

Preparing and Publishing a Scientific Manuscript

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ABSTRACT

Publishing original research in a peer-reviewed and indexed journal is an important milestone for a scientist or a clinician. It is an important parameter to assess academic achievements. However, technical and language barriers may prevent many enthusiasts from ever publishing. This review highlights the important preparatory steps for creating a good manuscript and the most widely used IMRAD (Introduction, Materials and Methods, Results, and Discussion) method for writing a good manuscript. It also provides a brief overview of the submission and review process of a manuscript for publishing in a biomedical journal.

KEYWORDS: *Imrad, manuscript preparation, manuscript submission, publication, scientific manuscript*

BACKGROUND

The publication of original research in a peer-reviewed and indexed journal is the ultimate and most important step toward the recognition of any scientific work. However, the process starts long before the write-up of a manuscript. The journal in which the author wishes to publish his/her work should be chosen at the time of conceptualization of the scientific work based on the expected readership.

The journals do provide information on the “scope of the journal,” which specifies the scientific areas relevant for publication in the journal, and “instructions to authors,” which need to be adhered to while preparing a manuscript.

The publication of scientific work has become mandatory for scientists or specialists holding academic affiliations, and it is now desirable even at an undergraduate level. Despite a plethora of forums for presenting the original research work, very little of it ever gets published in a scientific journal, and even if it does, the manuscripts are usually from the same few institutions.^[1,2] It serves the purpose of academic recognition; and certain publications may even contribute to shaping various national policies. An academic appointment, suitable infrastructure, and access to peer-reviewed journals are considered as the facilitators for publishing.^[3]

The lack of technical and writing skills, institutional hurdles, and time constraints are considered as the major

hurdles for any scientific publication.^[3] In addition, the majority of clinicians in India are involved in providing healthcare in the private sector in individually owned hospitals or those governed by small groups of doctors. This necessitates performing a multitude of tasks apart from providing core clinical care and, hence, poses an additional limiting factor because of the long and irregular working hours.

It is extremely challenging to dedicate some time for research and writing in such a scenario. However, it is a loss to science if this group of skilled clinicians does not contribute to medical literature.

Maintaining the ethics and science of research and understanding the norms of preparing a manuscript are very important in improving the quality and relevance of clinical research in our country. This article brings together various aspects to be borne in mind while creating a manuscript suitable for publication. The inputs provided are relevant to all those interested, irrespective of whether they have an academic or institutional affiliation. While the prospect of becoming an author of a published scientific work is exciting, it is important to be prepared for minor or major revisions in the original article and even rejection. However, persevering in this endeavor may help

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preserving one's work and contribute to the promotion of science.^[4,5]

Important considerations for writing a manuscript include the following:

- (1) Conceptualization of a clinically relevant scientific work.
- (2) Choosing an appropriate journal and an alternative one.
- (3) Familiarizing with instructions to authors.
- (4) Coordination and well-defined task delegation within the team and involvement of a biostatistician from the conception of the study.
- (5) Preparing a skeletal framework for writing the manuscript.
- (6) Delegating time for thinking and writing at regular intervals.

STEPS INVOLVED IN MANUSCRIPT PREPARATION

A manuscript should both be informative and readable. Even though the concept is clear in the authors' mind, it is important to remember that they are introducing some new work for the readers, and, hence, appropriate organization of the manuscript is necessary to make the purpose and importance of the work clear to the readers.

- (1) *Choosing the appropriate journal for publication:* The preferred choice of journal should be one of the first steps to be considered, as mentioned earlier. The guidelines for authors may change with time and, hence, should be referred to at regular intervals and conformed to. The choice of journal principally depends on the target readers, and it may be necessary to have one or more journals in mind in case of nonacceptance from the journal of first choice. A journal's impact factor is to be considered while choosing an appropriate journal.
- (2) *Title and authorship:* The title of a manuscript gives the first impression about the manuscript. It is estimated that a reader dedicates less than 2 s to read the title.^[6] Most of the search engines use keywords to locate relevant articles, and, consequently, the title needs to be well thought of. A comprehensive title may have the following three important keywords: general, indicating the area or specialty the article belongs to; intermediate, referring to a specific disease or condition; and specific, referring to particular tests or interventions.^[6] It is important for the title to convey the new information the concerned study is offering. Abbreviations should be avoided, and many journals have limitations on the number of characters to be included in the title.^[7] In addition, some journals require a short running title for the readers' ease of reading.

Majority of the biomedical journals with good impact factor have specific authorship criteria.^[8] This prevents problems related to ghost authorship and honorary authorship. Ghost authorship refers to a scenario wherein an author's name is omitted to hide financial relationships with private companies; honorary authorship is naming someone who has not made substantial contribution to the work, either due to pressure from colleagues or to improve the chances of publication.^[9]

Most of the journals conform to the authorship criteria defined by the International Committee of Medical Journal Editors.^[10] They are listed as the following:

Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; ANDDrafting the work or revising it critically for important intellectual content; ANDFinal approval of the version to be published; ANDAgreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Some journals require authors to declare their contributions to the research work and manuscript preparation. This helps to prevent honorary and ghost authorship and encourages authors to be more honest and accountable.^[11]

- (3) *Abstract:* An abstract is a stand-alone part of the manuscript giving a brief overview of the contents; it may influence the editors, peer reviewers, and readers regarding the quality of the manuscript. It can be free styled or structured as per the journals' norm. A structured abstract has sections pertaining to Background, Aim, Materials and Methods, Results, and Conclusion. There is a word limit of 250 words for abstracts in majority of the journals. The abstract should be revised every time the manuscript is revised or changed.^[12]

Keywords: are mentioned at the bottom of the Abstract section. These words denote the important aspects of the manuscript and help identify the manuscripts by electronic search engines. Most of the journals specify the number of keywords required, usually between 4 and 8. They need to be simple and specific to the manuscript; a good title contains majority of the keywords.

The general flow of the manuscript follows an IMRaD (Introduction, Materials and Methods, Results, and Discussion) structure. Even though this has been recommended since the early 20th

century, most of the authors started following it since the 1970s.^[13]

- (4) *Introduction:* The Introduction section sets the tone of the manuscript and, hence, should be focused. It provides a relevant background for the study with appropriate references and establishes the context of the work.^[14] Any word or name with standard abbreviation should be written in its expanded form the first time, with the abbreviation in parenthesis. Subsequently, only the abbreviation should be used throughout the manuscript. The Introduction section is generally in the form of a funnel, with the first paragraph highlighting the magnitude and importance of the disease in question. Subsequent paragraphs summarize the relevant facts known and the areas with uncertainty in the context of the study question; this is followed by the relevance of the current study and ends with the aim of the study^[14-16] [Table 1]. A common error while writing an introduction is an attempt to review the entire evidence available on the topic. This becomes confusing to the reader, and the purpose and importance of the study in question gets submerged in the plethora of information provided. Issues mentioned in the Introduction section will need to be addressed in the Discussion section, and it is important to avoid repetitions and overlapping. Some may prefer to write the Introduction section after preparing the draft of the Materials and Methods and Results sections.

The last paragraph in the Introduction section defines the aim of the study or the study question using active verbs. If there is more than one aim for the study, specify the primary aim and address the secondary aims in a separate sentence. It is recommended that the Introduction section should not occupy more than 10–15% of the entire text.^[14]

- (5) *Materials and Methods:* The Materials and Methods section is the link between the Introduction and Results sections. The entire section is described in past tense. It describes the methods and means used to conduct the study in such a way that other researchers should be able to perform a

similar study with the given information.^[16-18] The type of the study (prospective/retrospective; interventional/observational; and cohort/randomized controlled/case–control study) should be clearly documented. It is then important to describe the place where it was conducted, the time duration taken, and to specify whether ethical approval had been sought and granted. The subsequent paragraph describes the study participants with selection and exclusion criteria, and provides information regarding the informed consent.

This is followed by a detailed description of the study protocol. At times, some of the methods used may be very elaborate and not very relevant to majority of the readers, for example, if polymerase chain reaction (PCR) is used for diagnosis, the type of PCR performed should be mentioned in this section, but the entire procedure need not be elaborated in the “methods” section. Either a relevant reference can be provided or the procedural details can be given online as supplemental data.

It is important to mention both the generic and brand names of all the drugs used along with the name of the manufacturer and the place of manufacturing. Similarly, all the hematological, biochemical, hormonal assays, and radiological investigations performed should provide the specifications of the equipment used and its manufacturer’s details. For many biochemical and endocrine parameters, it is preferred that the intra- and interassay coefficients of variation are provided. In addition, the standard units of measurements and the internationally accepted abbreviations should be used.^[18]

There are online guidelines available to maintain uniformity in reporting the different types of studies such as Consolidated Standards of Reporting Trials (CONSORT) for randomized controlled trials, Strengthening the Reporting of Observational studies in Epidemiology (STROBE) for observational studies, and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) for systematic reviews.^[19] Adherence to these guidelines improves the clarity and completeness of reporting.

Statistical analysis: One of the most important deterrents for publishing clinical research is the inability to choose and perform appropriate statistical analysis. With the availability of various user-friendly software systems, an increasing number of the researchers are comfortable performing complex analyses without additional assistance. However, it is still a common practice to involve biostatisticians for this purpose. Coordination between the clinicians and biostatisticians is very

Table 1: Important components of the Introduction section

General background of the condition to be discussed
What is known so far
A brief description of unknown aspects relevant to the study
Primary and secondary question/s to be answered by the study (aim)
Introduction section should preferably occupy about 10–15% of the manuscript

important for sample size calculation, creation of a proper data set, and its subsequent analysis. It is important to use the appropriate statistical methodologies for a more complete representation of the data to improve the quality of a manuscript.^[20]

It may be helpful to refer to a recent review of the most widely used statistical analyses and their application in clinical research for a better data presentation.^[20]

There is some evidence that structured training involving data analysis, manuscript writing, and submission to indexed journals improves the quality of submitted manuscripts even in a low-resource setting.^[21] Short, online certificate courses on biostatistics are available free of cost from many universities across the globe. The important aspects regarding the Materials and Methods section are summarized in Table 2.

- (6) *Results:* The Results section mirrors the Materials and Methods section and, for every step/intervention performed, there would be a result. It is a useful practice to put together the results in an orderly manner at the beginning of the manuscript preparation so that the message to be given becomes clear. It starts with the sample size, inclusion and exclusion details, which may be shown effectively as a flow chart, and followed by the basic characteristics of the study sample, usually represented in the form of a table.

The results of the study are summarized in the form of tables and figures. Journals may have limitations on the number of figures and tables, as well as the rows and columns in tables. The text should only highlight the findings recorded in the tables and figures and should not repeat every detail.^[16] Primary analysis should be presented in a separate paragraph. Any secondary analysis performed in view of the results seen in the primary analysis should be mentioned separately [Table 3].

When comparing two groups, it is a good practice to mention the data pertaining to the study group followed by that of the control group and to

maintain the same order throughout the section. No adjectives should be used while comparing, except for the statistical significance of the findings. The Results section is written in the past tense, and the numerical values should be presented with a maximum of one decimal place.

Statistical significance as shown by *P*-value, if accompanied by odds ratio and 95% confidence interval gives important information of direction and size of treatment effect. The measures of central tendencies should be followed by the appropriate measures of variability (mean and standard deviation; median and interquartile range). Relative measures should be accompanied by absolute values (percentage and actual value).^[22] The interpretation of results solely based on bar diagrams or line graphs could be misleading, and a more complete data may be presented in the form of box plots or scatter plots.^[20]

- (7) *Discussion:* The Discussion section provides the interpretation of results and describes them in the context of available evidence. The first paragraph summarizes the main results in 2–3 sentences. The subsequent paragraphs should review the results in the context of available body of literature elaborating the similarities and differences. Any result not conforming to expectations or previous evidence should be analyzed, and any unexpected result should be highlighted as such.

The strengths and weaknesses of the study should be discussed in a separate paragraph. This makes way for implications for clinical practice and future research.^[16,23]

The section ends with a conclusion of not more than one to two sentences. The Conclusion section summarizes the study findings in the context of evidence in the field. The important components of the Discussion section are summarized in Table 4 [Figure 1].

- (8) *References:* A referencing tool such as EndNote™ may be used to store and organize the references. The references at the end of the manuscript need to

Table 2: Important components of the Materials and Methods section

Study design and setting; time period
Participants – inclusion and exclusion criteria
Ethical approval
Informed consent
Protocol of the study
Data collection
Sample size calculation
Methods of data analysis

Table 3: Important components of the Results section

Sample size with details of exclusion
Basic characteristics of the sample (demographic details)
Main results in tables/figures with brief description in text without any interpretation
The Results section should reflect the Materials and Methods section
Secondary results (post-hoc analysis) should be given separately
Written in past tense

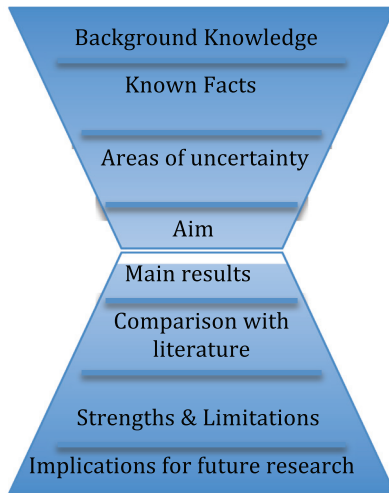


Figure 1: The hourglass structure of the Introduction and Discussion sections

be listed in a manner specified by the journal. The common styles used are Vancouver, Harvard, American Psychological Association (APA), etc.^[24] Despite continued efforts, standardization to one global format has not yet become a reality.^[25] A referencing tool such as EndNote™ may be used to store and organize the references. The references at the end of the manuscript need to be listed in a manner specified by the journal. The common styles used are Vancouver, Harvard, APA, etc.^[24] Despite continued efforts, standardization to one global format has not yet become a reality.^[25]

It is important to understand the evidence in the referenced articles to write meaningful Introduction and Discussion sections. Online search engines such as Pubmed, Medline, and Scopus are some of the sources that provide abstracts from indexed journals. However, a full-text article may not always be available unless one has subscription for the journals. Those with institutional attachments, authors, and even the research division of pharmaceutical companies may be unconventional but helpful sources for procuring full-text articles. Individual articles can be purchased from certain journals as well.

- (9) *Acknowledgements:* This section follows the Conclusion section. People who have helped in various aspects of the concerned research work, statistical analysis, or manuscript preparation, but do not qualify to be authors for the study, are acknowledged, preferably with their academic affiliations.^[26]
- (10) *Conflicts of Interest (COI):* It is important for authors to declare any COI relevant to the

Table 4: Important components of the Discussion section

Summary of main findings
Ensure that the results answer the main study question
Compare the results with other studies
Strengths and limitations of the study
Highlight implications for clinical practice and future research
Introduction and Discussion sections together form a hourglass pattern
No new results to be presented in this section, and no repetition of the actual data presented in the Results section
One-line conclusion

manuscript. The COI may be personal, commercial, political, academic, or financial. These may have negligible to very significant impact on the quality of the manuscript.^[27] Holding a post in a pharmaceutical company or being a beneficiary of grants from pharmaceutical industry may have COI with the quality of research.^[28] Even reviewers and the editorial board members need to declare COI before accepting to review an article.

The aforementioned section provides the general guidelines for preparing a good manuscript. However, an exhaustive list of available guidelines and other resources to facilitate good research reporting are provided by the Enhancing the Quality and Transparency of Health Research network (<http://www.equator-network.org>).

ADDITIONAL FACTORS INFLUENCING THE MANUSCRIPT QUALITY

- (1) *Plagiarism:* Plagiarism is a serious threat to scientific publications and is described by the office of Research Integrity as “theft or misappropriation of intellectual property and the substantial unattributed textual copying of another’s work and the representation of them as one’s own original work.” The primary responsibility of preventing plagiarism lies with the authors. It is important to develop the skill of writing any manuscript in one’s own words and when quoting available evidence, substantiate with appropriate references. However, the use of plagiarism detection tools and a critical analysis by the editorial team prior to submitting an article for peer review are also equally important to prevent this menace.^[29] The consequences of plagiarism could range from disciplinary charges such as retraction of the article to criminal charges.^[30]
- (2) *Language:* One of the important limitations to publication is the problem of writing in English. This can be minimized by seeking help from

colleagues or using the language editing service provided by many of the journals.

- (3) *Professional medical writing support*: In recent years, it is acknowledged that the lack of time and linguistic constraints prevent some of the good work from being published. Hence, the role of professional medical writing support is being critically evaluated. Declared professional medical writing support is found to be associated with more complete reporting of clinical trial results and higher quality of written English. Medical writing support may play an important role in raising the quality of clinical trial reporting.^[31] The role of professional medical writers should be acknowledged in the Acknowledgements section.^[32]

SUBMISSION TO JOURNALS AND REVIEWING PROCESS

The submission of manuscripts is now exclusively an online exercise. The basic model of submission in any journal comprises the following: the title file or first page file, article file, image files, videos, charts, tables, figures, and copyright/consent forms. It is important to keep all the files ready in a folder before starting the submission process. When submitting images, it is important to have good quality, well-focused images with good resolution.^[33] Some journals may offer the choice of selecting preferred reviewers to the authors and hence, one must be prepared for this. Once the manuscript is submitted, the status can be periodically checked. With minor variations, a submitted article goes through the following review process: The Editor allocates it to one of the editorial team members who checks for the suitability for publication in the journal. It is checked for plagiarism as well at this stage. The article then goes for peer review to two to three reviewers. The review process may take 4–6 weeks, at the end of which, the reviewers submit their remarks, and “article decision” is made, which could be an advice for minor/major revisions, rewriting the whole manuscript for specific reasons, acceptance without any changes (very rare), or rejection. It is important to take into consideration all the comments of the reviewers and incorporate the necessary changes in the manuscript before resubmitting. However, if the manuscript is rejected, revise to incorporate the valid suggestions given by the reviewers and consider submitting to another journal in the field. This should be effected without delay overcoming the disappointment so that the research still remains valid in the context of time.

PREDATORY JOURNALS

Some of the well-known journals provide an “open access” option to the authors, wherein if the manuscript is

published, it is accessible to all the readers online free of cost. However, the authors need to pay a certain fee to make their manuscript an open access article. In addition, some of the well-known journals published by reputed publishers such as BioMed Central (BMC) and Public Library of Science (PLOS) have online “open access” journals, where the manuscripts are published for a fee but are subjected to the conventional scrutiny process, and the readers can access the full-text article.^[34] The Directory of Open Access Journals, <http://doaj.org>, is an online directory that indexes and provides access to high-quality, open access, peer-reviewed journals. However, many online open access journals are mushrooming, which provide a legitimate face for an illegitimate publication process lacking basic industry standards, sound peer review practices, and solid basis in publication ethics. Such journals are known as “predatory journals.”^[35] The pressure of needing to have scientific publications and the lack of knowledge regarding predatory journals may encourage authors to submit their articles to such journals. Currently, it is not easy to identify predatory journals, and authors should seek such information proactively from mentors, journal websites, and recent and relevant published literature. In addition, editorial oversights (editors and editorial board members), peer review practices, the quality of published articles, indexing, access, citations and ethical practices are important aspects to be considered while choosing an appropriate journal.^[36]

SUMMARY

A relevant research hypothesis and research conducted within the ethical framework are of utmost importance for clinical research. The natural progression from here is the manuscript preparation, a daunting process for most of the clinicians involved in clinical research. Choosing a journal that provides an appropriate platform for the manuscript, conforming to the instructions specific for the journal, and following certain simple guidelines can result in successful preparation and publishing of scientific work. Allocating certain time at regular intervals for writing and maintaining discipline and perseverance in this regard are very important prerequisites to achieve the goal of successful publication.

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Conflicts of interest

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