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Scientific research article – How to write and get it published?

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ABSTRACT

Writing scientific research article is necessary for the evolution of scientific knowledge and may be helpful in the professional advancement of researchers. It, thus far, not only improves the writing skill of the researcher but also opens the door to getting scientifically connected with peer groups. Many manuscripts are not being published in any scientific journal, simply because the author(s) have not adhered to the basic rules to construct a good manuscript or have not followed the publication guidelines as recommended by the journal. It is not a difficult job if the minimum standards or protocols are being followed systematically. The authors, in the present review, highlight the salient points to keep in mind before starting to write the manuscript and provide readers with a few elementary steps to generate a good quality manuscript. Moreover, a plan of the revision process that may require to publish the manuscript has also been highlighted.

Keywords: Scientific research article, Connect with peer groups, Writing manuscript, Basic structure, Publishing

INTRODUCTION

The primary aim of a scientific script is to send the researcher's message to the scientific community in a readily understandable and precise manner.[1] Most scientific journals consider several types of publications. The usual type of articles submitted by researchers includes original research work, case studies, and meta-analyses. On the other hand, the Editor in some specific contexts invites Reviews and Editorials. In the present review, the discussion mostly concentrates on the former type of publications.

WHY PUBLICATION OF SCIENTIFIC WORK IS VITAL?

A publication is a gateway to communicating newly found data to the scientific community of the world. The process of presentation of the data in a concise, readily understandable manner, will develop the skill of scientific writing among the authors. The process also helps to evolve the author's proficiency in the particular field of research. The process of peer review helps authors to evaluate the validity of the work being presented. The process of publishing a scientific work will subsequently help the scientific community to prepare for the future directions of their areas of interest. Even a data presented in a conference carries a sustain impact only once published in a scientific journal and can reach a large number of readers.

HOW TO STRUCTURE THE RESEARCH INTO THE MANUSCRIPT?

The structure of a scientific paper usually follows the Introduction, Methods, Results, and Discussion (IMRAD) style that was adopted in the 1980s and consists of four major sections, namely, **I**ntroduction, Methods, Results, and Discussion.[2] The goal of every research work is to draw an inference. The inference may or may not establish the hypothesis. In any case, the work has to be conveyed to the peer group as the data are the stimulus for further research work. Only a published work carries a sustained intellectual impact.

"INTRODUCTION" – THE BEGINNING

The purpose of this segment of a scientific article is to deliver contextual information – thus to persuade the readers regarding originality as well as rationale and importance of the scientific work. In general, a "deductive approach" is usually applied in the introduction. Specific consequences or hypotheses are deduced by the application of reasoning to familiarize with general theories and principles. The principal impression regarding the scientific content, the research uniqueness, the soundness of its observations, and the writing style can be obtained from the introduction. Therefore, an improperly written introduction can misinform the readers of the content of the scientific paper. This may, further, resist the readers from reading the subsequent sections/in contrast, the reader can be convinced of research logic in a well-written introduction; therefore, the initial challenge faced by the author during the preparation of the scientific manuscript is the drafting of the introduction.

An introduction should contain a background of the current knowledge of the field and also the lacunae of knowledge. Afterward, brief essence of the relevant literature may usually lead to the aims and the research question or hypothesis.

A typical structural approach for writing the introduction is shown in [Figure 1]. A typical format of the introduction section is typically approached in a rotated cone-shaped manner; from broad to narrow. The largest part of the cone depicts the overall situation and the significance of the research work. It is followed by describing the knowledge gap. At the end of the introduction, the aim of the work, and the research hypothesis, the approach used to inspect the research hypothesis in a methodical are usually stated. Therefore, research ideas paving from general to specific aspects of scientific research are described in the introduction.

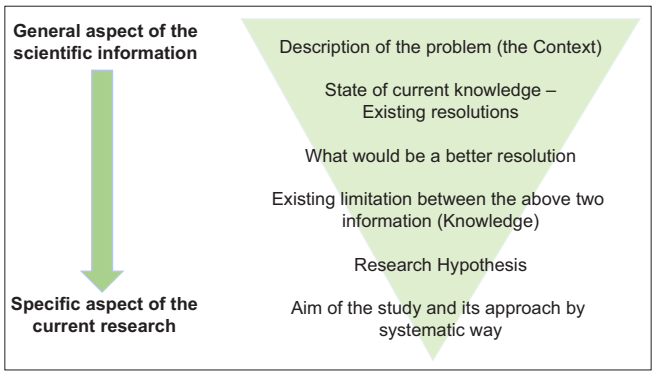

Figure 1: Structure of introduction of a scientific manuscript.

"MATERIALS AND METHODS" – COMPILING ALL THAT IS USED IN THE RESEARCH

The purpose of this section of the article is to facilitate other researchers to replicate the scientific work and to persuade the scientific community that the work has been done in the proper means.[3] This section in a research article is incorporated to describe different materials including subjects that constitute the experimental process, the type of study, and the procedure that has been followed including statistical techniques.

The material section should include:

Chemicals

Different chemicals (e.g., drugs, culture media, buffers, and gases) used in the study should be described. Specification of the source (manufacturers, etc.) is not mandatory in respect of elementary laboratory chemicals. However, the same should be mentioned for other chemicals used in the work. In the case of drugs, vital details such as generic name, manufacturer, purity, and concentration; for solutions, the solvent, pH, temperature, total volume infused, and rate of infusion, routinely be stated.[4]

Experimental materials/animals/humans

Experimental substances such as molecules, cell lines, and tissues are usually elaborated on in this section. Genera, species, and strain designations should accurately identify the plants and microorganisms.[5] If animals are being used in the study, the source of animals, the number of animals used, species, strains, sex, and weight should be mentioned.[4] In the case of observational studies involving human subjects, the eligibility criteria, sources, and methods of selection of participants should be described. In cohort studies, methods of follow-up should be mentioned. Similarly, the basis for the selection of cases and controls, sampling methods, and source of the control group in case-control studies must be disclosed. In respect of case-control studies, criteria for matching are described. The number of exposed and unexposed participants' in cohort studies and the number of controls per case should be specified.[6]

The methods should consist of

Study design

The method section should begin with the design of the study – the central strategy of research work. The study design guides the reader to realize in respect of approach to data acquisition and enables them to appropriately comprehend the result. It should be mentioned at the beginning of this section, especially in those studies which are testing a hypothesis.[7] The section describes an outline of the procedures with relevant details in discrete subsections.[4] The type of study may be observational, interventional, experimental, and comparative analyses, surveys, or interviews. The major design of the scientific study includes cohort studies, randomized controlled trials, qualitative studies, and case–control studies. The studies may be based on a single-center or multicentric depending on the nature of subjects and experimental design.

Methods of measurements/assessments

A detailed description of methods of measurements and assessments rests on the target reader as well as the type of study. However, a balanced approach is crucial. In general, procedures should be described if it is essential for the study replication. In essence, readers should be informed of the pathway of deriving the vital outcomes and not represents a manual of the procedure.[8] A brief guideline is depicted in [Table 1].[9]

Scientific style

Signs and symbols for units should be internationally recognizable. The authors, as far as possible, use systematic names as recommended by Chemical Abstract Service or IUPAC. Species name and genus should be written in *italics*.

Table 1: Standard guideline for describing methods in a scientific writing[9]

Method	How to Report
Familiar for everyone in the field	Not to be mentioned
Well-established methods, protocols, standards, or previously published methods	Should be described in brief with appropriate citation
Relatively uncommon methods	Should be described in sufficient details with reference to original description and specific modifications made
Newly developed method	Should be described in more details including all reagents, conditions, and equipment

Role of statistical analysis

This section describes the justification of statistical analysis and the rationale of statistical methods applied.[4] As per "Uniform requirements for manuscripts submitted to biomedical journals" recommended by the "International Committee of Medical Journal Editors (ICMJE)," this segment would "describe statistical methods with enough details to enable a knowledgeable reader with access to the original data to verify the reported results."[10]

In general, the materials and method section of a scientific article is an intersection that links the introduction segment and the results section – thereby paving a clear scientific scheme.[11] The main queries such as "who, what, where, when, why, and how" of the research work should be answered in this section.[12] The section "Materials and Methods" ensures credibility and reproducibility of the experiments that were conducted. The key component of this section is summarized in [Table 2].[9]

"RESULTS" – THE KERNEL OF THE SCIENTIFIC PAPER

This segment represents the core of the scientific work that is being presented around which other segments of the manuscript are being arranged.[13] The content of results section is researcher's findings – the key to the progress of scientific literature by providing original, newly discovered information in the study population.[14] The data, thus, obtained are also analyzed by statistical methods to evaluate the proposed hypothesis of the study.[15] The section must deliver an objective account of major discoveries clearly and concisely.[16,17] Authors require to apply a combination of tables, texts, figures, videos, etc., for portraying the

Table 2: Constituents to be included in Materials and Methods[9]

Components	Examples
Materials	
Chemical	Drugs, culture media, buffers, gases
What was examined	
Experimental materials	Molecules, cell line, tissue
Experimental animals (e.g., rat and mouse) Human subjects	
Methods	
Study design	
A. Observational	Cross-sectional Case–control Cohort
B. Interventional	Clinical trial Experimental
Measurements/assessments	
Statistical analyses	

results in an easily understandable way to answer the study question.[18]

The observations of the study, in general, are described in the text portion of the result section, while the most significant data should be depicted in figures and tables. Relevant statistical analysis is also incorporated in this section of the manuscript.[19] Results are the significant findings presented in the text of the manuscript that state what the data (facts and numbers) depict.[20] Thus, results are descriptions in the main text which denotes the importance of the data.[21]

The format of presenting the results and data of the research depends on the way that the data most suitably support the observation of the research work. There must be dynamic coordination between text and figures, tables, or any other form of data presentation, for example, audio/video. The most important observations are usually depicted in both formats.[22] In general, three or fewer observations should be incorporated in sentences in the main text. The use of a table/chart is desirable for more number of observations.[23] Tables should be used for presenting specific information or exact values which are useful to summarize and compare sizeable data.[24] On the other hand, comparisons and patterns are better depicted by figures.[24] Observations of both the study and control group should be provided.[19] The specific information include in this part is the most meaningful observations corresponding to the aim of the scientific study and the hypothesis that have been mentioned in the introduction section.[19] This section may also provide the secondary findings, including the observations from subgroup analyses.[25]

Researchers must also provide results that deviate from the research hypothesis or are not supported by the current scientific literature.[25] Reporting such negative results may direct the future review of current scientific knowledge and direct the scientists toward unabridged science.[26]

"DISCUSSION" – THE HEART OF THE MANUSCRIPT

The discussion section of an article is considered as the most innovative segment of the manuscript to communicate the inference of the research.[27] In this segment, "the story of your research" or "the narrative connecting key findings and producing a larger picture" is offered to the readers.[27] The scientific community may try to understand the inference of observations of the study rather than the data depicted in the result segment.[28] The purpose of this segment is an interpretation of results for the scientific community and thus informing its inferences and effects.[29] The content of the section should include contextualization of important results at the beginning. It should be followed by the significance of the study. Related similar and contentious researches are discussed. Furthermore, elucidation of strengths and weaknesses should be addressed followed by the application and future perspectives/recommendations. In the end, the take-home messages and conclusion should be incorporated.[27-29]

The most interesting part of a manuscript is the discussion for readers though at the same time most tough for authors to represent.[30,31] As an ill-written discussion can muffle the scientific message of the work, constructing this segment requires the most intense effort to make it readily understandable to the readers.[32]

The major purpose of the discussion is being depicted in [Table 3].[33] The discussion segment should correlate the relevant observations with evidence, infer and validate the significance, and contribute to the present scientific literature. It also paved the way for future research by raising specific propositions.[34,35] Observations depicted in the result sections are placed in a wider setting and specify their significance for practical as well as theoretical and domains.[36]

The discussion should contain answers to the questions that were mentioned in the hypothesis, which is strengthened by the support of clarifications of these answers.[37] It should be appreciated that answers in the discussion are not identical to the results but should be a generalization of the observations. The answers and supportive argument should only focus on the study population.[37] Results of the present works are required to strengthen the answer by reasoning.[37] Other components of the discussion include statements regarding the significance of the originality of the study, related research work (similar as well as conflicting findings), contextualized important results, strengths and weaknesses of the work, and discussion on unforeseen observations, and implications. The discussion should terminate with future viewpoints, recommendations, and take-home messages.[29,37] Results and discussion are presented in combination in some scientific journals. However, the preferable mode of presentation is in separate sections.[38]

The discussion should essentially be organized into three parts – a beginning, a middle, and an end.[37] The first few paragraph(s) at the beginning should have a brief description of the key findings, including the primary outcome, to be depicted for answering the objectives of the study and supporting those with observations.[29,37] The middle segment

Table 3: Major purpose of the discussion section.[33]

Function	Explanation
To answer the questions of the study	Use the same words and key terms in the introduction
To explain how the results support the answers	State the relevant results after stating answers
To explain how the answers fit in with the existing knowledge on the topic	Present the meaning of the results and contributions of the study in the field

emphasizes the interpretation of results, along with the strengths and limitations of scientific work. Strengths that are highlighted can be related to the study objectives, methods, and/or participants. Some examples are as follows – diagnostic or screening tests used are more sensitive and/or specific, sample size adequacy, the drop-out rate is low, minimizing biases using relevant methods, clinically relevant endpoints applied, etc.[29] In the middle part, sequences of the topics are governed by scientific evidence or are sequenced by the most important to the least concerning the objectives of the study.[37] Limitations are usually stated in the penultimate paragraph of the discussion segment of the manuscript. The usefulness of acknowledging the limitations of the study can be appreciated by the fact that comprehending such findings and placing them in the setting of current information will generate novel research ideas and aware pitfalls of potential errors.[39] This section only incorporates tables/figures in case of data derived from many sources and for the depiction of multifaceted mechanisms, respectively.[29] Typically, the end or the last paragraphs of the discussion contain the conclusion and take-home messages.[29,37]

"CONCLUSION" – THE LAST PARAGRAPH

The conclusion represents clear concise information of the research work. It, usually in a single paragraph, simply and succinctly restates the main theme, inferences, and arguments related to the study. This is accomplished by restating the observation in the context of the objectives followed by summarizing the significance of the scientific work.[37] It should concentrate on the aims and hypothesis of the study.[40] Moreover, the conclusion must be reinforced by the specific observations and their significance. The conclusion also should disclose whether the results affirm or negate the hypothesis.[29] One must avoid the repetition of concepts and data already included elsewhere in the manuscript and no references are accepted or allowed.[41]

"REFERENCE AND CITATION" – BE CONSISTENT ACROSS THE DOCUMENT

Undoubtedly, this is the most neglected part of any draft manuscript and may be one of the very common reasons for the rejection of submitted manuscripts before peer review. Style of citation recommended by the ICMJE (known previously by the Vancouver system, Vancouver reference style, or the author–number system) is the most common system for referencing used by medical scientific journals.[10] The references are consecutively numbered of appearance in the manuscript. They are identified in the text by Arabic numerals enclosed in parentheses (1, 2, 3, 4…, etc.). The list should clearly identify references cited from journal articles, books, internet sites, or other electronic databases, in detail so that the readers have to scope to track and cross-read the reference(s). Internet sources may, in time, be deleted or changed, critically evaluating the reliability of the information. It is better to keep a hard copy for records. Before any submission, the authors have to follow the journal site for citing and referencing.

"PUBLICATION ETHICS" – RESPONSIBILITIES OF AUTHOR(S)

Ethical issues

Among the many different ethical issues involved in writing a scientific work, the commonly encountered is the fabrication of data/information, plagiarism, identical publication, untruthful citations, and forged alteration or manipulation of images.[42] When patients or volunteers participate in experimental/clinical research, the researchers must provide approval from the Institutional Ethics Committee (IEC) or Institutional Review Board (IRB) authorities, and informed consent from patients/volunteers.

Ethics statements – A must in any submission

Ethical issues are a crucial aspect of biomedical studies. In the scientific publication, the ethics segment should include a statement stating that approval from the IEC or IRB was obtained bearing the registration number. Authors are required to declare that the study was performed according to the previously outlined protocols like the Declaration of Helsinki if the research issues are relevant. The author(s) may follow the following tips of publishing ethics to minimize the rejection of a manuscript: (a) Declare that the current manuscript is not submitted/published elsewhere, (b) declare any conflicts of interest, (c) check all coauthors meet criteria for authorship and ensure appropriate acknowledgments (if required), (d) include a statement of the funding, and (e) that the manuscript is read and approved by all the authors.

Plagiarism

No data, text, tables, or figures from others authors should be presented in a way depicted as the author's own ("plagiarism"). Other authors' works must be given appropriate acknowledgments in references/bibliography that includes materials that are quoted and/or paraphrased. Maintain transparency by avoiding "self-plagiarism" (text recycling) and "salami-slicing" (single study split up for submission in different journals or to the same journal over time).

"ABSTRACT" AND "TITLE" – BEING CONCISE AND PRECISE ARE THE KEY

The abstract needs to be written in a simple, specific, concise, and precise way; it preferably is structured (divided into

different sections) or maybe unstructured also depending on the requirement of the journal. It must be consistent with the main text of the manuscript. The abstract must include the key message for better understanding and Search for the scientific community.

Although presented at the very beginning of any draft manuscript and published article, writing a meaningful and appropriate title usually follow the whole write-up and even the abstract. The use of a handful of words, in the truest sense, reflects the theme of the study and the manuscript as a whole.

HUNT FOR THE "RIGHT JOURNAL" – THERE IS NO SINGLE SILVER BULLET

The process of choosing a journal should be guided by various important relevant parameters. The initial selection is governed by the scope of the particular journal and the type of works considered for publication. Most scientific medical journals only publish articles on specific subjects. Similarly, some journals only publish review articles. Authors should be aware of the articles already published in a particular journal before submission. Moreover, authors must also be well aware of publication and other processing charges (if any) open-access policy and print and/or online mode of publication.

Another important aspect of any journal is indexing. Authors must check the correct indexing status of the journal and also check for any discrepancy in indexing as claimed by the journal versus indexing authorities. The quality of the article published should be evaluated by the impact factor; where available, journal metrics are helpful to understand the impact of a journal. Moreover, before choosing any journal, the rejection rate and average processing time must also be considered.

Authors are advised to evaluate the suitability of a particular journal with the novelty of their work before the preparation of the manuscript according to the journal's guidelines. There are a vast number of academic journals in existence; the author needs to narrow down the field to a shortlist. Ideally, the choice of a journal should even start before writing the draft manuscript; but, in practice, it is the nature of your research work that will guide you in choosing wisely. Sometimes, it may be of help to consult knowledgeable people around – colleagues, supervisors, and academicians working in the field.

Authors are also advised not to fall victim to predatory publishers; ICMJE offers a description: "These journals (predatory or pseudo-journals) accept and publish almost all submissions and charge article processing (or publication) fees, often informing authors about this after a paper's acceptance for publication. They often claim to perform peer review but do not and may purposefully use names similar to well-established journals."[43]

Journals that are not reputed can diminish the trustworthiness of publications of authors' novel and significant research, and limit researchers' career. Moreover, such publications consequence in little or no dissemination and uptake of scientific knowledge.[44]

REVISING AND RESPONDING TO THE REVIEWS

Once submitted, over time, the usual different types of "decision letters" received by the authors from the editorial board are – major/minor revisions as suggested by the reviewers or acceptance/rejection by the editorial board. Responding to the reviewer's comments, is yet another hurdle, as may be regarded by the author(s), in the battle to get their research published. However, the peer-review process, as is true in the majority of cases, actually improves the quality of the manuscript with answers to many "ifs and buts." Take some time to work on it and respond; do not be in a rush. Initially, check that you have understood the comment; if not, may seek clarification(s). Respond respectfully by giving "point-to-point clarifications" to questions/comments raised by the reviewer(s); the final revised copy is to be submitted along with a rebuttal letter.

CONCLUDING REMARKS

A judicial and organized approach is of utmost importance to publishing scientific research work in a reputed journal. The basic structures of writing a scientific research manuscript must be followed meticulously to achieve the target.

Declaration of patient consent

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

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Conflicts of interest

There are no conflicts of interest.

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