Advice on how to write a paper – Original Research
(separate guidance is provided on writing up systematic reviews)

General
Writing reports and papers is a necessary and important part of any research – unless the results are communicated accurately to others the value of the work will be lost. Writing concise and clear papers is a very important skill for any future researcher to develop as rapidly as possible. There are efficient ways of doing it and there are inefficient ways. It is worth learning quickly how to avoid the latter because your research collaborators and supervisors will not appreciate reading multiple badly prepared drafts when a few good ones would have done the job. Also you are more likely to have your work published at the first attempt if it is well written. So writing is important and worth developing as a skill. Its all about planning, clear thinking and following a few simple rules. The more papers and reports you write, the faster you will learn this very important skill.

You can learn a lot about paper writing by reading other papers. It is therefore important that when you read papers you pay attention not only to the scientific content but to the style, layout and construction, and ask yourself whether it is clear, readable and conveys all the important information.

Always use the active tense – "we did such and such" and NOT the passive - "It was done".

Use subheadings liberally and avoid long paragraphs.

Avoid abbreviations wherever possible.

Remember that vast amounts of papers are published daily and so if you want your message to get across, you have to be as brief, clear and concise as possible and make it as easy as possible for the reader to find their way around the text. Nothing puts people off more than dense complex text full of abbreviations.

George Orwell, one of the clearest and best writers of English, had the following advice:

> *Never use a metaphor, simile, or other figure of speech which you are used to seeing in print.*
>
> *Never use a long word where a short one will do.*
>
> *If it is possible to cut a word out, always cut it out.*
>
> *Never use the passive where you can use the active.*
>
> *Never use a foreign phrase, a scientific word, or a jargon word if you can think of an everyday English equivalent.*
>
> *Break any of these rules sooner than say anything outright barbarous.*

(Orwell G. Politics and the English Language. 1946)

Use one side of the paper only, in 1½ or 2 line spacing, leaving a good margin all round. Number all pages. Start each section on a new page. Be consistent with headings and formatting but DO NOT over format your paper as many journals will not accept manuscripts with complex formatting of headings and so on.

If you are not sure whether your writing is going in the correct direction, then showing an early draft to your supervisor or collaborator can often be very helpful in steering it in the right direction and in identifying sections that are not as clear as you thought. Your paper and any report of your research during your PhD or other project should emphasise the methods,

communication, assessment and interpretation of results, put them into the general context of the project and the work of the others, and summarise implications for current practise and future research.

As a guide, the total length allowed in many journals is about 3,000-4,000 words including references. However journal styles vary considerably and you MUST check the style of the journal you are aiming for early on. There is no point in preparing a 7000 word manuscript for a journal that restricts manuscripts to 3000 words. If you are not sure which journal, then go for about 3000 words – its easy to increase from there and not so difficult to cut if necessary and few journals are more restrictive than 3000 words.

Similarly, requirements for figures (and tables) vary between journals, so find out what format (and size) the target journal accepts before preparing figures – you can waste a lot of time by using the incorrect graphics package or producing figures that are too big or too small for the journal.

The International Committee of Medical Journal Editors website (http://www.icmje.org/manuscript_1prepare.html) provides a useful check for general aspects of manuscript preparation, including the correct order of table superscripts.

Note the timeline from start of writing to final publication in print or on line can be very long. You can influence some parts of this process – prior to the point of submission - but not others – from the point of submission onwards. For example, the peer review process can take many weeks, dealing with reviewers comments can take a couple of months, then the paper has to go for further review possibly with further revisions before it is finally accepted. Once finally accepted, the paper can be sitting in the pipeline for over a year in some cases. So the longer you delay in getting your paper ready to submit in the first place, the longer it will be until it appears in print. Remember, someone else may be out there doing similar work and pip you to the post.

It's good to plan ahead and even write the outline of the paper – introduction, methods, outline of results and key points for discussion – as you go along. You can fill in the gaps once your results come through. But writing is a difficult skill to learn and good writing takes a long time, so do not leave writing the paper until the last minute – unexpected glitches often occur and may result in serious delays in publication.

Be meticulous in saving corrected versions of the paper as it goes through each iteration of editing. Using a date in the filename is a good idea so at least you can identify which version you last worked on quickly. Save versions with edits coming back from co-authors using their initials at the end of the file name – then you can identify easily which version it was (from the date) and whose comments they were (from the initials). Otherwise it can be very confusing trying to amalgamate comments from several co-authors and avoid accidentally missing one. Few things annoy co-authors more than spending time editing the paper and then finding that their comments have apparently been ignored.

Missing authors off papers causes even more annoyance, especially if they feel that they have put in time or other effort and they are quite senior, as senior people have very little time and are judged even more on their publications, so their input should not be overlooked. Therefore, if in any doubt about who in a team merits authorship, you should discuss it with your team/supervisor/PI up front. Criteria for authorship are clearly spelt out on many journal websites - there are several types of contribution that do merit authorship and it can cause enormous offence if authorship is not correctly attributed. If in doubt, ask the boss at an early stage, before the opportunity for offence has arisen. Offence is very easy to create and very difficult to erase, so best avoided in the first place.

NOTE: Detailed guidance on general aspects of manuscript preparation is available on the International Committee of Medical Journal Editors website (http://www.icmje.org/manuscript_1prepare.html). This website contains very good advice on preparing each section of a manuscript and is worth following closely to optimize your chances of getting your work published as quickly as possible.

Also, detailed guidance on how to make sure that you correctly report your type of scientific work (eg epidemiological study, randomised controlled trial, etc) is available on ***The Equator Network*** (www.equator-network.org/). Checklists are available for different types of study (observational studies, diagnostic tests, randomised trials, epidemiological studies, etc) to make sure that you do not overlook any important points in papers describing the results of a range of different types of primary studies or systematic reviews. The Equator Network states:

"Reporting guidelines are statements that provide advice on how to report research methods and findings. Usually in the form of a checklist, flow diagram or explicit text, they specify a minimum set of items required for a clear and transparent account of what was done and what was found in a research study, reflecting in particular issues that might introduce bias into the research.

Most widely recognised guidelines are based on the available evidence and reflect consensus opinion of experts in a particular field, including research methodologists and journal editors. Reporting guidelines complement advice on scientific writing, which concentrates on the basic writing principles and styles of research reports and publications, and journals' instructions to authors."

Please keep this in mind when reading the following general advice and consult The International Committee of Medical Journal Editors and The Equator Network for further details and guidance.

Two types of report that are not yet well covered on either of these websites are: a) reporting of industry sponsored medical research, which is now addressed in the GGP2 Guidelines;[1] and b) reporting of studies assessing potential biomarkers for prognosis, eg in stroke or tumour growth, now addressed in the REMARK guidelines.[2]

Details of how to set out a manuscript

Title Page
This should give the title of the project, authors' names, qualifications, affiliations, key words, short title, word count, figure and table and reference counts. Different journals have different requirements but these are common features that are requested. The title should be informative and an accurate reflection of the work, without exaggeration.

Abstract
This should be on a single page. The abstract should present the project; indicate the nature and scope of the work performed and point out the major findings and conclusions. It should be self-explanatory, without the need to refer to the main report. Subheadings are usual and include Background, Methods, Results and Discussion, although individual journal requirements vary. A 250 word limit is advisable, although some journals have a 200 word limit.

Introduction
This is the reader's first exposure to the subject matter and so the introduction should give adequate reference to previous work on the subject, highlight gaps in knowledge or where previous results have disagreed and state the reasons for performing the work. Here you can present a short summary of the literature and highlight the background and context of the work. However take care to avoid the *Introduction* becoming too much of a *Discussion*. If there is no relevant literature, then say so. The introduction should be normally no longer than a couple of pages and the briefer the better. The introduction should end with a sentence which states clearly the aims of the project; be careful not to duplicate statements made elsewhere.

Methods
Here you should concisely describe the methods employed to obtain data (subject identification, recruitment, inclusion and exclusion criteria, assessments performed, etc), any

definitions, the methods of data and statistical analysis and the materials ad equipment used (including suppliers).
Detail should be sufficient for others to repeat the work. Imagine that you are trying to describe the work to someone who does not know what you did.
There is no need to give excessive details of previously published procedures if they are performed exactly as in the original papers – but make sure full references are accurately quoted and modifications to the methods described.
It is very important to describe any sample size calculation and statistical methods carefully.
Avoid putting any results in the methods.
Use subheadings.
Refer to the appropriate reporting guidelines for your type of study, as outlined above.

Results
Describe your results logically and clearly. Avoid ambiguous statements.
Start with describing your population and how many subjects, patients or animals were included, summarise their features (age, sex, severity of disease, etc as appropriate) and how many dropped out or were not analysable for any reason (and give the reasons).
Then describe the key results in a logical order. Use tables and figures and avoid repeating everything that is in a table in the text. The text should be used to highlight key results. Numerical data should be presented in a summarised form (e.g. tables, graphs, histograms) with statistical analysis. Unless there are special reasons, the same data should not be presented in more than one form (i.e. you don't need a graph and a table of the same data). Non-numerical data may be in the form of line drawings or photographs. Provide a concise description of your results. Do not describe the conclusions to be drawn – these should be in the discussion.

Discussion
The final section of the text will be the discussion in which you interpret and discuss the results obtained, and to draw and defend your conclusions. It should not simply reiterate the results of the literature review in the introduction. You should where possible show how your results relate to those of others' and what further work may be required. A useful way of setting out the Discussion is to follow the advice of a former editor of the British Medical Journal and structure the Discussion under these headings:[3]

- statement of principal findings;
- strengths and weaknesses of the study;
- strengths and weaknesses in relation to other studies, discussing particularly any differences in results;
- meaning of the study: possible mechanisms and implications for clinicians or policymakers;
- unanswered questions and future research.

Avoid multiple repetitive paragraphs. Don't over speculate or exaggerate the importance of your findings – its very irritating to expert reviewers! Don't draw conclusions that are not based on data presented in the paper. Nothing annoys reviewers more than authors who over promote the value or importance of their work. Its much better to be considered, rational, modest and objective.

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You must acknowledge funding agencies and grant numbers, and any people who have helped you but not to the point that they merit authorship. For example if someone proof-read the manuscript.

References
The Harvard or Vancouver (Numbering) system are most commonly used but each journal has particular requirements. You should use a reference programme like Reference Manager or Endnote for storing, retrieving and sorting references. To try any other way of referencing a manuscript is a complete waste of time and will just result in errors. Also by the time it comes to writing a thesis or a really large report, you will need to have the references in a form so that you can easily manipulate them, change the order, etc. So use a referencing programme.

Harvard system:
This is wordy and can disrupt the flow of sentences, so many journals prefer the Vancouver numbering system. I would avoid citing references by author name if at all possible. Harvard goes like this: "…Bottle and Wyatt (1966) have written an extensive guide to the published literature …advice on writing scientific reports is also readily available (O'Connor and Woodford, 1971)." For three or more authors you should name only the first author followed by *et al*. Where more than one papers by the same author(s) is published in the same year they should be referred to as 1990a, 1990b, etc. In the final list of references, articles should be in alphabetical order, except for those by three or more authors given in texts as "*et al*" which should be group chronologically after any other papers by the first author.

Vancouver system:
This is much better as the numbers take up less space. References should be cited in the text by sequential numbering in square brackets e.g. [1], [2-6], [1,4,5,7-10] or superscripted. The final list should then be in numerical order, preceded by the appropriate number.

Tables and **figures** should be placed on separate pages at the end of the manuscript (check journal requirements as a few journals ask for tables in the text). Each needs a Legend and any abbreviations should be explained. See advice on figure and table preparation from the International Committee of Medical Journal Editors in the general section above.

Tables usually should be on separate sheets and numbered consecutively. They should have an informative heading and an explanatory legend. These should make the general meaning comprehensible without reference to the text. Consider the layout carefully so that the importance of the data can easily and quickly be grasped. Do not overpopulate tables. Avoid presenting p values without the actual statistic (eg correlation coefficient). Indicate the magnitude of any effect and not just whether it is significant or not. Statistics should be quoted where appropriate. Units in which the results are expressed should be given at the top of each column. Use the most appropriate units – avoid long strings of zeros and numerous significant figures – ie round up to one or to decimal places in general.

Figures should be on separate sheets and numbered consecutively with appropriate headings and legends. Consider whether graphs, histograms, bar-charts or other formats are the most appropriate form to record your results. Do not make the figures over complex by presenting too many sets of data. Avoid unnecessary use of colour (colour publication is very expensive and not worth it unless your figure really needs to be in colour). On graphs, each line should have a different symbol. Error bars should be shown where appropriate. Carefully check the figure format required for your target journal well in advance as editing figures into the correct format can be very time consuming (see International Committee of Medical Journal Editors advice above).

Finally, **presentation of your manuscript is really important**. A scruffy manuscript full of typos gives the impression that your science may be scruffy and full of holes too – not good! Take the time to double check your manuscript for spelling errors (eg does the journal want UK English or USA English?). Get the page layout looking nice. Are the figures and tables as neat as they possibly can be? It can be the difference between getting your hard work into a high impact journal where it will be widely read and quoted, or into a mediocre and not widely read journal where it may sink without trace – not good for your future career or the future funding of the group that you worked with.

References

1. Graf C, Battisti WP, Bridges D et al. Good publication practice for communicating company sponsored medical research: the GPP2 guidelines. BMJ. 2009; 339:b4330

2. McShane LM, Altman DG, Sauerbrei W et al. Reporting recommendations for tumor marker prognostic studies. J Clin Oncol. 2005; 23:9067-9072

3. Docherty M, Smith R. The case for structuring the discussion of scientific papers. BMJ. 1999; 318:1224-1225