Scientific Writing: A Friendly Guide

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The primary purpose of scientific writing is to inform an audience of other clinicians or scientists about an important issue, and to document the particular approach that was used to investigate that issue. Bio-medical journals are a primary means by which clinicians and scientists convey their information. The information is usually presented in the form of a research article, which is written in a very specific structure. Scientific writing is, therefore, an essential skill for the successful clinician and scientist. This guide is aimed at giving some simple and practical advice on the preparation of a research manuscript. It includes a suggested structure and a guide to what should go in each section. It also explains the practicalities of English grammar. The guide was originally written for research students in medicine and biological science, and most of the specific examples given are taken from those disciplines.

Part One. Contents of a Scientific Paper

A scientific paper normally consists of the following sections: *Introduction, Methods, Results, and Discussion*. This is commonly referred to as the IMRAD structure. However, each original scientific papers always include an *Abstract* section to summarize all aspects of the research project.

I. The *Abstract*

There are two kinds of abstracts: unstructured and structured abstracts. The former is a one-paragraph summary of the study. The latter is a summary of major aspects of the entire paper in a prescribed sequence such as *Background, Aims, Methods, Outcome Measurements, Results,* and *Conclusions.* However, whether it is structured or unstructured, an abstract must convey the following information:

- The *question(s)* you investigated (or purpose). State the purpose very clearly in the first or second sentence. It is also a good idea to include a single lead sentence to state the critical background to provide context for the work.
- The *experimental design or methods* used. Clearly state the basic design of the study (treatments, controls, replication, sampling scheme, etc). Clearly explain the basic methodology used without going into excessive detail - be sure to indicate the key techniques used.
- The *major findings* including *key numerical results*. Report those results which answer the questions you were asking; identify trends, relative change or differences, etc.
- A brief summary of your *interpretations* and *conclusions*. Clearly state the implications of the answers your results gave you.

Whereas the *Title* can only make the simplest statement about the content of your article, the *Abstract* allows you to elaborate more on each major aspect of the paper. The length of your Abstract should be kept to about 200-300 words maximum (a typical standard length for journals). Limit your statements concerning each segment of the paper (i.e. motives, methods, results, etc.) to two or three sentences, if possible. The *Abstract* helps readers decide whether they want to read the rest of the paper, or it may be the only part they can obtain, e.g., via electronic literature searches or in published abstracts. Therefore, enough key information (e.g., summary results, observations, trends, etc.) must be included to adequately summarise the work.

II. The *Introduction*

Here you should answer the question "why did you start?" The *Introduction* must be able to convey the following: (a) what have been done; (b) summary of conflicting findings in the literature; and (c) what you want to do. Therefore, you should begin the *Introduction* by reviewing background information that will enable reader to understand your study's objective and its significance, relating the significance to the larger issues in the field. Include only information that directly prepares the reader to understand the question investigated.

Most ideas in the *Introduction* will come from the literature, such as scientific journals or books dealing with the topic you are investigating. All sources of information must be referenced and included in the *References* section of the paper, but the *Introduction* must be in your own words. Refer to the references when appropriate. Unless otherwise instructed, place the author of the reference cited and the year of publication in parentheses at the end of the sentence or paragraph relating the idea for example, "(Finnerty, 1992)."

The *Introduction* usually consists of unstructured, free-flowing text. However, it is always helpful if you keep in mind the following guidelines when write the introduction:

- *The Introduction should not be long*. Try to limit it within two double-spaced pages.
- *The Introduction should not contain an exhaustive historical review*. Assume that the reader has knowledge in the field for which you are writing, and it does not require a complete digest. Do not forget that citing appropriate and specific credit to relevant earlier works is part of your scholarly responsibility.
- *The Introduction should outline the objectives of your study*. You should try to make sure that when a reader finishes reading your introduction, he/she will know the significance of the question. Try to maintain the flow from broad to specific. Do not use the introduction as an information dump to show the reader how much you found on a topic. Show the reader you understand the relevant issues in a field and know how your study complements this information.
- *Write the Introduction in past tense when referring to your experiment*, but when relating the background information, you can use both past and present tenses when referring to another investigator's published work.

Consider the following hypothetical example: ″Measurement of bone mineral density predicts subsequent risk of fractures among the elderly [1-3]. However, bone mineral density in later decades of life is a dynamic function of peak bone mass achieved during growth and its subsequent age-related rate of loss. It has been estimated that over a lifetime, a typical woman loses about half of her trabecular bone and one third of her cortical bone [4], although some women experience greater loss than others. It is not clear whether the rate of bone loss is an independent risk factor for osteoporotic fractures. The present study was designed to assess the contribution of bone loss to the risk of osteoporotic fractures in elderly women.″ This *Introductions* introduce the reader to the state of knowledge before the research was started, defines the gap of knowledge which the research will fill, and states what the authors set out to do. It does not review the history of the subject from the time of Pythagoras to the present day (which is more appropriate for a thesis, not a paper).

Consider the following example: ″It is well recognised that nonsocomial infection is associated with an increase in morbidity and mortality together with a significant economic cost [1]. Patients in Intensive Care units develops nonsocomial infections more frequently than other hospitalised patients [2]. This is a result of severity of illness, multiple exposure to invasive procedures and multiple therapies [3]. Patients in surgical and orthopaedic wards are also at a high risk of developing nonsocomial infections. These patients are exposed to various invasive procedures (including surgical wounds) which may be similar to those in ICU. Because of the expected differences in the nature of risk factors, patients' illnesses in the therapeutic and infection control measures in the above wards, it was necessary to conduct a study to assess the nonsocomial infection rates.″ After reading this introduction, one does not have any idea how significant the project is. In fact, the ideas and arguments are not that coherent, nor convincing enough to carry out the study. The aims of the study are also not clear. This style of writing should be avoided.

III. The *Methods*

This section is sometimes referred to as *Materials and Methods,* or *Study design and Methods*. In this section, you should answer the question "*What did you do*?" The answer must include what patients, animals, or specimen the results were obtained from; what techniques were used to obtain them; and what statistical techniques were used to analyse the results. Many readers read the *Methods* section first to see if they can understand what the authors did, and whether there is enough information for them to repeat the work themselves. If there is not, readers can not judge whether the results are of any value and there is no point in reading it further.

The *Methods* section should be divided into labelled sub-sections. These usually include descriptions of the participants (or patients), the apparatus (or materials), and the procedure.

(a) *Participants*. Appropriate identification of research participants is critical, particularly for assessing the results (making comparisons across groups), generalising the findings, and making comparisons in replications, literature reviews, or secondary data analysis. The sample should be adequately described and it should be representative. Conclusions and interpretations should not go beyond what the sample warrants.

When particular demographic characteristics are experimental variables or are important for the interpretation of the results, describe the group specifically, for example, in terms of racial and ethnic designation, national origin, level of education, health status, or language use.

In medical research, one must check the number of patients, how they are grouped, the inclusion and exclusion criteria, whether informed consent was obtained, and indeed whether the experiment or trial had been approved by an ethics committee and conforms to the ethical standards of the Declaration of Helsinki. Similar checks will be made if animals were used. Failure to fullfill the ethical requirements will almost certainly mean that the Journal will reject the paper, without asking any question.

Example: All women requesting an IUCD (intrauterine contraceptive device) at the Family Welfare Clinic, Kenyatta National Hospital, who were menstruating regularly and who were between 20 and 44 years of age, were candidates for inclusion in the study. They were not admitted to the study if any of the following criteria were present: (1) a history of ectopic pregnancy, (2) pregnancy within the past 42 days, (3) leiomyomata of the uterus, (4) active PID (pelvic inflammatory disease), (5) a cervical or endometrial malignancy, (6) a known hypersensitivity to tetracyclines, (7) use of any antibiotics within the past 14 days or long-acting injectable penicillin, (8) an impaired response to infection, or (9) residence outside the city of Nairobi, insufficient address for follow-up, or unwillingness to return for follow-up.

(b) *Setting*. It is necessary to tell the reader the location where your study was conducted, or where the data were collected. Location can affect the external validity of your study, since subjects vary considerably between residential areas, due to climate, physical environment, economics, and socio-cultural milieu.

Example: Volunteers were recruited in London from our general practices and the ear, nose, and throat outpatient department of Northwick Park Hospital. The prescribers were familiar with homoeopathic immuno-therapy.

(c) *Procedures*. The subsection on procedure summarises each step in the execution of the research. Include the instructions to the participants, the formation of the groups and the specific experimental manipulations, or interventions. Describe method of randomization, counterbalancing, blinding techniques, and other control features in the design.

You should also justify why you chose the variables to measure and the reliability of measurement. Do not forget to mention the equipment that you used (manufacturer and model number, if unusual). If there is a simple well-known procedure, it is acceptable to name the technique. If it is new or you did something different, you should spend time describing the protocol used. If relevant, you should also stipulate the conditions used when the test was performed (temperature, light, etc.)

Example 1: Patients with psoriatic arthritis were randomized to receive placebo or etanercept (Enbrel) at a dose of 25 mg twice weekly by subcutaneous administration for 12 weeks ... Etanercept was supplied as a sterile, lyophilized powder in vials containing 25 mg etanercept, 40 mg mannitol, 10 mg sucrose, and 1-2 mg tromethamine per vial. Placebo was identically supplied and formulated except that it contained no etanercept. Each vial was reconstituted with 1 mL bacteriostatic water for injection.

Example 2: Blood pressure (diastolic phase 5) while patient was sitting and had rested for at least five minutes was measured by a trained nurse with a Copal UA-251 or a Takeda UA-751 electronic ausculatory blood pressure reading machine (Andrew Stephens, Brighouse, West Yorkshire) or with a Hawksley random zero sphygmomanometer (Hawksley, Lancing, Sussex) in patients with atrial fibrillation. The first reading was discarded and the mean of the next three consecutive readings with a coefficient of variation below 15% was used in the study, with additional readings if required.

(d) *Measurements of Endpoints*. Clearly define primary and secondary outcomes of your study. The primary outcome is the pre-specified outcome of greatest importance and is usually the one used in the sample size calculation. It is also the outcome, to which the result of your study is assessed upon. Secondary outcomes include measures that were of interest, which may include unplanned or unintended effects of the treatment or intervention.

Example: The primary endpoint with respect to efficacy in psoriasis was the proportion of patients achieving a 75% improvement in psoriasis activity from baseline to 12 weeks as measured by the PASI (psoriasis area and severity index). Additional analyses were done on the

percentage change in PASI scores and improvements in target psoriasis lesions.

(e) *Sample Size*. For scientific and ethical reasons, the sample size for a study needs to be planned carefully, with a balance between clinical and statistical considerations. You should provide a statement about the sample size. Clearly state how the sample size was determined.

Example: We believe that the incidence of symptomatic deep venous thrombosis or pulmonary embolism or death would be 4% in the placebo group and 1.5% in the ardeparin sodium group. Based on 0.9 power to detect a significant difference (p 0.05, two-sided), 976 patients were required for each study group. To compensate for nonevaluable patients, we planned to enroll 1000 patients in each group.

(f) *Randomization*. If the study was a randomized clinical trial, you need to describe the method of randomization, or details of any restriction (e.g., stratification, blocking) of randomization were use.

Example: Women had an equal probability of assignment to the groups. The randomization code was developed using a computer random number generator to select random permuted blocks. The block lengths were 4, 8, and 10 varied randomly.

(g) *Blinding*. In a clinical trial, blinding is a procedure to keep study participants and clinicians, and sometimes those collecting and analyzing data unaware of the assigned intervention, so that they will not be influenced by that knowledge. If your study included this procedure, then it should be described in the paper.

Example: All study personnel and participants were blinded to treatment assignment for the duration of the study. Only the study statisticians and the data monitoring committee saw unblinded data but none had any contact with study participants.

(h) *Data Analysis*. It is vital to include a sub-section of *Data Analysis* or *Statistical Methods*. In this sub-section, you should tell the readers what are your endpoints (or outcome variables), how did you analyze the data, whether data transformation was used and what was the rationale for the transformation.

Example: All data analysis was carried out according to a pre-established analysis plan. Proportions were compared by using Chi-squared tests with continuity correction or Fisher's exact test when appropriate. Multivariate analyses were conducted with logistic regression. The durations of episodes and signs of disease were compared by using proportional hazards regression. Mean serum

retinol concentrations were compared by t-test and analysis of covariance ... Two-sided significance tests were used throughout.

IV. The *Results*

The description of results obtained throughout the development of a research project is the heart of the publication. This section must answer the question "*What did you find*?" Therefore, this section is a communication of facts, measurements and observations, not interpretation of data or speculation. It is sometimes a challenge to present so many analyses into a few pages. It is often more appropriate to start with results that are easiest to interpret, regardless of when they were obtained. Here are some guidelines which you may find useful in writing your *Results* section:

- *The Results section should be presented to support what you state to do in the Introduction***.** The results section is where you "present your case". The logical flow is critical; you must convince your reader that your argument is sound. If the readers are confused by your results, or do not follow your interpretation, they may not accept that your conclusions are correct or recognize the relevance of your findings.

  Be sure you have looked at your data and that you are clear about what each result means ... if you're not clear about it, you're reader can't hope to be. Once you figure out what your data means design your presentation to illustrate those ideas as clearly as possible.

- *Set out the important results in a series of tables and graphs* that you want to include in the paper. You should also write down any results that you think are interesting, but have no strong "backup" and hence will only be used for comment. If a result is simple, recording it in the text is sufficient. However, for complex results, tables and figures will be needed.

  How do you choose a table or a graph? If the exact number for each data point is important then you should use a table; however, if the trend or pattern between data points is important then a graph is probably more informative. Either way, a table or a figure should be titled and captioned in such a way that it is understandable on its own, so that a reader is not having to flip between your text and the tables in order to understand your point. In addition, both graphs and tables should include only the data that is relevant to the points you are making when referring to that table.

  Refer to figures and tables within the paragraph as you describe your results, using word Figure or Table, followed by its number, for example: "An exponential increase in egg production of Acartia tonsa was found for algal concentrations between 10 and 1,000 cells per ml r2 =0.779, p= 0.05 (Figure 1)," rather than: "Figure 1 shows an exponential increase in egg production of Acartia tonsa was found for algal concentrations between 10 and 1,000 cells per ml r2 =0.779, p= 0.05."

- *Do not include trivial or distracting information*. If it is important present it in a table or a figure; if it is not, no matter how much work went into getting that data ... throw it out!

- *Avoid a long list of results with no interpretation.* For example: "Hours in sunlight significantly affected growth (Table 1). Soil moisture significantly affected growth (Table 2). Soil nitrogen also had a significant effect on plant growth (Table 3)." Develop each idea within the text: describe the effect; how did the levels of the independent variable differ.

  It is sometimes a good idea to divide the *Results* section into sub-sections which your have described in the *Methods* section earlier. This helps keeping the manuscript coherent.

- *Do not use qualitative words in the Results section*, e.g. do not write "This difference was highly significant (p = 0.001)," but simply state "This difference was significant (p = 0.001)."

- *Do not interpret the data in the Results section*. Comments such as "the data suggest that ...." are not really meaningful, a sort of "putting words into the readers' mouth." Save these indirect interpretations for the *Discussion* section.

- *It is very unwise to make statements such as* "The ANOVA showed that.…" Statistical tests do not show anything; they just crunch numbers. It is up to you to use the right test and consider its results.

- *You should report negative results* - they are important! If you did not get the anticipated results, it may mean your hypothesis was incorrect and needs to be reformulated, or perhaps you have stumbled onto something unexpected that warrants further study. In either case, your results may be of importance to others even though they did not support your hypothesis. Do not fall into the trap of thinking that results contrary to what you expected are necessarily "bad data". If you carried out the work well, they are simply your results and need interpretation. Many important discoveries can be traced to "bad data".

- *When describe data in a table*, you should try to: (a) minimise stating the numbers in the table; (b) give the reader more information which is not included, but is mentioned to, in the table; and (c) be concise - as always in scientific writing. For example: "Data from 1194 women and 761 men, whose BMD measurements were available, were analysed. The average (and standard deviation, SD) of age for both sexes was 69.5 (6.5) years old (Table 1), with an above-average concentration of subjects in the younger age group of 60-69 years (58%), followed by 70-79 years (33%) and 80+ years (9%). The distribution of body mass index (BMI) in the sample was normally distributed for both sexes, with mean of 26 (3.6) kg/m2 for men, almost identical to that of in women (25.4 (4.6) kg/m2). Approximately one-third of women and

36% of men had BMI greater than 27 kg/cm^2. Dietary calcium intake was skewed toward the lower level, with median for men (592 mg/day) was not significantly different from women (573 mg/day). In both sexes, approximately 75% of intakes was below 800 mg/day. Quadriceps strength in men (33 (13) kg) was significantly higher ($p < 0.0001$) than women (20 (8) kg). Physical activity index (PAI) in men was also higher ($p < 0.001$) in men (35 $\pm$ 8.9) compared to women (30 (4.4)); 75% of men and women had PAI lower than 38 and 32, respectively."

For a complex table, some explanations should be firstly provided. For example, the following present the genetic and environmental analyses of contributions to the determination of body composition and bone mass: *"* [*Briefly explain the figures*] To assess whether the observed relationships between BMD at various sites and body composition were attributable to genetic or environmental factors, multivariate genetic model-fitting analysis (as described in Figure 1) was performed. Squared standardised path coefficients (Table 2) can be interpreted as estimates of heritability of specific and decomposed in terms of the portion in common with and independent of other genetic factors. Off-diagonal elements of this analysis were small relative to diagonal elements, which indicate that the majority of heritability of each variable trait is due to specific genetic factors. [*Then a typical description*] The heritability of fat mass in this sample was 0.65, and the portion of this due to shared genetic factors with lean mass was 0.02, whereas approximately a third of the environmental variance of FM was due to shared environment with lean mass. This is consistent with the non-significant genetic correlation between lean and fat mass (0.16; $p = 0.24$), and the significant environmental correlation (0.51; $p < 0.001$, Table 3)."

V. The *Discussion*

In this section you should answer the question "*What do these results mean*?" and possibly "*What gaps in knowledge remain to be filled*?" You should explain your results in light of other published data, by adding information from sources you cited in the *Introduction* as well as by introducing new sources. This section is a free-flowing text, however, a good *Discussion* should have the following structure:

- *Begin the Discussion by summarising the background, aims (or hypotheses) and findings*, e.g. is/are your hypotheses "vindicated"? The reader is helped if the main results are summarised at the beginning of the discussion, and also if the aspects of the

subject thought worthy of discussion are clearly identified, if necessary with subheadings. If necessary to stress the point, write down the specific data, including results of statistical tests.

Example: "There has been little doubt that BMD measured at various sites is one of the best measureable determinants of fracture risk [28-30]. BMD is, in turn, regulated by genetic, hormonal, dietary and mechanical factors. The present study addressed a small part of this complex system by using the classical twin design. It was found that (i) both lean mass and fat mass were associated with areal BMD; however, fat mass alone appeared to have an independent effect on BMD/height ratios and volumetric BMD; (ii) both lean mass and fat mass as well as BMD were under strong genetic influence and (iii) the association between fat mass (and lean mass) and BMD were mainly mediated through environmental influences."

- *Compare your results with previous literature, explain why your results are or are not consistent* with the literature. Similarities and differences between your results and the work of others should clarify and confirm your conclusions. Do not, however, simply reformulate and repeat points already made; each new statement should contribute to your position and to the reader's understanding of the problem.

  Example: "This study confirms the familial influence on bone density with estimates of heritability for the lumbar spine, femoral neck and total body BMD of 78%, 76% and 79%, respectively, comparable with previous estimates [12-16]. However, the present study also indicates that a common source of genetic and ... ."

- *Elaborate on mechanism involved in your study*. How do your results fit in with what you know? What is the significance or implication of your results? Can your results be generalised to other populations? You are free to examine, interpret, and qualify the results, as well as to draw inferences from them. Emphasize any theoretical consequences of the results and the validity of your conclusions.

- *Provide a generalization of your findings, if possible*. Comment on how your results can be applied to other settings or populations. Can the results be applied to an individual patient; if so, what are assumptions?

- *Discuss weak and strong points of your study, take into account sources of bias or imprecision*. List weaknesses you have identified in your study or experimental design. You may remark on certain shortcomings of the study, but do not dwell on every flaw. Negative results should be accepted as such without an undue attempt to explain them away. Avoid polemics, triviality, and weak theoretical comparisons in your discussion. In general, be guided by the following questions: what have I contributed here; how has my study helped to resolve the original problem; and what conclusions and theoretical implications can I draw from my study?

This is not to say that mistakes in experimental design or reasoning should not be criticised, but it is better to show your results correct a false impression or lend themselves to a different interpretation. In medicine and biology phenomena are so complex that it is rare for there to be just one interpretation. For example: "The present findings must be interpreted in the context of a number of potential limitations. The data were obtained from a Caucasian population in Sydney, among whom, cultural backgrounds and ... ."

- *Write a "big" bottom line*, something that the reader can remember about your paper. The reader is greatly helped by a final paragraph in which the message of your article is firmly stated. It is called "take home message." It is helpful to point out where further gap in knowledge could usefully be filled but the blanket statement "Further research is needed", although usually true, will suggest to the critical reader that you have not thought it out. When the paper throws light on new aspect of the subject, it is useful if you say whether you intend to explore them. This need not be very detailed but must be an accurate and honest guide to fellow research workers who may be planning experiments in the same areas.

  Example: "In conclusion, these data indicate that the clinically relevant association between volumetric BMD and body composition is mediated only through fat mass. Furthermore, lean mass and fat mass, as with .... These data also suggest that modulation of environmental factors could translate to clinically relevant changes in BMD and presumably fracture risk."

One of the things that usually annoys readers is that it is difficult to attain an adequate level of assurance from conclusions such as "This seems to suggest ..." Such lack of assurance should be avoided.

When discussing the conclusions of other research workers, you should clearly state their origin and quote them correctly bearing in mind that unfavourable comparisons with previous work do not increase the merit of your own work. Some students also agonise that they will be criticised if they do not mention every previous papers in the field, but it is necessary only to identify previous results or comments which illuminate or which are illuminated by the present (your) results.

Finally, it should be noted that it is in the *Discussion* section that you incorporate your contribution into existing knowledge.

VI. The *Tittle, Acknowledgments, and References*

1. *Title.*

The title should be centered at the top of page 1. It should not be underlined or italicized. The authors' names (or primary author first) and institutional affiliation are double-spaced from and centered below the title. When there are more than two authors, the names

are separated by commas, except for the last which is separated from the previous name by the word "*and*".

The title is what catches the reader's eye and deserves careful thought. It should be short and yet sufficiently descriptive. If the title does not indicate the contents come within the reader's range of interests when they do, the reader may miss a useful paper. If the title suggests that the contents do come within his range of interests but they do not, the reader will be annoyed. So, information must be packed carefully into the title.

Creating a title can sometimes be a challenging exercise. The following rules may be helpful:

- *Abbreviation should never be used*. Remember that your paper may be read by people who are not experts in your own field, so never use abbreviation in the title.
- *Do not write paradoxical or obscure title*. This is dangerous as it indicates that your study has not resolved anything; it is thus a waste of time to read the paper.
- *Do not write a long title*. A title should not exceed 20 words. Long title is at risk of distraction. Title such as "Genetic determination of bone mineral density in adult women: a reevaluation of the twin model and the potential importance of gene - environmental interaction on heritability estimates" is unnecessarily long, as "potential", "estimates", "adult" are not essential. The author could use "Roles of gene-environmental interaction in the estimation of heritability of bone mass: a reevaluation of the twin model."
- *Try to make a "new" thing*. This can attract readers' attention. For example: "A new family of mathematical models for describing the human growth" has a higher chance of getting attention than "A family of mathematical models for describing the human growth."
- *Do not make a statement in title*. Sometimes, titles such as "Smoking causes cancer", "Oestrogen is associated with bone loss, Physical activity is not a predictor of mortality," etc. make experienced readers annoyed. There is nothing absolute in science. We can never prove a hypothesis. It is extremely unwise to make such confirmatory statements.
- *Keep in mind that the title also provides information used by computerised information systems*. Most of the existing bibliographic compilation programs are of the multiple entry type, so that a paper is classified under several headings. For example, "The effects exercise on free fatty acids in the blood," it would be classified under "fatty acids", "metabolism of fatty acids", "exercise", and "blood". But if a title "The effects exercise on free fatty acids in the blood: a study in rats using chromotographic techniques," it would be classified under

"composition of fatty acids", "chromotographic technique", "fatty acids in rats" and thus reach a wider audience.

2. *Acknowledgments*

This section of the paper should consist simply of "We wish to thank ...." all those who deserve recognition for their contributions but who have not made a significant intellectual contribution and are therefore not included as authors. Gratitude may, for example, be given to a physician who has allowed his patients to be studied or to a sponsoring organisation for drugs or equipment.

Editors may require you to obtain written permission from each person acknowledged by name because readers will assume that anyone acknowledged endorses the data and the conclusions.

3. *References.*

The term "references" is generally used in preference of "bibliography", which strictly speaking, means a complete list of everything that has been published on a subject, but in practice, is often used rather imprecisely to mean "further reading". References can be typed out either alphabetically (called "the Harvard System") or numerically (called "the Vancouver System").

References are provided to indicate the sources from which you have obtained information, but the value of an article is not measured by the number of references and they should not be included merely to show erudition.

The importance of citing sources in scientific publications should not taken lightly. After all, citations are the reward system of scientific publication. To cite someone is to acknowledge that person's impact on subsequent work. Citations are the currency by which we pay the intellectual debt we owe our predecessors. Furthermore, failing to cite sources deprives other researchers of the information contained in those sources and may lead to duplication of effort. On the other hand, the sources quoted must be relevant and they must be quoted accurately.

Throughout the body of your paper (primarily the *Introduction* and *Discussion*), whenever you refer to outside sources of information, you must cite the sources from which you drew information. When citing information from another's publication, be sure to report the *relevant* aspects of the work clearly and succinctly, in your own words. Provide a reference to the work as soon as possible after giving the information. Never use information from another source without providing the reference.

Citation formats may vary between journals. If you are trying to publish a paper in certain journal, you will be required to follow the format of that journal. Some journals,e.g., *Science*, use a number system to give the text reference, e.g., “BMD is a predictor of fracture (1).” Other journals use the text system. Under this system, the author's last name and the

year of publication are written *parenthetically,* e.g., (Nguyen 2000) or in the case of multiple authors (Nguyen *et al*. 2000).

Personal communication. Sometimes, information is not gained from a publication, but rather in a personal conversation with or letter from an expert on the subject, Dr. X People, for example. When you have talked with, or written to, someone, and have gained some information or data that are not published, you should give credit to that person in the following way: "It has been found that male subjects .... (Dr Peter M. Smith, personal communication)." No date is entered for a personal communication, nor will not be entered in your *References* section.

VII. Some Practical Advice on Data Presentation

1. *Numbers and statistics.*

- Use tilde (~) to mean *approximately equal to.*
- Numbers beginning a sentence must be fully spelled. For example, "Ninety-nine patients were recruited."
- Put a space between numbers and units: for example, "75 kg." Exception: 75%.
- Use a zero before decimal numbers that are less than 1. For example, write "0.32," not ".32."
- Note: 143, 2,461 or 2461, 21,278, 1,409,000…
- When you quote numbers, make sure you use the minimum number of significant digits or decimal places. For example, 23 ± 7 years is easier to read than 23.4 ± 6.6 years, and the loss of accuracy is not important in most situations.
- Use the appropriate number of digits: two significant digits for standard deviations (one digit if the standard deviation is for a descriptive statistic like height or weight, or if precision is not important); two decimal places for correlations, two significant digits for percentages. Examples: 73 ± 5; r = 0.45; r = 0.08; 16%; 1.3%; 0.013%.
- If it is more convenient to show p values than confidence limits, show the exact p value to one significant digit (for $p < 0.1$) or two decimal places (for $p > 0.10$). Do not use $p < 0.05$ or $p > 0.05$. Examples: p = 0.03; p = 0.007; p = 0.09; p = 0.74. (The exact p value is important for anyone using your data to calculate confidence limits or using your data in a meta-analysis.)
- Make sure the significant digits of the mean and standard deviation are consistent. Examples: 20 ± 13; 0.020 ± 0.013; 156 ± 7; 1.56 ± 0.07; 15600 ± 700.
- Use the standard deviation as a measure of spread. Do not use the standard error of the mean.

- Avoid test statistics like t, F and χ^2, but if the journal insists on them, show only two significant digits.
- Show 95% confidence intervals for effect statistics like a correlation coefficient or the difference between means.
- Interpret the magnitudes of outcomes in a qualitative way, using both your experience of the magnitudes that matter in this area of human endeavor and also any published scales of magnitudes (e.g., Cohen, 1988; Hopkins, 1998). You must interpret the observed effects and the confidence limits. For example, you might have to say that you observed a moderate effect, but that the true value of the effect could be anything between trivial and very strong.

2. *Tables.*

- Create tables with the Table pull-down in Word. Do not use tabs.
- Examples of tables in scientific style are shown in Tables 1 and 2.

Table 1: A simple generic table for articles[a].

Characteristics	Group A	Group B
Item 1	item[b]	item
Item 2	item	item
Item 3	item	item
Item 4	item	item
Item *n*	item	item

[a]Put any footnotes here. Note that the caption and footnotes are in cells of the
[b]Number footnotes as shown.

Table 2: A complex table[a].

Characteristics	Group 1	Group 2
Males		
Item 1	item[b]	item
Item 2	Item	item
Females		
Item 1	item	item
Item 2	item	item

[a]Put any footnotes here. Note that the caption and footnotes are in cells of the [b]Number footnotes as shown.

3. *Figures.*

- Note these rules for choice of figure format:
    - line diagrams or scattergrams if independent and dependent variables are numeric;
    - bar graphs if only the dependent variable is numeric;
    - bar graphs or pie charts for proportions.
- Do not use scanned images of graphs or diagrams, because the lines and symbols become too "pixelly." Draw the figures directly in a computer, using preferably PowerPoint, Excel, or the drawing window of Microsoft Word.
- Make sure the fonts and any symbols are big enough.

4. *Italic and bold letters.*

- Use *italics* for emphasis and **bold** for strong emphasis.
- Use italics in expressions such as the term *whatever,* and for listing descriptors of a scale. For example, items on the 5-point scale ranged from *not at all* to *always.*
- Put the title of a paper, book, or journal in italics in the body of the text. In the reference list, titles of papers are in normal case.
- Write headings in **BOLD UPPER CASE**.
- Write subheadings in **Bold Title Case**.
- Write sub-subheadings in Plain Title Case.
- Do not use italics for foreign words and abbreviations common in scientific English, such as *ad lib*, *per se*, *et al.*, *via*, *ad hoc*, *post hoc*, *a priori*, *a posteriori*.

5. *Abbreviation and acronyms.*

- An abbreviation or acronym (short name) is justified only if the full expression is excessively long or if the abbreviation is well known to all researchers in the field. Even so, an easily understood short form of the expression that avoids abbreviations or acronyms is preferable.
- If you must use an abbreviation, define it in parentheses the first time you use it: for example, body mass index (BMI), maximum oxygen uptake (VO_2max), the fatigue dimension of the Profile of Mood States (POMS-fatigue).

- Use the following well-known Latin abbreviations only within parentheses: *that is* (*i.e.*), *for example* (*e.g.*), and *so on* (*etc*.). Do not use the abbreviations for namely (viz.) or *compare* (*cf*.), which few people understand.
- Use *vs* (*versus*) and *et al*. (*and others*) inside or outside parentheses without defining them.
- Use Note: instead of N.B. (note well).
- Use abbreviations without explanation for the following terms in the Summary, but define them in the *Methods*: standard deviation (SD), 95% confidence interval (95%CI), 95% confidence limits (95%CL).
- Use no periods or spaces in abbreviations of countries: USA, UK, NZ.
- Use a period only if the last letter of the abbreviation is not the last letter of the word, as in these examples: `Prof., Dr, Mr, Ms, Vol. 1, p. 3, p. 23-25, 2nd ed., et al., vs, etc.`, and so on.
- Scientific names consisting of genus and species, should be underlined or italicized, with only the genus capitalized: *Homo sapiens* or Ilex opaca.
- Use the following Systeme Internationale (SI) abbreviations for units of measurement, and never add an "s" to the following abbreviations.

  `meter, m; gram, g; kilogram kg; mole mol; liter L; mililiter ml; degree` $^{\circ}$`C; millisecond ms; second s; hour h; minute min; day d; week wk; year y.`

- Use the style `ml.min`$^{-1}$`.kg`$^{-1}$ for scientists and `ml/min/kg` for non-scientists.

Part Two. Grammar and Usage

I. Some Grammatical Notes.

Due to limited space and restricted costs of printing, most scientific papers are short. Some journals only accept papers with a pre-determined length of 15,000 words or less. However, all aspects in the IMRAD structure must be satisfied. Therefore, scientific papers are written in a very clear and very concise style. Good English is very important in scientific writing. The following notes are designed to provide major points in English grammar.

1. *Paragraph construction*. The purpose of paragraphing is to give the reader a rest. It is the unit of thought or information, and thus should encompass just one idea, and then give the reader a mental and visual break. A paragraph must consist more than one sentence. Always start a paragraph with a sentence which sets the topic for the paragraph. Try to avoid any unlinked ideas in the same paragraph.

2. *Sentence checking*. Each sentence should be checked to ensure that it has a subject and a verb, and that they agree. For example, many readers will waste a few seconds working out what is wrong with: "`The new group of drugs were associated with many adverse reactions.`" In fact, the verb should be `was` (not `were`) because the subject in this case is `group`, a singular noun.

3. *Clauses and phrases.* When the main subject and verb of a sentence have been identified, the subordinate clauses and phrases can be checked. Adjectival clauses and phrases must refer to specific nouns. For example, the difficulties an author can get into are shown by the following example: "`The results could not be analysed because the serum creatinine had not been recorded except in one case which was unfortunate.`" The adjectival clause `which was unfortunate` refers to `case`, which does not make sense. It is distracting to have to work out that the author meant: "`It was unfortunate that the results could not be analysed because the serum creatinine had not been recorded except in one case.`"

   An adverbial clause or phrase refers to a verb and should be placed next to that verb. In "`The bronchoscopy was performed by the same member of the team under general anaesthesia,`" was it the member who was under general anaesthesia? If "`Under general anaesthesia` refers to `performed`" it is adverbial, not adjectival, and must be moved next to "`performed`" to make that clear: "`The bronchoscopy was performed under general anaesthesia by the same member of the team.`" This is more likely to be what the author meant. It is often better to simplify sentences by splitting the subordinate clauses and phrases off and making them into sentences of their own.

4. *Nouns and adjectives.* Whether nouns are plural or singular may also distract the reader. For example, "`28 patients had a prepyloric ulcer on gastroscopy`" probably means that they each had one. Perhaps it should be written as "`28 patients`

had prepyloric ulcers on gastroscopy." Still, that sentence reads as though individual patients could have had more than one prepyloric ulcer! The author must rewrite it to explain clearly what he/she does mean.

Noun clusters, in which nouns are used as adjectives, such as "The patient liver enzyme status," should be examined critically. What is "patient liver" or "patient status"?

Adjectival clusters, such as "Clear cellular atypia," should also be written carefully. Does the author mean an atypia of clear cells or that cellular atypia was obvious?

5. *Pronouns stand for nouns*. A particular difficulty, similar to that illustrated by the commas above, concerns the pronouns used for commenting and defining clauses. For example, in "This case should be referred to the coroner's office, which deals with cases of suicide," the "which" clause is a comment and that can not be used. However, in "The office that deals with suicide cases is the coroner's office", "that" is defining the office.

6. *Verbs and tenses.* Two parts of a verb end in -ing: the present participle and the gerund. The former acts as an adjective, and the latter acts as a noun. Despite the distinction, this still occasionally causes confusion. For example, in "After reviewing the X-rays, the patient had a transplant, the word reviewing" is an adjective and refers to patient. The reader is distracted by the unlikely idea that the patient reviewed his own X-rays. On the other hand, in "Reviewing the X-rays before the heart transplant was a waste of time," the word reviewing is acting as a noun and is part of the subject of was and is correctly used. When in doubt, words which end in -ing are easily avoided: "After the surgeon had reviewed the X-rays, the patient had a transplant and It was a waste of time to review the X-rays before the heart transplant."

   With regard to tense, it is a useful convention to put anything that has been done in the past tense and to put general statements in the present tense. When "After exposure to freezing air the most striking changes were (are) a rise in heart rate and a raised serum cholesterol concentration" is in the past tense, it implies that the statement was true in the specific circumstances of the study being reported, but that we do not know if it is always true. If it is written in the present tense would be used if the author wanted to imply that the statement is true in all circumstances.

   The future tense is sometimes used illogically. For example, "In this review some facts about the connections of the globus pallidus will first be summarised," there is a small problem: in the review in the journal in front of the reader, the facts are summarised (in the present) or, indeed, have been

summarised (by the author, in the past). The only question for the future is whether the reader will read the summary!

Another illogical usage is illustrated by "This paper reports," which implies action by the inanimate paper. What is meant is "In this paper we report." It is sensible to check all passive verbs to see if they can be rewritten in an active form. The convention that authors are more scientific if they write in the third person is now dying. The sentence such as "I first summarise some facts about the globus pallidus" is easier for the reader than "Some facts about the globus pallidus are first summarised."

7. *Adverbs.* Adverbs tell one more about verbs and to do so an adverbs must be put next to its verb, as must adverbial clauses and phrases. Adverbs can sometimes be made out other words by adding "*ly*" but care is needed. Take the example: "Because the tube and the film are always centered exactly, positioning the patient becomes very simple. More importantly, also routine radiographic views are repeatable." The word always is correctly placed after are and exactly is correctly placed after "centered", but "also" has become separated from its verb (a common occurrence) and should be moved up to "are also repeatable." On the other hand, "importantly," an adverbial adaption of the adjective "important", is used fashionably but wrongly as an abbreviation for "what is more important".

   If adverbial clusters are used, the meaning must be kept clear. For example, "The contrast medium was injected quickly manually" sounds odd, but the meaning is clear, whereas "The contrast medium was injected three times simultaneously bilaterally" is ambiguous and the author has to be asked for its meaning.

8. *Preposition*. Prepositions are used to mark a relationship between a noun (or pronoun) and another word. There used to be a rule which itself broke the rule: "*Do not use a preposition to end a sentence with*". Prepositions which imply place (*where*), time (*since, when*) and person (*who, whose*) should be used accurately or replaced with an all-purpose preposition (*which, as, if*). For example, "Since all tumours are visible at bronchoscopy, this is the investigation of choice should be written as *As* all tumours are visible at bronchoscopy, this is the investigation of choice." Also, "*Where* the primary tumour can be resected, the prognosis is good should be "*When/if* the primary tumour can be resected, the prognosis is good." The word "*Following*" should not be used as a preposition because it also has another meaning.

9. *Punctuation*.

   - A *comma* can be used wherever there would be a slight pause between words or phrases in the spoken sentence.

- A *semicolon* is used between two parts of a sentence; the proviso is that both parts must be able to stand alone as separate sentences.
- Use a *colon* to introduce an explanation or an example of something: here is an example. If there are several simple explanations or examples, separate them with commas; otherwise, use semicolons.
- Avoid excessive use of *parentheses* ( ). Use them to make an aside (an extra remark) only if commas could be confusing. Never use parentheses within parentheses: find another way of saying it.
- Use *square brackets* [ ] for material inserted into a quotation and ellipsis (three dots) for material omitted: *According to Smith (1999), "few such [descriptive] studies were done… before 1950."*
- Use *dashes* -- two hyphens with no spaces anywhere-- for emphatic asides.
- Use one or two *spaces* after a period.
- Use double *quotation marks* (") for speech and verbatim quotations.
- If a quotation is long, type it as an indented block of text without quotation marks.
- Use double quotation marks the first time you introduce a newly coined or slang term; do not use quotation marks thereafter.
- Use single quotation marks (') for quotes within quotes.
- Use the apostrophe (') to denote possession: "`a patient's responses,`" and "`many patients' responses.`" But note that `its = of it`, whereas `it's = it is`.
- Put commas, semicolons, colons, and periods outside closing quotation marks: "`this`", for example, but not "`this,`" or "`this.`" Exception: "`If the quotation ends in a complete sentence, the period is part of the quote and should therefore go inside the quotation marks, like this.`"
- Use of *and/or* instead of *or* is acceptable when you want to emphasize *either or both.*
- The forward slash (/) can be used instead of *or* in sentences that are already replete with *and*s and/or *or*s.

10. *Use of article.*

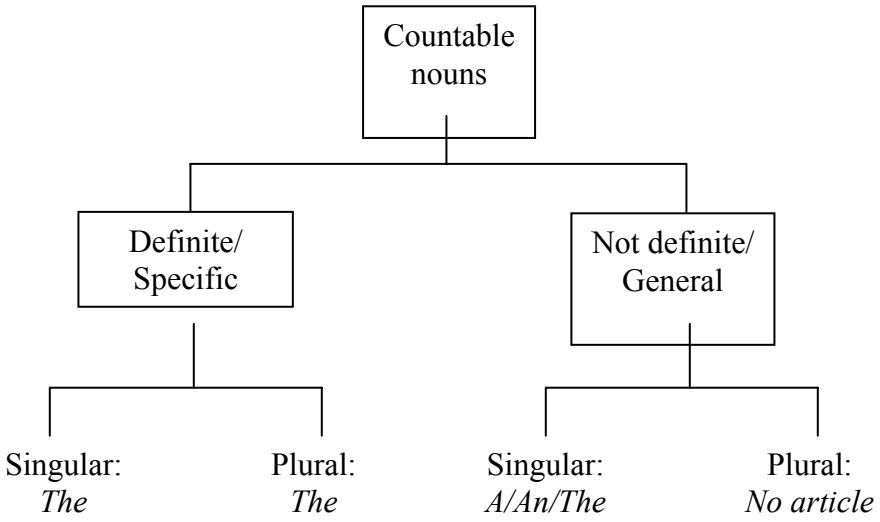
For most authors of non-English speaking background, the use of articles (*a, an*, and *the*) is a complicated matter. One of the central problems seems to be in understanding two basic concepts: countability and definiteness.

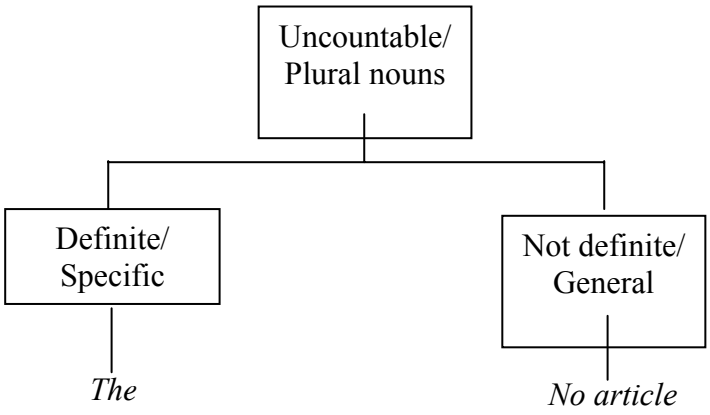
Countable nouns refer to people, places, or things that can be counted. *Uncountable nouns* refer to food, beverages, substances, or abstractions (meat, tea, steel, information). However, there is no clear-cut distinction between countable and uncountable nouns.

Some nouns can be both countable and uncountable. Moreover, a noun that is countable in one language may be uncountable in English, and vice-versa. For example, *soap* is countable in Spanish, but uncountable in English.

Definiteness. A noun is definite if it refers to something specific that is known to *both* the writer and the reader. There are five sources of definiteness: (a) the noun has been previously mentioned; (b) a superlative or ranking adjective makes the noun's identity specific (e.g., "`the tallest person in group A`"); (c) the noun describes a unique person, place, or thing (e.g., `The earth revolves around the sun once every 365 days`); (d) a modifying word, phrase, or clause *follows* the noun and makes it clear which specific person or thing you are referring to (e.g., "`Do you remember the patient who was here last week`"); and (e) the context or situation makes the noun's identity clear (example: "`Close the door.`")

The following algorithm may be helpful in choosing an appropriate article:





- The above algorithm indicates that *every definite noun takes the definite article "the"*, regardless of whether it is singular, plural, or uncountable.

II. Some Practical Advice on Effective Expressions

1. *Decide what you want to say*. Keep in mind to whom you want to say it and where.
2. *Organise your thoughts in logical sequence*, or at least in an orderly way so that each thought follows naturally the one before it. Remember that thoughts that are closely related should group themselves into paragraphs. Consider the following abstract, "The present paper reports an association between polymorphisms of the VDR gene and bone mass. Bone mass was measured by DEXA densitometry ...," the authors first state their aim and then next talk about method of measurement, which is rather incoherent. The paragraph may be written as "The association between polymorphisms of the VDR gene and bone mass is unclear. The present study was designed to assess the magnitude and direction of this association. Bone mass was measured by DEXA densitometry ..."
3. *Avoid distractions*. One of the commonest "sin" in scientific writing is distraction, which includes the use of unnecessary words, excessive use of abbreviations, jargons, unclear expression, etc. Distractions occur very often in simple messages of the eight parts of speech (noun, pronoun, adjective; verb, adverb; preposition, conjunction; and article) or of their positions in sentences.

   Consider the following abstract: "At the present time it is believed (Jones and Smith 1981) that approximately 150 ml of intravenous dextropomorpho-editate antimony (IvDEA) is required for the treatment of each severe case of panacetate encephalitis, but adverse reaction are numerous.

   After treatment commences the vast majority of patients emonstrate skin rashes and complain of intractable pruritus and the skin comparatively frequently becomes purple in colour due to the fact that IvDEA contains traces of laevopomorpho- editate antimony (LEA). The literature shows that the serum LEA is persistently elevated in excess of 0.8 micrograms ml throughout the duration of the skin lesion. It is also possible that the blood supply to the epidermis is significantly decreased especially in female subjects.

   Brown et al (1982) are of the same opinion but having had some experience of other forms of encephalitis, they anticipate that intrathecal DEA (LtDEA) will be of assistance to a wider spectrum of patients at some future time.

In this unfortunate therapeutic situation it seemed to the present researchers that , as already stated , more sophisticated forms of DEA therapy could be developed. They heorised that sacrificing various laboratory animals following tDEA would reveal data about the externalisation of DEA across the brain blood barrier."

Comments:

Distraction	**Comment/suggestion**
At the present time	Delete
It is believed	Delete
Approximately	About
IvDEA	intravenous dextropomorpho-edita antimony
Is required	are needed
commences	begins, starts
vast majority	Most
demonstrate	develop (it happens to the patient)
skin rashes	Rashes
comparatively	Delete (compared with what?)
In colour	Delete (purple can be nothing else)
Literature shows	Which literature? Reference please?
serum LEA	Concentration in the serum
elevated	Delete (raised)
In excess of	Above
Epidermis	is epidermis meant? or is this elegant variation of skin
significantly	Change (this is a technical word statistics)
female subjects	Women
of the same opinion	Agreed (past, they did in 1982)
be of assistance	Help
spectrum	Change - a technical word in optics
at some future time	Delete (implied by "would")
as already stated	Delete
It seemed to the prese researchers	we thought
they	We
theorised	Argued
sacrificing	Killed (no ritual implication here)
various	Specify which

following	After
reveal change - too stron not a revelation	
data	facts
externalisation	be more specific
Communication	paper, article
Reports	we report - a communication inanimate

The abstract can be rewritten as follows:

"About 150 ml of intravenous dextropomorpho-editate antimony is required for the treatment of each severe case of panacetate encephalitis, but adverse reaction are numerous. After treatment commences most patients demonstrate skin rashes and complain of itching and the skin frequently becomes purple, because dextropomorpho-editate antimony contains traces of laevopomorpho-editate antimony. The concentration of laevopomorpho-editate antimony in the serum is above 0.8 micrograms/ml while the rash lasts. The blood supply to the skin may be less than normal, especially in women.

Brown et al (1982) agreed but, having had experience of other forms of encephalitis, they expected that dextropomorpho-editate antimony would help a wide rang of patients. We thought that better dextropomorpho-editate antimony therapy could be developed. We argued that killing rates and guinea pigs after giving dextropomorpho-editate antimony intrathecally would tell us whether dextropomorpho-editate antimony could escape across the brain-blood barrier."

4. *Aim for economy*. Write because instead of ~~based on the fact that~~; for or to instead of ~~for the purpose of~~. Similarly: ~~there were~~ several subjects ~~who~~ completed…; i~~t is suggested that~~ a relationship may exist…; ~~both~~ alike; ~~one and~~ the same; ~~a total of~~ n subjects; four ~~different~~ groups; ~~absolutely~~ essential; found ~~previously~~; small ~~in size~~; in ~~close~~ proximity; ~~very~~ close to zero; ~~much~~ better; ~~period of~~ time; summarize ~~briefly~~; the reason is ~~because~~; ~~also~~ included; ~~in order~~ to; except ~~for~~.

5. *Quest for simplicity*.

   - The vocabulary of the English language is made up of several languages, including the Arabic and Asian languages. Keep in mind the following five rules: (a) prefer the familiar word to the far-fetched; (b) prefer the concrete words to the abstract; (c)

prefer the single word to the circumlocution; (d) prefer the short word to the long; and (e) prefer the Saxon word to the Romance. Therefore, there are good reasons to avoid inter alia, per annum, prima facie, ceteris paribus, mutatis mutadis, con amore, carte blanche, by using among others, a year, at first sight, other things being equal, with the necessary changes, enthusiastically and blank cheque (for "free hand").

- Do not use a long string of qualifiers in front of a noun: a modified test of cognitive function is better than ~~a modified cognitive-function test~~.
- Avoid grammatically questionable formal cliches, such as: ~~Based on these results, it is concluded that~~ and ~~The results showed that~~.
- *Slang and informal writing should be avoided*. A scientific paper is an international communication, which is read by scientists of non-English speaking background. To these readers, slang and idiom make the paper harder for them to understand. Try to use precise, scientific terms where possible (without unnecessary jargon) and avoid colloquialisms and figures of speech: "*somewhat*" rather than "*sort of*," "*many*" or "*a great deal*" instead of "*a lot*."

6. *Be specific*.
   - Do not make unnecessary generalization. For example, do not write some if you know of only one instance.
   - Be careful with "This". This on its own is known as an ambiguous antecedent. Use instead this test or this problem or whatever.
   - Avoid hype (hyperbole). Words like very and extremely are usually unnecessary.
7. *Select your facts and ideas* so that you include all that are necessary to your purpose. Exclude all that distract the reader from the real point of your message. Take the following example: There is ample evidence indicating that smoking is a risk factor for cancer can be simplified to Smoking is a risk factor for cancer. Remember that journals' editors always look for ways to reduce pages (and hence reduce cost).
8. *Organise your thoughts in logical sequence, or at least in an orderly way so that each thought follows naturally the one before it*. Remember that thoughts that are closely related should group themselves into paragraphs. Consider the following sentence: The present paper reports an association between polymorphisms of the VDR gene and bone mass. Bone mass was measured by DEXA densitometry. The authors first state their aim, and then next talk about method of measurement, which is rather incoherent. It is perhaps better to write: The association between polymorphisms of the VDR gene and bone mass is unclear. The present study was designed to assess

the magnitude and direction of this association, and the method of measurement can be moved to the *Methods* section.

9. *Express your thoughts in sentences which are as clear, concise and complete (and correct) as you can make them*. For example, at the first glance of "Some fundamental questions remain to be addressed or explored: 1) How much variation in BMD can be explained by heritable component? 2) How much common genetic determination does BMD …", the first question seems to have been answered by previous studies! One can also ask what is heritable component here actually refers to?

10. *Revise everything you have written*. Prune, substitute and rewrite to make your message say precisely what you intend it to say. Second thoughts may not always be best, but they do help to improve first thought.

III. Some Confusing Words and Expressions

In reporting and recording research, you should strive to be as accurate and precise in describing it as in doing it. Avoid ambiguous and "faddish" words. The following list includes some of the troublesome words, terms, and expressions, which may confuse authors and readers alike:

Above ("the above method," "mentioned above," etc.). Often, you are referring to something preceding, but not necessarily *above*; a loose reference, convenient for writers, but not for readers. Be specific. You know exactly what and where, but your readers may have to search (sometimes through much preceding material).

Affect, effect. Affect is a verb and means to *influence.* Effect, as a verb, means to *bring about*; as a noun, effect means *result.*

Agree to, agree with. Use *agree to* when you mean "to grant or to give approval." Use *agree with* when you mean "to be in harmony," "to conform," or "to hold similar views."

A lot. Write *a lot* as two words. However, avoid use *a lot* in formal writing.

All of, both of. Just "all" or "both" will serve in most instances.

Alternate, alternative. Be sure which you mean.

Among, between. Use *among* with three or more objects or people. Use *between* with only two.

Amount, number. *Amount* refers to mass or quantity. It is followed by the preposition *of* and a singular noun. *Number* refers to things that can be counted. It is followed by *of* and a plural noun.

And (to begin a sentence). Quite proper. You have been told not to do this in grade school. But teacher's purpose was to keep you from using fragmentary sentences; either "and" or "but" may be used to begin complete sentences. And both are useful transitional words between related or contrasting statements.

And etc is a redundant expression, because *etc.* means "and other things" or "and so forth".

Anyone, any one. *Anyone* means "any person at all." It refers a specific person or thing within a group. Similar cases are *everyone, every one* and *someone, some one.*

Apparently (apparent) means *obviously, clearly, plainly evident*, but also means *seemingly* or *ostensibly* as well as *observably.* You know the meaning that you intend, but readers may not. Ambiguity results. Use *obvious(ly), clear(ly), seeming(ly), evident(ly), observable* or *observably,* etc., as needed to remove doubt.

Appear, appears. Seem(s)? "He always *appears* on the scene, but never *seems* to know what to do." "Marley's ghost *appeared* but *seemed* harmless."

As. Dialectal when used in place of *that* or *whether*; do **not** use *as* to mean *because* or *inasmuch as.*

As, like. See **like**.

At the present time, at this point in time. Say "at present" or "now" if necessary at all.

A while, a while. *Awhile* is an adverb meaning "for a short time." It is not preceded by the preposition *for*. *A while* is an article plus a noun. It is usually preceded by *for*.

Being as, being that. Use the more formal *because.*

Below. See comment about *above.*

Beside, besides. *Beside* is a preposition that means "next to." *Besides* can be a preposition (which means "in addition to" or "except for") or an adverb (which means "furthermore.")

But (to begin a sentence). Go right ahead (see "And" and "However").

By means of. Most often, just "by" will serve and save words.

Case. Can be ambiguous, misleading, or ludicrous because of different connotations; e.g., "In the case of Scotch whiskey,...." *Case* also is a frequent offender in padded, drawn-out sentences. For "in this case," try "in this instance."

Commas and punctuation. Not precisely a word-usage matter except in relation to how words are put together. The trend is toward less punctuation (particularly fewer commas), but that demands careful writing, without misplaced or dangling elements. Do **not** omit commas before the conjunctions in compound sentences. Most journals, but not all, use final commas before "and" or "or" in series; check the journal.

Compare with, compare to. Use *compare with* when referring to the similarities between essentially unlike things. Use *compare to* when referring to the similarities and differences between things of the same type.

Comprise. Before misuse, comprise meant to contain, include, or encompass (not to constitute or compose) and still does, despite two now opposite meanings. Use and meanings now are so confused and mixed that "comprise" is best avoided altogether.

Continual, continuous. *Continual* means "recurring regularly." *Continuous* means "occurring without interruption."

Convince, persuade. *Convince,* which is often used with *of,* means "to cause to believe." *Persuade,* which is often used with and infinitive, means "to cause to do."

Correlated with, correlated to. Although things may be *related to* one another, things are *correlated with* one another.

Criteria, data, phenomena. These words are plural and in formal writing take plural verbs. The singular forms are *criterion, datum, phenomenon*.

Different from, different than. Different from! Also, one thing *differs from* another, although you may *differ with* your colleagues.

Disinterested, uninterested. *Disinterested* means "impartial." *Uninterested* means "indifferent" or "not interested."

Due to. Make sure that you don't mean *because of.* Due is an adjective modifier and must be directly related to a noun, **not** to a concept or series of ideas gleaned from the rest of a statement. "Due to the fact that..." is an attempt to weasel out.

During the course of, in the course of. Just use "during" or "in."

Either....or, neither...nor. Apply to no more than two items or categories. Similarly, *former* and *latter* refer only to the first and second of only two items or categories.

Etc.. Use at least two items or illustrations before "and so forth" or "etc."

Everyday, every day. Use *every day* as an adverb. Use *everyday* as an adjective.

Experience(d). To experience something is sensory; inanimate, unsensing things (lakes, soils, enzymes, streambeds, farm fields, etc.) do not experience anything.

Farther, further. Use *farther* to refer to geographical distance. Use *further* to refer to time, quantity, or degree.

Fewer, less. Use *fewer* to refer to things that can be counted. Use *less* to refer to a collective quantity that can not be counted.

Firstly, secondly. Use *first, second* instead.

Following. "After" is more precise if "after" is the meaning intended. "After [not *following*] the procession, the leader announced that the ceremony was over."

High(er), low(er). Much too often used, frequently ambiguously or imprecisely, for other words such as *greater, lesser, larger, smaller, more, fewer*; e.g., "Occurrences of higher concentrations were lower at higher levels of effluent outflow." One interpretation is that greater concentrations were fewer or less frequent as effluent volume(s) increased, but others also are possible.

However. Place it more often within a sentence or major element rather than at the beginning or end. "But" serves better at the beginning.

Hyphening of compound or unit modifiers. Often needed to clarify what is modifying what; e.g., a small-grain harvest (harvest of small grain) is different from a small grain harvest (small harvest of *all* grain), a fast *acting* dean isn't necessarily as effective as a fast-acting

dean, a batch of (say, 20) 10-liter containers is different from a batch of 10 [1-] liter containers, *and a man eating fish is very different from a man-eating fish!* Grammatically, adjectives are noun modifiers, and the problem is when adjectives and nouns are used to modify other adjectives and nouns. **Adverbs** (usually with "ly" endings), however, **are** adjective modifiers.

In, into. *In* indicates position. *Into* indicates direction of movement.

In order to. For brevity, just use "to"; the full phrase may be used, however, [in order] to achieve useless padding.

In regard to. Use *in regard to* or *regarding* or *as regards*.

Irregardless. Never use this, but write *regardless*. However, *irrespective* might do.

It should be mentioned, noted, pointed out, emphasized, etc.. Such preambles often add nothing but words. Just go ahead and say what is to be said.

It was found, determined, decided, felt, etc.. Are you being evasive? Why not put it frankly and directly? (And how about that subjective "felt"?)

Less(er), few(er). "Less" refers to quantity; "fewer" to number.

Lot of, lots of. In formal writing, use *a great deal of, much, plenty of,* or *many* instead.

Majority, vast majority. See if *most* will do as well or better. Look up "vast."

May be, maybe. *May be* is a verb phrase. *Maybe* is an adverb meaning "perhaps."

May of, might of, must of. Use *may have, might have,* or *must have* instead.

Myself. Not a substitute for me. "This paper has been reviewed by Dr Smith and myself" and "The report enclosed was prepared by Dr Jones and myself" are incorrect as is "Don't hesitate to call Dr Doe or myself"; *me* would have been correct in all instances. (Use of *I* also would have been wrong in those examples.) Some **correct** uses of *myself*: I found the error myself. I myself saw it happen. I am not myself today. I can not convince myself. I locked myself out of the car.

Partially, partly. Compare the meanings (see also *impartially*). *Partly* is the better, simpler, and more precise word when partly is meant.

People, persons. Use *people* to refer to a large group collectively. Use *persons* to emphasize the individuals within the group.

Percent, percentage. Not the same; use *percent* after a specific number; use *percentage* after a general adjective indicating size. Example: `"The data show that 75 percent of the subjects have the disease."` `"A large percentage of subjects had the disease."`

Predominate, predominant. *Predominate* is a verb. *Predominant* is the adjective; as an adverb, *predominantly* (not "predominately").

Prefixes (mid, non, pre, pro, re, semi, un, etc.). Usually not hyphened in U.S. usage except before a proper name (pro-Iowa) or numerals (mid-60s) or when lack of a hyphen makes a

word ambiguous or awkward. *Recover* a fumble, but perhaps *re-cover* a sofa. *Preengineered* is better hyphened as *pre-engineered*, one of the few exceptions so hyphened. Breaking pairs such as *predoctoral* and *postdoctoral* into *pre- and post-doctoral* "forces" hyphening of both otherwise unhyphened words.

Principle, principal. They're different; make sure which you mean.

Prior to, previous to. Use *before, preceding*, or *ahead of*. There are *prior* and *subsequent* events that occur before or after something else, but *prior to* is the same kind of atrocious use that attempts to substitute "subsequent to" for "after."

Proven. Although a *proven* adjective, stick to *proved* for the past participle. "A *proven* guilty person must first have been *proved* guilty in court."

Provided, providing. *Provided* (usually followed by "that") is the conjunction; *providing* is the participle.

Raise, rise. *Raise* is a transitive verb meaning "to lift." Its past and past participle forms are both *raised. Rise* is an intransitive verb meaning "to go up." Its past and past participle are *rose,* and *risen*.

Really, real. *Real* is an adjective. *Really* is an adverb.

Reason is because. Use *that* instead of *because*.

Reason why. Omit *why* if reason is used as a noun. The reason is...; or, the reason is that... (i.e., the reason **is** the why).

Sensual, sensuous. Both of these adjectives mean "appealing to the senses." However, *sensual* describes something that arouses physical appetites, while *sensuous* describes something that leads to esthetic enjoyment.

Shall, will. The distinction between the two words is fading. In formal writing, however, use *shall* with first person pronouns, and *will* with second- and third-person pronouns to indicate simple futurity. Reverse the order to indicate determination, duty, or need.

Since. This word has a time connotation; use "because" or "inasmuch as" when either is the intended meaning.

Small in size, rectangular in shape, blue in color, tenuous in nature, etc.. Redundant.

Sometimes, some time. Use *sometimes* as an adverb to mean "at an indefinite or unnamed time." Use *some time* after a preposition.

That, which. Two words that can help, when needed, to make intended meanings and relationships unmistakable, which is important in reporting scientific information. If the clause can be omitted without leaving the modified noun incomplete, use which and enclose the clause within commas or parentheses; otherwise, use *that*.

To be. Frequently unnecessary. "The differences were [found] [to be] significant."

Varying. Be careful to distinguish from *various* or *differing*. In saying that you used varying amounts or varying conditions, you are implying **individually changing** amounts or conditions rather than a selection of various or different ones.

Where. Use when you mean *where*, but not for "in which," "for which," etc.

Which is, that were, who are, etc.. Often, they are not needed. For example, "the data that were related to age were analyzed first" means that the *data related to age* were analyzed first. Similarly, for "the site, which is located near Ames," try "the site, located near Ames" or "the site, near Ames." Rather than "all patients who were present voted," just say that "all patients present voted." Rephrasing sometimes can help. Instead of "a survey, which was conducted in 1974" or "a survey conducted in 1974," try "a 1974 survey."

While. Preferably not if, *while* writing, you mean *and, but, although,* or *whereas*. Remember that a research report should communicate and record information as accurately and concisely as possible. The purpose is to report, not to impress with elegance. Excess wordage, tortuous construction, unnecessary detail, duplication, repetition, third-person passive pseudo-objectivism, etc., obstruct rather than facilitate communication. It's the message that is important, not sheer numbers of words. Use precise words and expressions of unmistakable meaning; avoid the clouded, ambiguous, vague, and needlessly complex.

A Final Advice: You Need Critical Colleagues

We all want to write a good paper – a paper that we can be proud of, that will be part of the medical literature for a very long time. However, no matter how careful you are, no matter how many times you have gone through your manuscript, the chance that you will make mistakes or your manuscript contains some deficient points is very high. It is unlikely that you can identify all of the problems yourself. You need colleagues, who critically go through the whole manuscript and give you frank comments/criticisms. Don't be afraid of being criticised! Get rid of your ego! You should be receptive of criticisms, and consider all comments carefully. In my experience, the colleagues' criticisms and comments, no matter how trivial or serious they are, almost always result in a better manuscript.

To conclude this Guide, I would like to borrow some words from a learned man, Confucius: "*If language is not correct, then what is said is not what is meant; if what is said is not what is meant, then what must be done remains undone; if this remains undone, morals and art will deteriorate*."

Further Reading

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