Review Article

How to write a research paper? A guide for medical professionals and students

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ABSTRACT

Research in medical academia is essential for generating medical evidence, formulating clinical guidelines, and drawing conclusions. However, many researchers struggle to disseminate their findings due to insufficiently prepared manuscripts and repeated rejections. Factors contributing to inadequate manuscripts include lack of originality, suboptimal research design, unsuitable methodology, errors in selecting statistical tools and methods, insufficient training in scientific writing, and grammatical and syntactical errors. This review aims to provide an overview of manuscript preparation for medical professionals and novice researchers, covering the structure of a medical research manuscript.

Key words: Manuscript, Medical research, Scientific article, Scientific writing

There are numerous reasons for conducting research; to generate medical evidence, to formulate clinical guidelines, and to draw conclusions for bewildering medical scenarios [1]. Likewise, the goal of writing a manuscript and publishing it may have completely different reasons; For example, to obtain certification as a prolific writer, receive citations for our work, career growth, accreditation, and stay current in our specialty. The final stage in the realm of medical academia is the dissemination of research findings through publication. Considerable effort is devoted to completing medical research; however, when it comes to disseminating these diligent efforts, a significant number of researchers either experience a decline in motivation or become disengaged. Insufficiently prepared articles and repeated rejections from different journals further diminish the morale of medical researchers; especially those who are novices in this attempt [2]. The absence of originality and novelty in research, suboptimal research design, unsuitable methodology, errors in selecting appropriate statistical tools for data analysis and techniques, insufficient training in scientific writing, grammatical and syntactical errors, and various other deficiencies are significant factors that contribute to the production of an inadequate manuscript. The pleasure and delight associated with the act of writing might wane if authors, although possessing considerable aptitude, experience repeated rejections of their works [3]. This review in two series of papers attempts to deliver an outline about preparing a manuscript for medical professionals and novice researchers; this paper will cover the structure of the manuscript and the later one will cover practical aspects, publication ethics, journal selection, and other pertinent aspects of preparing scientific manuscript.

Access this article online	
Received: 10 November 2023 Initial review: 11 November 2023 Accepted: 19 November 2023	Quick Response code
DOI: 10.32677/yjm.v2i3.4349	

STRUCTURE OF A MANUSCRIPT

Like a well-directed movie, a scientific manuscript should have a beginning (Introduction), a middle portion (Materials and Methods), and a climax (Results). The Discussion (the moral of the story) puts the study in perspective along with the implications. The "IMRAD" format is the globally accepted structure for presenting a research study in a paper. However, it may vary depending on the article type. Sometimes further subheadings are needed to structure the manuscript as per journal demands. In general, a manuscript will have sections as depicted in Box 1.

Title of Manuscript

The title gives the first impression of the manuscript and is the first part the reader sees after publication; therefore, it should be appealing. There are limitations to creating interesting clinical trial titles because experimental studies must follow a specific structure when creating titles. Population, Intervention, Control/Comparison, Outcome, and Time (PICOT) and PICO formats are

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followed often for experimental studies. The title is also utilized by Journal finders. Ideally, Medical Subject Headings (MeSH) terms usage is preferred while preparing a title. It is not mandatory to be traditional like the title of academic thesis or dissertation. Certain authors depict that the length of the title can be 10–15 words, as shorter titles receive more citations [4,5]. Use punctuation commas, colons, or semicolons as appropriate. No abbreviations, jargon, or humor need to be used in the title; but there are instances where authors use globally used standard abbreviations. Steps in preparing a title for a manuscript are depicted in Box 2.

Examples of some engaging titles; Publish or Perish: The Art of Scientific Writing [6], Mirror, mirror on the Wall, Who Is the ugliest of them all? The Psychopathology of Mirror Gazing in Body Dysmorphic Disorder [7]. Depending on the individual style of writing and the nature of the article, the title structure will vary accordingly. It is advisable to keep titles as formal as possible but if the article is opinions or commentaries, can be less restrictive. Including humor, jargon and measures to make the title strange can be counterproductive as well [8]. Different types of titles can be used based on their structure, detailing such is out of the scope of this article. However; authors can go through this article for detailed information on titles – *Choosing an appropriate title for your manuscript* [9] by Dr Samir Kumar and Dr Shaul Ameen.

Abstract of the Manuscript: Executive Summary

The abstract is the executive summary of what was done, why and how, and to what ends. Before preparing the abstract for a manuscript, authors should refer to a couple of published abstracts from the selected journal to get an understanding of the structure and format of the abstract. The word length is specific to journal guidelines, ideally the word limit (150–250 words) and it can be structured (with subheadings; background, materials and methods, results and conclusion) or unstructured (without subheadings).

Box 1: Sections/headings of a manuscript

1. Title
2. Abstract
3. Keywords
4. Introduction
5. Materials and methods
6. Results
7. Discussion
8. Conclusion
9. Conflict of interest
10. Funding details and authors' contributions
11. Acknowledgments
12. References

Box 2: Steps to prepare a title

- List all possible keywords relevant to the study.
- For each keyword generate all possible alternatives
- Use varying combinations and sequences of keywords and connecting words.
- Phrase maximum titles possible
- Correlate with manuscript text to ensure its connection within.
- Feedback and finalize with experts in the field and peers

Contents that need to be inculcated in an abstract are as follows;

Background and purpose

Two or three sentences are needed in this section. Utilize this section of introducing the topic, to portray research lacunae in the area of research with crux obtained from the review of literature and pose research questions as objectives.

Materials and methods

Research design, details of study subjects, tools and techniques, and data collection process of the study can be mentioned very briefly. If it is a review paper; mention the process of selection of articles used for the review.

Results

This section should be presented with statistical data; No speculation or opinions are required. Such aspects can be discussed in detail in the discussion section of the manuscript. Present the main findings of the study in relation to the main objectives. A detailed presentation of demographic data of the subjects can be avoided in the abstract.

Conclusions

Why study results are important, do not restate or summarize results, avoid "clichés", don't stress how novel; let results speak for themselves. Attempt to present the insight gained from the study and implications obtained from findings.

It is not advisable to include too much information in the abstract. Avoid details of the software, criteria for statistical tests, abbreviations unless they are repeated, and references within the abstract [10].

Choosing Keywords

Keywords give an idea about the pillars of the manuscript. Typically, a set of 3-10 keywords is necessary to accompany the abstract, serving to indicate the primary subject matter of the research. The words that should be included in the MeSH of the National Library of Medicine (NLM) databases. Keywords can be topic, conceptual approach, methodology, applications, and population. Select keywords carefully as search engines may use these to identify (or not) your article. The use of MeSH option from PubMed is the commonly utilized way to find out keywords for medical literature [11].

Introduction Section

A funnel approach to this section can be a useful heuristic while writing the introduction section. This part is one of the hectic tasks

in preparing manuscripts and major corrections or suggestions from reviewers are often reported in modifying the introduction. Certain questions need to be addressed while presenting the introduction section;

- What do we know about the phenomenon under discussion?
- What we don't know?
- Why is it important to know this?
- What is your paper proposing to do towards this end?

The introduction of a manuscript should be able to present the background of the study/article as well as the need and importance of the study. The authors should explain how this study fills a gap in the literature, whether this manuscript serves to clarify a previous idea, illustrate an approach, test a hypothesis, and illustrate its contribution to theory or practice development, etc. It is worth noting that, unlike theses or dissertations, a separate section called "literature review" does not exist in a research paper. Instead, the introduction contains a brief literature review.

When thinking about the overall structure of the introduction section, it is helpful to visualize the introduction as a funnel: Starting with a broad problem statement and narrowing it down to a specific problem and the direction in which the solution is to be sought. The Literature should be analyzed and evaluated critically rather than simply described. The author should set up the argument of the paper; and consolidate and focus the rationale for the study. A detailed introduction gives an overview of; what can be expected from the work, the background of the research question mentioning the importance and magnitude of the problem, previous research in the relevant area, problems with the available literature, and what the authors have done to address such problems, and hypothesis of the study. Try to present the above aspects without subheadings [12]. In the last paragraph of the Introduction section, the author should clearly state the aim of his study.

Authors should refrain from certain mistakes in the introduction such as; quoting unwanted arguments "*No study so far attempted*" or *"This is the first study"*, unless a proper literature search has been conducted. Let readers and reviewers decide the novelty and importance of your study. Beware of plagiarism, as it can result in definite rejection. The introduction should have a clear flow, conclude the introduction with a statement that justifies your study, and leave details, speculation, and criticism in the manuscript for the discussion portion.

Materials and Methods Section

This is one of the straightforward sections of a manuscript, and it is comparatively easy to write. The authors usually start manuscript preparation with materials and methods. Alhough it is easy, it should be clear and written in detail so that others can grasp the crux of the study and, if necessary, be able to reproduce it. Although four headings are often used in the Materials and Methods section: Participants and Subjects, Tools and Techniques, Procedures, and Statistical Analysis [13], this section may contain subheadings based solely on journal policies and the nature of the research. The components of the materials and methods section are summarized in Box 3.

Box 3: The components of the materials and methods section

- Design, setting, and population of the study.
- Sampling, sample size calculation, eligibility criteria (inclusion and exclusion), PRISMA flow chart for systematic reviews and meta-analysis.
- Flow charts can be placed if the manuscript is a review paper, which depicts how papers reviewed in the manuscript are screened and selected.
- Randomization procedure, allocation of subjects and concealment details, blinding in the case of clinical trials and experimental studies.
- Tools and techniques used (e.g., scales, devices), scoring details, psychometric properties (reliability, validity), interpretation of scoring after analysis.
- Details of variables such as dependant and research (primary, secondary), confounding variables if identified any.
- Description of interventions used in experimental studies in all the groups (e.g., Experimental, control, and or placebo).
- Statistical procedures used (software and its copyright with references, tests used for the study).
- Ethical considerations of the study (Include Institutional Ethics Committee approval number and dates, if using standardized tools mention author permission availed as appropriate).

Avoid information about the institution, the location of the institution, and other salient details that can hinder the blind peer review process. A common mistake authors make is presenting materials and methods sections using bulletin points, which is not recommended by editors or indexed journal guidelines.

Results Section: Portraying Results in the Manuscript

The section titled "Results" holds significant importance within a research study. Indeed, the authors will disseminate the findings of their research through the results section to their readers. To mitigate potential reader disengagement when perusing a scientific paper, it is advisable to present certain facts in a visual style, such as graphics and figures, as opposed to densely populated numerical values inside the textual content. Tables and figures are commonly examined by peer-reviewers and authors should ensure they are self-explanatory. The inclusion of high-quality tables and figures enhances the likelihood of manuscript acceptance for publication [14]. During the writing process of a research manuscript, it is commonly believed that positive and significant findings hold greater importance, appeal, and value, but negative and insignificant findings are deemed useless and less appealing. Scientific study is conducted with the purpose of testing a hypothesis, rather than confirming it. In addition to documenting positive and statistically significant findings, it is important to recognize the value of negative or statistically insignificant outcomes that challenge prevailing beliefs and expose fallacies in widely held opinions. Hence, it is imperative to include all research findings within the designated "Results" section [15].

Tables should be in the order suggested by the editorial board of the journal. It is not advisable to duplicate data inside the main body of the text or in tables many times. Tables must possess a

level of comprehensibility such that a reader may form an idea regarding the findings solely by perusing the tables without the need to delve into the accompanying text. The data presented in tables should adhere to the information provided in the main text, and the percentages displayed in rows and columns should be calculated appropriately. It is imperative to provide a clear and precise definition for the unit of measurement for each variable. It is highly recommended to clearly specify the sample size for each category. Values should be represented in academic discourse as values accompanied by the standard error, range, or a 95% confidence interval. Tables should incorporate accurate p-values, and the level of significance determined through statistical analysis should be clearly noted in the footnotes [16]. Always start with the descriptive statistics of study subjects and then move on to the next core objectives and higher inferential statistics as appropriate.

Summary tables provide a comprehensive overview of the characteristics of the subjects participating in a study, providing valuable insight into the study population. In addition, these tables serve to place the study in the appropriate context and thus enable a better understanding of the research results. There exist various methods for presenting the primary findings, with the choice contingent upon the nature of the variables under investigation. When composing a manuscript, it is crucial to create well-defined tables that effectively present the characteristics of the study population and the primary findings. Effective utilization of tables can greatly benefit readers and enhance the likelihood of paper publication [17]. Tables and their utilization in the manuscript are detailed in the article; *Getting Started with Tables* by Inskip [18].

In the "Results" section, numerical expressions should be articulated using terminology that is technically appropriate. The numerical value of the digits following punctuation marks should be consistent throughout the text. In academic practice, it is recommended to represent data using the mean or median along with the standard deviation. To provide comprehensive information, it is important to provide data such as age and scale scores, along with their respective ranges of values. It is necessary to provide the absolute numerical number that corresponds to a given percentage. In statistical analysis, it is recommended to present p-values in their absolute form. When documenting statistically significant data, it is recommended to report the exact degree of significance rather than using the notation "$p<0.05$". When $p<0.001$, it can be expressed as $p<0.01$. In the "Results" section, it is important to highlight essential data that readers should be reminded of in the main body of the text. Including further demographic statistics in tables or figures would be considered appropriate [12].

If the data is normally distributed, it is shown as the mean (standard deviation [SD]). If it is not normally distributed, it is shown as the median (interquartile range). If the SD number is more than half of the mean that could mean that the data is not normal. It is important to report more than just the size of the range. You should also include the upper and lower limits of the ranges and their lowest and highest figures.

Statistics that describe categories are shown as n (%). However, saying only, the number of patients and the percentage may be misleading if any data is missing. For example, saying "14 patients (23.33%) had no improvement" without saying how many patients were in the group could be misleading. When writing the percentage, specific guidelines recommend using one decimal point when n is higher than 100, none when n is between 20 and 100, and not writing the percentage at all when <20.

Discussion Section

The significance of the discussion section within a manuscript cannot be overstated. The significance of the findings acquired in the study is elucidated in this section. The researcher accepts or rejects the proposed hypothesis and offers contextualization for the obtained results. A well-crafted discussion enhances the lucidity and intentionality of the work, garnering appreciation from the readers.

Do not repeat in detail statistical data or other information given in other parts of the manuscript, a narrative summary of results is appreciated. Link the conclusions with the objectives of the study and avoid unqualified statements and conclusions not adequately supported by the data. In particular, distinguish between clinical and statistical significance while discussing study findings. State new hypotheses when warranted, but state them clearly. The organization of the discussion section is based on; a summary of results, discussion of major findings, discussion of other results, strengths of the study, limitations of the study, implications, generalizability, future recommendations, and conclusion of the study. Subheadings are not warranted for this section [19].

It is unnecessary to reiterate the objectives throughout the discussion phase. Furthermore, it is unnecessary to duplicate the procedures and findings. In certain instances, throughout the discussion of methodologies and findings, it may be necessary to rewrite the language. The reader gains an understanding of the significance of the study findings on reviewing the discussion section. It is crucial to elucidate the salient facets of the study and situate them within the framework of preexisting knowledge. While some degree of subjectivity may be included in the discourse, it is important to strive for objectivity to the greatest extent possible. The composition of this form of writing necessitates a comprehensive comprehension of the research strategy and outcomes, as well as an extensive engagement with the pertinent scholarly works. Consequently, the first draught should undergo multiple iterations of modification before reaching its ultimate form. Researchers must possess the ability to effectively articulate their narratives within the manuscript [20].

Stating the Limitations of the Study

Limitations are often inculcated within the discussion section or sometimes under a separate heading as per journal guidelines. This section portrays the weaknesses of the study in terms of study design, data collection process, data analysis, study

results, feasibility, threats to internal and external validity, and the presence of possible issues for replication of the study in the future. The authors need to describe all potential and encountered limitations along with any suggestions on approaches to mitigate such in future research. The authors need to mention what these limitations indicate and any measures adopted for addressing such limitations present in their study if any [21].

Conclusion Section: Concluding the Manuscript

The manuscript's conclusion should summarize and reiterate the paper's core argument. It needs to be short and sweet, avoiding any details that were not already covered elsewhere in the text. Instead, you can make suggestions about how your research can be expanded or improved and provide a conclusion. Like the abstract, this section of the manuscript should not contain citations.

Stating Conflicts of Interest

The majority of academic publications mandate that the authors include a comprehensive disclosure of any conflicts of interest pertaining to the research presented in their manuscript. The authors are often obligated by various publications to fulfill the need to complete and sign specified forms. Furthermore, some individuals may request explicit language requirements either inside a particular section of the manuscript or within the accompanying cover letter.

Conflicts of interest in research refer to circumstances in which the impartiality of professionals may be affected, or perceived to be compromised, due to conflicting financial, personal, or professional affiliations, as well as personal views and positions. The presence of conflicts of interest in research and academic writing is a frequently observed phenomenon. Although the presence of undisclosed conflicts of interest may not be considered inherently unethical, the failure to acknowledge or disclose them might be viewed as unethical and can have detrimental effects on the researcher's professional standing. The identification and declaration of potential conflicts by all parties involved in research and publication, particularly authors, is crucial to facilitate the seamless processing of a paper.

Funding Details and Authors' Contribution

Funding details should be mentioned in this section with all essential information about the organization and relevant identifiers. The author contribution is usually demanded by journals as a research project typically involves multiple contributors, including a principal investigator, students, and technical staff. The order of authorship is crucial, with the first and last positions being the most sought-after. The first author is the primary author, who contributed significantly to the study design and data collection, while the last author is the PI who conceptualized the research and helped secure funding. This order can cause confusion and ethical issues during submission.

Box 4: Examples of in-text citations

- Author and date: Within text or at the end of the sentence in brackets, e.g., (Manoj, 2021).
- Numbering style intext citation: Superscript or in parentheses, e.g., "as reported in a large-scale study [2]." or "as reported in a large-scale study [2]."

Reference Section

Proper referencing is a cardinal step while preparing a manuscript. The authors should give due credit to sources of literature and data in the manuscript. The quality of the manuscript may be in question if no proper citation is placed. This even can affect the credibility of authors and a doubt of plagiarism may also come up. Poor referencing is not appreciated by any journals and sources cited from poor-quality journals or predatory journals may also warrant a modification and or rejection from the editor as such [22]. If a current and well-known article is not cited, it can be assumed that a proper literature search was not carried out before writing the manuscript. Strict referencing can eliminate all of these potential problems in the manuscript. A manuscript with all correctly cited sources, a reference list with exact spelling, page numbers, and information about the authors gives editors and reviewers clarity about the transparency of the manuscript. Always try to cite the primary sources and unless it is appropriate avoid self-citation, which is against publication ethics [23].

Authors should strictly adhere to the citation method recommended by the journal in the author guidelines. Commonly used citation styles include Vancouver, the NLM, Harvard, and the American Psychological Association (APA) style. However, it may vary from journal to journal. All methods have different formats for representing a reference depending on the type of sources, such as journals, books, websites, etc. Basically, the citation methods are either "author name and date" (such as APA style) format and numerical system (Vancouver or NLM style). The in-text citation refers to placing identifiers within the text; it could be the author and date, or a numbering list as depicted in Box 4. In-text citations should follow the list of references placed at the end of the manuscript in the reference section.

The authors can refer to "The art of referencing: Well begun is half done!" [24]. By Divecha CA, Tullu MS, and Karande S which details referencing methods for scientific manuscripts. Common errors in referencing include duplicates in the reference list, in-text citation numbers that do not match the list, citing after reading only the abstract of an article, and self-citing to increase the authors' h-index [25]. The authors may use free reference software (Zotero, Mendeley, etc.). Cite this, is an automatic bibliography generator (www.citethisforme.com) that can be used to generate references when writing a manuscript.

CONCLUSION

Almost every important and desired aspect of putting together a publishable scientific manuscript has been discussed in this narrative review. Everything included in this summary is an

essential part of the academic writing process before submission for publication. Although certain topics may have been touched on only briefly, this article is intended to cover the basics of research writing. Further information is available for free download on the International Committee of Medical Journal Editors website (www.icmje.org).

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Funding: None; Conflicts of Interest: None Stated.

How to cite this article: Larson MK. How to write a research paper? A guide for medical professionals and students. Yemen J Med. 2023;2(3):124-129.