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AVOIDING MISTAKES WHILE WRITING SCIENTIFIC MANUSCRIPTS IN HEALTH SCIENCES

Como evitar erros durante a redação de manuscritos científicos nas ciências da saúde

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ABSTRACT

INTRODUCTION: This article is part of a special series designed to help authors in the process of scientific writing. **OBJECTIVE:** To address common mistakes that researchers commit while writing a manuscript, in order to understand and optimize the process of writing a new research paper. **METHODS:** The authors made a nonsystematic search in the current literature (PubMed) to retrieve papers that address the most frequent mistakes found by editors, peer reviewers, journals and authors. **RESULTS:** According to the search results, key findings about the most common mistakes for each section of a manuscript were described (introduction section, methods section, results section, discussion section, conclusion section, references, title and abstract). **CONCLUSION:** There is a great amount of avoidable mistakes in each section of a scientific manuscript. Overall, among the most common mistakes are missing data, incomplete sections, excessive report of current literature or reporting data in an inadequate section.

KEYWORDS: manuscripts; editorial; journal article; medical writing.

RESUMO

INTRODUÇÃO: Este artigo é parte de uma série especial destinada a auxiliar autores no aprimoramento da redação de manuscritos científicos. **OBJETIVO:** Abordar os erros mais comuns que autores cometem ao escrever um manuscrito, a fim de destacar as principais falhas e otimizar o processo de redação. **MÉTODOS:** Foi realizada uma busca não sistemática na literatura (Pubmed) de artigos que abordam os erros mais frequentes encontrados pelos editores, revisores, revistas e autores. **RESULTADOS:** De acordo com a literatura pesquisada, existem diversos erros comuns e que usualmente se repetem em cada seção de específica de um manuscrito, (introdução, métodos, resultados discussão, conclusão, referências, título e resumo). **CONCLUSÃO:** Existe uma grande quantidade de erros em cada seção de um artigo científico que podem ser contornados de maneira relativamente fácil. Via de regra, as falhas mais frequentes estão relacionadas à descrição de dados de maneira incompleta, seções incompletas, descrição excessiva de literatura atual ou descrição de dados locais inadequados.

PALAVRAS-CHAVES: manuscritos; editorial; artigo de revista; escrita médica.

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INTRODUCTION

During the year 2010, an approximate number of 6,000 papers were received by the New England Journal of Medicine, one of the most important scientific journals in the world. Noteworthy, 62% were initially rejected without even going through peer review, especially due to trivial and common mistakes that can be avoided by using a more careful writing framework. Furthermore, the remaining 38% underwent peer review, and 31.2% were rejected after revision.¹ In addition, between 2010 and 2013, the journal Nature received almost 10,000 submissions; overall, approximately 800 to 900 manuscripts were accepted and published.²

Looking at those numbers, an author should wonder the reasons why a massive amount of manuscripts is rejected. Surprisingly, most of the reasons are not related with the science content, study design and results, but to the way it is reported. Overall, among the most frequent causes of rejection, the following examples are important to point out for the purpose of this manuscript:

1. lack of consistency among the sections of the manuscript (missing data);
2. the manuscript does not follow the guidelines requested by the journal;
3. poor English structure, including grammar and spelling;
4. unclear hypothesis.^{3,4}

The purpose of this review was to describe common mistakes that researchers often make when writing scientific manuscripts. Additionally, we provide general tips for writing research articles in order to optimize writing and help in the development of a successful scientific manuscript.

Overall structure of scientific manuscripts

Currently, there are several available types of scientific papers such as: randomized clinical trials (RCTs), case reports, systematic reviews, meta-analyses, surgical Notes, etc.⁵ Each type has its own specific features that need to be addressed while writing. However, they usually share some common characteristics that will be mentioned in this paper to highlight the common mistakes made by authors during challenging process of writing a scientific manuscript (Table 1).⁶

The most common structure for scientific papers is based in the IMRAD format that includes the following key points: Introduction, Method, Results and Discussion.^{7,8} Despite the fact that it has been used since the first half of the 20th century, a potential mistake while writing a scientific paper is an inadequate or incomplete description of one or more of its components.⁷⁻⁹

How to discuss the concepts of manuscript writing

In order to retrieve relevant data and discuss the skeleton of a scientific manuscript based on the IMRAD format, a search was performed in the most important data bases (PubMed, Web of Science and Google Scholar), utilizing keywords such as “manuscript writing”, “scientific manuscript”, “medical writing”, “manuscript” and “journal article”. Moreover, a brief discussion towards the major flaws found at the conclusion, references, title and abstract of a manuscript is also provided.

Table 1 Most frequent mistakes.

Introduction section
1. Excessive summarizing all the available bibliography
2. Excessive utilization of loose expressions
3. Absence of a clear hypothesis
4. Citing references that are not relevant to the study
5. Vocabulary too specialized for the desired audience of readers
Methods section
1. Not standardized measurements
2. Missing data
3. Inadequate support for sample size calculation
4. Inappropriate basis of validity and reliability of outcomes
5. Inadequate specification when outcomes are used for first time (new outcome tested)
Results section
1. Adding discussion or interpretation of data
2. Inadequate graphics, figures and tables
3. Not following adequate statistical rules
4. Incomplete data reported
5. No logical order
Discussion section
1. Reporting just positive outcomes
2. Inadequate comparison with current literature
3. Overestimation of results
4. Citation of unrelated papers
5. Not addressing limitations or existence of conflicting reports

Introduction section: catching the reader's attention

A good first impression is critical to get a manuscript approved by an editor and reviewers. Furthermore, it is of utmost importance to catch the reader's attention. The introduction plays a unique role, once it helps to properly place the research in context to the current literature.¹⁰ A good introduction must convince both audience and editors that the study is relevant and interesting; therefore, it is worth reading and publishing.^{11,12}

In order to reach a high-quality level, the introduction should address some specific questions. The first one is referred to the context and the importance of the manuscript (what is the research question?). In the opening part, it is important that the authors support arguments with scientific facts, evidence and references, showing editors and readers the "real problem" that was chosen to be studied.^{6,11,13}

The second point must be focused in briefly describing available solutions for the specific problem, providing a background with the essential information. As a result, the reader will be able to understand the study and its contributions.¹¹ A frequent mistake is to write the introduction as it was a summary of all the available bibliography on the subject, adding detailed description of the overall literature in the topic. However, the ideal goal is to focus on topics specifically related to the manuscript that the researcher is writing.⁶ Another common mistake is to cite references that are not clearly relevant for the study. Although it is important to provide a background and cite the main scientific contributions, improper citations and judgments of the overall knowledge can jeopardize the introduction section.³

The third observation is called the "however argument" or "gap", which might be one of the most relevant issues related to the introduction. The author should point out the limitations of the available evidence and present the literature gap to the readers. In other words, they should emphasize that there is a lack in the literature that requires further investigation and also has major relevance. After approaching all the first issues of the introduction, in this part, the author should go directly to the point, be concise and avoid using an excessive amount of words.¹¹⁻¹³

Moreover, in order to have an adequate sequence throughout the introduction, the author should consider following the analogy of the "funnel framework". An overall picture of the topic should be provided at the very beginning. Afterwards, a more detailed explanation related to the gap in the current knowledge and how the available literature is still not in agreement have to be considered. Furthermore, the author should conclude with the desired research question to be evaluated and responded with the clinical study.^{6,14}

Finally, in the last subsection of the introduction, the author should state the work hypothesis and objectives. The purpose and research strategy adopted in the scientific project have to be clear at this point. A common error is mixing results and conclusion in the introduction part.¹¹ It is not unusual to see unclear hypotheses, which in fact are one of the key stones of a research paper. The authors are encouraged to describe in a clear manner a hypothesis that includes the corresponding outcomes to evaluate it. Overall, a good hypothesis should be a formal statement of the expected results addressing the relationship of the study variables.⁶ In order to be clear, the researcher should go back to the question that is intended to be answered, and, based on the evidence, do a prediction on the results that so far were not proven or disproven.⁶

Besides that, some other aspects should also be taken into account for a well-written introduction section. The target audience must be considered in order to write accordingly to their perspectives (e.g. physicians use more specialized vocabulary to talk to a peer from the same department than to talk to a physician in a different specialty or to a different type of scientist). With that in mind, it is also important to select a proper journal. Some journals focus on basic research areas, while others focus on clinical research. The manuscript also needs to meet the criteria of the journal that the researcher is willing to submit it to.¹⁵ Furthermore, some editors suggest that lose expressions such as "novel", "first ever", "paradigm-changing" are not appropriate and should be used with caution. It is also important to carefully search the current literature for similar, prior research with the same hypothesis. Mistakes in any of those aspects could mislead the proper development of the manuscript. Although the general suggestion is not to use these terms at all, if the study is really innovative, terms such as "to the best of our knowledge, this is the first study to", or "as far as we are concerned, this is the first study to" are more appropriate.

Method section: the heart of the manuscript

The overall goal of the method section is to provide the reader with a detailed structure of the study design.¹⁶ In addition, this section should contain an ideal amount of information in order to enable a proper understanding and to allow the study's reproducibility.^{10,17} Nevertheless, one of the most common mistakes that can be encountered while describing this section is any potential missing information towards its components and steps such as an inappropriate description of study overview, eligibility criteria, sample size, inclusion and exclusion criteria, randomization, allocation concealment, blinding and statistics methods.^{6,13,18}

In order to avoid any missing data, checklists (e.g. CONSORT checklist for RCTs,¹⁹ PRISMA for meta-analyses and systematic reviews,²⁰ STROBE for observational trials,²¹ SPIRIT for research protocols²²) play a key role to assure that every component of the design will be taken into account and, therefore, properly described.^{6,13} These guidelines should be followed while reporting a scientific research in order to avoid missing information or reporting bias, giving more importance to some aspects than to others. For instance, even though most of the RCTs are published following the CONSORT criteria, some mistakes are frequently found, such as the lack of information about the randomization process, allocation concealment, or pre-established interim analysis.

While describing the outcomes, a frequent mistake is the lack of information regarding the reliability and validity of the corresponding measurement.¹³ Providing this information will give the reader sufficient evidence supporting the adequate decision of selecting specific measures and, as a result, strengthening the evidence of the meaningful effects of the results (either positive or not).^{6,13} Nonetheless, in the case of novel methods, the author must be even more clear while describing it, and must provide the scientific base that led to the development and use of novel outcomes for the clinical study.²³

In spite of being less frequent, the lack of comments regarding the approval of the study by an ethical committee can be considered a major drawback. In fact, any scientific publication that involves the participation of subjects, animals or the use of tissue should specify that an independent third party cautiously reviewed and approved the methods that were adopted during the development of the study. Likewise, the author must mention that the participants signed the informed consent according to the current statement of ethical principles guiding the research, such as the Declaration of Helsinki, as well as any specific institutional review board (IRB).^{13,16}

Another common pitfall found in multiple manuscripts is the lack of detailed information about the sample size calculation. This crucial aspect requires to be adequately explained in a scientific manuscript. There are several methods to calculate a sample size; all of them are based in specific conventions and assumptions. The aim is to reduce the risk of underpowered results, which is the reason why it always has to be calculated before the beginning of the study. The method chosen to calculate the sample size should be addressed in the manuscript, as well as the report of the key elements applied. Also, the power of the study and the p-value, in addition to information providing the origin of these data utilized to calculate the desired sample

(e.g. literature, previous studies, pilot study), have great relevance. It has been shown that comprehensive description of the sample size calculation strengthens the reliability and validity of the results described in the manuscript. Likewise, special attention should be given to the description of the statistical analysis subsection; in that way, the author should clearly specify the measure of dispersion, normality test and statistical test that were used for each specific outcome (dependent variable).²⁴

Finally, an inadequate standardization of the measurements is also a recurrent mistake. General conventions such as “the international system of units” (SI) for units measurements, or the “international union of pure and applied chemistry” for chemical measurements, should be applied for each corresponding measurement in order to avoid this error.²⁵ An adequate description of all this aspects in the methods section will give a strong structure to support most of the developed work.¹⁶

Results section: the art of being concise and avoiding unnecessary data

The result section focuses on showing your findings. This section should present facts; the authors should question themselves regarding the gap that was intended to be filled with the development of the study, and consequently show in which manner the available results are relevant in order to provide new knowledge to the scientific world. However, it is not the place to either perform data interpretation or discuss the results. A clear description of the findings and centering all the attention on reporting the data are of unique relevance.¹⁶ A common mistake in the results section is to refer to others studies. The writer should not include any references in this section and should focus solely on the author’s own findings.^{6,25,26}

For a high-quality results section, providing proper and elucidative figures, illustrations and graphics of the findings is mandatory. Additionally, the results should be presented in the most effective possible way. A common mistake is to place non-informative figures or illustrations that require extra explanation in the text to be understood. There is no right number of figures and tables required for this section, therefore, the authors should balance their use. Too many graphics and tables can be confusing for the reader, while the opposite may not be enough to report well the data. Moreover, illustrations should not replicate the information described elsewhere in the manuscript or vice versa. The captions of the illustrations should be self-explanatory: the reader must understand what is being presented even without reading all the manuscript.¹⁶

Others errors while preparing illustrations are: small axis label, unclear symbols, changes in the axis sizes in a same panel, inadequate use of lines, number of decimals, decimal separators (always use dots, not commas) and position of units.¹¹

Additionally, it is important to account for all the details when describing the results. If the researcher fails to report the amount of participants that dropped out or were excluded from certain subset analyses, the reader may not understand the final results. Considering the example of RCTs, the CONSORT Statement recommends that authors should include a flow-chart presenting exactly how many patients were assessed at each point.¹⁹ Likewise, guidelines such as PRISMA or STROBE are available for systematic reviews/meta-analyses and observational studies, respectively.^{20,21,27}

At this point of the manuscript, the author should decide which pieces of information are crucial. Unfortunately, it can be very difficult to include all findings in a manuscript. In addition, overreporting can be confusing and can divert the reader's attention to important points. However, the author should keep in mind that most journals offer the possibility of adding supporting material, so it can be used for secondary data. It does not mean that data should be "hidden" or saved for a second manuscript; on the contrary, the data should be used as evidence to reinforce your conclusions.

Furthermore, a logical and systematical order of describing the findings allows a better understanding for the reader. Generally, the results section should present the data following the identical order of the method section. In order to accomplish this, the author can include subheadings in the results section; each subheading should include a description of the question, the experiment carried out to answer that question and the results accompanied by the final answer.¹⁶ On the other hand, it is important to previously check the authors guidelines for the possibility of using subheadings.¹⁵

Moreover, the lack of a detailed statistical description of the findings is often observed. Adequate report of the descriptive statistics, such as measures of central tendency (mean, median, mode and range) and measures of dispersion (e.g. standard deviation) adequate for the type of data (parametric or non-parametric data) should be provided. A careful report of the statistical test applied is important as well (e.g. degrees of freedom, the value of the test and the p-value). Even though this is not a consensus throughout the research fields, some journals have specific rules regarding the data format presentation. For instance, some journals suggest that the results of test statistics and p-values must be rounded and just two significant digits should be presented, except for cases where further precision is extremely necessary. To report

statistically significant differences between conditions, the writer is encouraged to indicate the direction of the difference; for example, explaining which condition is higher or lower than the other. Moreover, the author should report the p-values and/or alpha level for each analysis. Finally, another potential mistake while reporting statistical data is utilizing words such as "reveal" instead of "demonstrate" or "indicate", since this is not an adequate word to describe statistical findings.

Discussion section: contributions, limitations and futures perspectives

Data interpretation must be highlighted in order to contextualize the topic and explain its contribution to the current knowledge. The main goal is to answer questions, such as:

1. How the results confirm or contradict previous or similar researches?
2. Why were the findings different from others?
3. How was the hypothesis confirmed or rejected?
4. What could be the plausible explanation for the encountered results?
5. Why the results happened?

Usually, the first paragraph of the discussion section must provide a brief summary of the most important results. However, it should not just a simple replication of the results section. In addition, summarized details of the research and future directions for further applications of the results must be stated. A potential mistake for this section is the inclusion of just a recapitulation of the results. Having said that, the author should elucidate how in fact the results support the study's hypothesis.¹⁶

Additionally, an incomplete discussion section lacks a natural comparison of the results with the available data on current scientific literature.¹⁶ A recurrent mistake developing this specific part is an extensive review of the literature.²⁸ On the contrary, the author should emphasize critical aspects that can be correlated with the findings of the study that is being published.

Discussing future consideration and possible practical implication of the obtained results could be an advantage of a manuscript; however, a disproportionate interpretation and overestimation of findings should be avoided in order to present valid and reliable results.²⁸

Moreover, it is important to discuss the strengths and weaknesses of the study, since a "limitation section" is required by most journals. This can be an opportunity to argue that the results are valuable and valid even if they have some pitfalls. Therefore, ignoring this opportunity leaves the field open to peer-review to criticism.^{6,13}

Finally, another common mistake is the likelihood to report just the positive findings. Despite the aims and hypothesis presented by the research group, an author requires to discuss negative findings as well as positive findings.²⁹ In the scientific research field, reporting bias or incomplete reports can lead to poor or erroneous interpretation of the data, leading to wrong conclusions about the relationship of the variables studied. For example, overestimating the results of a drug trial with no reports about its adverse effects, only about its efficacy. This is an unethical practice that can jeopardize future research plans and the overall knowledge in that specific topic.³⁰

Conclusion section: showing your remarks

In the conclusion section, the author should give a brief presentation of the important findings and show how the data contribute to the current state of the art.¹¹ In some journals, this section is grouped with the discussion section (last paragraph), one of the reasons why it is not included in the IMRAD format.⁷

In both cases, the conclusion should be clear and present a final statement on the study with respect to its significance, implications and limitations, showing its merits to be published in the journal.³ Common mistakes in this section are regarding the content, for instance, not addressing limitations of the study or providing just a summary of the findings without explaining the advances that this could potentially bring to the state of art in that field.^{3,11}

Title and abstract section

The title is a fundamental aspect of a manuscript; in fact, some readers could potentially select or avoid reading a paper after just reading the title. Therefore, selecting an appropriate title should be a task that requires as much effort as the discussion or methods section. An appropriate title should have key elements to anticipate the manuscript's content, catch the reader's attention, and reflect the purpose and organization of the study. So far, there are different informal guidelines available regarding the title writing process; these can be used as a kick-off in the best title search process.^{31,32} A usual flaw with the title is not following the guidelines stipulated by the journal to which the author desire to submit its paper.¹⁶ Following the journal's instructions is the simplest way to avoid this.

Additionally, another frequent error found is an extremely long title. In general, 10 to 15 words should be enough to describe the manuscript in an interesting manner.¹⁶

Moreover, the inclusion of jargon in a title is not recommended, even though the author is writing a scientific paper.

The final idea is to attract the most diverse populations of readers, and more importantly, the reader should be able to clearly understand the aspects described.¹⁶

Last, but not least, is to avoid the excess of punctuation, as well as terms in quotes. The author of the manuscript should be concise and develop an engaging title that elucidates important aspects without trying to overestimate and inflate the relevance of the findings.¹⁶

The abstract section contains the most relevant information for a reader and it could be compared with a hook that will help to decide whether a reader will go deep and continue reading or discard the manuscript. Some key factors such as an adequate description of the population, concise methodology, as well as detailed principal findings and the take home message in the conclusion.³³ Due to this, having a very well written abstract is one of the most important steps for developing a successful manuscript.¹⁶

As the manuscript follows a structure (IMRAD), the abstract should contain each of those sections in a short, clear, summarized way, describing key points that can help the reader to briefly understand the objectives of the article, the methods used to evaluate those objectives and, finally, the results encountered during the study. Any missing data is considered a major mistake.²⁹ The writer should be able to reflect the entire skeleton of the manuscript briefly and clearly to engage the reader with the content of the paper.^{6,16}

Additionally, most of the journals have specific guidelines for the abstract section. However, it is frequent to find that the author does not follow the instructions, which could immediately disqualify a good manuscript.¹⁵ The author is encouraged to devote an adequate amount of time to develop and review this fundamental section of the paper.²⁹

References section

The references are a vital aspect of a manuscript, since they provide the source of the information that the author is presenting. For every journal, there are detailed rules that an author is obligated to follow in order to succeed and achieve the final goal of publishing a manuscript. Not following the specifications required for the journal to which the author will submit the manuscript is very common.³⁴ This inaccuracy can be avoided easily by searching the journal's guidelines in the corresponding section of their webpage, to understand and apply the guidelines required for each individual journal.³⁴ Additionally, updated references are critical for scientific manuscript, as they show that the author is contextualized with the current literature.⁶ Finally, in order to help research groups during this task, there are several reference management software available nowadays (e.g. EndNote,

Mendeley, Sciref, Zotero). Most of them have free access and are suggested by the journals, since they can avoid common formatting mistakes.

Final considerations

The aim of this review was to highlight the most frequent mistakes found in each section of a scientific manuscript, in order to approach them and provide suggestions to improve writing with high-level standards.

It is important to emphasize that there are key recommendations to avoid those errors, such as:

1. using a checklist to guarantee that all components were added in the final version;
2. strictly following the guidelines of the journal that you are planning to submit the article to;
3. reviewing multiple times before submitting;
4. standardizing measurements in all the tables, graphics and text;
5. providing necessary data to support detailed aspects of the paper (e.g. sample size);
6. creating graphics first;
7. following the IMRAD structure (whenever possible).

Even though some details of scientific writing could be in some way monotonous and easy in the eyes of an expert author, a wide range of mistakes are often found while

reviewing a scientific paper. The primary reason for a paper not being accepted can be related to these common errors while reporting, and not because the science content *per se*.

This study provides suggestions to improve the quality of manuscripts and comments on the most common mistakes made by researchers when writing their articles. The advantages that come with understanding and acknowledging the most common mistakes will potentially optimize manuscript writing for young researchers that are starting in the world of scientific writing, as well as for experienced researchers, who could improve and enhance their dexterities in this field, therefore having a higher chance of having their work accepted for publication.

CONFLICT OF INTERESTS

The authors report no conflict of interests.

AUTHOR'S CONTRIBUTIONS

F.G.S. Velez and C.P. Bonin substantial intellectual contributions to the conception, design and final version of the manuscript.

M.R. Chalita, D.P. Falcão, F. Fregni and R.F.B. Amorim wrote the first draft, supported the design and approved the final version of the manuscript.

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