

## Writing A Scientific Paper: Getting To The Basics

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### **Abstract**

*Research is an important tool in the discovery of new events and inevitable in the advancement of our understanding of new phenomena. However, the process of carrying out a research will be incomplete and irrelevant if the results are not published. While the process of carrying out a research is a challenging experience for many researchers, an even more daunting exercise is publishing the research findings. Thus, writing scientific paper requires skill and experience.*

*A scientific paper should have a clear purpose, be organized systematically and target a specific audience. It is important that before planning to write out a scientific paper certain questions regarding the message of the paper and its worthiness, the format, target audience for the message and the journal for that audience, are addressed. These issues are crucial and determine how well written a paper is and its acceptability for publication.*

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### **Introduction**

Research is an important part of development and in its absence most of the discoveries today would not be possible. However, the process of carrying out a research is incomplete and irrelevant if the results are not published. Therefore, although scientific paper writing is challenging and daunting to many researchers, it is unavoidable. A number of papers have been written by researchers at different levels of development but, because they fail to meet some standards, they are rejected by publishers of journals. It is therefore our desire, through this paper, to assist researchers to contribute to the world of science by minimising their frustrations during publications.

Before planning to write or actually writing a paper, certain questions must be answered. These include *what do I have to say? What will be the message? Is the paper worth writing? Have I already published such a paper or any part of its probable content? What will be the right format? Who will be the audience for the message? What is the right journal for that audience?* Failure to answer these questions has led to the rejection of some papers by publishers. Unfortunately, many researchers have not recognised how crucial these issues are, hence the continuation of these errors. It is our aim to provide useful hints that will aid your answering these questions so as to improve the quality of the papers submitted for publications.

### **Preparing to write: Materials and Tools**

The purpose of a scientific paper is to provide an answer to a question or a solution to a problem. It should provide sufficient evidence to enable the reader to assess the validity of the answer and the conclusion. To achieve this purpose, the author of a scientific research article must first state the question the paper addresses. The author should then provide appropriate evidence to convince the reader that the answer to the question and the conclusion drawn are correct.

Ideally a research paper should address only one main research question. If a paper attempts to answer different questions, it will be difficult for the readers to tease out the answer to the individual question they are interested in. However, some studies may have main questions which are multi-faceted and can be included in one single paper or the main question may have a number of related subsidiaries which can be published in one paper.

When a variety of data relevant to a number of questions have been collected, the data will answer the subject question of a particular paper should be extracted for that paper. And if the main question can be

broken down into a number of more specific questions you should identify the data relevant to answering each specific sub-question.

### Choosing a topic

A thorough literature search is important before writing a paper because it helps you identify the areas of need in a particular field of science. If the paper stands little or no chance of changing anyone's thinking it is probably not worth writing. Therefore you must determine the value of each paper by applying "the so what test".

### Who is the intended audience?

An effective paper deals with a question that may be important only for a specific audience. For example, a paper on malaria fever, a tropical disease, will be more appreciated by an audience in a tropical than a temperate region. The probability that a paper with a clear message will emerge from a research is determined more by how the research was conceived, planned and executed than by how well the paper is written. A clear question must be posed before the research is planned, the design of the research must be adequate and the data properly collected and analyzed. However, it should be noted that well conceived and executed research may not necessarily lead to an answer that may be considered important to a large audience.

If you are satisfied that a paper will have a definite, valuable message, then ask yourself *who is likely to read it* and not *who should read it*. If you overestimate the probable audience, you may prepare the paper for and send it to a prestigious large circulation journal likely to reject it; and you will have lost valuable time. It is important that you clarify the potential audience that your paper is aimed at before you start writing.

Issues that will meet the need of a wide range of audience should be considered. The message of the research will be accepted usually if the message is new to medical literature or at least new to the journal's audience. Even if the message is not new, the paper may get published because it expands on or firms up a previously published message.

Once the potential audience for the paper has been identified, you should decide which journal is likely to reach your target audience. It is extremely important that you decide the journal you plan to submit your paper to before you start writing so you can tailor the style and the content of your paper to its requirements and increase your chances of getting your paper published.

### Choosing the right journal

Choosing the right journal is an early step in planning the paper. Journals differ widely, even within the same scientific discipline or clinical specialty. They differ in scope, the balance of topics, formats and in the balance of research reports and synoptic papers. You should draw up a list of journals that seem to be suitable choices. The topic of the proposed paper should be within the scope of the journal and should match the audience reached by the journal, agree with its format by complying with the guidelines contained in information-for-author's page. Reading through recent issues of the journals on your list will help you to determine or size up who might be interested in your paper. *The information -for-authors' page* of the journal, which may be described with other titles such as "information for contributors", "advice to authors" or "Instruction to authors", should be consulted to obtain information on the topics and formats. Information on the limits of the acceptable numbers of tables, illustrations, references and other specifications may be provided. Other contents of a typical *Information for authors' page(s)* include categories of acceptable papers such as general articles, research articles, reports, policy forums, perspectives, letters and technical comments. Details on titles, abstracts, texts, and other relevant information on manuscript preparation; manuscript assignments for editorial processing, reviewing and other decisions; conditions for acceptance, printing and publication are also included. It is also important to consult the checklist for submission section as it defines what should be in a submission letter and what to include with the manuscript. The paper must be prepared to the journal's specifications from the outset of writing.

*The information-for-authors' page* may be found in the first issue of each volume of the journal; or in every edition for some journals. It may also be found in the journal's web site. *The information-for-authors' page* of many journals draw from the Uniform Requirements for Manuscript Submitted to Biomedical Journals issued by, the International Committee of Medical Journal Editors.<sup>1</sup>

### Assembling evidence

Virtually all papers published in professional journals support their conclusions with evidences such as observational data, photographs and citations of published papers. All these should be assembled before writing is commenced. Various kinds of documented evidences in support of conclusions in the paper other than your own tables and illustrations

should be submitted with written permissions for use of such materials. These documents include extensive quotations from text; illustrations, tables of data; photographs of patients; photomicrographs; letters and other personal communications such as unpublished papers. Assembling these documents early will avoid possible delays in completing your paper. In general, the factor determining the need for permission is the effect of quoting, on the economic interests of the copy right holder. Some quotations are generally regarded as fair use under the copyright law and permission to use them is not needed.

### Authors and co-authors

An important early step is to decide who will be the authors of the paper and their roles. An author should be able to take public responsibility for the intellectual content of the paper and have participated in the following- the conception or design of the work or analysis and interpretation of the data or both, writing the article or revising it for critically important content and final approval of the version to be published.<sup>2</sup> Once the co-authors have been identified everyone involved must agree on the following points-the order in which the authors' names will appear, the main study question that the paper will address, the target journal, the role of each co-author in the writing process and the process for reading drafts, giving feedback and approving the final manuscript.

### Types of scientific research papers

There are two main types of scientific research papers: primary and secondary research papers. A primary research paper is a report of an original research that has not been previously published. A secondary research paper on the other hand reviews data from a number of studies many of which have been previously published. A secondary research paper may take the form of an overview, a systematic review or a meta-analysis. Primary research papers are innovative studies which include observational studies, clinical trials or laboratory research<sup>3</sup>.

**Review articles and most scientific editorials** are similar in that they look analytically and critically at important questions based on critical assessment of the literature with the aim of providing justified answers. Reviews are of two general kinds: descriptive (sometimes called "narrative" reviews) and systematic reviews. The systematic review is mostly dealt with by meta-analysis which calls for systematic assessments of quantitative data, most often of drug trials or some other kind of intervention.

**Case reports** are of four kinds: the unique, or nearly unique, case that appears to represent a previously undescribed syndrome or disease; the case with an unexpected association of two or more diseases or disorders that may represent a previously unsuspected causal relation; the case representing a new and clinically important variation from an expected pattern (the "outlier" case) and the case with an unexpected evolution that suggests a possible therapeutic or an important adverse drug effect.

**Case series** is a hybrid kind of paper based on retrospective study of case records, usually cases collected in one institution or in an individual practice. The cases may be described in short case reports that are followed by such generalizations as can be drawn from these cases and perhaps, from similar case reports in the literature. They report a spectrum of manifestations in a group of patients with clearly defined diagnoses or having experienced a particular intervention such as a specific surgical procedure.

**The editorial and the letter-to-the-editor** are short papers that respond to specific issues that have been or are being addressed in the journal. They may contribute additional information to the paper they are responding to.

### The content and format of papers

When a paper is written the readers want to be convinced that the message of the paper, its answer to a question and its solution for a problem are valid. Scientific papers, even if based on sound research, must provide arguments to make people believe what they conclude and must be built on the principles of *critical argument*. *Critical* means assessing the evidence for its validity and what evidence to accept or reject. *Argument* on the other hand is a coherent series of reasons, statements, or facts intended to support or establish a point of view. The natural arrangement of ideas in critical argument set by Graves and Hodge<sup>4</sup> includes (a) statement of the problem; (b) marshalling of evidences- first on the main points, then on the subsidiary ones-the same sequence being kept throughout the argument; (c) credibility of evidences examined; (d) statement of possible implications of all evidences not wholly rejected; (e) the weighing of conflicting evidences on the scale of probability and verdict. The concept of critical argument includes more than just the content of argument. Graves and Hodge's outline specifies a sequence for the argument. The question is made clear at the beginning. This format

should be applied to all scientific papers as the readers need to know at the beginning exactly what the paper is about and what question (s) it is setting out to answer.

The IMRaD (Introduction, Methods, Results and Discussions) format, a conventional and widely used format for research papers is recommended by the International Committee of Medical Journal Editors.<sup>1</sup> This format is based on principles derived from the content and sequence of critical argument. The IMRaD format is essentially a format only for research reports such as those of clinical trials, observational studies, or laboratory research. Other formats are needed for other kinds of articles, such as reviews, meta-analyses, case reports, editorials, and opinion papers.

### Writing the first drafts

To approach the first draft of your paper you start with writing the title. It is the first part of the paper that the potential readers see. A good title will enable readers to judge quickly if the paper is likely to be of interest to them. It should be presented in a clear easily accessible format and not cluttered up with unnecessary detail. Therefore, a good title should provide readers with enough information to enable them to judge whether or not the paper is likely to answer questions that they are interested in.

A good title will contain three important pieces of information- (a) the subject matter addressed by the paper (e.g., malaria incidence; risk factors for diabetes); (b) the study design (e.g. prospective cohort study, community-based prevalence study); and (c) the study population (e.g. children under five years, villages in the Delta region of Nigeria etc). Titles are of two types- indicative and informative title. An indicative title tells what the paper is about; and an informative title tells briefly in sentence form the message of the paper. For a start in writing, an informative title is more helpful because it forces you to come to an unequivocal decision on the paper's main message. The title could be changed later to an indicative type which is more widely used than the informative type.

After writing the title, a draft of an outline can be made which represents a more detailed version of the eventual paper. Using the IMRaD outline, jot down your thoughts as they come to enable you remain in trend. You could use a word processing program if you are skilled at using a computer or you could write on a paper. During this time it is important to include your reference citations using the format recommended by the journal- e.g. the citation-sequence system (Vancouver style)<sup>1</sup> in which the

references in the reference list are numbered in the order in which they are first cited in the text. The other citation style that could be used is the Harvard system<sup>5</sup> which uses the name-year date system where the paper cited is identified by author's name and year of publication. The former reference style is however, more frequently used in medical literature. You may assign numbers to the references but note that these numbers may change as you revise your drafts.

The abstract should then be written. It could be of two types- an informative type or the indicative type. The informative type gives a concise summary of the content of the paper while the indicative type indicates what the paper is about. The informative type is better written for research reports. The indicative abstract simply indicates what the paper is about, does not summarize what each section says and is especially written for review articles. The abstract should represent each section of the paper by at least one sentence. A structured-abstract format should be used even if the journal for which you are writing the paper does not use the structured-abstract format. Structured abstracts do not differ greatly in content from traditional single-paragraph abstracts but include headings that reflect the main elements of the papers and therefore provide more details. Most journals specify in their *information-for-authors* the maximum length of abstracts they will allow. The recommended length is usually 250 words and the National Library of Medicine truncates abstracts in its MEDLINE database at 250 words.

When you are preparing to write your paper some of the materials at hand probably included tables of data and illustrations. Tables serve four main kinds of needs- presentation of precise numeric values rather than just proportions or trends and large numbers of related data; summarizing information in a clearer form than in running text; and presenting complex information more clearly than in running text or a figure.

You need to find out how many tables the journal may allow for a text of a particular length. If information on this is not included in the *information for-author's* page, derive this by looking at recent issues of the journals and calculating the ratio of text length to the number of tables. A usual rule is no more than one table (or illustration) per 1000 words of text and because the average page of text in a manuscript with double-spaced text and with 1-inch or 3 cm margins usually runs to between 200 and 250 words, the rule can be

stated roughly as no more than 1 table or illustration per 4 pages of manuscript text.

Note that the tables should not replace text statements. Some descriptive information may be more efficiently presented in a table than in the paper's main text. The relation of the tables to the text should be such that their sequence is correctly tied into that of the text and numbered accordingly. The tables should have the following parts: a title which briefly describes its content; the number, and the field (the space carrying numerical data and descriptive terms or phrases that together carry the table's message). The content of the field should be arranged in rows and column with each identifying the kind of data. Descriptions lined up vertically or horizontally beneath the table and footnotes which explain the details of content of the table may also be included.

Illustrations should not be used because they are available but for one or more of the following three needs-evidence, efficiency and emphasis. They could be graphs, diagrams, flow charts, radiographs, pictures, electrocardiography and other tracings.

### Timing of writing the papers

Data obtained from research work should, as much as possible, be sent for publication early. Delays in submission of articles for publication may render the contents stale and irrelevant because of newer findings in the field. Additionally, delays in publication of your findings may allow others discover what could probably have been attributed to your research work if their materials are published earlier than yours.

### Revision of content and structure

Once the first draft has been written, revising the content, structure and prose style form the next step and should involve all its authors. All authors, irrespective of their experience should work through no less than two drafts of a paper before the final version. Most first drafts are not good enough for review by co-authors or colleagues. The first draft should be revised before being given to a second person. In order to make an effective criticism of the first draft you need to put it away for a week or two before looking critically at it again as the labour of writing the first draft often drains the energy you need for looking critically at what you have written and for preparing the second draft. All should read and approve the final version of the paper before its submission to a journal.

There is great value in external criticism. Familiarity with the content of a paper often dulls the eye. Apart from the

co-authors, sharper critics of your paper may be colleagues who are aware of, but not familiar with the research you are reporting, the case you are describing or the literature you are reviewing. Someone who does not understand every detail in a paper may be better able than the authors to see what is not clear, out of sequence, deviated from the subject or that what is most important is lacking(-the needed evidence). Some honest friends should serve as preliminary peer reviewers and give you a close reading of the paper and all possible criticisms.

Each section of the paper should be revised to ensure that all that has to be said and no more than is needed has been supplied and that all the elements of the paper are in the right sequence with clear details to other readers. During the revision, all the comments and corrections made should be written in the margin of the paper. If the drafts are being keyboarded for you by someone else, you may need to ask for additional copies of the draft being corrected so that one copy is used to cut up for pasting of some paragraphs or parts of paragraphs in new locations for better sequence. If reworking on the manuscript yourself with a word processor you may need to keep backup files of each draft. Each draft should be identified with numbers and dates so that subsequent mix up of drafts is not made.

In revising the draft for prose structure and style, five important qualities should be ensured. They are the fluency, clarity, accuracy, economy and grace of the prose. A good sequence for revising prose structure and style include reviewing and revising large elements first (e.g. paragraph lengths, connections of paragraphs, and internal sequence of each paragraph); next, the sentences, the elements of paragraphs including sentence lengths and sentence varieties; and then the elements of sentences which include clauses and phrases, modifiers and word choices.

### Preparing the final manuscript

In preparing the final manuscript, review the manuscript requirements of the journal stated in its *information-for-authors'* pages. If the journal for which you are writing your paper does not provide detailed information on the manuscript requirement then a checklist could be found in the *Uniform Requirements for Manuscripts Submitted to Biomedical Journals*.<sup>1</sup> Review the manuscript's content and format again to ensure that all requirements on the title page have been met. The title should be appropriate and if a subtitle is used, it may be placed following the main title after a colon. Also, on the



title page the first, middle and last names of all the authors with their highest academic qualifications, departments and institutions to which the paper should be attributed, disclaimers if any, contact addresses of the corresponding author, grant support and a running title or key words (head or foot-line) should be provided.

The abstract page should meet the allowed length of the journal which is usually 250 words and key or indexing terms preferably drawn from the Medical Subject Headings (MeSH) list which contain 3 to 10 words or short phrases are supplied.

On the text paper, the headings appropriate to the type and sequence of the paper such as introduction, methods, results and discussions should be followed and, where subheadings are used, they should be clearly distinguished from headings by the choice of typeface. The citations in the text references should be in accordance with the specifications of the journal's information for authors which could be either the Vancouver or Harvard citation system. The order of citation of references should be to the journals' specifications.

Acknowledgements of persons who have contributed substantially to the content of the paper but do not qualify as authors or who have been given technical or financial assistance should have their permission before their names are written.

Where tables or illustrations have been used, they should be provided on separate pages and each numbered consecutively in accordance with their order of citation in the text. Each table or illustration should have a title and explanatory text or non-standard abbreviations explained in footnotes. Photographic copies of illustrations in prints should not be larger than 8 by 10 inches (20.3 by 25.4 cm). The legends for the illustrations should be provided on the manuscript text page not on the back of the figures. After these steps, the final version of the paper should be reviewed to ensure that its content and prose style are well written and do not need further reworking.

In submitting the article, it is important to check to see if the journal expects to receive an electronic version of the manuscript (diskette or e-mail transmission) in addition to the paper manuscript and the number of copies to be submitted.

When the final version of the paper is ready for submission, the following steps should be followed:

preparation of the letter of submission to accompany the manuscript, getting the signatures of all authors on forms required by the journal with submissions, assembling all other items that should be sent with the manuscript, packing the letter, manuscript, illustrations and other documents and checking again in the journal's *information-for-authors'* pages on whether it expects submission of papers as a word-processing file on a floppy disk or via electronic mail. Finally, the packaged manuscript is ready for mailing.

Journals differ in the procedures used for reviewing submitted papers and decisions on which to accept. Most use some variations of the peer review system in which experts are asked to give the editor their judgements on the papers' validity and importance. Some of the criteria used include; the relevance of the paper to the journal's scope and audience, importance of the paper's message to most of the journal's audience, newness of the paper's message, scientific validity of the evidence supporting the paper's conclusions and the usefulness of the paper to the journal in its maintaining a desirable range of topics. Even when the paper is acceptable using the above criteria, the editor may apply additional criteria such as the effect of acceptance on the journal's backlog of already accepted papers, quality and pertinence of the presentation in the manuscript and the extent of revision that would be needed for an acceptance. If the paper is accepted some revisions may still be needed to meet reviewer's and editorial requests. If the paper is rejected, consider carefully, not angrily, whether the rejection was justified and whether the paper should be carefully revised again, before submission to another journal. It is important not to give up on your efforts to get your paper published.

## CONCLUSION

Scientific papers contribute immensely to development in all fields. Writing them requires careful planning and commitment. There is need to carefully consider the issues raised above to improve the quality of your paper and reduce the frustration associated with the rejection of manuscripts by publishers. Scientific papers should not be written because of the drive to publish or perish. Quality work should be done to move the field of science ahead in our generation.

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