goals.
- Helps with promotion and tenure.
- Increase respect for the institution.
- Helps with the recruitment/retention efforts.
- Promote friendship/collaboration with members of the discipline and stimulate further research.

What is a scientific paper?

A scientific paper is a published report describing the results of original research.

Scientific papers include not only original research, but also review articles and descriptions of innovative approaches to routine procedures.

Scientific papers

A good scientific paper is a finely tuned instrument of persuasion, but all too often, the result is merely a collection of disconnected facts, like a telephone directory. A paper should capture the reader's interest with the title and with each new section, encourage continued reading.

Thoughtful planning is the first and foremost step in scientific writing.

Iverson C *et al. Am Med Assoc Manual of Style*, 8th edition, Chicago, Am Med Assoc, 1989.

Why Conduct Experimental or Clinical Studies?

Experimental and clinical studies are usually conducted in order to fill the missing gap in current knowledge or obtain new information of significance.

There are several sources for ideas, which include the following:

- New procedures, treatment, intervention techniques or diseases;
- Information on current topics in the area of clinical practice, education or management;
- Comprehensive review or update of a topic;
- Unusual or challenging patients;
- Creative and innovative ideas in teaching or clinical practice;
- Any topic that is minimally covered in the literature, but is of interest;
- Research findings.

A thorough review of literature should be conducted prior to designing any clinical or experimental study so that one does not reinvent the wheel.

It is important to propose a clear hypothesis and plan appropriate experiments to test the hypothesis.

It is essential to obtain animal or human use committee approval prior to the initiation of the experimental or clinical studies.

It is of utmost importance that all animal care and use, as well as studies involving humans, be carried out with the highest standards, ethics and humaneness, in accordance with the local national, or international guidelines.

"*Before beginning to write a piece for publication, be sure that you have something important to say*."

Zellmer WA, *Am J Hosp Pharm* 48:687, 1991.

Regarding a manuscript, getting started is half the battle. The first step is usually to identify the general idea that will become the focus of the manuscript.

Journals publish

- Editorials
- Review articles
- Original research articles
- Epidemiological studies
- Letters to the Editor

Journal Selection

* Subject area and readership
* Impact Factor – reflects the number of times a journal's papers are cited by other authors.
* Suitability of the study for the journal
* Page limitation
* Time between submission and publication
* Submission charges
* Page charges
* Reprint costs

Factors involved in the selection of a journal

Although many factors are involved in selection of a journal for potential publication, often the factor that affects journal selection is the desired level of prestige.

An official society journal is usually more prestigious and widely read.

Type of Research Paper

Based on the significance of the findings, one can decide whether to publish as a:

* Rapid Communication--if the data is novel and merits early publication
* Preliminary Communication--if the data is exciting, takes time to complete full study but merits early publication
* Full Research Paper

Original Research Articles

Original research articles are frequently divided into full length manuscripts and brief communications. In a journal, the shortest format that provides sufficient details to convey the main message is preferred.

Full Length Research Paper

Every journal publishes detailed *Instructions to the Authors,* usually in the first issue of each volume. It is important to read the Instructions to the Authors before writing the manuscript. The instructions include the type of research the journal publishes and details concerning:

1. Title Page: Author(s), Institution and Addresses
2. Abstract/Summary
3. Introduction
4. Materials and methods
5. Results
6. Discussion
7. References
9. Journal requirements on Tables, Figures and Legends
10. Acknowledgments

Title of Manuscript

The title of a manuscript is a highly condensed version of the abstract, which in turn is a miniature of the paper. It is important that the title reflect the main message of the paper; however, it may or may not convey the conclusion.

Title Page

Title: Should not be too long (generally about 150 characters) and should convey the message of the work. Also suggest a short title or running head.

Authors: Include all those who have substantially contributed to the study. Include the address, telephone and fax numbers as well as e-mail address of the corresponding author.

Authorship

- In order to qualify as an author, a person must be able to accept intellectual responsibility for the paper.
- An author should be actively involved in the study, either in the design phase or in the final analysis.
- An author need not write the entire manuscript but should contribute to the manuscript and should be involved in the decision to publish the final draft.
- An author must also accept ethical responsibility for the manuscript. Next to tampering with data, plagiarism is perhaps the greatest sin.

Summary/Abstract

Should be brief (200 – 250 words) and should contain:

- A short introduction and the aim of the study
- How the study was conducted
- Results
- Conclusion
- Significance of the study

Abstracts often consist of a sentence or two for each of the main sections of the paper. A writer should ensure that any data given in the Abstract matches that in the tables and/or text.

Abstract

- The attention authors devote to writing the Abstract/Synopsis is rewarded because some readers decide from reading the abstract that the ensuing article is worth reading, and because many readers look at the Abstract, the Introduction and the Conclusion, as a way of obtaining an overview of research in a field.

Introduction

- Should not be too long, approximately 500 words is usually sufficient
- Should clearly state the problem and the reason for the investigators' approach to the problem
- Should provide background or rationale for the study - why the research was undertaken
- Should refer to earlier work relevant to the study
- May end with a description of the study design.

Introduction

The quality of the Introduction often dictates whether the paper will be read or published. If the Introduction is too short, several people may dismiss the paper because of perceived superficiality. If, however, the Introduction is too long, readers may view the paper as boring and irritating.

Materials and Methods

- Describe study setting, subjects, experimental groups, equipment and materials
- Provide detailed information on reagents used including the vendor and vendor location
- Describe the assay procedure in detail if it is new or modified
- Explain and cite references if the assay procedure is already established
- Provide sufficient details to enable reader to reproduce experiments and validate the results
- Include interventions, outcome measures and methods of data analysis
- Include procedures used for the statistical analysis

Materials and Methods

- In a clinical study, it is important to mention whether written consent was obtained from the patients or volunteers.
- The inclusion and exclusion criteria, the intended sample size and the handling of dropouts should be specified.
- Information on interventions should include randomization procedures used and drug(s) administered.

The writer who explains the approaches taken is more likely to convince readers of the validity of the main message.

Statistics

Most biomedical journals have adopted rigorous policies to ensure that the statistical tests used by the authors are appropriate for the study and correctly carried out.

Results

- Please organize the data is logical sequence.
- Please be brief in describing the results.
- Please limit the presentation to the results obtained – not interpretation.
- It is usually better to include Tables and/or Figures showing the means ± SE or SD.
- Please explain the data presented in Tables or Figures.
- Please do not amplify, overstress or simplify the data.

Tables / Graphs / Illustrations

- Should be freestanding -- they should contain enough information to be readily understood without referring to the text
- Should present the data clearly
- Tables should show statistical variations and the significance of analysis
- Must provide an abbreviated procedure of methods and analysis utilized
- Illustrations should be self-explanatory
- Legends for illustrations should be typed separately and should include a summary of the experiment and the statistical significance

Discussion

- May begin by answering research question posed in Introduction
- Discuss the results in reference to studies reported in the literature – if previously published data contradicts writers' conclusion, assess validity of your findings
- Highlight the important finding(s) of the study
- Avoid overstatement and oversimplification
- Emphasize the significance of the study
- Discuss potential limitations of the study and what remains to be determined
- May recommend future investigation
- End with a concluding statement regarding the potential implications of the study

Conclusions

The authors should not hesitate to state their conclusions boldly and bluntly. Day (1988) compared the shy writer to a squid. Writers who are doubtful of their facts tend to retreat behind a cloud of ink.

Day RA. *How to Write and Publish a Scientific Paper.* 3rd edition, Phoenix, AZ, 1988.

Conclusions

If the writer carefully collected, analyzed and integrated data, there is no reason to hedge or avoid making a conclusion.

Mulrow CD. *Annals Internal Med* 106-485, 1967.

Acknowledgments

- Technical help
- Colleagues and peers who offered suggestions and criticisms of the manuscript if they are not included as authors.
- The granting agency and other financial support.

References

- Cite all references included in the text.
- Cite a review if there are many references for an observation.
- Limit references to 35-50. This can be accomplished by referring to published reviews.
- Follow the journal format.

This section should contain key, relevant, and current articles, not all articles on the subject that have previously been published. It is essential to verify references, including the entire citation. Accurate quoting is important for credibility; it also enables the reader to retrieve the references. Authors should include only those references and materials that they have personally reviewed.

Papers must be persuasive

According to Bazeman, “With a journal service as a forum, contention grows. This contention pushes the individual author into recognizing that he/she is not simply reporting the self-evident truth of events but rather is telling a story that can be questioned and that has a meaning which itself can be mooted. The most significant task becomes to present the meaning and persuade others of it.”

Bazerman C. “Shaping Written Knowledge: The Genre and Activity of the Experimental Article in Experimental Science”, Madison, WI, University of Wisconsin Press, 1980.

Papers must be Persuasive

Papers in medical and scientific journals must be persuasive for two practical reasons. First, competition within the profession dictates that in order to secure a publication source for their findings, authors must convince an Editorial Board that their work is credible and that they, themselves are reliable reporters of their work.

Papers must be Persuasive

Secondly, once a paper is published the reputation of the authors depends on its recognition within the professional community. When authors fail to convince a substantial readership of the worth of their research, their work is not cited in the publications of their peers and dissolves into obscurity..

Scientific Writing

The directives to the scientific writer have not substantially changed in the last 300 years. According to the *Journal of the American Medical Association*, "The primary purpose of medical and scientific writing is communication of scientific knowledge to other scientists and physicians" and therefore, "Information must be presented with accuracy and clarity in a manner that can be read easily and rapidly."

Barclay WR, et al. "Manual for Authors and Editors." Am Med Assoc, p. 9, Lange Med. Pubs., Los Altos, CA, 1981.

Style

According to Aristotle, "*It is not enough to know what to say - one must also know how to say it.*" For the scientific writer, style is especially important, not only author familiarity with conventional scientific style, but also, according to Ziman, "Appropriate use of such a style has the effect of identifying a piece of writing with knowledge already accepted in the field- effectively begging the question of significance by creating the impression that what is argued is already known."

Ziman J, *Public Knowledge: An Essay Concerning the Social Dimension of Science,* p. 97, Cambridge University Press, Cambridge, MA, 1968.

Prior to Submission

- Ask a colleague who is knowledgeable about science and the official language of the chosen journal to review the manuscript.
- All authors listed in the manuscript must be sure that the results provided are accurate and that all authors have contributed significantly to the design, execution, and/or writing/revision of the manuscript.
- If all these factors are considered and addressed thoroughly, the chances of acceptance of a manuscript are significantly enhanced.

Important Points

Since manuscripts are peer-reviewed by 2-3 referees who are experts in the field, the following important items/issues should be considered.

1. Write in simple sentences that are easily understood
2. Check spelling and grammar carefully
3. A thorough literature survey will be helpful
4. Do not make wrong assumptions and false claims
5. Since the purpose of research is contribution towards advancement of knowledge, reevaluate your study's contribution before submission
6. The bottom line is a clear and lucid presentation clearly written

Submission of manuscripts

- It is important that the same manuscript not be simultaneously submitted to different journals without informing the Editors.

- Camouflaging a manuscript submitted simultaneously by rephrasing the title, shuffling authors' names, switching the x- and y-axes in graphs, and use of different languages, is not ethical.

Statements from Referees

(that you don't want to receive)

"Thank you for asking me to see this manuscript…
I do not think that the senior author read it through."

"Unfortunately, I cannot make any suggestions
to the authors which will enhance this paper
to the point of being acceptable."

Statements from the Referees

"Is this a test to see if I really read these papers prior to providing reviews? Am I on Candid Camera?"

"Terrible paper…..unacceptable by any standard. Language, design, experiments, discussion, are all primitive."

Statements from Referees

"There is no hypothesis here, but there is a lot of overdone pseudoscience with standard deviations (often exceeding the value of the mean) and inappropriate or meaningless comparisons."

Statements from Referees

"Although written in King's English and fascinating in its own way, I do not believe that it should be published."

"The manuscript exhibits syntactical redundancy, misplaced and vague modifiers, and abuse of passive voice. They should consult a grammarian and submit a revised manuscript."

Summary

It is usually not difficult to publish a well conducted hypothesis-based study. Clarity and brevity in presentation of the data in the manuscript are very important.

Summary (1)

In writing and publishing research papers, it is important that:

- One proposes a clear hypothesis and plans appropriate experiments to test the hypothesis;
- After the protocol and the experimental design are formulated, the investigator must obtain animal or human use approval prior to the initiation of the experimental or clinical studies;
- All animal care, as well as studies involving humans, should be carried out with the highest standards, ethics, and humaneness, in accordance with the local, national, or international guidelines

Summary (2)

The manuscript should be written in a clear and concise manner. Most manuscripts have an introductory section and the first sentence usually sets the tone, explaining the subject area and why this topic is of interest. A selected review of the literature is recommended, and the reference section should contain key, relevant and current articles, not just all articles on the subject that have previously been published. It is critical to verify references, including the entire citation.

Summary (3)

Accurate quotation is important for credibility. It also enables the reader to retrieve the reference. The authors should include only those references and materials that they personally have reviewed.

Summary (4)

The Materials and Methods section should outline procedural details to the extent that another investigator is able to utilize that model or methods, if they so choose. It is also essential to describe the statistical methods utilized for determining the significance levels of the values presented.

Summary (5)

The body of the manuscript must contain a development of ideas. Each paragraph should relate to the central topic and follow a progression, either logical, sequential or chronological. Tables and figures should summarize materials that are tedious to list or describe and they should visually illustrate a point. It is important that information presented in tables or figures should not be repeated in the text but can be highlighted or referred to in the discussion.

Summary (6)

The Results section should contain only the results and not a discussion or interpretation of them.

Summary (7)

The Discussion section should be pertinent to the aim of the study and how the results obtained validate or invalidate the hypothesis tested, as opposed to generalized discussion of diverse areas, which are poorly linked to the objective.

Summary (8)

The Discussion should also critically evaluate the pros and cons, as well as the limitations of the study. Whenever possible, it is important to discuss the potential mechanisms responsible for the results presented. The same principles apply to basic science and clinical studies.

Summary (9)

Careful review of the manuscript for grammar, spelling and clarity is strongly recommended before sending the manuscript to the journal. Prospective authors should ask selected colleague(s) to read and comment on the manuscript. These colleagues may be from the same or different institutions but should be selected from among those who will give the writer an honest critique of the manuscript.

Summary (10)

It may be necessary to do several revisions before the manuscript is at its best. However, the time spent on this stage of the process is extremely worthwhile. It is most important to proofread the final draft meticulously since carelessness will reflect negatively on the authors.

Summary (11)

Once a manuscript is submitted, most journals provide feedback to the authors about the manuscript's strengths and weaknesses, whether the decision is to accept, table for another review, revise or reject.

Summary (12)

- Acceptance letter are always welcome; however, editors may request changes or special preparation of figures and tables for publication.
- Letters requesting major revisions are welcomed with less enthusiasm by the authors, but criticisms should be dealt with objectively.

Summary (13)

If the author does not agree with a particular comment(s), they may want to prepare a rationale and include that in a cover letter to the editor, with their revisions. Comments that are helpful should be addressed and appropriate changes made in the manuscript. Some changes will be relatively easy to make; others may not be possible at all.

Summary (14)

It is easier to change a paragraph that is unclear than to correct a major design flaw in a completed study. When the changes have been made, selected colleagues should be asked to reread the entire manuscript.

Summary (15)

If a rejection letter is received, the authors must carefully review the manuscript and re-evaluate its strengths and weaknesses. The authors certainly have the right to consider an alternative journal, and more important, ask the question whether the journal to which it was submitted was appropriate for the manuscript. The authors must balance persistence with knowing when to put a manuscript aside and go on to another publication effort.

Summary (16)

Publishing a manuscript is an important professional effort that is rooted in the science and art of writing. It is an activity that deserves more attention, particularly by the younger audience.

Material presented was taken from The International Committee of Medical Journal Editors (ICMJE) recommendations and also from the following publications:

- P.K. Rangachari. The word is the deed: The ideology of the research paper in experimental science. *Adv Physiol Educ* 12:S120, 1994.
- J.Z. Segal. Strategies of influence in medical authorship. *Soc Sci Med.* 37:521, 1993.
- A.G. Apley. So you want to get it published. *J Royal Soc Med.* 86:6, 1993.
- M.R. Ventura. Guidelines for writing for publication. *J NY State Nurses Assoc.* 23:16, 1992.
- A.W. Hamilton How to write and publish scientific papers. *Am J Hosp Pharm* 49:2477, 1992.

Conclusions

The same ethical principles apply, and the same writing skills are needed whether the writer is a beginner or a full-time professional scribe. Good scientific writing follows a standard pattern regardless of the audience and the publication vehicle. The journal's "Instructions for Authors" provide practical guidelines and should be consulted frequently. The result should be a well-written paper that supports and disseminates the writer's message.

Conclusions

Writing a scientific paper, in many ways, is like compounding a medication. Good scientific writing, like an ad lib prepared medication, requires precision, hard work and an artistic touch.

CONCLUSION

"*Writing is like having a baby; the gestation period is long and the labor painful, but in the end, you have something to show for it.*"

Apley AJ, *J Royal Soc Assoc Med* 86:6, 1993.

THANKS

- “Those who stand on the shoulders of giants see farther than mere mortals.”
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- Family: For Unconditional Support.
- You: ευχαριστώ For your kind Attention.

I will be happy to answer any questions you may have.