REVIEW

How to write a paper

P Driscoll

Take a moment to think about the last time you read an exciting paper or an article which changed your clinical management. What was good about it, was it understandable, relevant and pithy? Consider now the latest article you have ignored—what put you off? Was it incomprehensible, irrelevant, or simply unbelievably boring?

Usually clinicians can bring to mind more bad papers than good ones. This is unfortunate because many problems can be avoided by following some simple guidelines before and during the writing of an article. The aim in this review is therefore to help you to write interesting and relevant medical papers which are enjoyable to read. In order to do this real and fabricated examples will be used to clarify certain points.

Planning and preparation before writing the paper

The more time and effort put into planning original research the easier will be the writing. Therefore before putting pen to paper, consider the answers to the following questions.¹

WHAT DO YOU HAVE TO SAY?

If you are not clear on what is to be described, then it is likely that the reader will be equally confused. Surprisingly this is a common error and can lead to exasperation in the reviewer and possible rejection by the editor. Readers do not have either the time or the patience to try and deduce hidden meanings. A good way of testing the clarity of any prospective article is to try and describe the message you wish it to convey in *one* sentence.

WHY SHOULD YOU SAY IT?

Ideally an article is written because the message it imparts will either change clinical practice or add to the "sea of knowledge" currently in existence. Sometimes, though, the primary aim may be more prosaic (box 1). Publishing for these reasons can result in poor quality papers lacking objectivity and, in more serious situations, tempt the author to commit fraud.

Box 1 Poor reasons for writing a paper
Egotism
Justifying a grant
To pad out a curriculum vitae

WHAT STYLE OF WRITING SHOULD YOU USE?

It is important that the text should be precise and pertinent as well as being appropriate to both the journal and the message of the article. However, the rhythm of the text must also be considered. For example, consecutive short sentences have the effect of exhausting the reader because many points are being made in rapid succession. In contrast, if the sentence is too long then the thread of the argument can be lost. The optimum is to use long sentences when making general points but shorten them when an important point or concluding remark is being made.

Unless the article is being written for a very select readership, trendy terms, abbreviations, and jargon speech should not be used. Example 1 gives some common phrases which are best avoided:

Example 1

As time goes by (cliché) we shall be able to facilitate networking on a one-to-one basis (jargon) during IPR (abbreviation) sessions by allowing those who are vertically challenged (trendy phrase) to sit down (circumlocution).

HOW LONG WILL IT TAKE TO WRITE?

The answers to the questions above will determine how long the writing is going to take. Time allocation should also include a period when the latest draft is put away and returned to after one to two weeks. By doing this the chances of identifying errors is increased. In addition it is strongly advisable to have a respected colleague constructively review the article before it is submitted.

Invariably several drafts will be written with corrections made with each attempt. A useful tip is therefore to date each draft so that you avoid the error of re-editing an out of date script.

WHICH JOURNAL?

The choice of journal is very much dependent upon the target audience. For example, will the article only appeal to specialists in the field or is it relevant to a wider readership? A clue to the former is if the majority of the references used in the article come from one journal.

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Impact factors of some common journals

<i>Journal</i>	<i>Impact factor</i>
Lancet	15.88
JAMA	5.59
British Medical Journal	4.49
Critical Care Medicine	2.431
British Journal of Surgery	1.95
J Trauma	1.194
Resuscitation	0.863
Injury	0.134
J Accident & Emergency Medicine	0.125

More recently the impact factor (IF) of the journal has also been considered (table).² This is calculated by the American National Library by dividing the number of citations of a particular journal by the papers published in the two previous years.³ However, this number needs to be interpreted with caution because it uses the *Index Medicus* as its main source and therefore tends to be biased in favour of American papers. There are two further limitations in only using the IF to assess the quality and reliability of accident and emergency journals. Firstly, authors outside the specialty are often unaware of the journals dealing with accident and emergency issues and will not therefore reference them in their papers. Secondly, the specialty is still developing and as such requires further time before the topics it deals with can develop their true impact in the medical literature.

WHAT FORMAT SHOULD BE USED?

You should have a clear idea to which journal the article will be submitted by the time the second or third drafts of the paper have been completed. Once this is determined it is possible to obtain further advice about the appropriate style, format, and length of text by studying the journal's "Instructions to authors" and scanning some of its papers.

WHAT DOES THE READER NEED TO LEARN FROM THE ARTICLE?

In answering the previous questions, the article will achieve what you want to say. However, it must also take into consideration the reader's desire to assess the observations made and the validity of the conclusion drawn. Consequently enough information must be present so that the whole study could be repeated.

The "IMRD" system

To achieve the reader's objectives the Introduction, Methods, Results, and Discussion (IMRD) system for writing a paper was devised (box 2). This in fact corresponds to the questions Sir Austin Bradford-Hill said an author should try to answer.⁴

Box 2 The IMRD system

Title
Abstract
Introduction
Methods
Results
Discussion

Though this represents a logical order to the reader it is rarely the order in which the paper is written. Instead it is usually easier to use the following sequence: (1) Methods; (2) Results; (3) Discussion; (4) Introduction; (5) Abstract; (6) Title. It is important to understand the particular requirements of these sections so that they can be met while the paper is being written.

METHODS

The aim of this section is to explain the design of your study, how it was carried out, and what statistical techniques (if any) were employed to analyse the results. In other words the reader should have all the information in the methods section to duplicate your study.

The method is therefore written first, because it represents a synopsis of the research protocol you should have developed before carrying out your study. Consequently in writing this section before completion of the study, you will have the opportunity to reassess—and correct—the methodology used before it is too late.

In recent years the writing of the methods section is becoming increasingly neglected (example 2).

Example 2

"Because of the inadequacies in our emergency room record-keeping system, there were limitations in our ability to accurately assess the timeliness and appropriateness of airway management and resuscitation from shock in all patients".⁵

This is a significant methodological flaw in this study, because the investigators were looking at the effect of a resuscitation course for doctors dealing with trauma patients. Such errors will no longer be tolerated by journals. In fact failure to meet the methods sections goals is one of the commonest causes of outright rejection by a medical journal.⁶

Design

This should be brief but pertinent and use key words which will be understood by the reader. When a new technique is introduced this must be described in detail, along with the accuracy of any measurements. In contrast, any standard experimental methodology used can be simply referenced to the original work. It is also important to describe the selection and randomisation process used when this is part of the study. The ethics considerations of the experimental design should be also addressed, because many journals expect proof that studies have been vetted by a local ethics committee where necessary.

The methods section must describe the statistical procedure used and, in complex situations, a rationale of why the analysis chosen was correct. The type of statistical tool should have been largely determined before the study started and you are strongly advised to have

already sought expert advice. Before seeing a statistician, however, it is best to have answers to three questions (box 3).

Box 3 Questions a statistician will ask you
What type of data are being collected?
What are the number and size of the samples?
Are the samples independent or related?

If the study involves a series of topics it is best to describe them in the most logical order possible. Often this reflects the aims of the study listed at the end of the introduction (see below). This order should then be maintained throughout the results section and, as far as possible, in the discussion section as well.

RESULTS

This part of the article should provide the reader with a description of the major findings and their statistical significance. Above all try and keep it as simple as possible, because complexity invariably leads to delay in having the paper published.

Though it is not essential to present every scrap of data collected, it is important to include crucial points which were not found in your study but have been found in others. A variety of ways and techniques can be used to convey the message, but care should be taken to avoid repetition, particularly between text and tables. Text is used to describe what has been found, whereas tables are ideal for presenting the results in a concise fashion. However, when you wish to demonstrate trends, figures are ideal as they make a more dramatic impression.^{7,8}

It is becoming common to have either a table or a paragraph (example 3) at the beginning of the results section, which describes the nature and comparability of any groups studied. This should then be followed by answers to the problems set out in the aims and method sections. Finally, any unexpected results should be described so that they can be referred to later in the discussion section.

Example 3
“The following analyses are based on the details of 14,648 patients from 33 hospitals which were held on computer at the end of December 1991”.⁹

When writing the results section it is helpful to remember the common errors which have been made in the past so that they can be avoided:

- (1) *Accuracy*—Do not give results an accuracy greater than their original measurement and make sure that any suggested differences are greater than your errors of measurement.
- (2) *Condensing results*—Give the numbers of subjects, the range of results, and the central tendency (for example, the mean and standard deviation).
- (3) *Legends and layout*—Use the format of the journal and make sure that the legend enables

the table or figure to be understood without the need to refer to the text.

(4) *Statistical methods*—Use appropriate statistical methodology so that the conclusions drawn are valid. A common error is incorrectly assuming a normal distribution of data and using parametric analysis incorrectly.

DISCUSSION

The aim of this section is to summarise the major findings of the study, discuss any methodological problems, and, by comparing the results with previous work, discuss the implications of the study. It should be approximately one third of the size of the whole article and avoid simply repeating the results or trying to review every single previous report.⁶

The first one or two sentences should try to encapsulate the major findings without simply repeating the data (example 4).¹⁰ The limitations of methodology can then be discussed, but you should defend your reasons for choosing the way the study was performed or the conclusions drawn.

Example 4

“The present findings support the notion that inappropriate triage, particularly under triage, can be minimised by evaluating the site and mechanism of injury in addition to the physiological status of the trauma patient”.¹¹

The critique of previous work should be restricted to scientifically sound work which is similar to the current study. By describing the strengths and weaknesses of these studies, you can show how the new results fit in with what has gone before, how they have been enhanced by it, and where studies should go in the future.

INTRODUCTION

This must be short and captivating so that the importance of the study can be stressed in a way which neither baffles nor patronises the reader. It is therefore important to be quite clear who you envisage will be reading the paper.

Example 5 is the opening sentence of a paper published in a journal read by a clinicians from a variety of backgrounds interested in trauma. The sentence is very long and detailed and would probably attract only the specialist reader.

Example 5

“Troponin T (TNT) is a 37 kilodalton protein subunit of the myofibrillar regulatory troponin complex, which is involved in the calcium-sensitive switch that regulates the interaction of actin and myosin in striated muscle”.¹²

It is essential that the first sentence is not wasted in this way but is, instead, used to entice the reader to want to know more. There are several techniques for this, including the use of

quotations, being controversial, describing a vivid scene, or relating some intriguing facts.¹³ Example 6 shows how this could be done in a hypothetical study.

Example 6

"We report the first long term study of sprained ankles in Martians".

It must be clear why the reader should be bothered with this study; for example does it set out to answer a problem which has arisen in clinical practice or is it adding to previous work? In the latter case you should concentrate on those references which are closest to the new study. This will keep the introduction short as well showing what this current study could add. Recently there has been a move towards presenting a systematic review of all previous work (box 4).

Box 4 Systematic review

A clear question is posed
All available evidence is gathered
Weak data are discarded
Analysis and conclusion
Derives further questions
Selects the questions which will be the aims of the current study

To do this properly it is essential that you carry out a methodical search of the relevant published reports. This includes *Medline*, *Index Medicus*, *Excerpta Medica*, *Current Contents*, abstracts, and conference reports. There are over 700 different types of computer database and in future the Cochrane Institute will be able to provide a data bank on all randomised controlled trials. A description of the literature search should be included in the introduction so that the reader can be assured that all potential sources have been checked.

Continuing with the hypothetical Martian study, example 7 shows how the objectives of a paper's introductory section can be achieved.

Example 7

"Since the Martian invasion, accident and emergency departments have been inundated with limping green men, many of whom are reattendees due to inadequate treatment.¹ A medline search using seven key phrases, discussion with the Flat Earth Society and a personal search of the five relevant conferences on musculoskeletal injuries in little green men, showed that two studies have been carried out on ankle sprains in Martians.¹² Both reported that ankle sprains were common. However, these studies assessed only two subjects, did not clarify which of the eight legs were used, and were curtailed early because one of the investigators was vaporised. We report a study on the weight bearing hind limb of 50 Martians over six months."

REFERENCES

Though it is essential to be aware of the published reports dealing with your study, you do not need to include them all in the paper. Instead only those which are relevant or essential for the understanding of the article need to be included. Indeed only reviews should have more than 40 references.

A common error made by authors with regard to references is in not obeying the journal's guidelines. This tends to make reviewers more wary because it can indicate that paper has been submitted to, and rejected previously by, another journal.¹⁴ It is also important that you check that your references are accurate. Delacy *et al* found that 46% of those listed in the *British Journal of Surgery*, 26% in the *British Medical Journal*, and 24% in *Lancet* were wrong.¹⁵ Since 1985, when Delacy's paper was published, editors have become much more sensitive in making sure references are correct.

Reference management systems are computer software aids which enable you to build up bibliographies while studying previous published work. These are a great help when it comes to writing the reference section because key terms and names can be selected.¹⁶ It is also advisable to keep a copy of all the articles which are going to be referenced. However, if there is a storage problem, a copy of the front page will do because it usually contains all the article's essential information.

ABSTRACT

Even after all your hard work in carrying out the study and writing the article, only the abstract may be read. It should therefore contain all the relevant information in the paper. To prevent it becoming uninformative or meandering, many journals now have structured abstracts. If this is the case, then the journal's guidelines must be followed. In contrast, when no such guidelines exist, Lillyman's advice should be followed, whereby the abstract is set out to answer the following questions¹⁷:

- Why it was the study carried done? (This should be one to two sentences.)
- What was done? (This should summarise the method using key phrases such as "randomised controlled trial".)
- What was found? (This should summarise all the important results.)
- What was concluded? (A clear message should be given but do not get into a prolonged discussion.)

TITLE

This must be short, pertinent, and enticing, otherwise there is a risk of the paper not being read. In this regard you can learn a lot from

journalists who have to achieve the same goals every day in the newspapers (example 8).

Example 8

Original title:

"Escape of a psychiatrically disturbed man who committed a lewd act on a cleaning lady"

Became

"Nut screws washer and bolts!"

Using this analogy, there is a good example in the medical literature¹⁸ (example 9).

Example 9

Original title:

"Microprocessor assisted clinical assessment and management of minor psychiatric disorders"

Became:

"The computer will see you now"

More recently there have been two examples which show the difference between an enticing title for the generalist and one which would only appeal to a specialist reader (example 10).

Example 10^{19 20}

"Urban hypothermia in the west of Scotland"

"Finite element analysis of the stress distributions in the proximal end of the femur after stabilisation of a pertrochanteric model fracture: a comparison of two implants"

AUTHORS

The list of authors should include only those who have made a substantial contribution to the study. All will need to sign a submission note. People who have helped in other ways can be acknowledged at the end of the paper.

Handling rejection

Rejection is always painful, especially when a lot of hard work has gone into writing the article. However, it is likely that rejection is qualified rather than absolute unless there is a fundamental flaw in your methodology.

Journals will usually send the referee's comments describing the faults in the article and,

occasionally, suggesting ways in which it can be improved. A rejection postcard with no other information commonly means that the article is not considered relevant to the readership of that journal. It does not mean, however, that it is unsuitable for any other journal.

Once the points identified by the referee have been addressed you should resubmit the article or send it to another journal. In the latter case bear in mind that certain changes to the layout of the article may be necessary to comply with the new journal's house style.

Summary

Potent papers are planned, pertinent, pithy, and precise and so take patience and perseverance to perfect.

This paper is based on a presentation given at the Royal Society of Medicine in 1995.

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