



## How to write a paper

### Introduction

Writing is often viewed as a difficult task, and is frequently left to the last minute out of dislike, lack of confidence or lack of know-how. However, writing can be fun, and the fruits of your labour can have substantial benefits. The purpose of this mini review is to provide a template on how to write a manuscript for peer-review publication. By conveying to the reader in a succinct manner how to write a manuscript, writing will be viewed as a straightforward and pleasurable activity.

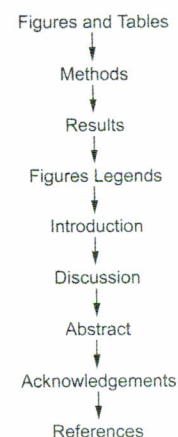
### Instructions to authors

Before writing, it is imperative to obtain the 'Instructions to Authors'. These instructions will detail the total character, word or page length for the manuscript, total number of figures and tables allowed, and total character or word count for the abstract. The precise format for the abstract will be provided, and typically includes a background, methods, results and conclusion sections. Many journals use different formats; thus, it is critical to obtain these instructions before starting to write. Another important aspect of the 'Instructions to Authors' is the actual typeset format used to prepare the manuscript document. While the majority of journals still require the document to be double spaced with specific margins (typically 1 inch) and specific sections, some journals have now adopted a single-spaced approach or even double-column single-spaced approach. Journals also have requirements regarding the use of abbreviations and references. Last, each journal has specific format requirements for figures. Many journals require the images to be JPEG or TIFF images, with specific requirements for image resolution if they are colour (i.e. 600 dpi) versus black and white (i.e. 300 dpi); however, some journals do allow images from PowerPoint files or as PDF images. Therefore, attention to these details will save time, energy and frustration on your part since submission using an incorrect format will ensure either automatic rejection or annoyance on the part of the reviewers, with the later potentially leading to a less than favourable review.

### Manuscript writing order

The key to writing a good manuscript is to *tell a story!* This is often best accomplished by writing the manuscript out of order from the journals prescribed order for the sections as certain sections are more logical and easy to write first, while others are easier to write after the bulk of the manuscript has been written. I recommend starting with the figures and tables, as the figures and tables should tell the whole story, as well as a good story (Fig. 1). After the figures

Order For Writing A Manuscript



**Fig. 1.** A flowchart depicting the suggested order to write the sections of a manuscript.

and tables are determined, create the title page, carefully including all of the information required by the journal. Be sure to include all middle initials of authors if they are used by the authors, as well as correct institution information. After the title page, the methods (or materials and methods) section should be written, as this is simple to do and a logical lead into the results section. Next, complete the results section and organize this section using subheadings. This should be simple to write with the figures and tables in hand. While on your mind, after preparing the results section, it is convenient to write the figure legends. The introduction, followed by discussion should be written next. After you have all these data committed to paper (or rather, electronically), the introduction and discussion sections are less daunting to write. After all of the above sections are completed, it is time to write the abstract. A common mistake is to write the abstract first, before the results section. However, you will have a better sense of what to include in the abstract, as well as what to emphasize, after the majority of the paper is written. Remember, the abstract should include all pertinent data from the manuscript and accurately portray what is in the manuscript. Finally, do not forget the acknowledgements and references sections.

### Figures and tables

The figures and tables of a manuscript should tell a story. They should be clear to the reader without having to read or refer to the text of the manuscript. Figures should be necessary and relevant. Unusual aspects of figures or aspects of the data that need emphasis should be labelled with arrows or other indicators, drawing the



readers' attention to these findings. Be careful and selective when including figures with negative data. While this can be very important to the overall message of certain manuscripts, more often than not, negative data are not sufficiently relevant to warrant a figure. Figures are used to emphasize data, and also to convey these data efficiently to the reader. Tables are typically used to convey larger sets of data for multiple different treatment groups, allowing the reader to make comparisons between groups. Tables are also helpful when providing background information and experimental or clinical data, especially numerical data. A common mistake made by authors is to include data in a table or figure and also describe it in the text. This type of redundancy is unnecessary and will usually be detected by careful reviewers and editors. Not only is it annoying to the reader, but it takes up valuable print space in the journal, and that costs money. Therefore, it is best to limit your tables and figures to relevant data and avoid redundancy.

## Methods

The methods section conveys to the reader what experiments or interventions were performed to address the hypothesis or question that was formed for the study. Methods should be described in enough detail so that the reader can judge whether the findings reported in the results section are reliable. Additionally, enough detail should be provided to allow the reader to reproduce the experiment. If the methods have been described in a previous publication, it is acceptable and advised to reference that publication and only briefly describe the method. However, if deviations from the published methodology occurred, this should be clearly stated and described. If a new methodology is described, be sure to explain what experiments were conducted to test or validate the new methodology. The methods section should be subdivided into descriptive subheadings based on logical topics.

## Results

The results section should tell a story and emphasize the take-home message. The results section should state the findings of the experiments and not contain conjecture. The latter is best left for the discussion section. Avoid repeating introductory material and minimize experimental details since experimental details belong in the methods section. Avoid lengthy analyses and comparisons to other studies, as those also belong in the discussion section. Furthermore, remember the difference between data and results. Data are the facts obtained from the experiments and observations, results are statements that interpret the data.

Arrange the results section in a logical fashion, either chronologically, most-to-least important, *in vitro* to *in vivo*, etc., using descriptive subheadings. For each subheading section, I find it helpful to state the purpose of the experiment(s) being performed to guide the reader seamlessly through these sections. After stating the purpose, the data are provided in a clear, concise and logical manner. At the end of each subheading section, a statement is provided that summarizes and interprets the data, that is, provides the results (e.g. 'These data suggest that. . .'). This technique is a very effective and efficient approach to convey data and results to readers. The results

section should also clearly direct the reader to the related figures and tables that support the data. Be sure to indicate '(Figure 3)' or '(see Table VI)'. In addition, it is important to avoid overlap between the text in the results section and the figures and tables. If data are described in a table or figure, there is no need to also list those data points in the text, as this is redundant. In summary, well laid-out and well-written results section should be simple to read and should provide a clear story of the data for the reader to interpret and make independent assessments and judgments.

## Figure legends

After writing the results section, it is simple to prepare the figure legends, as these two sections are very similar. Use brief sentences to describe the figure. Different journals have unique requirements regarding the format. For example, some journals prefer including a title sentence for each figure legend that is description, while others do not. It is prudent to review publications from that journal to determine how figure legends are formatted. Figure legends should be free-standing from the text of the manuscript, meaning that a reader should be able to fully understand the experiment and data provided in the figure by reading just the figure legend, and not having to refer to the text of the manuscript. Describe all aspects of the figure, and if the figure has multiple panels, each panel must be described separately. Minimize experimental details, as that is the purpose of the methods section. All abbreviations, lines, bars, arrows and symbols must be described. Provide statistical information; if the figure contains statistical notations such as asterisks, the *P*-values for these statistical notations should be provided in the figure legend.

## Introduction

Grab the readers' attention with the introduction. Awaken the readers' interest and prepare them to understand the manuscript as well as its context to the scientific area being studied. Limit the introduction sections to no more than three paragraphs. In the first paragraph, clearly state the clinical problem being addressed and its significance within the medical community. In the second paragraph, state what is known and then what is not known about the clinical problem. In the third paragraph, relate what is not known about the clinical problem to your study, providing clear support for why your study is important and being conducted. Then, clearly state the goals or aims of the study, along with the hypothesis. If the introduction is too long or confusing, the reader will lose interest and not read the rest of the manuscript.

## Discussion

Many authors fear writing manuscripts because of the discussion section. However, if the discussion section is deconstructed to just five paragraphs, it can actually be fun to write. In the first paragraph, summarize the results section and answer the question or hypothesis stated in the introduction. Place the data in the context of the bigger clinical problem. Examples of sentences that signal the answer include: 'This study indicates that. . .', or 'The results of this study



show that...'. Examples of sentences that link the results to the answer they support include: 'In our experiments, we showed that...'. or 'In our subjects, we found that...'. or 'The evidence provided in this study shows that...'.

The second and third paragraphs require the most thought and insight to write. First, use these two paragraphs to compare and contrast your data to existing literature. An example is: 'Though our results may differ from those of Chen *et al.* we used a different method to ascertain compliance with therapy,' or 'While our results are opposite to those of Kao *et al.* we used a different rat strain with our studies.' Second, explain unexpected findings. For example, 'We were surprised to find that a normal WBC was predictive of morbidity following endovascular interventions.' Third, describe patterns, principles, and relationships that the results show. Fourth, address if the results have theoretical or practical implications. Do the results relate to other situations or other species? Do the results help us to understand the broader topic? By addressing these issues, you will have provided the reader with additional insight into your study and how to place your results in context of the greater scientific field of study.

In the fourth paragraph, address limitations and/or weaknesses of the study. Let's be candid – there is no point in ignoring the limitations of your study. All studies have weaknesses and/or limitations and if you do not address them, you are leaving yourself open to criticism by the reviewers. Thus, address the limitations and weaknesses openly and discuss why these limitations or weaknesses exist and how they may affect interpretation of the data.

The fifth and final paragraph should be the concluding paragraph. Provide a brief and global summary of the results and what it all means in context of the larger clinical problem discussed in the introduction. Signal the end using phrases such as, 'In conclusion,' or 'In summary'. Indicate the importance of the work by stating the applications of the work, recommendations suggested from the work, implications of the work or speculations about the importance of the work. Remember, do not overstate the conclusion, understate it.

When writing the discussion section, several errors are common. First, do not restate the results. This is a crutch that many authors use if they do not know what else to put in the discussion section. Second, understate the conclusions rather than overstate them. Overstating conclusions is a certain way to annoy reviewers and readers. Third, be focused with your writing. Long, tangential thoughts make for sloppy and difficult to read discussion sections. Fourth, write clear and logical paragraphs with introductory and concluding sentences.

## Abstract

The best time to write the abstract is after the manuscript is completed. The length of the abstract will be clearly stated by the journal

and it is prudent to adhere to the length requirements. Sentence writing should be concise and succinct in the abstract, given the length requirements. Additionally, be careful to adhere to the formatting guidelines, as each journal has unique subheadings that must be used. In general, the abstract should provide an overview of the paper that makes sense when read alone and when read with the paper. The abstract should provide enough information for the casual reader to understand what the manuscript is about. Include information from each section of the manuscript in the abstract, being careful to include, highlight or emphasize important data and take-home messages, as often the abstract is the only part of the manuscript that is read. The abstract should not contain information that is not included in the manuscript. However, there may be some data in the manuscript that is not necessary to include in the abstract if it is not germane to the overall conclusion of the paper.

## Acknowledgements

The beauty of the acknowledgements section is its simplicity and importance. This is where most journals require the listing of support from funding agencies. Also, acknowledge individuals that contributed to the work but did not meet criteria for authorship. Gifts of special reagents, animals, software, etc., can be described here. Administrative support can be acknowledged. Of note, many journals now require that authorization be obtained from all individuals named in the acknowledgements section, so be sure to read the 'Instructions to Authors' on this matter. Last, some journals ask for conflict of interest information or additional disclosure information in this section, or specifically have separate sections addressing those topics.

## Conclusion

In summary, writing a manuscript can be fun when it is deconstructed into simple parts. By following this simple template on how to write a manuscript, writing should be simple and enjoyable. In particular, limiting the introduction to three paragraphs and the discussion to five paragraphs makes writing a manuscript a less daunting task.

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