How to write a scientific paper

Satish Shukla

Editor / Chairman, Indian Journal of Surgery, Retd. Prof. and Head of Surgery, M.G.M. Medical College and M.Y. and Associated Hospital, Indore, India

For correspondence:
Satish Shukla, Lakshmi Memorial Hospital & Research Centre, Indore - 452001, India.
E-mail: drsumit_shukla2003@yahoo.co.in

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Rain drops falling on the earth get absorbed, giving life to dormant spores and dry vegetation. The environment becomes green, rejuvenating flowers, birds and insects. Similarly, the human mind is a fertile cosmos, capable of working, should the will of the individual desire it to do so. Individuals are their own masters who can command their mind to work to get definitive results.

Scientists should have critical minds to judge everything in order to relate their own results, to their ideas or theories, to get the background for writing a paper.

Before writing a paper, it is best to address the following questions: WHY does one wish to write a paper? Is it a compulsion or desire to reveal something new and/or worthwhile? If it is a compulsion, the paper will follow a pattern set in available literature. But if you are convinced about your positive efforts, then publish the material before your zeal fades away. Paper writing has three components:

(a) Language and orderly writing
(b) Basic norms of Scientific writing
(c) Scientific material writing

English is the primary language of Scientific Communication all over the world. Take the help of MS-Spell Star / Stedman Spell Check or an English teacher to help you write the paper. It should be in simple, grammatically correct and commonly used scientific language to be understood by the intended readers. Composition should be evidence-based with a clear message and should not mix many thoughts or views.

Writing up results of studies is always in narration and in the past tense. It is advisable not to mix verbs, adverbs and tenses and to use the active voice and not passive voice.

Example: Passive - My first operation will always be remembered by me.
Active - I will always remember my first operation.

SOME THINGS TO AVOID

• Complicated literary words not commonly used in scientific literature.
• Use of slang, commonly used in general talking
• Use of contractions like “don’t” (instead of do not), “isn’t” (instead of is not)
• Abbreviations are to be avoided. Only units of measures like cm (centimeter), mg (milligram) etc. can be used. A list of abbreviations should be provided in the appropriate section.

The basic norm of writing a scientific paper is the truthful presentation of facts taking ETHICAL issues into consideration. Experimental use of drugs as well as all procedures to be performed on animals should have the approval of the Ethical committee of the Institution.

PLAGIARISM

Clearly attribute information, ideas and photographs used in the article from other sources without permission.

Every Journal has its own format. Note the format carefully before beginning to write. Most journal formats are the same although there may be minor changes. For example, the words such as “Abstract” may need to be underlined or given separately. Similarly, the References may require a particular format, i.e., they may need to be arranged alphabetically or sequentially—year of publication first and page number later or volume, page number and then the year.
You also have to consider your target audience. Will your intended readers be undergraduate or postgraduate students, your faculty colleagues, highly skilled scientists working in the same field or is it a general paper without any impact group? Depending upon your intended readership, your writing should give emphasis to different points depending on the targeted readers.

Once some basic clarity for writing the paper is achieved and all results are in hand, it should be completely analyzed.

Lay down a format (as given below) which is followed by most journals and electronic sites.

Now that all results are ready for compiling into different categories and to compare with the available data in literature, one can begin to organize the article. A scientific article is divided into following sections:[1-4]

- Title
- Abstract
- Introduction
- Materials and Methods
- Results
- Discussion
- Conclusions
- Acknowledgment
- References

**Title**

As studies progress, many new results emerge which give some new dimension to the subject. Hence, the Title should be framed to give a clear and concise picture as to what has been studied.[2]

Example:

- Role of Trace elements in malignancy
- Role of Zn and Cu in malignancy
  - Correct: Role of Cu, Zn and Ca in diagnosis of malignancy

The Title should be less than 10 words and reflect the factual contents of the paper. It should be straightforward and use Keywords known to the target readers.

**Abstract**

The Abstract is the main theme of the subject emphasizing the main or desired results and the comparison of these results with the available literature. The abstract should briefly give the conclusion in simple words and in the past tense.[4]

The abstract should be 150-250 words in length with proper phrasing and break-up into paragraphs. Keywords or search words should be made prominent to help other researchers to find the article online.

-Finally, consider the following:
(a) Any New Questions?
(b) Any New hypothesis?
(c) Any important negative findings?
(d) Any suggestions for a new study to strengthen your work?

If any of the above point is relevant, include it in the last one or two sentences.

**Introduction**

The introduction is written keeping in mind the main objective and theme of the procedure. Established scientific knowledge and its relevance to your hypothesis should be mentioned.[2,3]

The introduction defines the subject, its objective and background to understand the entire body of work. By reading the introduction, readers should get a clear understanding of the Author’s hypothesis and the means of testing it.

Clarity of thought with proper wording makes it easier to understand what is to follow and interests the readers to go deeper into the paper.

**Materials and Methods**

In medical science, materials consist of patients or Experimental Animals in which case, the studies are termed as clinical or experimental studies respectively. Criteria for patient selection should be defined clearly in accordance with the objective of the paper. Every clinical study has various parameters which should be described clearly without any ambiguity.[5]

Investigations designed in the project or study should be relevant and as per the objective. The methodology of the investigations should also be described clearly. If biochemical or histocytochemical methods are used, names of the equipment used and the basics of its function along with full functional procedures should be given. Details should be included if any chemicals are used.[6]

In experimental work, details of the animals such as average age, sex and average weight should be given. Any precautions to be taken before, during and after the procedure along with details of the procedure should be included. Consent should be obtained from the ethical Committee and a declaration regarding the same should be obtained.

If a study involves a surgical procedure, it should be written in detail stepwise until the completion of the procedure. Any precaution of any nature relevant to the study or for the patient’s safety should be written under the heading: “CAUTION”.

**Results**

Proper presentation of data is the key to success for your
article. Only when data is presented properly and in full only then it can be analysed correctly to arrive at proper conclusions.\textsuperscript{[1,4]}

This heading should include no data analysis or conclusions but should give just a presentation of facts in the form of words, figures, charts, tables, graphics or photographs depending on the type of your work. Laboratory-assisted projects will need a better presentation in the form of figures, charts, tables and graphics. Clinical and procedure-related articles should have photographs, graphics, figures and tables to supplement the work. There should not be any duplication of results, though results can be supplementary to each other.\textsuperscript{[5,6]}

Example:
(1) \% increase in Liver enzymes and \% increase in white blood cell counts in fulminating Hepatitis following septicemias and its response to drugs can be presented in charts, tables and graphs to show the relative trend.

(2) Similarly in surgical complications following Typhoid fever like perforation of the small bowel, the clinical condition of the patients in relation to body enzymes, hematology, pulmonary functions and its response to various surgical interventions can be presented in all forms for better understanding without duplication of the same result.

Data should be analyzed and presented in figures, graphs, tables or in descriptive forms of observation called CONVERTED DATA. This is done to simplify the results in different forms in relation to the subject. No interpretation or conclusions should be given under this heading.

Discussion
By the time you come to the stage of writing the Discussion, your knowledge about the subject is at its best. After presenting the results in different forms (as stated above) to explain one’s hypothesis, one has a clear idea as to where the results are leading the reader. The data should be compared with the original hypothesis and points both favoring and not favoring the hypothesis stated clearly. These points can be written in chronological order as per table/figure/chart number or in order of their importance.\textsuperscript{[4,6]}

Data available in literature which support the writer’s hypothesis / results should be presented followed by data which oppose the writer’s hypothesis. However, to avoid confusion, literature reports giving contradictory views should not be intermingled.

Care should be taken to ensure that data selected for their support or contrary to your hypothesis and results should be compatible to each other in terms of statistical analysis.

While analyzing and interpreting data, DO NOT say that the results are inconclusive. If the data is inconclusive, studies should be modified to enable clear conclusions either confirming or rejecting your hypothesis and literature reports gathered which will support these new results and interpretations.

All observations are to be explained as much as possible, focusing on the mechanism in the experimental or laboratory subject. In clinical studies involving patients, age, sex, past disorders, other present disorders, hereditary or familial disorders, environment, geographical consideration and personal habits make all the differences in the study though primary data regarding the disease or procedure of the subject studied remains the same. Thus, first explain the data as per your results and discuss this with the help of available literature. If this is not possible or if it leads to a different topic of discussion, mention this clearly, giving suggestions for further studies.

Once you have written the discussion and you are fully aware of the available literature, address the following questions:
(1) Do the experiments or studies performed address the hypothesis correctly?
(2) Do the studies need more experiments or clinical data for better comparative analysis?
(3) Do the studies need any modifications to get the desired results which would confirm one’s hypothesis?
(4) Are the results contrary to your expectations?
(5) Does the study lead to a new question?
(6) Does the study lead to a new hypothesis?

Points 1 to 3 should be explained properly in the last part of the discussion. Point No. 4 should be explained with reasons as to why results are contrary to the stated hypothesis and perhaps to the available literature. If no explanation can be given, then a complete redesign of the study is warranted. Point No. 6 is to be viewed with caution. The new hypothesis derived from one’s study should be carefully reviewed in light of literature reports. Such new results should be clearly described as “New finding” or “New data”. In general, scientific studies should speculate as little as possible although if the findings of the study suggest some new theory to be explored, this can be stated as the need to confirm the current findings with further studies. Finally, the discussion should encompass what has been stated in the objective and should try not to fall short of or exceed its limits.

Conclusion
The conclusion of the paper is the thumbprint of your work. It should give the message of your hypothesis, belief and work in clear words and short sentences. Ambiguity should be avoided and words such as
“may be” or “possibility of” should be avoided. The conclusion should be precise in summarizing the results of the study and explain their agreement or disagreement with the hypothesis stated in the abstract.[2,6]

**Acknowledgment**

The acknowledgment is an attribution to all those who have guided you and helped in carrying out your work including the Head of the Unit, the Guide, Teachers, Students, Lab Workers, Librarian and others. All persons involved in carrying out the studies from Administrative faculty to the personnel conducting the studies are to be given their due respect and recognition.[2,7]

**References**

Scientists and researchers who have published work in the same, related or associated field, which may have helped you in your study should be included as references. The reference article should have a part or an entire study which supports or contradicts one's hypothesis. Journal instructions should be followed when listing references. It can be numbered chronologically as per its order of appearance in the article or alphabetically by the last name of the authors.[1,6]

References should usually list the authors starting from the first (corresponding) author, title of the article, name of the Journal, year of publication, volume number and page number in that order.

If many references are available, only those references should be selected which are critical to one's work and aid in the analysis and discussion of the results. There is no limit for the number of references but usually 15-20 references of the highest priority should be included.

**Conclusion of this article**

There may be different aims to writing scientific articles but the need is to be truthful in one's objective and hypothesis, collection, presentation in relevant charts / graphs / tables etc. with proper labeling and discussion of data is of utmost importance. Ethical presentation and discussion of one's findings lends credibility to one's paper and puts forward a clear message regarding one's work.

**REFERENCES**