

## Publish or perish: The art of scientific writing

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Publishing manuscripts is the only way by which scientists communicate with each other. In recent times, there is an increasing desire to publish manuscripts from the developing world for a variety of reasons. Though, performing a research study is challenging in itself, writing it for publication is the final frontier that can be daunting, especially for the novice. Work that remains unpublished in one form or the other is essentially incomplete or undone. Hence, it is critically important for one to publish one's findings in a reputed journal. The purpose of this paper is to alleviate the mystique involved in manuscript writing and provide a blueprint where the subheadings given under each of the sections of introduction, methods, results and discussion can be expanded as per the particular study and the manuscript can be constructed in a stepwise manner. We hope that by following this approach, potential researchers and practicing ophthalmologists will develop the skill and aptitude for medical writing, and that the developing world shall do justice to its tremendous intellectual capital by making meaningful contributions to global scientific literature.

**Key words:** Manuscript preparation, publication, scientific writing

“Publish or perish” is a phrase that we come across frequently. However, we often wonder whether it applies to ophthalmologists and clinicians at large or is limited to basic science and laboratory-based researchers. This is the only way scientists communicate with each other and gives the authors credit for the work they have done. In recent times, publishing has become vitally important even for clinicians for a variety of reasons, including career advancement,<sup>[1]</sup> mandatory government regulations, greater opportunity for international collaborations as well as monetary incentives in the form of grants.<sup>[2]</sup> Hence, there is a lot of desire to publish these days, especially from the developing world where >3/4<sup>th</sup> of the world population resides and clinical data is abundant. Governments are striving to provide adequate resources and training, sought and attained with collaborations and short-term courses. Yet, one faces many barriers while conducting a research study such as choosing the appropriate study design, ensuring good quality data collection, data storage and entry and appropriate statistical analyses. However, after overcoming these barriers in conducting a research study, one is faced with another daunting challenge, that is, to write a research work for publication. It may be considered as the final milestone in the entire exercise of conducting research. Work that remains unpublished in one form or the other is essentially incomplete or undone. Hence, it is critically important for one to publish one's findings in an accessible and reputed journal.

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Writing a manuscript is like giving shape to your ideas. The art of scientific writing can be acquired by following certain basic rules for writing a manuscript.<sup>[3]</sup> One needs to understand that writing for publication requires a set of skills that are very different from conducting a research study, and even more different from clinical practice.<sup>[4]</sup> Approaching the challenge of writing for publication in a methodical manner can make the task more efficient and rather attainable even for the novice.<sup>[5]</sup> Writing for publication is not a single step, but a process that includes planning, writing, submitting, revising, resubmitting, and proofing.<sup>[6]</sup> In this paper, we concentrate on the aspect of “writing” and present a general outline of the steps to be followed while constructing a manuscript. Though there are many types of manuscripts such as case reports/series, review articles, letters to editor and photo essays, we will focus on how to construct a manuscript from an original study. The purpose of this paper is to remove the mystique involved in manuscript writing and provide a blueprint where the headings given under each section can be expanded as per the particular study and the manuscript can be built up in a step wise manner.

### Prerequisites

Before embarking on the task of writing, one needs to carefully consider the following prerequisites that make the manuscript better.<sup>[3]</sup> In general, a well-designed and conducted study is easier to write, though discussing various study designs and nuances of executing studies are beyond the scope of this article.

### Review the literature

Before we are convinced of the merit of an idea for research (objective), we must vigorously review all the available literature on the subject to ensure the originality, to identify the lacunae in the current knowledge. The 2<sup>nd</sup> review is done while discussing the paper to compare and contrast our outcomes with those of previous studies.

### Know your data well

The content of the manuscript revolves around the data that is to be presented and hence, it is imperative that one knows one's

data thoroughly. For this, it is essential to communicate with a statistician from the very beginning of the study, even before data collection. In addition, a particular research project may yield more than one paper. It is, therefore, important to identify which outcome of the research is to be published in the current paper. It is easier to write the methods and the results sections before the introduction and discussion. Another helpful technique is to prepare empty tables and figures right in the beginning of the process, which will help you and your statistician to focus on the relevant analyses to be done and results to be presented.

### Authorship

Issues over authorship should be settled as early as possible.<sup>[7,8]</sup> The first and the corresponding authors, thus, have the freedom to chaperone the paper and lead the way for creating a clear and concise storyline.

### Select a journal

Preparing the manuscript as per the specifications of the journal of choice is perhaps the most important and often neglected prerequisite. One should choose the highest-impact journal where the manuscript has a reasonable chance, depending on the scope of the journal, the originality of the idea, the quality of evidence, and the importance of findings. The instruction to author's section usually provides guidelines that differ from one journal to another.<sup>[9]</sup> A good idea is to adhere to the general guidelines of a top-ranked journal (e.g. Ophthalmology), which generally make the manuscript fairly admissible to lower-ranked journals.

### Title and Abstract

Choosing a title can be one of the most challenging aspects of manuscript writing.<sup>[10]</sup> Remember that the title of the paper will be read first and most often. Additionally, electronic indexing services rely heavily on the accuracy of the title to allow its users to find papers relevant to their queries. You may choose a more descriptive title which is usually longer and more informative but less catchy or you may choose a shorter, more attractive title that may be too cryptic and reduce the likelihood of your paper showing up on electronic search engines.<sup>[11]</sup>

After the title, it is an abstract that will be read most. It is a résumé for the manuscript and hence must be informative, must extract everything relevant from the study and serve as a highly aggregated "stand alone" for the full paper.<sup>[12]</sup> If there are critical elements that one simply cannot fit in, one may want to consider splitting the work into > 1 abstract, or submitting to a journal that allows for longer abstracts. The title and abstract help editors to decide whether the manuscript is worthy of being sent out to reviewers and gives the reviewers the first impression of the scientific content. Additionally, as the abstract may be the only section available freely, it provides the readers an opportunity to comprehend the rationale, methods and results of your study without reading the full text. Follow the format for abstracts provided by the journal meticulously, but creatively and always respect the word count.<sup>[13]</sup> It is generally a good idea to choose the title and write the abstract after the final draft, in consultation with all the coauthors.

### Parts of a Manuscript

A manuscript is usually divided into four parts reflecting Aristotle's requirements for an oratory: Introduction, narration,

proof and epilogue. In modern terms, these four parts are generally referred to as an introduction, methods, results and discussion, also referred to as the IMRAD format. We shall discuss the major headings to be included in each of these in the following sections.

### Introduction

The introduction is where we tell the readers why we did the study. It must be relevant to the study and narrow down from a general overview of the subject to the specific question the study addresses, that is, the funnel approach.<sup>[14]</sup> Identify the key topics that the study deals with and introduce them in different paragraphs. It is a good practice to first describe the magnitude of the problem, followed by a brief description of current knowledge and lacunae that exist in the literature. It is critical to define the "hole" in the literature that your work is going to fill. When one has set the stage for the need of the study, the hypothesis is introduced, keeping in mind the primary study outcomes. One must also briefly state what was done to prove/disprove the hypothesis (e.g. prospective, retrospective, randomized trial etc.) as a prelude to the methods section. Remember that the last part of the introduction is the one which will instil the idea of the study to the editors, reviewers and potential readers alike. A caveat is to differentiate the introduction from the discussion section. Though a bit of overlap cannot be helped, preserve the comparison of your results with other studies for the discussion, and choose the references sparingly.

### Methods

The purpose of writing the methods section is to enable another scientist to reproduce the study again and compare the results.<sup>[15]</sup> The rigor, relevance and precision of the methodology determine the destination of the paper. Table 1 shows an outline of the points that must be covered in the methods section. Let us discuss salient features of each subheading.

#### Ethics clearance

It is desirable to start the methods section with a mention of the clearance for the study obtained from the institutional review board of your organization, especially when the study involves animal or human subjects. You must also be aware of the tenets of the Declaration of Helsinki and specify whether your study conformed to them. Most journals do not require ethical clearance for a retrospective study.

**Table 1: Outline for writing the methods section**

Ethics clearance
Study period (month and year), location and type
Inclusion and exclusion criteria
Sample size and randomization/masking
How data was collected-case files in retrospective and pro forma in prospective study
What clinical tests/investigations were done at each visit (technical details)?
Study execution protocol (only for prospective studies)
Duration of follow-up: How many study visits were included?
What parameters were recorded at each visit?
Outcome measures: Primary and secondary
Statistical methods

### Study period, location and type

Specify the duration of the study with the start and end dates (month/year) followed by the location of the study. If the journal does not allow disclosure of the institute's name to maintain anonymity during the review process, then mention whether it's a primary, secondary or tertiary care eye center and from which part of the country (south, north etc.). It is essential to mention the type of the study such as a randomized controlled trial, prospective/retrospective cohort study, case-control study, or cross-sectional survey. If your study does not fit a particular definition you may describe the key design components, e.g. an interventional and/or observational study and whether data were collected longitudinally or cross-sectionally.

### Inclusion and exclusion criteria

This section explains how subjects were recruited for the study. Define the terminologies used in these criteria using standard references. For, e.g. when recruiting subjects for a study on glaucoma, you must mention how glaucoma was diagnosed for the particular study including the intraocular pressure (IOP) and visual field data. In the case of extensive exclusion criteria, it is a good idea to tabulate the inclusion/exclusion criteria. Remember that these criteria are equally important while performing both, a prospective and a retrospective study.

### Sample size and randomization/masking

Sample size calculation depends on the uniqueness of the study question and the outcome being measured. The statistical strength of the study depends on the sample size as well. Hence, it is important to provide a rationale for the sample size. However, if the study has been performed without calculating a sample size, the power of the study to determine the statistical difference can be calculated *post hoc* and mentioned in the statistical analyses section. Randomization generates the highest level of evidence in prospective, comparative studies. "Masking" the investigators help in alleviating the bias in studies. Hence, it is imperative to describe in detail how randomization and masking were performed.

### Data collection, interventions and tests

This section describes how the study protocol was executed. A consort flow diagram depicting the progress of the patients throughout the various steps of the study is very appealing and provides insight into the study design and execution at a glance. It is important to precisely define the parameters (e.g. visual acuity, IOP, surgical steps etc.) that were studied, and when (e.g. preoperatively, and 1, 3 and 6 months postoperatively) and how (e.g. using the early treatment diabetic retinopathy study chart, applanation tonometry) they were measured. Cite previous research on the measurement tools that were used, and state if a tool was designed or modified specifically for the study. Provide details of measurement properties if these are crucial for the interpretation of the main results (e.g. Kappa statistic for interobserver variability). When specialized equipment, software, and reagents are used, it is desirable to mention the manufacturer's name and location (including city, state, and country). Additionally, you must also mention how the data was recorded at each visit (e.g. using a pro forma or entered electronically into the database directly). In retrospective studies, it is important to mention how the case records were drawn from the medical records department (e.g. using ICD coding etc.).

### Outcome measures

This is also called the dependent variable and is by far the most important part around which the statistical analyses revolve. Hence, you must define and describe outcomes thoroughly. Additionally, it must be sufficiently clear whether you are considering this as a continuous (e.g. visual acuity) or categorical (e.g. visual acuity divided into ranges, like 20/20–20/40) variable. Always start with the primary outcome measure and then describe other outcome measures of interest.

### Statistical analysis

Try and provide sufficient detail on how the statistics were done and do not assume that the readers are aware of the tests done. Describe the analyses used to determine the primary outcome variable first followed by the rest. If using a multivariable analysis, mention how the covariates were chosen. Additionally, it is advisable to mention the regression diagnostics that were done to test the robustness of the multivariable statistical models. The name and edition of the statistical software package must be mentioned at the end of the statistics section. Most journals recommend that a statistician do the analysis, and write this part of the methodology.

After drafting the methods section, determine again whether the study can be replicated by others interested in the same research question. Finally, omit certain redundancies that are not important for the study, especially when it is one of the many papers from a larger study.

## Results

The results of the study should be presented in a concise manner. As a general rule, the results must satisfy all the questions (that is. outcome measures) raised in the preceding sections.<sup>[16]</sup> A caveat is to present the results without interpretations as this should be a part of the discussion. Furthermore, it is preferable to use the term "statistically significant" to describe differences that are significant at your chosen *P* value threshold. The information in tables should be only summarized, and not reiterated in this section. Table 2 shows an outline of the points that must be covered in the results section.

### Demographics and preintervention analyses

It is good practice to first describe the study population in terms of the number of patients recruited, their demographics and parameters measured in a tabular format. The significant differences between the groups may be written in words at the beginning of the results. Preintervention analyses of the baseline parameters are essential to determine whether the groups were comparable and rule out selection bias that may

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**Table 2: Outline for writing the results section**

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Mention sample size over the study period (months)

Demographics: Mention the important ones in words

For comparative study, mention whether the 2 groups were comparable in terms of the parameters studied before the intervention

Results of the primary outcome measure

Results of the secondary outcome measures

Other results. E.g., Complications of a procedure

Tabulate results, use graphs, avoid pie and bar diagrams

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influence the outcomes. For surveys and descriptive studies, this section is the most important and must form the bulk of the results section. It is useful to present continuous variables as box and whisker plots with the outliers. Most experts strongly advise against the use of pie charts or bar diagrams to present the results. Use of color and 3-dimensional figures should be similarly minimized. The R-statistical software (open access at <http://www.r-project.org>) is probably one of the better packages available for creating artistic figures.

### Primary outcome measures

After describing the demographics, the results of the analytical statistics should begin with the primary outcome measures in a new paragraph. Differences between comparative groups before and after an intervention (e.g. surgery, laser etc.) or investigation (e.g. optical coherence tomography) must be presented in detail including the absolute values of the parameters (e.g. visual acuity, IOP etc.) and the *P* values. While presenting results of regression analysis, it is prudent to present data from the univariate analysis first. While presenting results from the multivariable analyses, in addition to the odds ratios, relative risks or coefficients, one must present the 95% confidence intervals which shows the direction of the treatment effect (whether toward harm or benefit), the size of the effect estimate, and its degree of precision. Additionally, it is a good idea to present results of the sensitivity analyses to see if the outcomes change if other covariates are included/excluded or if only specific subpopulations are analyzed.

### Secondary outcome measures

Remember that the study was not designed to evaluate these outcome measures (e.g. complication rates in a randomized study to determine visual outcomes) and that the study will usually be underpowered to determine the significance of these results. Hence, clearly indicate that these results were generated from a “*post hoc*” analysis and are mainly intended to generate further hypothesis for future studies. It is good practice to report all these outcomes in one paragraph at the end of the results section.

Remember that results are always written in the past tense. Maintain an uniform order of results and describe one group before the other with respect to all the results. Always present measures of central tendency together with their appropriate measures of variability: Mean (standard deviation) or median (interquartile range). Presenting percentages (e.g. 23/150 (15.3%) subjects showed poor visual outcome) gives more perspective to absolute numbers. Also, maintain a consistent use of decimals (e.g. present numerical values with one decimal place) throughout the manuscript.

## Discussion

The purpose of the discussion is to give a perspective to your findings. Table 3 summarizes the points that should be part of the discussion. As aptly describe by Cals and Kotz, the discussion can be imagined as an inverted funnel and together with the funnel shaped structure of the introduction, it forms an hourglass shape.<sup>[17]</sup>

### Recap positive findings

You should start with providing a brief summary of the results and highlight the positive findings that you will be discussing in subsequent paragraphs. However, this should be succinct

**Table 3: Outline for writing the discussion section**

Recap the methods in short and summarize the positive findings of the study
Compare the outcomes with similar studies from literature. In case of differences, postulate reasons for these differences
In case of agreement-mention that too
Mention strengths and limitations of your study
Conclusions (take home message)
Scope for future research from the study findings

and not > 3 lines. Do not use absolute numbers and percentages unless absolutely necessary. For example, instead of saying “33% of subjects showed poor outcome”, you may write “a third of our patients showed poor outcome.” Also, do not omit unexpected results even if these are against the hypothesis and/or common belief.

### Comparison with literature

It is advisable to start discussing the results from your primary outcome measure first. Compare your results to those reported by other investigators. It is preferable that you select the most recent articles in the highest ranked journals to compare your results. Comparisons are always tricky, especially if your results are contrasting those that have been previously reported. In the case of differences, postulate reasons for these differences; avoid harsh criticism of other studies. The differences may be related to the study design and inclusion criteria (methodology related) or may be due to other factors such as ethnicity, race, etc.,. It is sometimes difficult to discuss your results when they are unexpected. However, they must still be a part of the discussion as their omission will be picked up by the reviewers and may compromise your credibility. When your results are in agreement with other authors, mention what novel data or perspective the study has contributed to already existing body of literature.

### Merits and drawbacks

This should be a separate paragraph towards the end of the discussion section. Most studies have limitations and it is appreciated when an author acknowledges the limitations of his own work. Additionally, it is very important that you suggest ways and means by which these limitations can be overcome in future studies. Similarly, always be careful with claims of precedence, no matter how novel your study, because it is almost impossible to review all the available literature across diverse databases.

## Conclusion

This should be the last statement of the discussion where one summarizes the key element of one’s study in light of the existing literature: What is new and why it is relevant to know. This is the section which contains the take home message and hence, must be articulate and precise. Try and keep this to a maximum of two sentences which can be verbally quoted by the reader.

### Summary

We have presented an outline of the recommendations in the tables, which may be used as a template or checklist before submission to a journal. Like surgical and diagnostic skills,

writing a research paper for publication is an art that takes considerable time and effort to master. The nuances of medical writing require practice: The more you do it, the better you get at it.<sup>[18]</sup> This sustained expense of effort is worthwhile not because of money, fame and status currently associated with research, but because of the sheer thrill and joy of finding something new and sharing it with like-minded colleagues. We hope that this treatise shall help potential researchers and practicing ophthalmologists to develop the skill and aptitude for medical writing, and that the developing world shall do justice to its tremendous intellectual capital by making meaningful contributions to global scientific literature.

## References

1. Tonges MC. Publishing as a career development tool: Don't forget to write. *Semin Nurse Manag* 2000;8:212-4.
2. Dixon N. Writing for publication : A guide for new authors. *Int J Qual Health Care* 2001;13:417-21.
3. Kotz D, Cals JW. Effective writing and publishing scientific papers : Part I: How to get started. *J Clin Epidemiol* 2013;66:397.
4. Hasse JM. Developing the "write" skills for publishing. *Nutr Clin Pract* 2013;28:153-7.
5. Moos DD. "Novice authors what you need to know to make writing for publication smooth". *J Perianesth Nurs* 2011;26:352-6.
6. Morton PG. Publishing in professional journals, part II: Writing the manuscript. *AACN Adv Crit Care* 2013;24:370-4.
7. Menezes RG, Kanchan T, Arun M, Manipady S. Authorship: An ethical issue. *Natl Med J India* 2006;19:111-2.
8. Marco CA, Schmidt TA. Who wrote this paper? Basics of authorship and ethical issues. *Acad Emerg Med* 2004;11:76-7.
9. Grant MJ. Writing for publication: Ensuring you find the right audience for your paper. *Health Info Libr J* 2010;27:259-61.
10. Grant MJ. What makes a good title? *Health Info Libr J* 2013;30:259-60.
11. Cals JW, Kotz D. Effective writing and publishing scientific papers, part II: Title and abstract. *J Clin Epidemiol* 2013;66:585.
12. O'Keefe-McCarthy S, Parry M. Writing competitive scientific and clinical abstracts: Tips for success. *Can J Cardiovasc Nurs* 2013;23:19-20.
13. Papanas N, Georgiadis GS, Maltezos E, Lazarides MK. Writing a research abstract: Eloquence in miniature. *Int Angiol* 2012;31:297-302.
14. Cals JW, Kotz D. Effective writing and publishing scientific papers, part III: Introduction. *J Clin Epidemiol* 2013;66:702.
15. Kotz D, Cals JW. Effective writing and publishing scientific papers, part IV: Methods. *J Clin Epidemiol* 2013;66:817.
16. Kotz D, Cals JW. Effective writing and publishing scientific papers, part V: Results. *J Clin Epidemiol* 2013;66:945.
17. Cals JW, Kotz D. Effective writing and publishing scientific papers, part VI: Discussion. *J Clin Epidemiol* 2013;66:1064.
18. Bowling AM. Writing for publication: You can do it. *J Pediatr Nurs* 2013;28:616-9.

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