

Resident Forum

## Fundamentals of writing a scientific article

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### INTRODUCTION

Writing a scientific article is an essential component of the academics and research field.<sup>[1]</sup> It involves a process thinking of the observation that needs to be conveyed to scientific forum.<sup>[2]</sup> Clear communication of the validated scientific data is a skill that can be acquired over a period of writing. Keep in mind that it is not a difficult process, but it is just time consuming. The workflow of scientific writing given in this article will give you a fair idea about how to start from the scratch while writing a scientific article.

The scientific article helps in enriching knowledge, gives impact on the society, and helps in academic and scientific progress. Many universities and scientific societies and bodies give scores to scientific articles for carrier achievement schemes and promotions. Before starting a writing, follow the path given in Figure 1.

### TYPES OF SCIENTIFIC ARTICLES

The following are the types of scientific articles that are commonly published:<sup>[3]</sup>

#### Original research article

It includes description of research, such as “how it was done” and “what are the observations.” The results are supported by discussion about the probable justifications of the findings.

#### Editorial article

It is a short review about a particular topic written by a subject expert. It includes expert suggestions or comments on the topic of discussion.

It is a summary of the available data from previously published articles on particular topic. It may be a narrative review or systematic review. Narrative or traditional review is a comprehensive summary of the topic. Systematic review is more well defined. It is a compilation of research findings based on evidence. Meta-analysis is a statistical procedure for combining numerical data from multiple studies. It is performed in the context of systematic review.

#### Case report

It is based on an unusual or novel finding.

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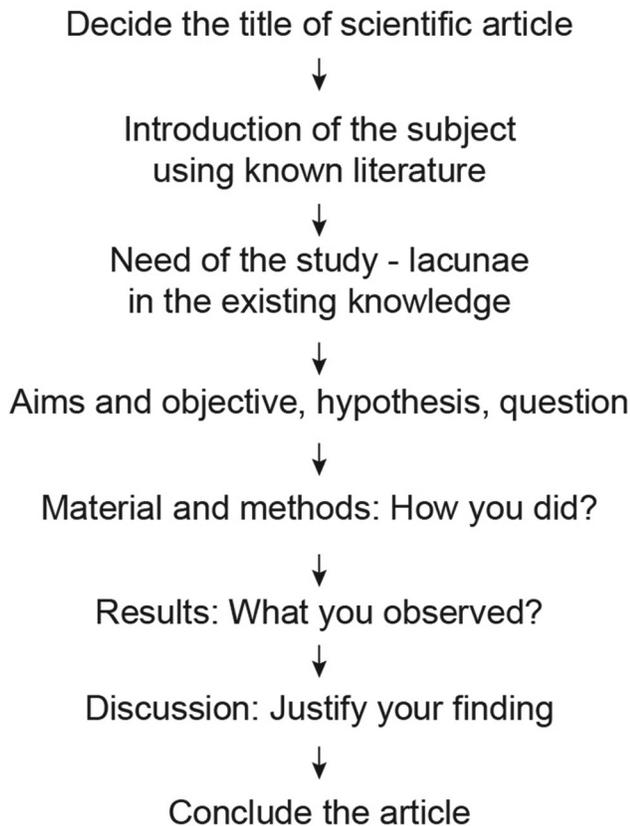


Figure 1: Path for writing a scientific article.

#### Letter to editor

It is a short communication to give justification to the results of previously published journal title that adds extra information.

#### Book review

It focusses on insight or critical opinion about the published scientific book.

### COMPONENTS OF SCIENTIFIC WRITING

Based on the type of research article, the components of the article vary. However, the basic components found in a scientific article are title, abstract, introduction, material and methods, results, discussion, conclusion, references, and acknowledgments [Figure 2].<sup>[4]</sup>

#### Title

The title should be precise, clear, and appropriate. It should seek the attention of the reader. It should reflect the setting or procedure of the study and result if possible. Do not exaggerate the subject of the title. It should be self-explanatory, yet not too lengthy.<sup>[5]</sup>

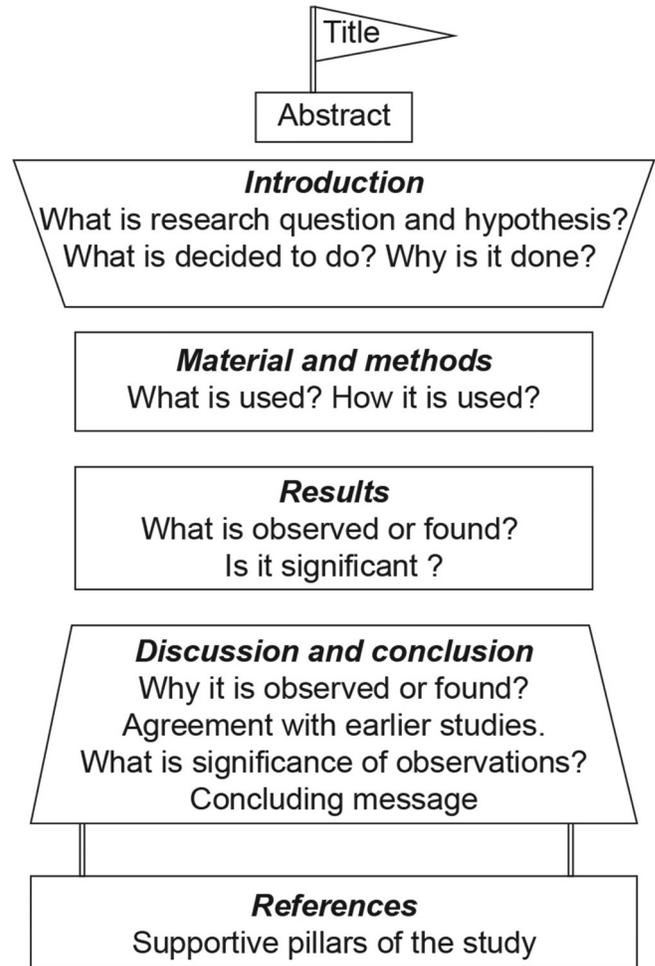


Figure 2: Components of research article.

#### Abstract

Most of the readers prefer to read the abstract rather than reading a full article. Hence, the abstract should include important summary features of the study.<sup>[6]</sup> It should begin with background knowledge and lacunae in the literature. It should reflect material and methods and main results with a concluding line. The abstract is of three main types: (a) Structured abstract that is grouped into foreground, objectives, material and methods, results, conclusion, and clinical significance; (b) indicative abstract is written as a single paragraph; and (c) informative abstract that forms an integral part of an original article.

#### Keywords

This section consists of nouns (words) or 2–4 phrases extracted from the research article that helps the reader to find your article when he/she conducts a search on the relevant topic. Avoid too long keywords (phrases).<sup>[6]</sup>

## Introduction

Introduction of a research article makes the reader familiar with the subject of the article and the terms used in the research.<sup>[7]</sup> It provides information about the background research studies and the existing gap in the scientific knowledge. It includes the reason for conducting the present work. It can include objectives, aims, research question, and research hypothesis.

### Components of introduction

Background knowledge information is given to justify the reason for carrying out the present study. It includes the novelty of the study, limitations of prior studies, and what further information the present study is going to add to the existing knowledge. Write briefly about each point rather than describing or discussing. Since the article is targeted to a specific scientific community, addition of basic information should be avoided. Introduction should begin by broadly introducing the readers to the topic and should narrow down toward the end explaining the reason for conducting the research study. *How to check the quality of introduction?* It should answer two questions – “what is studied?” And “why is it studied?”

### Material and Methods

It is the evidence to how the work was done. It is a technical part of the research article.<sup>[8]</sup> It is useful for other researchers to validate and carry out the same work with further dimensions. In this section, describe the methods in brief with sufficient details to observe the reproducibility of the experiments. If an already existing method is used, then provide reference for the same instead of describing it in details. It should include the relevant information such as place of study, participant selection criteria, exclusion criteria, study design, methods of analysis, statistical test, ethical approval, and so on. *How to check quality of research study?* It should answer the following questions – “Is it able to test the proposed hypothesis or answer the research question?” “Is it uniformly applicable to the participants?” And “Has it used the available resources minimally?”

Sample size calculations should be included in material and methods. The reference parameter and reference study utilized for the sample size calculation need to be included. As per the study protocol, this section can contain questionnaires, intervention details, and clinical assessments. The information about the making of specific chemical and instrument, if required, can be included.

### Results

This section gives the answer to the research question or hypothesis. It consists of the text explaining observations

or findings of the study.<sup>[9]</sup> It may be positive or negative finding. Organizing of result section is important. It should be disclosed in a meaningful sequential order from wider findings to the hypothesis acceptance or reflection. Summarize only the key findings of the study rather than elaborating findings irrelevant to the hypothesis or research question. It can be supported by a bar graph, flowchart, table, line graph, schematic drawing, or photographs for an effective visual illustration. For example, list of numerical data can be presented with table or list, and comparative numerical data can be represented by a bar graph. Do not repeat the data included in visual support, such as tables and figures. Rather than repeating to numerical data in text form, the interpretations should be included in the results with support of tables of the numerical data and bar diagrams. Do not over conclude the findings using vague terms. Do not compare the findings of your study with other studies in the result section – this can be included in the discussion section. Including negative findings are equally important as the positive results, though they are against the hypothesis of the study.

### Visual support for text

The scientific writing should be supported with the help of visual modes to make it more effective and to save the readers time.<sup>[10]</sup> They are as follows:

#### Table

It should be used to consolidate or summarize the data, to save the space, to show the correlation, and to avoid numerical overload on the result section. It may be of two types: (a) Word table that includes relationship, classification, and so on and (b) numerical table that summarizes complex quantitative data. The table should be organized logically. Keep the non-dependent variable in the rows and dependent variables in the column. Abbreviations can be used to save the space in the table but provide their expansions as foot note.

#### Figures

These are provided for better explanations of the fact given in the text. The figure should provide evidence to the given facts. It should be self-explanatory and unambiguous. While using a patient's photograph, care should be taken to mask the identity of the individuals. File formats are very important in the submission of figures. Read carefully the required file format –.jpeg,.exif,.tiff,.gif,.png, and so on. Scaling of the image should be done carefully. Avoid distortion of the anatomical shape of the structures. Label the image whenever necessary.

## Graphs and charts

These are used to represent comparison of the data, trends, relationship, incidence, and so on. During preparation of graphical illustration, keep non-dependent variables along the x-axis and the dependent variables along the y-axis. Selection of various graph diaphragms is based on the data. For continuous data, use line graphs; for non-continuous data, use bar diagrams; for discrete variables, use bar or columns; for frequency of distribution, use scatter graph; and use pie graph for showing relationship of number of parts to the whole.

## Discussion

This section includes the main inference about the interpretation of the findings of research study. Already existing facts are utilized to justify the reasons behind the findings.<sup>[11]</sup> It also includes agreements or disagreements with the findings of other researchers and the probable reasons for these arguments. It also includes the strength and limitations of the present study. It should convey the message about the benefits of the findings of the study and its utility in fulfilling the gap in the existing knowledge, and how it can change the life style of the society or existing scientific problem. Do not repeat the data from the result section. Avoid inclusion of only favorable supportive studies; include studies that do not agree with your findings and try to give probable reason for the same. Do not exaggerate the findings or utility of your study. Use past tense to describe your findings and past tense for referring prior studies. Add only scientific studies from the peer-reviewed indexed journal. Do not add the facts from non-scientific magazines. Discussion of negative findings is as important as the discussion about the positive findings. Avoid inclusion of huge numerical data in the discussion. Keep in mind that copied data come under plagiarism.

## Conclusion

It can be added separately or can be added as a last concluding paragraph in the discussion. In conclusion, summarize the finding of the study in one or two lines. Do not exaggerate the findings and do not draw unjustified conclusions. Try to avoid mentioning the need for further studies requirements for finding the association of factors. Do not disclose your ongoing studies. Conclude the article with a logical statement.

## References

Citation of existing knowledge is an important component of scientific writing. Each journal follows its own writing style for references and citations.<sup>[12]</sup> Vancouver format of referencing is widely accepted. It is always advised to go through the instructions to author from journal's website as

well as the recently published articles from the same journal. Other reference stylings include Hayward referencing style, American Psychological Association System, the Chicago Manual of Style, and so on.

Cite only the valid, relevant, and recent publications. Arrange the publications as suggested by the publishers or journals guidelines. Reference validates the statements made in the article. It helps the reader to refer the cited article for gaining further knowledge. For citing the reference in text, it should be numbered and that number should be set as superscript or in bracket at the end of the referred statement. Use single or double quotation ("\_\_\_\_\_") mark to cite a direct quote in text as per British or American English.

## Statistics in scientific writing

To validate the data, statistical analysis is essential. It is required to measure the variable, to test the hypothesis, to find the significance, or to draw the inference.<sup>[11]</sup> The data of the study should be presented in the language of statistics using words such as variable, constant, and attributes. The variables should be categorized as discrete and continuous, or categorical and dichotomous variables. Research population, selection of sample, the method of sample selection, and distribution of data (normal or skewed or bimodal distribution) need to be mentioned. The method of sample size calculations and factors that affected sample size such as minimum differences expected, standard deviation, level of significance, power, error, and dropout rate should be mentioned. The statistical tests applied for drawing the inferences should be mentioned. The use of the statistical test depends on the sample size and distribution of data, study design, and type of analysis. The main parametric tests include students test (unpaired and paired), analysis of variance test, correlation analysis, and regression analysis. The main non-parametric tests include Wilcoxon signed-rank test, Friedman two-way test, Spearman's rank correlation test, and Chi-square test. The value of inference includes mean, median, mode, standard deviation, and coefficient of variation. The *P*-value helps to determine levels of significance. It should be mentioned at what *P*-value the level of significance is considered. The degree of freedom, risk, and odds ratio should be mentioned in statistical analysis as per the requirements of inference. For a diagnostic test, sensitivity, specificity, and F1 score need to be included.

## WRITING STYLE

English writing style varies according to the publishing house. If the writing abides by the style that is set up, the chances of acceptance increase. Brief idea about the guidelines of the scientific language is included in this section.<sup>[13]</sup>

## Numbers

Selection of numbering style such as numerals (1, 2, 3,...), spell out numbers (one, two,...), and Roman numerals (I, II,...) should be done carefully to enhance the understanding of presentation. Except for price, measurement, and numeral series, the Roman numerals use should be restricted to classification, blood clotting factors, cranial nerves, and so on.

## Grammar

Use of correct grammar is important in any type of writing. Ensure that use of adjectives, articles, pronouns, verbs, active and passive voice, tenses, infinitive, participle gerund, adverbs, prepositions, conjugations, interjections, and so on are appropriate and add value to the content. Subject-verb disagreement is one of the most common problems noticed during review process of the scientific writing.

## Punctuations

The use of punctuation at the right place is very important, as getting it wrong can completely change the meaning of the sentence. It is essential and clarifies the meaning of the written text. Use of end period (full stop), commas, serial commas, semicolons, colons, questions marks, hyphens, en dash, em dash, parentheses, square brackets, braces, slash, quotations marks, and apostrophe should be appropriate. Most commonly observed mistake is the interchanged use of hyphen (-), en dash (–), and em dash (—). The en dash is used to replace “to” and to correct conflict, directions, and so on. For example, 1–2 pm, 1996–1999, Delhi–Mumbai route, and so on. The em dash is always used without spaces on either side. It is used in place of parentheses and comma to set off additional information. For example, the patient was finally discharged – nearly 3 months after the admission. In *Microsoft Word*, the en dash and em dash are given in symbol section as special characters (insert – symbol – special characters). In this section, only information on en dash and em dash is added to make the reader aware about their uses.

## Language preferences

The writer has to see the English language preference of the publisher or journal. There are many differences between British and American English in terms of writing styles and spellings. The writer should focus on dates, use of “z” or “s,” “l” or “ll,” “o” or “ou,” suffix “ll” or “l,” “-er” or “-re,” “oe” or “ae” or “e,” “-eable” or “-able,” “-ce” or “-se,” hyphens, time, and many more. Some examples are listed in Table 1.

## Abbreviations, acronyms, and contractions

These should be used cautiously. Only standard acronyms such as LASER can be used. Their use improves readability

**Table 1:** Differences between British and American English.<sup>[1]</sup>

Point	British English	American English
Date	9 July 2021	July 9, 2021
“o” and “ou”	Colour	Color
“z” and “s”	Analyse	Analyze
“l” and “ll”	Counselling	Counseling
“ll” or “l”	Skillful	Skillful
“-er” or “-re”	Centre	Center
“oe” or “e”	Anaemia	Anemia
“-eable” or “-able”	Shakeable	Shakable
“-ce” or “-se”	Defence (as verb)	Defense

and saves space. Abbreviations and acronyms should be spelled out at their first occurrence. Avoid the use of contractions such as can’t, don’t, and so on. Using a period is purely based on the style followed. For example, “Dr” (without period) is the most preferred use in British English, while “Dr.” is American’s. Do not add “-s” to abbreviations to make them plural.

## PLAGIARISM AND ETHICAL WRITING

Plagiarism is claiming someone’s owned material, idea, literature, and research without giving due credit to the individual. It is always advised to write the manuscript in own words using pen and paper rather than copy-pasting in a computer.<sup>[14]</sup> Ethical writing involves acknowledging the data source, writing in your own words, and use of double quotes (“...”) to indicate copied lines; copying of own written published material without citation also comes under plagiarism. Lack of knowledge and lack of plagiarism check facility may lead unintentional plagiarism. There are many free and paid websites available to check the plagiarism, such as Paperraters, Duplichecker, Quetext, Plagscan, Grammarly, Ithenticate, and so on.

## CONCLUSION

Scientific writing is a skill that can be acquired by practice and reading. It is the essential tool for scientific communication and academic carrier progress. It not only involves scientific knowledge but also involves technical writing skills for scientific writing, think – write – read – modify to achieve your goals.

## Declaration of patient consent

Patient’s consent not required as there are no patients in this study.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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