Writing and Publishing A Scientific Article

A HANDBOOK PREPARED BY

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SECTION 1. GETTING STARTED

Around the world, health scientists are busy at their work of carrying out research, answering questions that are important to them, to their universities, institutes and programmes, and of course to the health of people in the countries where they live. Research is essential because medicine is an evidence-based science, and the delivery of effective healthcare needs the evidence that is gained from research. While much research has its greatest value within the local community, the results of studies may also be of interest and value to the international scientific community. The research experience of scientists in developing countries, who may study specific diseases, especially tropical infections, or may approach issues from different perspectives, is an important contribution to the global base of scientific knowledge. Progress is made when scientists can compare the results of their own experience with that of others and use that information to formulate a new explanation for all of the different findings. It is vitally important, therefore, that scientists make the results of their research available to the scientific community – indeed it is often said that "the research is not completed until the study is published."

One of the best ways of ensuring that research experience is shared is for scientists to publish their findings in international journals. Other scientists around the world can then examine the data, review their significance and perhaps use the data to gain new insights into health problems in a global perspective. Unfortunately, health scientists in developing countries often do not have experience in the skills needed to get an article that reports their research results published in an international journal. In many Western countries, graduate students learn how to write papers in the course of their graduate work, learning from their supervisors and colleagues through discussion and through giving assistance in writing papers in collaboration with their supervisors. Some universities require that students at higher levels follow courses in writing and that they publish their results before they can graduate. But in many countries, especially those in resource-poor settings, the access to international scientific literature is not good, and many researchers will not have experience in publishing outside their national journals. The problems are partly due to language barriers,

but also due to a lack of familiarity with the customs and assumptions concerning scientific articles and how to write them.

There are courses that are held in writing research articles but mostly such courses are held in Western countries, and so are too expensive for those from the developing world to attend. There are also books and articles on scientific writing, and reference is made to some of these articles in this handbook.

Writing a paper for an international journal is a skill that, like any other skill, requires practice. The more papers you write, the easier it is to write them. Writing the first paper is however the most difficult part of acquiring this skill and many scientists in developing countries delay writing their first paper because it seems too hard. We hope this handbook will help you to overcome that barrier and give you the courage to write your own paper, submit it to an international journal and eventually become successful in scientific writing.

Objectives

The objectives that we are hoping you will achieve at the end of working through this book are that you will be able to:

1. Recognise the major sections of a scientific article.
2. Formulate the statement of the problem and the research question relevant to their studies.
3. Write at least an outline for an article, and preferably a full article for publication, with each section being clear and concise.
4. Select and prepare the most appropriate way to present your results.
5. Use and record reference articles in a correct, clear and efficient way.
6. Criticise the draft articles prepared by yourself and your colleagues in a constructive way.
7. Be aware of ethical issues in publication and of the need to follow good research practice in publication of your research findings.

This handbook is aimed at helping you to write a paper that will be acceptable in the international scientific publishing world. To be acceptable the paper need not be in perfect English. Editors are increasingly aware that for many authors, English is not their first language. Editors are concerned more about the ***scientific*** quality of an article – if the science is good, they will be more likely to help you in getting the language correct. There have been a number of comments about the difficulties faced by writers from developing countries, with the editor of The Lancet even suggesting that this

amounted to “institutional racism” in publishing papers. Journals have been challenged with improving access to publication, through the inclusion of editors and reviewers who have experience in developing countries, and so who may be more sympathetic to the difficulties faced by researchers in those countries and give them more support.

In general though if the scientific quality of a paper – both the way in which the study was done and the way it is described in the paper – is poor, editors and reviewers, whether from a developing country or not, will not spend valuable time in suggesting corrections. So the major thing is to get the science right, and worry about the language later.

General points

Later in this handbook, we shall describe in detail the way in which a scientific paper is put together, often using actual examples from publications in different journals to illustrate particular points. It would be useful at the very beginning, though, to make sure that you understand the basic structure of a research article. This structure enables a reader to determine the need for that particular piece of research to be carried out, the materials that were used and the way the research was done, the findings of the research itself, and the significance of the findings in relation to current knowledge.

In order to write an article, the assumption is made that, as a health scientist, you have already completed some studies of one or another kind and that the data have been analysed. You may not yet, though, have put the data together with all the other information you have in the shape of a scientific paper. This handbook can then be used as a guide to help you assemble your research results into an article, and to submit this article for publication in an international journal. If you are still collecting data, you can still use the handbook – in fact it may help you to make sure that you have included all of the data collection you will need when you start to write your paper. Even if you are only just starting out on your career in research and are still planning research programmes this handbook will be helpful in guiding you. Many of the points about scientific writing that we make here are applicable in other situations, such as writing a grant proposal for example, though our main focus is on writing for publication in an international journal.

Today, most scientists have access to computer technology for data collection, storage and analysis, and also for writing their articles. In the past, a secretary was usually employed to transform the hand-written text of the researcher into neat and legible typescript. Now, though, because of the increasing availability of laptop computers and the ease of using word processing programmes, most scientists have learned to type – albeit at different speeds! We strongly recommend that you acquire these skills if you do not already have them. You have much greater control over the presentation of the data, and it is much easier to change or move sections of text by computer than to ask a secretary to retype a whole article because you have decided to move a paragraph. Do make sure though that you save what you have written, if possible in two different files, for example on the hard drive of the computer and on a diskette or memory stick. There is nothing more frustrating than to lose your document that you have spent hours, days or weeks writing. ***So save, save and save all the time***.

Most word processing programmes also have a "Spell Check" function that allows you to make sure you have spelled words correctly, and this may be very useful if English is not your first language. Remember though that this function only identifies words that are not in its database – so not all errors will be detected, if the word is misspelled in such a way that it matches another word for example. *"Their were 492 women in the study ….*" it will not be detected as a misspelling of the correct version *"There were 492 women in the study ……"*. So while a spell-check is useful it is not infallible. And if you are using a scientific word that is not in the database, it will be identified as misspelled even if you spell it correctly.
Another problem for non-native English speakers is that Spell-check usually proposes another word, the closest match that it can find to the misspelled word. Be careful with accepting the proposed change, because it may be a word with a very different meaning and not what you want to say at all. The best spell check is still a friend with good English.

In addition, many journals now require submission both in "hard copy" i.e. printed pages, and "electronic copy" i.e. a diskette with the article in a word processing programme such as MS Word or WordPerfect. . Indeed, many journals now either allow or require submission "on line" through the internet, without paper being used at all, though this may not be readily accessible to scientists in many developing countries.

A very useful exercise is to ask your colleagues for their suggestions and comments at all stages of the writing process. Being open to critical suggestion by your peers is an essential part of developing a scientific article for publication, and indeed if you are going to publish in an international journal, this is exactly what you will be doing – exposing your research findings to the critical review of the global research community. The comments from your scientific companions may be very useful in giving you the confidence that what you have written is clear, correct and useful.

As in many other areas, the skills of scientific writing take time to acquire, and the expected outcome may not be realised immediately. There are many difficulties in publishing, not all of them being difficulties that you can do something about yourself. Many scientists have had the experience of having an article accepted for publication while working at a laboratory in Europe or North America, but when the address is a developing country an equally good article is rejected. In a study to determine the degree of bias, changes were made to papers already published in particular journals. Among the changes made were to change the names of authors and their home institution to less prestigious addresses. When the papers were resubmitted as "new submissions" to the same journal where they had been published, many were rejected. So bias in favour of famous names and famous institutions does happen, and much of the bias is directed against developing countries. Do not be disheartened by this experience, however, rather make use of it to ensure that the next paper you submit is so good they cannot possibly reject it!

The IMRAD structure

The standard structure of a scientific article is often referred to by its initials: IMRAD. The IMRAD structure of scientific publications is based on the following arrangement:

Introduction	-	Why did you do the research?
Materials and **M**ethods	-	What did you use and how did you do it?
Results	-	What did you find?
And		
Discussion	-	What do these findings mean?

These headings will be addressed again in more detail in the following sections. There are, of course, many other sections, like the Title, Abstract, References and Acknowledgements, which also are necessary, before you can submit an article to a journal. Advice on these is given later in the handbook. With IMRAD, though, you will at least have the basic framework from which the final paper can be put together.

The IMRAD structure evolved mainly in response to the need for a standardised format for science articles in other disciplines such as chemistry, biology and physics – and the structure may not be fully suited for articles in the health sciences. Health science research is carried out usually not in a laboratory but in a setting such as a community or a hospital; the research is conducted using people, rather than materials; the results may only become clear after statistical analysis; the conclusions often lead to specific recommendations about action – to change a treatment policy or to introduce a new intervention measure for example. So, in health journals, the IMRAD structure is not always the most appropriate, and it may be modified to suit the kind of research that is being reported. Nevertheless it is still a very useful structure to use as a skeleton on which to build the specific article you are writing.

Writing in English – a problem?

For many researchers in developing countries it is important not to fear too much the actual process of writing an article. Many people for whom English is not their mother language are so worried about making mistakes in English that they hesitate to write at all. Some of you may want to publish in another language, French or Japanese or Russian – whichever of these, the same advice applies. When you are preparing an article for publication, ***do not think about the English*** until after you have laid out the points needed for each section of the paper. The language only becomes important to check ***after*** you have nearly finished the writing. If sentences scare you, then write everything in point form, and worry about verbs and adjectives later. Scientific articles have to be clear, complete and concise; they must be accurate but they do not have to be works of literature.

Writing the first draft

Where do you start? Remember that you do not have to write your article in the order in which it will finally appear. Usually it is easiest to start with the “Materials and Methods” section. Although

scientists can't always say clearly why they did the work (Introduction) or what it means (Discussion), they usually do know exactly how they did it. Also, the language used in this section is simpler, describing populations, places and techniques. If that is your situation, then start with this section. It will make you feel like you have accomplished something and will give you confidence to work on the other sections.

We have noted previously that the conventional "Materials and Methods" may not always be appropriate in health research, because the studies are carried out in communities and using people, rather than in a laboratory and using test tubes. It would be quite acceptable to use sub-headings such as "Study population" and "Study design" within this section if these are more appropriate to the research you are describing.

Following the Methods section it may be easiest to report the "Results", again because you have the data and know more or less what the results mean. This is harder than Materials & Methods, though, because the presentation of the data and the text to lead from one result to the next must be very, very clear. A scientist who was not involved in the research should be able to follow your reasoning and understand your results from the description you give. At this stage you may want to prepare your results in different formats, as a table, a figure or a graph for example, to see which presents your results in the clearest way. Later on you will select one particular format, but when you are writing the draft it is preferable to have all of the different formats in front of you so that you have all of the options from which to choose.

It is useful to start early on the "Introduction" section, because reviewing the existing knowledge and the gaps in it that led you to do the research will also help you to interpret your data and to see clearly the advantages and disadvantages of the methods you used and the limitations of the data you obtained. You cannot start with the Introduction until you have already looked at the literature to see how your research will fill a gap in scientific knowledge. Of course, you should have reviewed the relevant literature when preparing to do your research, to be sure of the need for that research to be done, so this part may not be too difficult.

The "Discussion" section is usually left until last, when the Why? and How? and What? have been made clear. In the discussion you will also need to consult the literature, to be able to compare your results to others from relevant studies in your field or a similar

one. It will be easier to know which articles are relevant after you have finished with your results section.

The “References” section is also important, both for the content and the style. While you are writing the draft, it is useful to note the references in the text using the author’s names and year and publication (what is called the Harvard style). This helps you to make sure you have the right reference in the right place, and to make sure that you have all of the references you need. Later you may need to change these to numbered references, as discussed later, but during the draft stages it is often easier to keep the Harvard style.

Many people find it helpful to make an outline first of each point and the order that the points will appear in each section. This shows where there is overlap (for example between Introduction and Discussion) and serves as a ‘skeleton’ that you can add text to in order to write the paper.

So – writing may seem like a big problem, but the main thing is to GET STARTED. The more you write, the easier it gets, and you can always reduce the volume later when you have the overall picture.

Once you have the first draft, you can then go through it carefully to make sure the style and the flow of the arguments and descriptions are clear and logical, using the points we describe here. It is perfectly normal to revise the draft 3, 4 or even 10 times before you are satisfied with the version you want to submit. So do not try to get your first draft perfect, just make sure you get it finished.

Selecting a journal

It is not absolutely necessary to select the journal before you start to write, but you should at least look at some different possibilities before you begin on your own article. By looking at the different journals that publish articles in your field, and scanning some of the articles they have published recently, you can get a good idea of what topics are interesting to the journal and its readers, and a good idea of which journal might accept a paper on the topic of your research. That might even give you some new ideas about points to raise in your discussion or which of your results to emphasise. When you select a journal it is a good idea to check

that journal for relevant references, so that by the time you submit you can show the editor that you have also made use of the articles published in that journal. You can also get an idea of how long it might take them to process your manuscript; the time between submission and publication is often included at the start or end of the paper.

If your study has generated large amounts of data (as some genetic analyses do, or population studies) or if you want to publish the details of your data collection instruments, or complex figures involving colour to show differences, you may have to select an online journal, where the space limitations are less than for paper journals. Online journals also often have faster publication times, because they eliminate the stage of printing; once the paper is accepted and finalised, it appears on the website of the journal immediately.

In very general terms there are perhaps three types of quantitative scientific research, descriptive, experimental and intervention studies and there is also growing awareness of the value of qualitative research. There is no intention here to put values on papers or journals in terms of the importance of data they contain. All data, if they have been collected in a carefully designed and executed study, add to the global body of knowledge and so have value. But we have to face reality – journals are produced for the purpose of being read, and so it is the value of a paper to the readership of the journal that ultimately influences decisions of acceptance or rejection. One of the most common reasons for rejection of a paper is that it is unsuitable for the readership of a particular journal.

☞ **Descriptive studies**, such as surveys for specific diseases or conditions in a community, often collect basic data – "*what is the prevalence of typhoid in a group of villages?*" This kind of study will be of more interest to readers of a local journal than to readers of international journals because health professionals need to know what health problems they may expect to meet in their own locality. A paper describing the findings of such a survey is therefore more likely to be published in a local or regional journal. The exception might be where the study concerns a disease that is newly emerging and brings international risks, like SARS or H5N1 influenza for example. With these emerging problems, all new epidemiological data are of international interest and so may be published in journals with an international readership. But in

general, in order to be published in an international journal, surveys need to provide data that supports (or not support as the case may be) a theory about disease epidemiology rather than as a straightforward description of a situation. So if the paper concerned *"what is the prevalence of typhoid in villages with different levels of water and sanitation?*" then that may be of interest to health workers in many countries and so would be more likely to be published in a journal with an international readership. Similarly surveys may provide epidemiological evidence showing the risk factors for infection – some of the risk factors for typhoid may be determined in the survey suggested above for example. These data would also be of interest to a wider readership because they have significance beyond the locality where the study was done. Note that is such cases, the quality of the study and the quality of the analysis and reporting must still match the standards of that journal.

☞ **Experimental studies** are usually based on research where the conditions of an experiment can be strictly controlled. Often this would be a laboratory study, but experimental designs are also found in clinical and epidemiological studies as well. With this kind of article you need to be very sure of the quality of your controls. This is especially true of articles from developing countries because questions of quality control are often applied more rigorously to them. Also remember that such an article is unlikely to be accepted by a "clinical" journal unless there was a very clear application to a clinical situation.

☞ **Intervention or evaluation studies**, such as the use of a new treatment, or a vaccine, chemoprophylaxis or behavioural modification, or an examination of a new diagnostic technique, are used to compare different approaches to disease management or prevention. This kind of study is also known as a "clinical trial" and is widely used for determining the efficacy of different treatments in specific diseases. A clinical trial is a design concept, where one set of individuals receives the intervention, and another set of matched individuals, the control group, receives another intervention or no intervention at all. The same outcomes, such as cure rate, time to resolution of symptoms, incidence of new infections etc., are measured in both groups and are then compared. If there are statistically significant differences between the two groups, then one intervention is clearly superior to another. Often it is easier to conduct clinical trials in countries where the incidence of disease is high because they can be completed quickly. For this reason,

many clinical trials are now done in developing countries, where the benefit of the intervention or technique can be determined in a short period of time. So it should be easier for scientists in developing countries to participate in this kind of study and to write a paper for publication. But also remember there is a great deal of competition in this area of research. Journals are expensive to produce, and editors are concerned with quality. So international journals will select only the best articles submitted to them from around the world. But it is a real boost to your status when your article is accepted. You have competed with the rest of the world and been successful!

☞ **Qualitative studies** look at diseases and conditions within the context of society and examine the interactions within society that affect the way in which the disease or condition occurs. These are very often descriptive studies that are based on the results of questionnaire data, observation and focus group discussion. Prominence is given to the perceptions of society about a disease or condition, since this may have a significant influence on behaviour. There are a number of special features of qualitative research such as identifying key informants – people who can give insight into community reactions to particular situations. There are now a number of journals that welcome this kind of research paper especially those concerned with community health, health information and health education.

Different journals use different styles for writing and for references, and allow a different number of illustrations, tables, and words in the text. When you are using citation software such as Endnote or Reference Manager, you can accumulate all the possibly relevant papers in a separate file, and insert them into the text as you write. Later, the program will adapt the format of the references to fit with the style required by the journal. Some publish not just standard articles reporting results of studies, but also review articles, clinical case studies or short reports. Every journal has a set of instructions to authors who wish to submit a manuscript to them, and you ***must*** follow these instructions when you send them a manuscript. The instructions are usually printed on a page in the front or back of the first issue of each volume of the journal. Many journals include their instructions in the information on their websites on the Internet as well. If you cannot find the instructions for the journal you want to send your paper to, you can of course fax or email to the journal to ask them to send you a copy. If you choose a journal ahead of time, you can save time by writing in the

style they require, and then you don't have to change it after you have finished writing. It is very useful as well to carefully read some articles published in the journal, as this can give you some ideas about the style of writing that they use. Some of the important aspects of style in different journals are noted in this handbook, and may help you in making sure that your article is compatible with the style of the journal.

Impact Factor

One of the most important reasons for publishing in an international journal, especially for someone who has chosen research as a career, is to improve status and improve chances of promotion in an institution. In general of course, emphasis is put on ***quantity***, how many papers has the researcher published? More and more frequently, though, emphasis is also placed on ***quality*****,** what kind of journal has the researcher published in? There are valid reasons for this, as for many international journals, the research itself has to be of the highest quality before it will be accepted for publication. Carrying out the research to the high standard expected, and writing the high standard of article that the journal requires, takes time. So while it may take only two months to carry out a small survey and publish the paper in a local journal, it would take two years to carry out an intervention study and publish the results in an international journal. Clearly there would be a big difference in the quality and in the scientific significance of these two articles, and that should be recognised.

In some institutions, the quality of a journal may be determined by an arbitrary classification, but most institutions now use internationally recognised mechanisms for ranking journals. The most common of these is the "Impact Factor" which is calculated from all of the papers published in a set of about 2,000 journals, and is based on the ratio of the number of times a particular journal is cited in the reference lists of all the papers in these 2,000 journals to the number of papers published by that journal in the same year. The Impact Factor is then used to rank journals in order – the theory being that the more often a paper is quoted in the reference lists, the greater impact that paper has had on medical research. A journal that has published a large number of such important papers will therefore have a higher impact factor than other journals. Top international journals (Lancet, New England Journal of Medicine, JAMA etc.) usually have impact factors >10, specialist journals (including many tropical medicine journals) have impact factors in the range of 1-10, and regional

journals usually have impact factors <1. The new open access online journals are just starting to be rated, and their impact factors are rapidly increasing, mainly because it is much easier for people to access the free journals online than the paper journals in a library, or the subscription journals online. Some of these journals, such as the BMC journals, keep a record of how many times the paper has been viewed; papers with a high score in their own discipline are marked as 'high access', which gives them a higher status and is now being cited in lists of publications by researchers, to show that their papers are of high relevance and quality.

Journals that publish papers in a language other than English are unlikely to be quoted very often, and so the Impact Factor of non-English journals will be very low. While this should not deter a scientist from publishing papers in his/her own language, the implication is that the findings that are published are unlikely to receive international recognition.

Because the "success" of a journal is usually determined by its Impact Factor, editors are always very keen to publish papers that they consider will be important for their readers, and that their readers will cite in the reference lists of papers that they subsequently publish in other journals . Editors are therefore under pressure to make sure that the papers they publish are both informative and of high quality, and if you want to publish your paper in that journal you will have to compete with all of the other submissions to match those requirements.

Responses from journals

If the first journal you chose does not accept your article, you can send it to another one, which might be keener to publish the paper, but then you ***must*** check the instructions for the second journal. The manuscript must be changed in line with these instructions and, as noted later in this handbook, in line with any comments that have been made by reviewers, before you submit it to the second journal.

Details about journals are presented later, but you should know that usually <5% of articles are accepted without revision. It is very unlikely that this will happen with your first, or indeed any submission you make. In probably 50% or more cases, depending on the journal, the article is "rejected" – with a short explanation for

why this decision was taken. Of the other 45% of articles, some changes are required before the article is accepted. These may be minor, with changes to the style of writing, or the way in which data are presented. For most articles, acceptance requires major changes – this means that extra experiments, usually controls, must be completed or described, or the article must be rewritten, for example as a short article instead of a full paper or you must add more discussion based on reference to other articles that you had missed the first time. .

Do not be discouraged by critical reviews – they are not personally directed at you, but are meant to increase the value of the article for science. In the early days of my (PM) scientific career I submitted a paper and received a critical review that was 5 pages long! While I was despondent about this, my supervisor advised me that anyone who goes to such time and trouble to write a 5 page review obviously thinks the paper is very good! Sure enough, the paper was finally accepted for publication.

GETTING STARTED

Key points

1. *Use the general IMRAD structure: Introduction, Methods, Results and Discussion, but remember this may be modified for some health research studies.*
2. *Write the first draft – do not worry about the English, getting started is more important.*
3. *Start with Method and Results – remember to use the past tense and non-personal word structure.*
4. *Keep accurate notes of the references you intend to use.*
5. *Think about the journal you want to publish in –make sure you have the Instructions to Authors and read some papers from that journal to get some ideas about style.*

SECTION 2: THE TITLE PAGE AND ABSTRACT

While it is presented here, because it appears at the beginning of an article, usually the title is decided only after you have finished with the rest of the paper. Only then is it really clear what you want to say, and only then can the key issues be included in the title. During the time you are writing the various drafts you should use a short draft title as a temporary means of identifying the article, but the final title should be decided very carefully.

Most journals require a separate title page that includes

- The full title, to be used at the head of the article.
- The running title, an abbreviation of the title that appears at the top of each page in the article when it is printed.
- Keywords that can be used to identify the paper in the index of the journal.
- The list of authors in the order in which they should appear.
- The affiliation of the authors, this means the organisation where the work was done, a university, a hospital or a research institution for example.
- The address for the corresponding author, the author who is responsible for all of the contact between the authors and the journal. This will usually be the name and address of the senior author, but often one of the other authors will be appointed as responsible for correspondence, especially if for example the senior author is moving, or is not easy to contact because he/she lives in a remote area. The address for the corresponding author should include the mailing address (a box number for example), the physical address (this is often needed by international couriers), the telephone and fax numbers, and if available an e-mail address.

The title

The title is a key part of the article that tells a potential reader what information they are likely to find in that article – it is probably the most critical factor that will determine whether or not the paper will be read, and so editors look carefully at titles. Also remember the title goes into abstracting and electronic search files such as Index

Medicus (and its electronic version, MedLine, available through the PubMed website). If the title is not clear, or if it is long and boring, someone searching for relevant articles will not bother to read the rest of the paper. Titles should therefore be short but informative, and should attract the reader to look at your article. Avoid phrases like “Some observations on….” or “A survey of…….” or “Studies into the …..”. These general words do not add information on the article but they do take up space Less than 5% of articles in top international journals have titles including 20 words or more, while 10% have less than 10 words in the title. So a title of between 10 and 20 words is normal.

Consider carefully the importance of each word and look for combinations that are short but still make clear what the article is about. If the title is too general, people will expect something different and be disappointed when they read the article. If the title is too specific, some people will not realise it contains valuable data that they are looking for. Trying to find the right words that balance these two extremes is not always easy, and that is why you should leave this until the whole article is written and you are clear in your mind what is was you did, and what you have found. The title should inform the reader about the subject matter of the study (a disease, condition, organism etc.), something of the nature of the study (survey, laboratory examination, clinical trial etc.), the people who were the subject of the study (adults, children, patients, community etc.) and perhaps something of the outcome (benefit or failure).

Some good examples include:

“Serological survey of toxoplasmosis in four rural communities in southern Africa”

“Risk factors for typhoid in children in remote areas of Vietnam”

“Rapid emergence of in-vitro resistance to ampicillin and cotrimoxazole in Shigella dysenteriae type d from Zimbabwe.”

Some bad examples for the same papers may include:

“Some observations on the numbers of men and women infected with toxoplasmosis according to a serological test conducted on serum samples collected in four rural farming districts of South Africa and Botswana.”

"Report of an investigation into poor hygiene behaviour as a reason for the acquisition of typhoid fever by some ethnic minority children in Vietnam"

"We should stop using ampicillin and cotrimoxazole to treat shigellosis."

If you compare the good and bad examples above you should be able to see the way in which to design the title for your article. While you are writing the article use a working title that helps you to keep track of it through the different drafts or while exchanging it with co-authors, and only when you are pretty sure the article is complete, should you compose the final title. Remember that most spell check programmes do not check words in capital letters, and there can be no worse introduction to your paper than a spelling mistake in the title! So check it carefully.

It is very common, especially in studies from the developing world, to include the name of the country, the province or even the village where a study was conducted. The country where the research was done may be found in 40-60% articles in regional journals from Africa and Asia, but in less than 25% of articles in international journals such as Lancet, New England Journal of Medicine or British Medical Journal (and then usually only when the research comes from a tropical country) . Always ask what is the relevance of the country name in the title? In most cases, the characteristic feature of the study site is more important than its name. So a description of this characteristic is more useful – "a high rainfall area", "an endemic region", "a resource-poor setting" for example. When a geographic name is considered to be useful, use a more general geographic or climatic description – "northern Viet Nam", "highlands of Zimbabwe", "tropical America" for example. These descriptions have more meaning for the international community than names such as "Khanh Phu Province" or "Mukumbura town".

Be sensitive also to the possible effects of using a village or town name in the title of articles – it may not be diplomatic to have a title such as *"Abnormally high prevalence of HIV in Chiredzi"* for example, as it implies there is something very strange going on in that town! This may create difficulties for you in the future if you want to do research there.

It may be useful to indicate the main finding in the title – such as the *"Rapid emergence .. "* title above. Attention is much more likely using that title than the dry and dusty alternative *"*Survey *of antibiotic susceptibility of Shigella dysenteriae type d in Zimbabwe"* but also remember not to make value judgements in your title like *"We should stop using …."*, This kind of title may get the attention but it tells us nothing of the content and is more suited to a newspaper than to a research journal.

Some journals, the British Medical Journal for example, favour the use of a colon in the title to break the title into sections. This may be useful when the study is complex with multiple outcomes – for example a study on syndromic management of sexually transmitted disease, where community nurses treat men with symptoms of either genital discharge or genital ulcers, using a combination of antibiotics and the study shows that this approach to management is acceptable to men, is more cost-effective than laboratory diagnosis and specific treatment based on the laboratory findings, and has led to a reduction in the incidence of new STD infections. A reasonable title for this study might be *"Randomized control trial of community level syndromic management of STD in men: an acceptable and cost effective means of reducing STD incidence."*

This includes all of the elements discussed above, the subject, the type of study, the participants and the main outcomes, while still being economical with the number of words.

Authors

Authorship is one of the most difficult issues in research publications, and has itself been the subject of a number of investigations and recommendations, for example those of the International Committee of Medical Journal Editors (ICMJE) and the World Association of Medical Editors (WAME). In many institutions, one of the main criteria used for promotion is the number of publications. To have your name on every possible publication is therefore very important. Although this is understandable, there are conventions that should be applied. While single author, or 2-3 author papers were very common 10 years ago, they are unusual now, with most research being conducted by a team where each member of the team contributes a specific skill. Most papers published now have 6-7 authors.

The importance of each author generally decreases as the number of authors increases. There are certain conventions about the order of authors – the first author is usually regarded as the senior author responsible for writing that particular paper. The second author is usually regarded as the statistician, the third is the laboratory or clinical specialist and the last is the head of the laboratory or institution where the study was done or the supervisor of the overall programme within which the study was done. Such conventions are not followed in every case, but studies have been made of the authors own conception of their major contribution to papers, and the findings have been consistent with this general pattern.

When large groups have worked in an equal way, the names may be put in alphabetical order, and that should be stated in the paper. In general you should try to limit the number of authors. If there are going to be multiple authors you may wish to form a "…..Study Group". The paper is then written for example by "Mason PR, Wright EP, Vu TT, Gwanzura L, Nguyen TK, Ley DC and the Leprosy Study Group". The full membership of the study group can be given as a footnote at the bottom of the title page. There are some publications with a very large number of authors – even as many as 35 – though these are not found very often. Such papers usually report on very large clinical trials carried out in several centres, or studies carried out in parallel in several countries such as some of the work on the human genome. Most of your research will involve a much smaller team.

Decisions about authorship are best made early on in writing the paper, and even early on in starting the research study itself. These decisions may help in avoiding disputes later. There are four main stages of getting a publication:

- First, having an idea and designing an experiment or study to test it.
- Second, carrying out the study, doing the tests and collecting the data.
- Third, analysing the data and describing the significant findings.
- Fourth, writing the paper for publication.

To be an author, the ICMJE and WAME recommend that a person should have made a significant contribution to ***at least two*** of these stages, and a senior author must have made a significant

contribution to ***all four*** stages. Generally, those who have provided expertise in only one area, such as collection of samples or data, specimen testing, technical expertise, or statistical analysis, are not included as authors. They may merit (depending of course on the quality of their contribution) mention in the acknowledgements.

An additional important word about authorship - anyone who is an author on a paper shares joint responsibility for all statements made in that paper. There have been cases where an author has falsified data for use in a publication – and all co-authors are then regarded as having responsibility for that falsification! An example of this appeared recently in the *Central African Journal of Medicine*, where a number of articles had to be withdrawn because the senior author admitted he had plagiarised the work of others. The co-authors had to bear joint responsibility, even though the senior author stated that he alone was responsible. So be very wary of having your name on a paper unless you know the data are correct!

Finally, each author, and not just the senior author, should be able to defend the paper and respond to critical reviews, and if they are unable to do this they should not be included as an author.

Recently a new system of authorship has been adopted by some journals. These journals recognise that some authors have contributed in one specific area, and so would not be able to meet the ICMJE guidelines, requiring that authors are able to take responsibility for all of the statements in the paper – someone who has contributed laboratory data, for example, may not be able to defend all of the statistical analyses in a paper. This new system recognises the main authors, whose names appear below the title, and who become the guarantors of the contents of the paper. The other authors are the contributing authors whose specific role in the study is described, and who take responsibility for specific parts of the study only. This system is gaining popularity and may become the standard form of the list of authors in the future.

Summary/ Abstract

For the majority of papers, the abstract is the only part of the paper that will be read and used as a source of information, and so it is an essential part of the paper and not something that is added on as an afterthought. Strictly speaking, a “Summary” is a restatement of the main points of the paper for someone who has already read the whole paper, and so it is printed at the end. An “Abstract” is a

short statement of the main points aimed at persons who will not necessarily read the paper and so it is printed at the beginning. In reality, these two terms are often used interchangeably, and either may be found at the beginning or end of the article. They have in common that they are short statements of the main points and all international journals require one or the other.

For most journals, the Abstract/Summary should be printed on a separate page, and not as part of the main text of the paper. The abstract should reflect the most important points of the story you are reporting – the research question, the methods, the results and the conclusion. If there is no clear conclusion, you may end with the statement that the "*comparison of methods A and B is discussed*" but if possible that should be avoided.

References, tables and figures should not usually be included in an abstract. Neither should you take sentences from your paper and use them in the abstract, it should be written as an independent section. Always find a way to say clearly what you found to be important using the least number of words. Most journals put a strict limit on the number of words you can use in an abstract, and you must stick to this. A word count function is included in most word processing programmes, and this makes it easier to keep within the limit.

There are two main kinds of abstract – open and structured. For open abstracts, the authors describe their study using their own language and format. Generally this will follow the IMRAD pattern where appropriate. For a structured abstract, authors are required to produce an abstract using specific subheadings, such as Context; Setting; Study Population; Design, Outcome measures; Main findings; Conclusion; Recommendation. Studies have shown that structured abstracts are easier to follow, and are a better source of information for readers and so these are becoming the standard for an abstract. Even for journals where subheadings are not used, this structure is useful in designing an accurate, complete and informative abstract, and we would recommend that new authors follow it.

Abstracting databases

The articles published in established journals are also included in a number of abstracting services, the most popular of which is Index Medicus, and its electronic version, Medline, which is accessible through the PubMed internet site. There are specialist abstracting

services as well, such as Global Health, Tropical Diseases Bulletin and others, which focus on particular areas of health research. Index Medicus abstracts information from nearly 5,000 journals and so provides the most extensive coverage. If your abstract or summary is short, clear and concise, it will be included in its complete form by the service, but if your abstract is too long and not clear, the service will shorten it. When they do that, they may leave out the points that you thought were most important. So make sure that your abstract or summary only contains the important points, and in a clear form so that those who only see the abstract can still follow what you did and found.

Key words

Often you are asked to select a number of key words from your abstract or paper. These are used for the indexing and reference systems that provide catalogued information both in the journal itself and in abstracting services that include that journal. Choose the most important words that someone might use to find your article on such a system, such as the disease name, the country name, the study type, the indicators you used, etc.

TITLE PAGE & ABSTRACT

Key points

1. *Make sure the title page has all the necessary information, title, authors, their addresses and include an e-mail address.*
2. *Use a short temporary title while actually writing the paper. You can decide on the exact title later.*
3. *Make decisions on authorship early. Remember authorship means taking responsibility for all of the statements in the paper, and this is not something to be taken lightly if you wish to make a career in science.*
4. *The Abstract should be brief but complete. Use subheadings (Background, Objective, Subjects, Methods, Outcome measures, Main findings, Significance etc.) to help with the structure even if this is not required by the journal*.
5. *Provide Key Words and Running Title*

SECTION 3. THE INTRODUCTION

The purpose of the introduction is to explain to the reader why you did the research investigation at all. It is very important in the Introduction to show where there is a gap in our current knowledge, and how the study you have done addresses this problem. The research question must be very clear to any of the readers of the article, and the question should be based upon existing knowledge, data, and reports using appropriate references. Point out where there are gaps in our knowledge or where there are conflicting results that need to be resolved. Make clear why this topic is worth studying or why you did the study – these are the objectives of your study – and how your study adds to the body of knowledge that is available. For publications in international journals it is usually not enough to just repeat a study that has been done elsewhere – unless there is a very good reason why the results of a study in Vietnam are not likely to give the same results of the same study in Tanzania. In such cases, you would need to make a very strong argument as to why these differences could be expected.

In the introduction, you do not need to make an extensive review of the literature. KISS – keep it "short and simple" – is the phrase to keep in mind. The usual number of paragraphs in the introduction in most health journals is 2 to 4 – so this is what you should be aiming for.

The introductory paragraph should set the context in which the research you describe was carried out. The opening sentence sets the context for the remainder of the paper, so it should catch the attention of the reader. Studies on a number of journals have shown that there are four main kinds of opening sentence. In more than half of all papers the first sentence can be classified as "historical, minireview, gloom & doom or new & exciting."

☞ The historical opening is one of the most common, and tells the reader the current situation in relation to past events. - "*Because of its low cost, ease of use, safety and efficacy, chloroquine has been the mainstay of treatment for malaria in Africa for many decades."*

☞ The "mini-review" is a sentence in which all of the major characteristics of a particular disease are summarised -

"*Schistosomiasis is a water snail-transmitted helminthic infection of the intestinal or urinary tract that is prevalent in many areas of the tropics and is responsible for considerable morbidity especially in children*."

☞ The "gloom and doom" is a sentence in which the size of the problem is stated – "*Food borne infections are estimated to cause 76 million illnesses, 300,000 hospitalizations and 5,000 deaths annually in the US*."

☞ The "new and interesting" is a sentence in which the emergence and spread of new pathogens may be described – *"Since the mid-1980's, concern has grown that invasive group A streptococcal infections have been increasing in number and severity."*

The historical and mini review are the most common of these in international journals, though there are some interesting variations on this pattern - the "gloom and doom" is more frequently used in the Lancet and in many of the tropical medicine journals, and as you may expect the "new and interesting" is the most frequently used opening in articles in Emerging Infectious Diseases.

Remember that it is not sufficient, in scientific literature, to state that a disease or health problem is 'very important' or is 'serious' – you need to state the magnitude of the problem in terms of numbers, population groups, geographical areas, costs, or some other measurable characteristic related to the impact of the problem. When you have given a specific number – the prevalence of an infection for example – always give a reference to the source of the data you have used.

Following the setting of your research, you should refer to ***recent*** papers that show that a problem exists. It is not very useful to give details of the historical context of a disease – who first showed that a disease was caused by a particular bacillus some hundred years ago for example is not really useful information (unless of course you are writing a paper in a science history journal). In general, with the pace of scientific progress, a paper that is more than 10 years old is no longer worth citing as a reference!

Show, step by step, what the problem, need or question was, how you approached solving or answering it, and if you like, a last sentence indicating what the outcome was. In general, every statement of fact should have a reference to support it. Most journals do not encourage the use of review articles as sources of actual data - rather go to the source of the information that is given in the review article – and this is discussed again later.

The flow of information

In writing the Introduction it is very important to have the right flow of information to show clearly how the study itself fills an important gap in scientific knowledge. This flow of information is often the most difficult part of the writing, and it is a skill that needs to be acquired by anyone who intends to make a serious career from their research. In general this flow should be:

- The background information
- The current state of knowledge
- The information that is missing, describing the gap that exists
- The research question that you want to investigate
- A brief description of how you have prepared your study to answer this question

Some examples

It may be useful to include here two examples of the ways in which this general pattern can be applied in different studies, both for field and laboratory based investigations. A study of a new technique for detecting early infections with malaria in children might flow as follows:

- Description of the prevalence and significance (morbidity and mortality data) of malaria in children in a global context (a “gloom and doom” start)
- Description of current diagnostic techniques, and the problems of using these techniques in children
- The potential for using the new technique in this situation, and why it may be an improvement over current methods or approaches,
- The need for carrying out a well designed and well controlled study in children, particularly in the context of the potential for treatment at an early pre-patent stage of infection

The last line in an Introduction for this kind of study could then easily be something like - "*In order to evaluate the technique in children, and the impact of early diagnosis and treatment on childhood morbidity, we compared the new technique with standard methods in communities living in area of endemic malaria*

in the highlands of Viet Nam." This then flows directly into the Methods section.

In many studies the data are often from a localised source of patients, rather than a broad representation of the community. In these situations, the flow should also be from the broader context of the problem to the specific context of the study. Again using the general format given above, the Introduction to a paper on pneumococcal antibiotic susceptibility in Harare might be:

- Statement that Respiratory Tract Infections (RTI) are prevalent diseases in developing countries, with many different causes and with varying impact (a "minireview" start).
- Data on the incidence of RTI in Zimbabwe and in Harare.
- Evidence that pneumococci are common aetiologic agents in RTI, and that antibiotic therapy is important for management.
- Preliminary data indicating that resistance to commonly used antibiotics is emerging, and the need to monitor susceptibility to these and to test alternative antibiotics.

In both of these examples, the reader is carried from the general context of the disease under study to the specific research question that was investigated in the study. For publication in international journals, the paper must also be interesting for the potential readers of the journal, and so the wider context of the research may need to be stated. While this context may be included briefly in the Introduction ("*This may have implications for the control of pneumonia in resource-poor countries with a limited number of available antibiotics*" could be a useful last line in the last example), the right place for this is usually in Discussion.

The research plan

Part of getting the right flow may be to set out clearly the possible explanations for a past observation, and then show how your study has been designed in order to more easily determine which is correct. For example, data may show that is some countries in S.E Asia, the HIV prevalence in sex workers is very high and there may be two possible explanations for this. The first is the obvious one of risky sexual behaviour, leading to sexual transmission of HIV from their clients. But people who are intravenous drug users (IVDU) may become sex workers in order to finance the costs of their drugs, and so they are also potentially at increased risk of

intravenous transmission. A well-designed behavioural change study (developing other sources of income for IVDU for example) and/or a well planned intervention study (supply of clean needles to HIV negative IVDU sex workers for example) could help to differentiate the relative risk of these two forms of transmission in this context. The introduction should then follow the flow of this argument – that if the latter were true (drug-taking behaviour were more important), then changing sexual behaviour would not impact on HIV transmission, and vice-versa. The reason for designing the study in this way is then clear to the potential readers.

This is not the forum for a description of the various different study designs and their uses, but the thing to remember is that your design has to answer a new research question, not one that has been answered before. In a good article both the description of the design and the reason for choosing that particular design are clear to the reader. This is one area where advice from a colleague, someone who was not involved in the study, may be useful in letting you know whether you have achieved this kind of clarity.

INTRODUCTION

Key points

1. *KISS – keep it short and simple*
2. *The introduction must follow a logical progression – for example from the background, to the current state of knowledge, to the information that is not known and the research question, to how your study design will answer that question.*
3. *The flow should also be from a global perspective, narrowing down to the specific study you have carried out*
4. *Get advice from colleagues about whether your description of the study design is clear.*

SECTION 4. THE MATERIALS AND METHODS

As noted above, this is often the best place to start writing your paper because you know what you did and how the study was carried out. Just like every other section, the Materials and Methods must have a logical structure so that the reader is quite clear how the study was completed without having to refer back to previous parts of the paper. This section is often quite lengthy, and in some journals the "Methods" section is printed in a smaller font size than the rest of an article. The usual number of paragraphs in Materials and Methods in health journals is 6 to 8, and subheadings are often used in these journals. This does not mean you have to have the same, but it gives perhaps some indication of how long this section might be.

An important point is that you are presenting surveys or experiments that you carried out some time before you began writing about them. This section is, therefore, conventionally written in the ***past*** tense. It is also usual to write Materials & Methods in the ***passive*** rather than active case. For example:

"The smears were stained with Giemsa and examined for malaria parasites"

rather than:

"We stained the slides with Giemsa and then we examined them for malaria parasites".

There are three reasons for this:

- You tell what was done and what was found, and that was done some time ago, and so it is in the past.
- Although the research was done by you, it could have been done by anyone and if it were done in an identical manner it would have achieved the same results. So the fact that you are the one that did it is not important.
- Most papers now have multiple authors, and not all of them did the same thing. So to say 'We stained the slides …' is not strictly correct – "we ordered slides to be stained by a technician" is probably closer to the truth

But it is much easier to say it in the past tense and the passive case, and then it doesn't matter who actually did it. There are a few journals that go against this convention. The Editor of the British Medical Journal, for example, has argued that the passive tense is overused, and prefers the active "*We analysed 1069 fine need biopsies…*" as being more acceptable English than the passive " *Results of 1069 fine needle biopsies were analysed ….*" A number of other English journals, the Lancet for example, also frequently use the active case ("We …") in the methods. Amongst American journals, the great majority use the passive case, with one important exception being the New England Journal of Medicine where about 30% of papers use "We…".

There are some situations in which particular authors may be identified as the ones who carried out specific examinations or tests. One example may be where only one or two members of a research team were responsible for a clinical opinion on a group of patients. In an article it is usual to show this by giving the initials of the authors concerned. An example might be:

"The X-rays were evaluated independently by two radiologists (PW and PM) and the final diagnosis was determined on the basis of their findings."

Structure

If people were involved in the research, as patients providing samples, etc. then strictly speaking, you should call this section "Patients, Materials and Methods" – people are not materials and so could be mentioned separately. In community and behavioural studies however, the participants are usually not patients, because they are not ill. They could be described as "Participants" – we do not usually use the word "subjects" now, because that implies they were subordinate to the researcher. In practice however, most journals regard the study subjects as part of the materials, and "Materials and Methods" is the usual title for the section.

When writing about people, be consistent how you describe them. Decide beforehand whether they are going to "men and women" or "males and females" and use these terms consistently throughout the article, including the tables. There are no hard and fast rules, but our preference is for men and women for adults. The terms "boys and girls" sounds, however, too informal and you may prefer "male and female children."

When you write the methods, tell what you did as closely as possible in the order you did it. This makes it much easier for a reader to follow the methods you used. So, for example, in a study

of antibiotic sensitivity of invasive *Salmonella* infection the flow of the methods would be paragraphs starting with:

- The study was done on patients admitted to hospital with symptoms of…..
- Blood cultures were collected by ……
- The culture bottles were transported to the laboratory and incubated …….
- *Salmonella* species were identified by ……
- Antibiotic sensitivities were determined by …..

This flows in a logical time sequence from the presentation of the patient at the health centre through to the final observation on antibiotic sensitivity. This is, however, not always easy as sometimes different investigations go on simultaneously. In some cases, especially where the criteria for selecting particular people for specific study are complex, a diagram of the procedure may be useful. Most journals will accept a flow chart where it can be demonstrated to be necessary. This is one of those areas where the advice of colleagues who were not involved in the research can be solicited. If they can understand the way you describe your methods, then that indicates that other readers will also be able to follow your description. Of course if they have difficulty in following the methods, then your description may not be sufficiently clear and you will need to re-write it.

You may find it easier, in draft stages, to use sub-headings such as study design, patient selection, sample collection, sample processing, data storage and analysis etc. In the final draft the sub-headings can be removed if the journal does not use them, but the flow of information will be more logical and easy to follow.

Study design

In describing the design of the study, the reasons for the design will have been described in the Introduction, and the actual design must take account of that. There are a number of specific items that must be included where appropriate:

- The planned study population, including control groups
- The sample size and selection (with a brief description of inclusion and exclusion criteria)
- The outcome measures and methods to measure and record them

- The planned interventions and implementation
- A brief description of the methods of statistical analysis

The description of the study design should show how control groups or samples were selected and/or treated so that it can clearly be seen how they act as controls. Remember that control groups are intended to help you to eliminate alternative explanations for any effects that you observe in your study or experiment. You must show that the controls serve that purpose.

Sample/data collection

Describe why you chose certain study sites. It is very common for authors to name the villages, hamlets or communes where specimens were collected, but you must ask whether this is important, or whether it is the conditions in the village – poor economic status, proximity to water, use of bed nets by inhabitants etc. – that are more important than its name. Remember the name means something to you, the researcher, but if you are intending this article to be read internationally the name of the village is of no value at all, because the readers will know nothing about it. Rather describe the study sites in terms of their characteristic feature, then everyone can understand why those sites were chosen.

Also remember that using the name of a village may in fact be unethical. For example would you want it publicised in an international journal that the village in which you live has an HIV seroprevalence of over 50%?

In most studies there is some form of selection of participants or samples used rather than attempting to enrol all of the people living in a study area, or all of the specimens collected within a time period. Describe the selection procedure but be careful of using phrases such as “a random sample” – this has a precise meaning in epidemiology, and the method of randomization would need to be described. In many cases, selection is not truly random but is by “convenience sampling” – taking the samples coming to the laboratory, or the patients coming to a clinic by a particular time each day for example. This is a perfectly acceptable form of sampling, but it is not strictly a random sample – you could be selecting only those who lived close to the clinic and so could get there in the morning, and excluding those who lived further away and so could only get to the clinic by the afternoon.

Techniques

Remember that the purpose of the Methods section is to let readers know exactly how the study was carried out, so that if desirable it could be repeated. In describing the methods you used, there must be a balance between too much detail and too little. If you are reporting a completely new technique, this must be described in such a way that others can follow that technique as well, and so some detail is necessary. In most cases, though, other researchers may have described, in previous articles, the methods that you have used in your research. If this is the case, there is no need for you to describe these methods again. It is quite adequate to give the reference that does describe the method in detail. For example, "*Organisms were identified by the method of Wright et al., 1990*".

In deciding what to include in the text, and what to leave out, ask yourself:

- Is the average reader who is likely to want to do this work already familiar with these procedures? If so they do not need to be described.
- Can this procedure be readily referenced? If so, mention only briefly what you did, tell the reference and state any modifications you made when doing it.

It may be difficult to make this decision. A basic rule is, if it is in a general textbook then the method should be known to all those reading the article and needs neither description nor reference. If the technique is new, and described only in research journals then it needs a reference but need not be described. If it is a modification, however, both the reference for the original method and a description of the modifications you made are needed.

Be very careful when using abbreviations, make sure you know what they mean – the last letter in ELISA, for example, stands for 'assay', so 'ELISA test' is an unnecessary duplication. Also please remember that the purpose of an acronym, ELISA for example, is to avoid having to repeat the full name later on in the article. So the full name is given when it is first written followed by the acronym in brackets. Thereafter make sure that you use the acronym each and every time. Do not use an acronym if it is not necessary – its purpose is only to save space when it is used repeatedly so if it used only once it is not needed.

There is also the convention about the names of organisms. In health journals it is sufficient to use genus and species though in some specialist journals a more exact scientific description may be necessary. The first time the organism is named, both genus and species are given in italics (*Neisseria gonorrhoeae*) but subsequently, the genus needs to be referred to by the capital letter only, followed by a full stop and then the species name, all still in italics (*N. gonorrhoeae*). Especially with infections take care with spelling of diseases ("gonorrhoea") and organisms ("*N.gonorrhoeae*").

You should mention materials as you use them in the methods. Avoid trade names; use the chemical or generic name so that people in all countries can understand what you mean. If you are using a particular kit, or special reagent the source (Company name and country is usually enough) should be given the first time you describe it – 'HIV antibodies were detected by an EIA dipstick (ICL, Thailand)' for example. This may be important in establishing the reliability of your study – if you used a restriction enzyme from an unknown company, there would need to be some information on the reliability of the enzyme. If you think you should mention the actual trade name, put it in inverted commas and then in brackets state the chemical or scientific name at the first mention. If there are a lot of materials from different sources, primers for PCR or different restriction enzymes for example, these can be put in the form of a table.

Ethical review

Ethical review is now required for any research study involving humans or vertebrate animals, and many journals will refuse to accept articles from studies using human or animal subjects unless ethical approval was obtained. The need for ethical review may not be fully appreciated in some developing countries, but it is an essential aspect of all international research. So if you want to take part in international research make sure you have access to an ethical review board. Usually the ethical approval is included as a short sentence in the Methods, often after the paragraph describing patient or participant selection. It is sufficient to state something like "*Approval for this study was given by the Institutional Review Board of the BRTI and all participants gave voluntary informed consent for inclusion in the study*" or something similar.

MATERIALS & METHODS

Key points

1. *There must be a logical flow of the procedures that were followed – from selection of subjects through to final tests*
2. *Use sub-headings to follow the logical flow, they can be removed later but the structure remains.*
3. *Give adequate detail in techniques so that others can repeat your experiment or study*
4. *Make sure you have Ethical Clearance, and state this in the Methods section*.

SECTION 5. THE RESULTS

The purpose of this section is to report what you found, letting the data speak for themselves. This section differs from most of the others, in that it contains both text and graphic material, such as figures and tables. The written text serves only to show the trend and direction of your reasoning as you proceed from the result of one step (intervention, measurement, or experiment) to the results of the next one.

Write the first draft in your own words, as if you are telling someone what you found. Worry about grammar and style later. As with the Methods section, this what you found in studies done some time ago, so it is written in the past tense, and in most journals in the passive case, though in some journals the use of the active case may be accepted - "*We enrolled 2,539 participants into the survey* ……" or "*We found the annual incidence of typhoid to be* ….".

Text

As with the Materials & Methods section, there must a logical flow in the presentation of results. So for example:

"*260 patients were seen at the clinic during the study period, and 230 of these met the entry criteria. Samples from 30 patients were not available as they refused consent, and so the data we present are based on 200 patients. H. influenzae was grown from 102 (51%) of these, and all of the isolates were tested for antimicrobial susceptibility*"

This tells you the source of the sample, and that some patients were unsuitable for study, while some patients refused to take part and the organism being investigated was isolated from just over half of the remainder. The text describing the susceptibility of these isolates then follows logically from this background.

The other main requirement of the Results section is honesty – report what you found even if it doesn't fit with a pre-existing hypothesis. You may not have to tell the whole truth – do not, for example, say "*We stained 236 slides, but the technician tripped and dropped a tray on the floor and we could not find enough pieces of 3 slides for examination*." Be more diplomatic in your description – "*Of the 236 slides that were stained, three were unsuitable for examination and so this report is based on findings in 233 slides*." The important thing is do not be tempted to pretend that all 236 slides were in fact examined, and do not try to extrapolate findings from the actual examinations to the 236 slides that were stained.

In general the results section should not include references, since you are describing what ***you*** found in ***your*** study. Any comparison with other findings belongs in Discussion. In some short articles, however, the results section also contains a brief discussion and the conclusions and references are then allowed. Make sure that the arrangement you choose fits with the journal to which you are planning to send the article.

While in most cases, the judicious use of tables, figures or diagrams is the best way to summarise the data they are not compulsory. The usual number of paragraphs in the Results section is 5-8, though it has been said that the best Results section is a single sentence:

"*The results are shown in Tables 1-3 and in Figure 1."*

While such a comment should not be taken too literally, a common concept is that

- Text describes what was found
- Tables provide the data
- Figures provide the information

If there are few data to present, it may be best described in text form only. Text uses less space and many journals limit the number of tables and figures, so you do not want to waste one on a small number of data.

A common mistake is to describe in the text the same information that is shown in a table or figure. It may be acceptable to describe in the text the highlights of the table or figure, but duplication is

something that editors dislike intensely. You may comment for example that the "*highest prevalence of HIV was in the 25-29 year olds, as shown in Table 1*". But do not state that "*the prevalence of HIV in 25-20 year olds was 27.8% compared with 17.5% in 15-19 year olds, 22.3% in 20-24 year olds and 18.2% in 30-35 year olds, as shown in Table 1*." This is unnecessary duplication of data.

The text may be used to give additional information such as p-values for significance or data that are not shown because they are similar to those in the table, or because they were negative. Be careful of using the phrase "data not shown" though it may be acceptable if the data showed no significant differences between groups, and the section is already very long.

Data presentation

As noted above, it is often useful to have the results in various different formats (raw data, tables, figures) in front of you when you are writing the results so you can decide which is the best way to present your data.

For qualitative variables, proportion, ratio and rate are appropriate ways to summarise the data. With quantitative data, the best summary depends on the distribution of the data. If they have a normal distribution the mean and standard deviation are the ways they are normally expressed, with the sample size being given as well. But when the distribution of the data is skewed either positively or negatively, it is better to use median and percentile. In some cases, the range may be used, but remember that a range only shows the highest and lowest values and does not provide information about the distribution within those limits.

The presentation of the data must be as clear as possible. Each figure or table must be understandable independently – that is without having to go back to the text. To achieve this, you must select the most appropriate way to show the data, in a table, chart or graph so that the reader can see the data and understand what it means. Tables and figures include a title and a legend, which explains the symbols and abbreviations, reports the significant differences, or shows the differences in details between groups. Make sure that the text in the legends is short but clear and that it is consistent with the text in the written section.

Tables

For each set of data, you must look for the best way to present it. Tables show complex details clearly but are boring to read, especially if they are too large. Tables are useful in providing information – lists of species of mosquitoes collected, expected amplicon sizes in PCR using different primers etc., rather than data for comparison. They are also useful for presenting large amounts of data – characteristics of populations, significant risk factors for diseases, frequencies of clinical or pathological features etc. You can use bold or italic letters to attract the attention of readers to the most important data, especially in tables that are complex.

It is relatively easy to compare data presented **within** a table, but it is difficult for the reader to make comparisons **between** tables. So if the data you want to present is comparative, the frequencies of a disease in two groups of people for example, include all of the data in one table. It is easier to see the differences between the groups in this one table than if the frequencies in one group were in one table and frequencies in the other group were in a second table. For these kinds of comparative tables it is necessary to include a p-value, OR, RR or confidence interval to show the strength of the difference between the data you are comparing.

Although the amount of data may be quite large in a table, it should have a maximum of five or six columns – more than that and the amount of information becomes too great to digest. There are different ways to do this. There is no need for example to show sample size, numbers positive and percent positive in separate columns. These can all be put into a single column in the format '25/250 (10%)'. Consider the following example of a study of toxoplasmosis in different villages in Africa. The data from the study were prepared as a table:

Table 1. Seroprevalence of toxoplasmosis in men and women in three African villages with different average numbers of cats per household in each village.

	Cats	No of Villagers			Toxoplasma test					
Village	per. house (mean)	M	F	All	Total +ve (N)	Total (%)	M +ve (N)	F +ve (N)	M +ve (%)	F +ve (%)
Gao	1.1	300	450	750	314	42.8%	186	208	62.2%	46.2%
Lumba	2.7	420	290	710	423	59.5%	263	160	62.6%	55.2%
Rugo	0.3	299	563	862	392	45.5%	188	204	62.8%	36.2%

The table is very complex, with 11 columns, and much of what is shown is not really of great significance to the study. A table this size would probably just about fit in the width of a normal journal page, but larger tables may have to be printed in "landscape" format – perhaps using up the whole page of a journal – a very expensive use of available space. The data above could have been summarised as:

"*In all 3 villages studied, the prevalence of toxoplasmosis was higher in men (range 62 – 63%) than in women (range 36 – 55%). In women, but not in men, the seroprevalence varied with the average number of cats per household, being lowest in villages with few cats (36%) and highest in villages with many cats (55%)*".

There is no loss of meaningful data, but considerable saving in space and complexity of the data presentation. Alternatively the data could be put into a much simpler table, with just 4 columns, as shown below.

Table 2. Seroprevalence of toxoplasmosis in relation to exposure to cats

		Toxoplasma positive	
Village	**Cats/house**	**Men**	**Women**
Lumba	2.7	63% (268/420)	55% (160/290)
Gao	1.1	62% (186/300	46% (208/450)
Rugo	0.3	63% (188/299)	36% (204/563)

Note that in this example, the title has been simplified – it still accurately describes what the table shows, but it highlights the reason for the study (does exposure to cats increase the risk of toxoplasmosis?), using much less space. The villages have been put into the order of the number of cats per house, rather than the alphabetical order of Table 1 – this allows comparisons between villages easier (though we may not even need to know the village name). The percentages rather than absolute numbers have been given prominence, since it is the percentages that are used to compare rates of infection in men and women in the different villages. The message of the table is clear – in men there is no relationship with exposure, in women there appears to be a direct relationship. Remember that the purpose of the table is get information across to the reader – so design the table in a way that does this most clearly.

In the table you may want to show which of the data are statistically significant. This can be done in several ways - by including a column to show the actual p-value for example, or by adding an asterisk to those data that have a p-value <0.05 with a footnote to explain this.

A brief word about percentages – a percentage is an ***approximate estimate*** of what you would expect to find if your sample size were 100. To give decimal points to a percentage gives a false sense of accuracy to what is by definition an approximation. Furthermore, in most situations the percentage is used in relation to discrete objects – 28% of men, 30% of cats, 22% of samples etc. There is no such thing as a decimal point of a person, an animal or a specimen and the use of the decimal point is inappropriate. The figure ’48.23%’ is no more accurate than ‘48%’ and there is no such thing as 0.23% of a person, so use 48%. The sample size would have to be enormous for a difference between groups of less than 1% to be significant, and so the decimal figures add nothing to getting information across. When the prevalence is very low, this is best shown as <1%, and if absolutely necessary to use an actual figure, it should be expressed as “3/1000’ rather than “0.3%”.

While the number of columns in a table must be limited, there is not such a problem with rows. The average number of columns per table in international health journals is 4-6, but many of these tables have 15 rows or more. Note that most journals do not use vertical lines in tables, so in general prepare your table using horizontal lines only, as shown above in Table 3. Check with the “Instructions to Authors” of the journal you intend to submit the article to for any restrictions on the number of tables to use, the size of the tables and the format required for submission. The number of tables varies greatly from journal to journal, but be wary of putting too many tables into your paper. Three would be the usual number so always consider whether more tables are strictly necessary, or could the data be presented in text form instead.

Choosing between tables and figures can be difficult, but in general, if a table has more than 6 columns there is too much information and the data should either be condensed, or be shown as a figure. If there is need for comparison of data, it is more difficult to compare data in two Tables, than to compare data in two Figures. So if the purpose is to make a comparison of data, use figures rather than tables.

Figures and graphs

Figures and graphs can show information such as differences between treatment groups or changes over time much more clearly than tables. It may then be much easier to recognise these differences or changes at a glance without having to wade through large sets of numbers in a table. Figures and graphs, like tables, must be clear without having to refer to the text. The titles given to bars, the X (horizontal) and Y (vertical) axes, and lines must be carefully thought out to ensure this is the case.

Many spreadsheet and word processing programmes include the ability to draw simple figures and graphs, and these are easy to use with a bit of practice. Anyone who intends to follow research as a career should acquire these skills as soon as possible. Remember, though, that these programmes were often written for accountants rather than research scientists, so many of the functions are of little value to you. Colour in charts and graphs looks good on a slide presentation, but journals do not print in colour (except online journals) and so this function is of no value, so choose shading carefully to make sure the figure is clear when it is printed in black and white. As with tables, limit the amount of information that is presented in each figure to what is necessary.

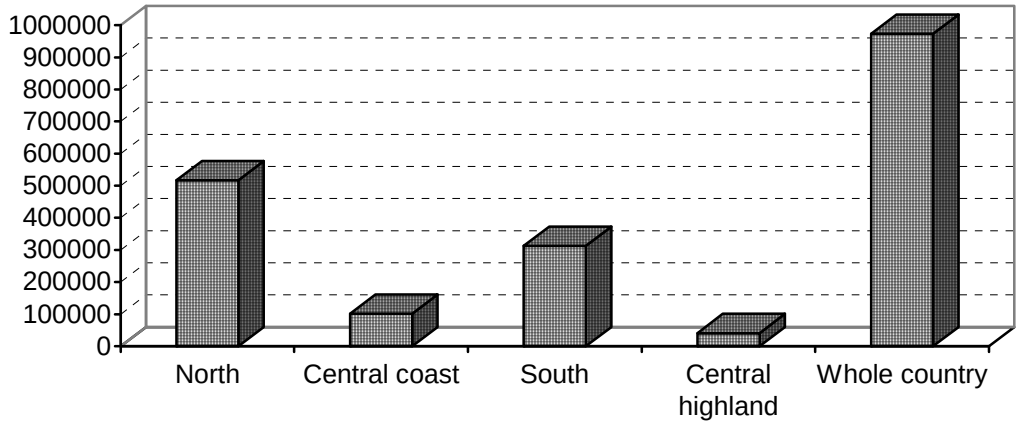
Each table and figure should be submitted on a separate page, with a Title (table) or Legend (figure) that clearly and accurately describes the content. Make sure that the figures you submit are printed clearly and cleanly. Below, we show the most common kinds of figures.

Bar charts

This kind of chart is perhaps the one most often used to present data. The bar cart is used to show the frequency or the proportion for different named (nominal) or numerical (ordinal) variables in order to visualize differences between them. There are two kinds of variable that are commonly used in bar charts, continuous and discontinuous, Discontinuous variables are usually nominal and include variables such as geographic location, occupation or different species of parasites. Continuous variables such as age, weight or blood pressure are ordinal and can usually be presented more clearly as a histogram.

As with tables, it is very important to think about what is the purpose of the figure – what is it supposed to show. In the example below, Figure 1, the numbers of cases of diarrhoea in different regions of Vietnam are shown. While the data could have been presented as a Table, the dramatic differences in the occurrence of diarrhoea in different regions are very clear.

Figure 1: Annual numbers of cases of diarrhoea in four regions of Vietnam



*

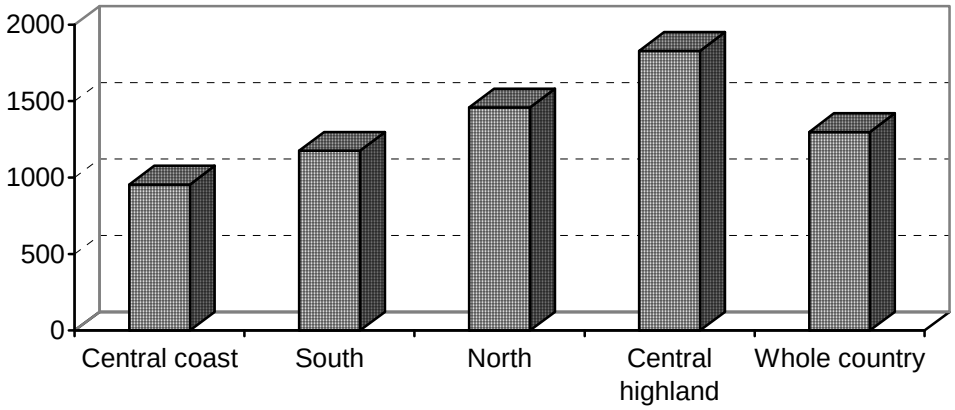
This example shows the total numbers of cases within a specific one year time period. One bar shows the whole country, and the other bars show the regions. This enables easy comparison of differences between the regions and also comparison of the contribution each region makes to the whole. From this chart we can see easily that most of the diarrhoea cases occurred in the North and South and we are led to believe that diarrhoea is not a big problem in the Central coast or highland.

It is often more useful, however, to show not just the total number of cases but the frequency of diarrhoea in relation to the population size of the region. The data have been transformed to show this in Figure 2 This figure shows a totally different situation, where the frequency of occurrence of diarrhoea is highest in the Central highlands, the region with lowest actual number of cases but also the lowest population.

There are advantages and disadvantages in using each of these two kinds of presentation, and which is better depends on what the data are going to be used for. If there is need to see how many cases of diarrhoea there are likely to be in a particular region, to

plan ordering medicine for example, then the first way of showing the data would be more useful. But if the need is to compare the risk of disease in different regions, then the second is more appropriate. The best way to present the data depends not only on the type of data, but also on the message you want to get across to the reader.

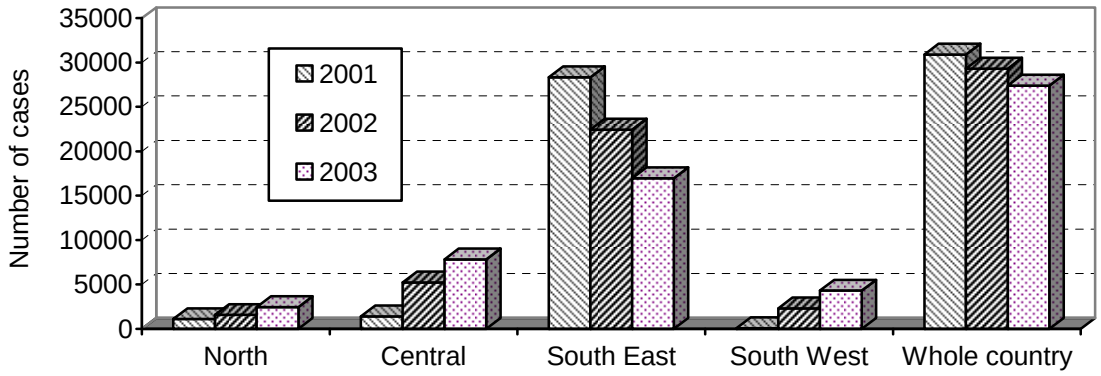
Figure 2: Frequency of diarrhoea per 100,000 population in Vietnam



Remember that with bar charts using nominal columns, the columns are discrete from each other and do not form a continuum. It is wrong, therefore, to try and join them by drawing a line through the centre of the highest point on each column. There are situations where a polygon can be constructed from the chart, but only in situations where the columns are ordinal and form a continuum – years in a surveillance program for example. This is discussed later.

Bar charts are also useful in comparing the situation in different years, showing trends in emergence of disease, or in disease control for example. This is shown in Figure 3

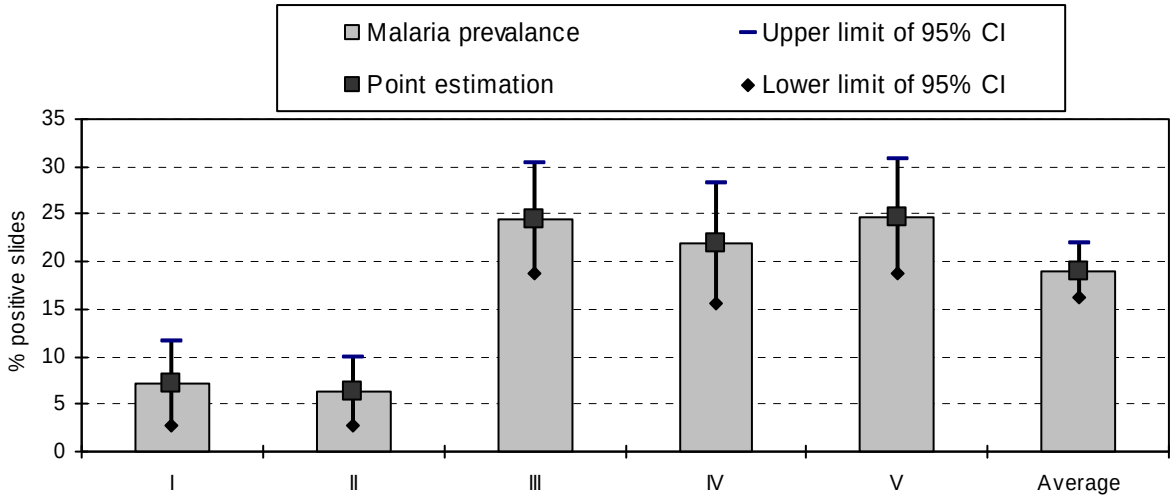
Figure 3: Trends in cases of communicable disease over a 3-year period



It is very clear in Figure 3 that the decreasing number of cases of infectious disease in the southeast of the country contrasts with the situation in all other areas, but has a major impact on the country as a whole.

Details can easily be added to bar charts to show confidence intervals of measurement points for example, and this may be useful in showing whether differences are statistically significant. In the example below (Figure 4) the frequency of positive slides of malaria in different geographic locations is shown, and it is clear that some rainfall regions have significantly higher occurrence of malaria than do others.

Figure 4: Point and interval estimation of malaria prevalence in different rainfall regions (I-V) in Zimbabwe



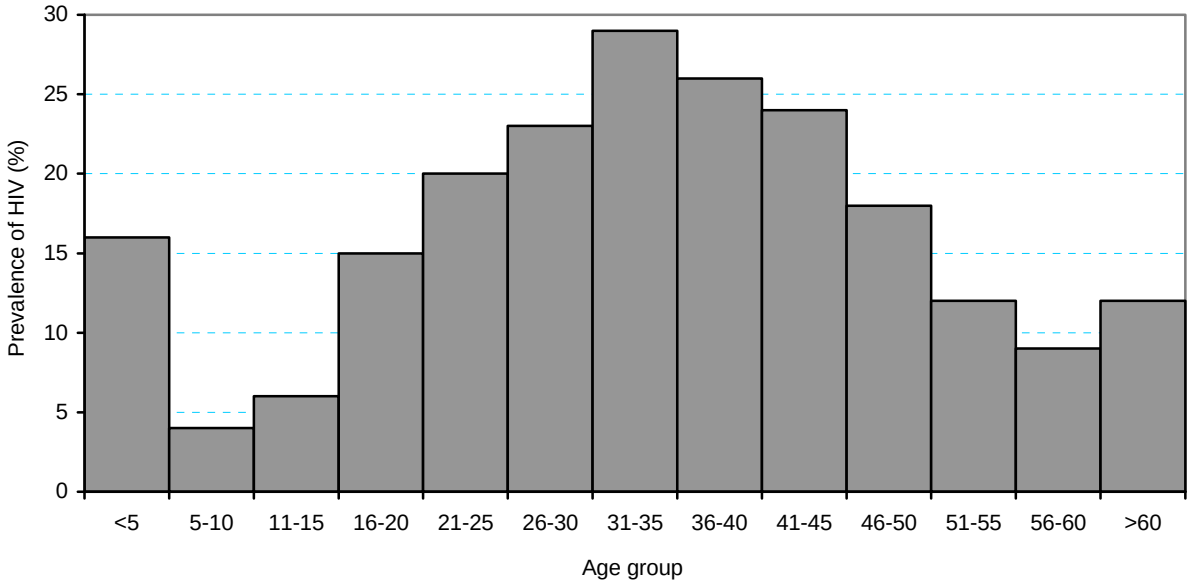
get the information across to the reader. So do not complicate the diagram by, for example, adding the actual data as numbers on the top of the bar. Only rarely is this useful.

Bar charts, then, are simple to construct, and can clearly show differences and short-term trends. They are less useful, though, when there are many data points in a figure. If a bar chart includes more than a total of 15 bars (see example 3 above), it is probably becoming too complicated, and should either be divided into two separate figures, or presented as a graph rather than a bar chart.

Histograms & polygons

The ***histogram*** is used to present data on the frequency of events (infections, diseases, pregnancies, cardiac arrests etc.) from categories that are grouped from a continuous variable, like age or blood pressure measurements. In the most common kind of histogram, the width for each group is equal, indicating that each bar represents a specific group – a 5 year age group for example. The height of the bar is then related to the frequency of the disease or condition. In Figure 5, the relationship between age and risk for being HIV seropositive is shown, demonstrating the high prevalence of infection in the 24-45 year age groups. Remember that in the text of the Results you can point out the most important trends, but do not repeat the data that are shown in the chart.

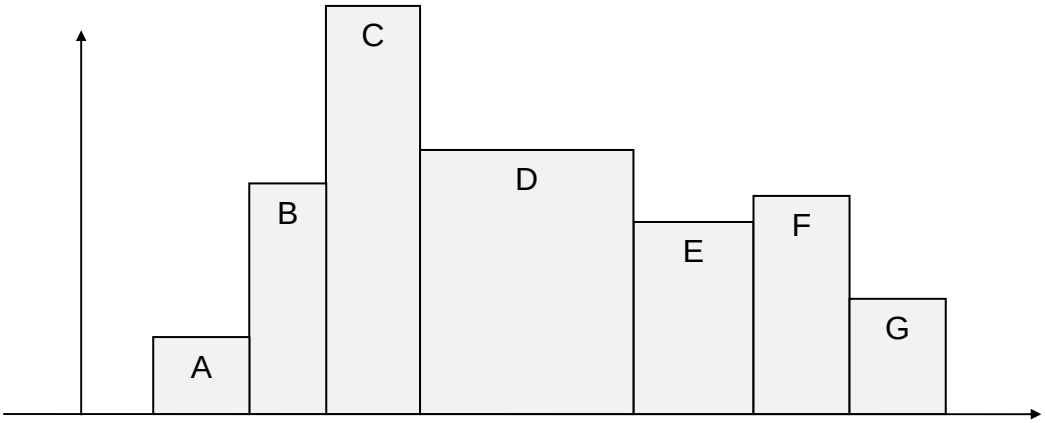
Figure 5: Prevalence of HIV positive blood samples according to age



In some situations, however, the range within each bar is not equal, because each bar represents a discontinuous variable. For studies on tooth decay for example, it is better to compare groups according to types of teeth and habits of tooth care rather than actual age. The age of study subjects can be divided, for example, into four groups: milk tooth (<6 years old), school age (6-15 years), teenage and young adults (16-35 years) and middle age/elderly. The first group has milk teeth, and the other groups, though all having adult teeth, show different standards of dental hygiene. With this kind of classification, the width of each age group is not the same, and the frequency of dental disease within each group is obtained from the area of the columns rather than from their height.. In Figure 6 for example while column C is the highest, the

area of column D is greater and so this represents the highest frequency of the condition under study.

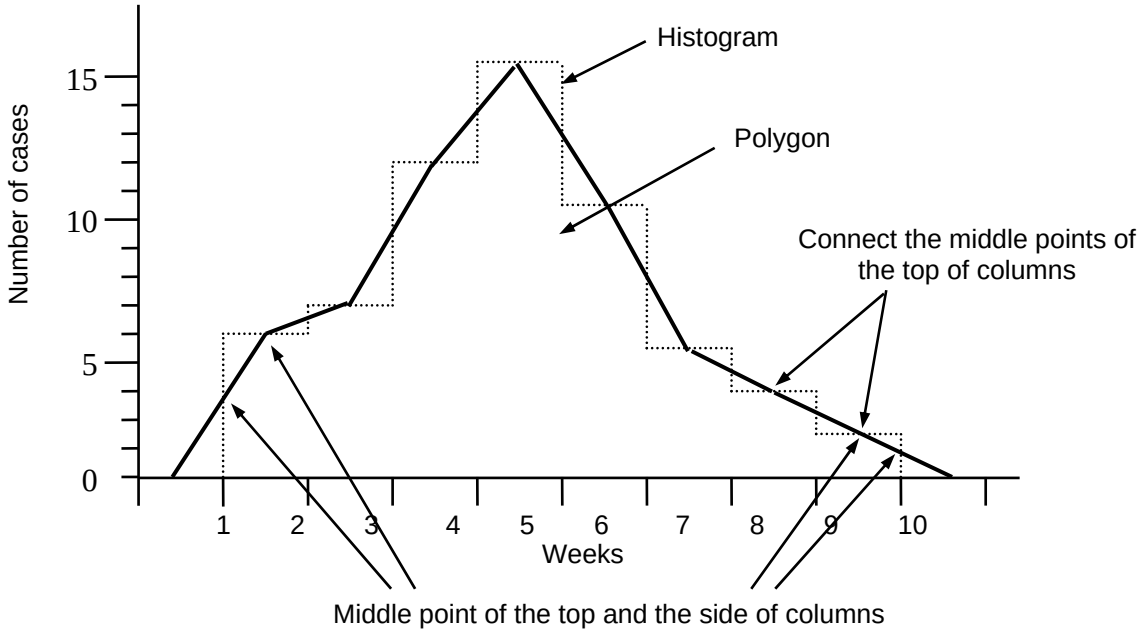
Figure 6: Histogram with variable intervals



A ***polygon*** is a mathematical figure that is characterized by being bound on every side by connected straight lines. In some cases it is the most striking way of showing trends, particularly trends over time. It is constructed from a histogram by connecting the middle points of the top of each column to give a sequence of straight lines instead of the columns themselves. To be complete the polygon must meet the X-axis, so that the figure is bound on every side. While it is easy to connect the middle points of columns in the centre of the chart, there is a problem with the first and last column because there is no other column to use for drawing the line. In this case, it is usual to connect the middle points of the top of columns with the middle points of the outer side of the outer column and then extend the line to the X axis..

The example below in Figure 7 shows both the original histogram of variation in the time required to detect colonies of mycobacteria in culture and the polygon that is constructed from it. Each culture tube was examined weekly, and the columns in the histogram of course represent the total numbers of positive cultures within each week, rather than the numbers of cases at a specific time point. The polygon is then a more representative visual demonstration of the data. There are both minimal culture periods, since tubes are examined only after the first week, and maximal culture periods since if the was no growth after 9 weeks the cultures were regarded as negative and so the extension of the data to the X-axis is a valid assumption.

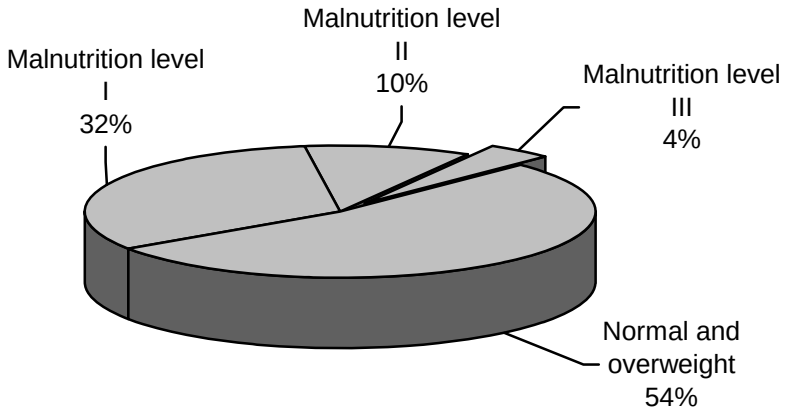
Figure 7: *Time to detection of mycobacteria on solid media*



Other charts

Where the relative proportions of several categories that added together make up 100% of a sample is to be shown, the **pie-chart** (Figure 8) may be used to show the proportions graphically

Figure 8: Nutritional status of children under 5 in one rural village in Laos



Note that for a pie-chart, the relative proportions of only a single measure – nutritional status, species of malaria parasite, type of leprosy etc. – can be presented. These charts are useful in showing such things as the relative importance of different agents as causes of disease, or different stages of a condition because

the relative roles can be seen clearly. Note that when giving percentage figures in pie-charts, do not use decimal points, because the purpose is to give an overall picture, rather than precision. This kind of chart does not convey much information, and so is not often used except in electronic journals where space is not a limiting factor.

When the purpose of the figure is to make a comparison of the relative contribution within each of several different categories, the **stacked bar chart** is more appropriate (Figure 9). This is like a multiple set of pie charts, combined into one bar chart, so that comparisons are possible between categories and also within categories at the same time. So if, using the example above, we had pie charts from several different villages we could compare them using a stacked bar chart.

Figure 9: Nutritional status of children under 5 in four African villages

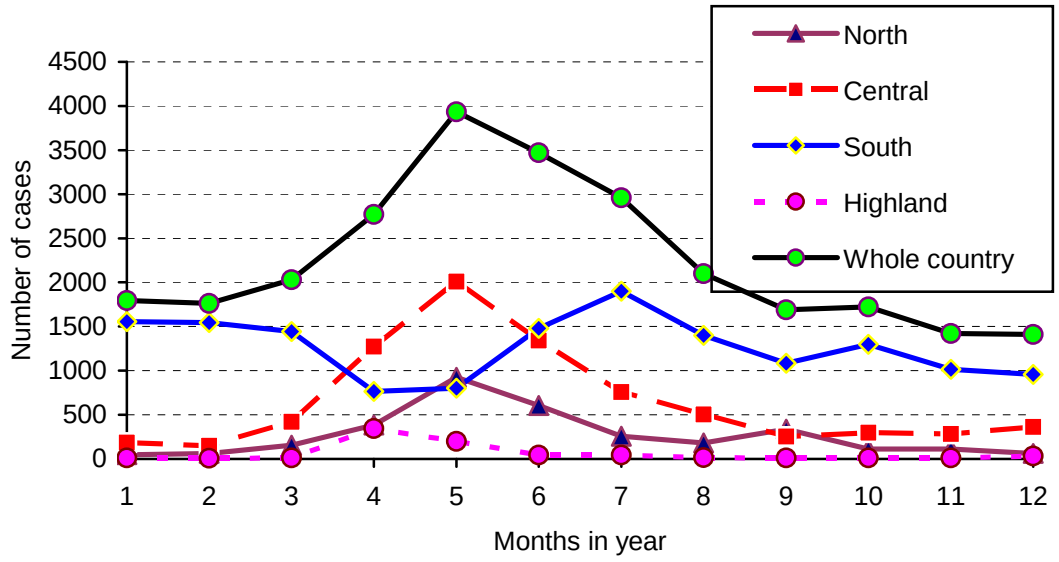
While the data in Figure 9 could have been presented as a bar chart with different variables, similar to that shown in Figure 3, the visual impact may be greater using the stacked bar chart particularly as we have 16 different variables to show.. The chart shows clearly the reduction in numbers of children with normal nutritional status that is mirrored by the increasing numbers of children with severe malnutrition while the numbers of intermediate levels of nutrition does not change very much.

Sometimes a stacked bar chart uses data such as household water sources or sources of health information. Because one family may have more than one source of water or each person in a household may receive health information from different channels, then the total may be >100%

Line graphs

When there are multiple data points, bar charts, even when stacked, become too large and complex and the data can no longer be clearly presented in this form. Trends or changes over time or other factors, such as concentration, temperature etc., can be more clearly shown as a linear graph. In the data presented below, (Figure 10) there are 12 monthly data points showing typhoid incidence from each of 5 sites, making a total of 60 data points – clearly too many to present as a bar chart.

Figure 10: *Annual distribution of cases of positive blood cultures in Cote d'Ivoire in 2001*



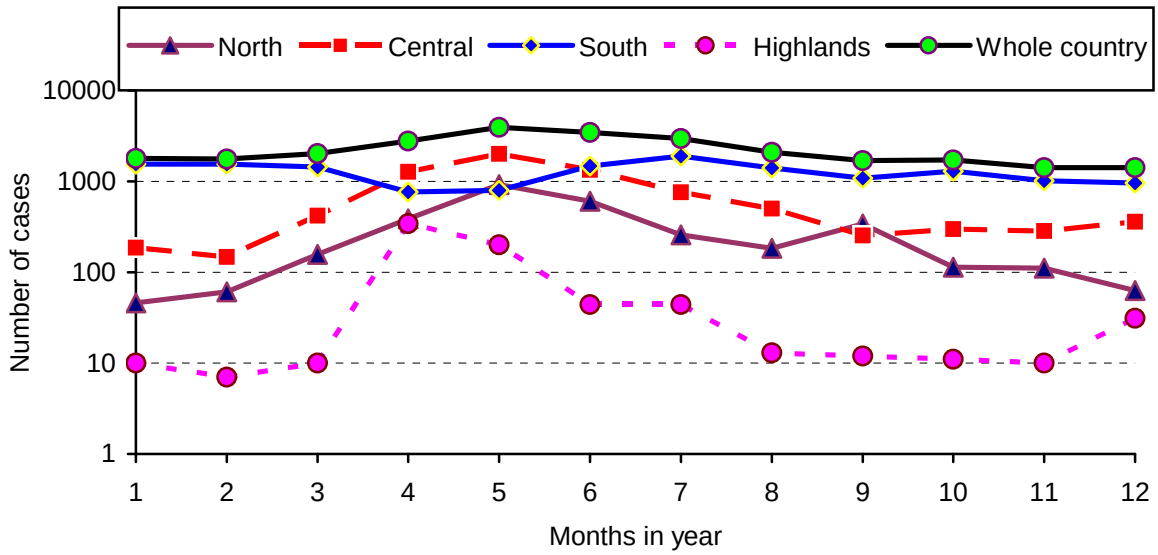
Conventionally a graph has the independent variable on the horizontal (X) axis, and the dependent variable on the vertical (Y) axis. In the example above, the number of cases of typhoid depends on the month of the year and so the number of cases is put on the vertical axis.

In this particular figure the vertical scale is arithmetic and so the pattern in regions with small numbers of cases is not clear. The peak of cases in the Highland for example is earlier than in other

regions, but the number of cases is so small that are hardly noticeable. One way to solve this problem is to use a logarithmic scale for the vertical axis . Low numbers then become more prominent, and the pattern of their distribution is not lost in the larger picture. The disadvantage of this technique of transforming the data, is that the size of the changes in the areas with higher numbers becomes less dramatic, and with large numbers the trends may become less readily visible, and this shown clearly in Figure 11 below, where the same data are used but a logarithmic scale is used on the vertical axis. A balance between the two objectives, to enhance low values without masking high values, has to be maintained.

The other alternative would be to present the data from the Highland region as a separate graph, but this would not allow comparison with the other regions.

Figure 11: Annual distribution of cases of positive blood cultures in Cote d'Ivoire in 2001



Sometimes, additional information can be added to a line graph to show specific factors affecting the pattern that is shown. Changes in the occurrence of a disease or condition may occur in response to a specific event. The introduction of a vaccination programme or the occurrence of an El Nino year may have a marked and sudden impact on disease prevalence. This can be shown graphically by marking the year in which the event occurred, so that the prevalence before the event can be contrasted with the prevalence

after the event. The number of such events on a single graph must be small, or the information becomes too complex for recognition.

Figure 12: Impact of vaccination on prevalence of measles in USA

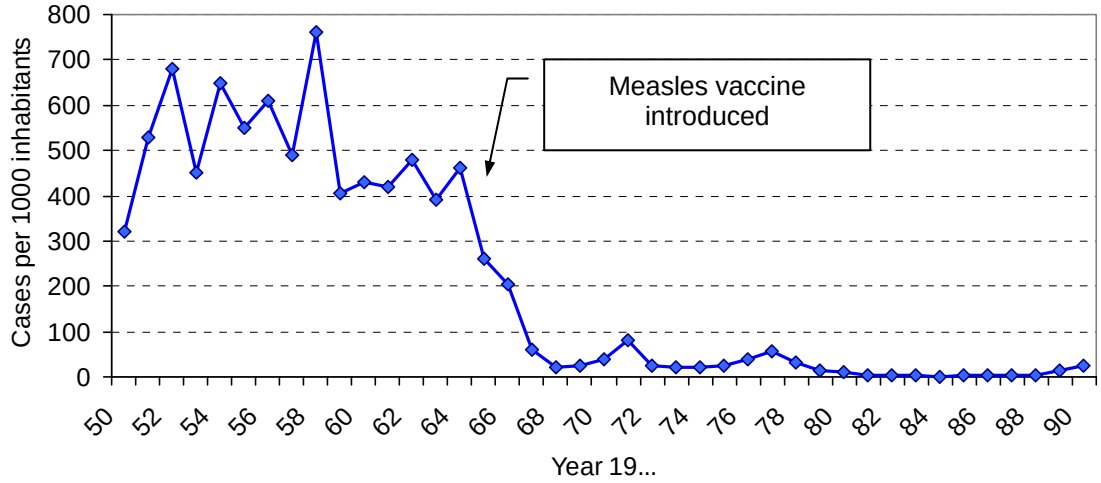
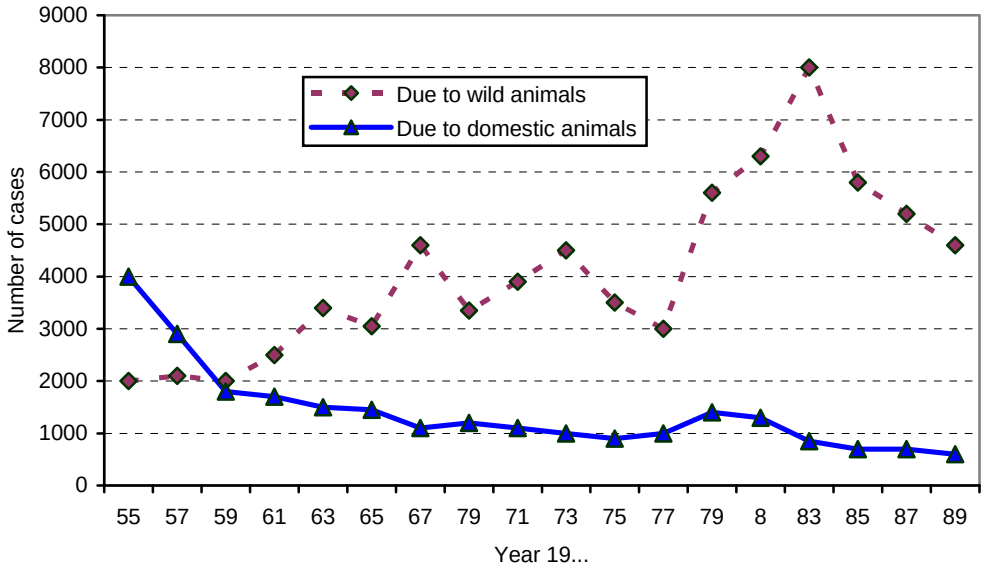


Figure 12 above shows very clearly that a single event – the introduction of measles vaccine – was associated with a very rapid and sustained decline in the incidence of measles cases. Note that in this particular example, it took a few years for the vaccine to have maximum effect, reflecting the time taken for vaccine delivery to reach the population at risk. The graph also clearly shows years such as 1970-72, 1976-78 and 1990, when the trend was not followed and there were small increases in measles incidence. Comment on possible reasons for these anomalies would be expected in the Discussion section of this paper.

Linear graphs can be used to suggest reasons for particular events, by showing trends in two or more measurable variables. If the trends follow the same pattern this is suggestive of an association between the two variables. Note the association may not be causal, since both measurements may be influenced by a third “confounding” variable, but nevertheless the diagram can demonstrate that there is a relationship of sorts between the two. Alternatively the graph may show differences in variables, showing that the two are not linked. This is shown in the graph below (Figure 13) of the occurrence of cases of rabies in domestic and wild animals.

There are clear differences in the trends of the occurrence of the disease in the two groups of animals, suggesting that the two are not causally linked. From the data shown the number of cases of rabies in domestic animals has shown a steady decline, since the 1950's. The numbers of cases of rabies in wild animals shows much greater variability in frequency and infections in wild animals account for the majority of rabies cases. This may be important information in the development of prevention measures, since clearly these should be directed at the wild animal population to have the greatest impact.

Figure 13: Cases of rabies in wild and domestic animals

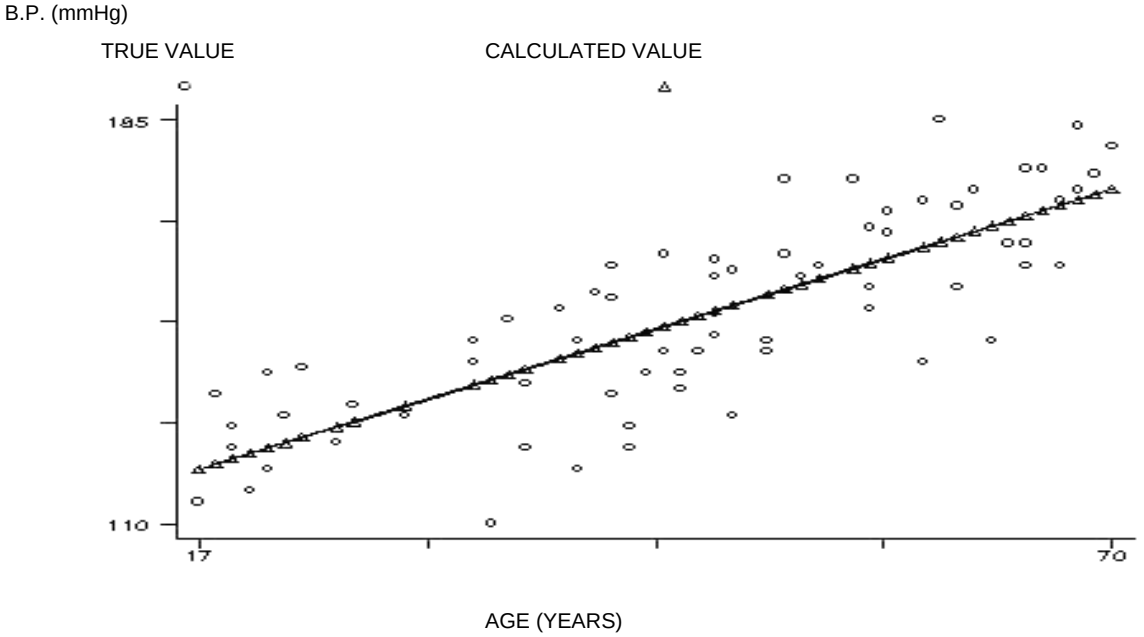


Scatter plots

In the above examples, the graph used a fixed X-axis, a time point and a variable, the number of cases of rabies. When the purpose a graph is to show the relationship between **two** quantitative variables, such that one may change in response to changes in the other, this is best shown as a scatter plot. The association may be positive (a increases as b increases) or negative (a decreases as b increases), and the strength of the association is shown by the degree of scatter of the individual plots – if they are widely scattered, the association is weak, but if they form a close pattern, the association is strong.

In Figure 14 below it is clear that there is a direct and fairly close relationship between age and blood pressure. To give a numerical value to the relationship, the correlation coefficient (r) can be calculated and included in the figure. If the association is positive, r is + and if the association is negative r is -. The strength of the association is measured on a scale of 0 to 1, so if r = +0.86 this would indicate a strong positive association between the two variables, and if r = -0.55 this would indicate a very weak negative association. In this particular case, because there is such a strong positive relationship between age and systolic blood pressure, the predicted linear regression can be calculated and included on the scatter plot. It can be seen that the actual values are mostly close to the predicted line, indicating that the association between age and systolic blood pressure in this population is a strong one.

Figure 15: Correlation between age and systolic blood pressure

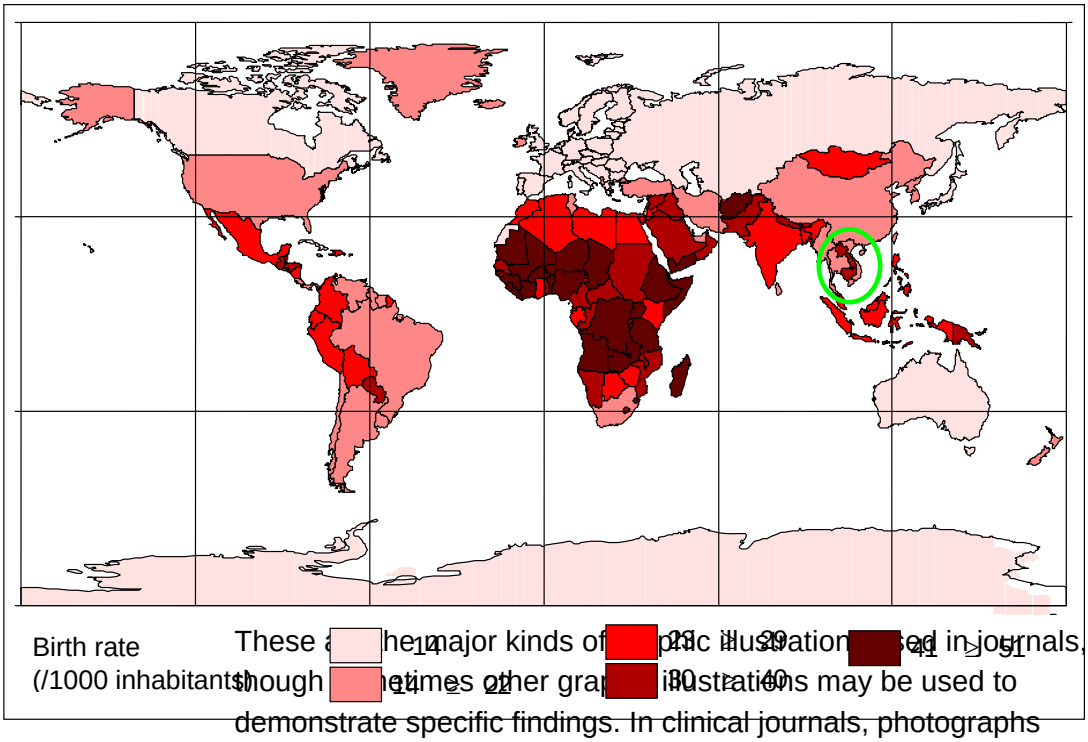


Geographic distribution

In showing the geographic distribution of diseases or conditions, maps can be used. Again, there are special computer programmes that can be used to show these kinds of maps, and any researcher who intends to publish particularly review papers should acquire the technology and learn the skills to show epidemiological data according to geographical boundaries. These maps generally use different colours or textures to distinguish prevalence rates, with the highest rates shown in darker colours, and progressively lighter colours used as rates decrease. White often used for areas where

there are no data. Often it is possible to highlight particular regions of interest to readers.

Figure 14: Global birth rates (2001)



These are the major kinds of graphic illustration used in journals, though sometimes other graphic illustrations may be used to demonstrate specific findings. In clinical journals, photographs showing particular conditions, or showing histological findings may be used. In general colour photographs are expensive to include in a journal, and you may be expected to contribute towards the costs – so only use them if you consider them to be essential.

Summary uses of different presentation methods

Type of figure	*Function/use of figure*
Bar chart	To compare frequency and proportion of nominal and ordinal variables and the mean and SD of quantitative variables. Multiple variables can be included, but numbers of bars should be limited to 15 in total.
Pie chart	To compare proportion of different categories of one qualitative variable that adds up to 100%.
Stacked bar	Combination of bar chart and pie chart, to show proportions of categories of qualitative variables in multiple sample groups.
Histogram	To show frequency of quantitative variables in samples grouped from continuous variables such as age.
Line Graph	To show the relationship between two continuous variables, one presented on the x-axis and one on the y-axis. Graphs can show lines from different samples, diseases, sexes, etc on one figure for the purpose of comparison.
Scatter Plot	To show relationship between two quantitative variables and how they change in relation to each other. A correlation coefficient can be calculated to show the type of association (+ve or –ve) and strength of relation between them (on a scale of 0 – 1).
Map	To show distribution in relation to geographical or other (climate, ecological, etc) characteristics of different locations

RESULTS

Key points

1. *Do not duplicate information in the text and in tables or figures*
2. *Limit the size of tables to a general maximum of 65 columns and 10 rows. If the table is larger than this, rather use a figure.*
3. *Do not over-embellish figures; they must be clear rather than attractive. Most journals do not use colour, so use shading in diagrams or graphs.*
4. *Each table or figure must be clear in itself, without having to refer to the text for explanation.*
5. *Tables have Titles and figures have Legends*.
6. *Use the most appropriate figure for the kind of data you want to present.*

SECTION 6. THE DISCUSSION

The purpose of this section is to analyse and to interpret your results, reported in the previous section. Do not repeat the results in detail. This section should answer the questions:

- What do you think is the meaning or significance of the results? If you asked a question in the introduction and your results answer the question, then that is the main point of your discussion.
- What are the limitations of the study, and how may this affect the conclusions reached?
- How do these results compare with others in the literature from similar or related studies?
- If there are differences or unexpected results, what are the possible explanations?
- What are the implications for future research?
- What are the conclusions that can be applied now and what must be done to apply them?

Basic structure

The discussion must be long enough to present the argument for your conclusions, but it must not so long that the reader will give up. Six to eight paragraphs should be sufficient. As with all of the other sections of an article the discussion should flow logically, and not jump from one argument to another without some connection between the paragraphs. A fairly typical sequence would be:

- A short introduction to summarise the context and purpose of the study.
- A summary of the main findings without the need for exact data, or p-values.

- A discussion of how this compares with other findings in similar studies, with some suggestions for reasons why your findings differ from previous studies if they do.
- A ***short*** description of any limitations in your study
- An indication of the potential value or significance of your findings.

The opening paragraph

The introductory paragraph should give an indication of the importance of the study itself. In about 30% of articles in international journals, the very first sentence provides the key to the whole of the discussion. As with the Introduction section, the first sentence should be designed to attract the attention of the reader, ***so be bold*** - as in the examples below:

"The absence of any recommended evidence-based method that can be used to identify cost-effective treatment for gonorrhoea has resulted in many problems in STD control."

Or:

"Characterization of biological markers for typing mycobacterial strains has greatly facilitated research into the epidemiology of tuberculosis."

Following this opening sentence, the paragraph may continue with a short section on the context of the study, and while this may be similar to the Introduction, you must use different words and phrases. Describe the way in which your study was conducted, indicating what is unique about your study and what distinguishes it from others.

Middle section

Following this opening paragraph, give a short description of the most important findings – this does not require the inclusion of actual data, but the main results can be summarised:

"*The cases seen during the study indicated a highly significant increase in the incidence of clinical infection with MSRA in our*

hospital in the last 12 months. These infections were detected in ……"

Remember to include in this section all of the important findings, it is quite a common flaw in many submissions to medical journals that a really important factor (differences in gender, site-specific variations, changes in disease patterns over time) may be shown in the data presented in Results, but there is no comment on this in the Discussion. The reviewer may make two observations, that you have failed to recognise an important feature of the results, or that you are using the "salami technique." This is using exactly the same data from the same study, in two or more publications, where one observation is highlighted in one paper and a different observation is highlighted in the other. The author gets two publications from just one body of work. These techniques are frowned on by both reviewers and editors!

You are expected to think and write critically about your own results. You should consider different possible explanations for the results you have obtained, and consider whether you can eliminate some of them in order to draw conclusions. If you have some results that do not fit with what you expected, or which you cannot explain, you must still include them in your report. These anomalies are often very interesting and others reading your paper may have ideas about how to explain them or account for them. As noted at the beginning of this handbook, this is often how progress in science is made. Compare your results with the findings of other studies, giving reasoned explanations of why there may be differences. Be kind to your peers – do not dismiss their studies as "flawed" or "erroneous" – remember they may be the ones who are assigned by the Editor to review your submission!

While other papers and authors may give you some ideas about how to develop your logical sequence, ***do not plagiarise***. Plagiarism is the taking of sentences or paragraphs from other papers and using them as if they were your own. In the world of science, this is theft and it is not treated lightly!

Finally, one of the most common mistakes is to try to build a big hypothesis on a limited amount of data, to conclude more than is justified. You may have, even should have, a hypothesis to explain your results, but you should not speculate about the data beyond what they actually tell you.

The conclusion

The last paragraph is usually the conclusion – what is the value of your finding? Again there are many typical endings, and three of the most common have been described as "Problem solved; Not proven; and More work needed."

☞ **Problem solved** indicates that the research question has been answered by the study, and the major use to which the data can be put are emphasised. Some examples of this kind of ending are:

"*This study underscores the need to implement rapid epidemiologic methods in managing tuberculosis outbreaks. We have shown that spoligotyping can be a* very *useful tool in …."*

"We have found conclusive evidence that …."

"Our findings support the rationale for the use of …."

☞ **Not proven** suggests that there are different explanations for research findings which makes it difficult to give a definitive conclusion. These different explanations should be presented, but not in too great detail.

"*The implications of our findings remain unclear. The presence of antigen in urine up to 8 days post infection, but not thereafter may indicate either decreased replication of organisms, or the formation of immune complexes not detectable in the assay used."*

"Some questions on the value of this test still remain……."

"While the present study has given evidence of this association, we cannot rule out ….."

☞ **More work needed** describes the need for more studies asking new research questions in new ways. These may be studies that are currently under development in your laboratory, or they may be suggestions for studies by others.

"*More studies are needed to improve our understanding of the epidemiology of this condition in different outpatient settings. We are currently investigating ….."*

"These findings suggest that further analyses are needed to ……"

"The only way to resolve these questions is to carry out longitudinal studies and these are planned."

While there are many other kinds of final paragraph, these may be found in 60-70% articles in, for example, tropical medicine journals and while the exact form varies, you should be able to recognise them easily. Sometimes the "Not proven" ending may be combined with the "More work needed" ending. Do not feel restricted that you must use one or the other of them. It may be that in your paper, none of them is suitable. The important thing is to provide an ending, a conclusion to the research study you have described and one that is based on the data that you have presented.

DISCUSSION

Key points

1. *There must a logical flow to the Discussion that follows the same pattern developed in other sections.*
2. *Write a bold opening paragraph, to set the context of the study, and to attract attention of the reader.*
3. *State the main findings of your study, details of actual data are not necessary. Make sure you include all of the important findings and do not use the "salami-technique."*
4. *Compare your findings with those of others, and explain why differences may have occurred. Include a comment on the limitations of your study.*
5. *Make sure that all conclusions are backed up by the evidence you have obtained from your study.*
6. *In the final paragraph, give the overall conclusion – "problem-solved, not proven or more-work-needed."*

SECTION 7. REMAINING POINTS

In the previous sections we have covered each of the major parts of a standard research paper, following the IMRAD structure. There are, of course, a number of other factors that have to be considered before a paper is submitted to a journal.

References

References usually appear in Introduction, Methods and Discussion, and this is one area that differs greatly from one journal to another. As noted later, journals are slowly becoming more standardised in the reference style they use, and many editors will now accept, for purposes of review at least, one of the standard formats and both ICMJE and WAME have given recommendations on which to use..

First of all, how to select which papers to include in the references? The point of the references is to provide a way for the reader to obtain background information that you do not give in detail in the paper. Each reference should serve this purpose – if you make a statement or refer to other work related to yours, you must give a reference. That reference should be published in a journal or book that is accessible to the reader.

You should limit the number of articles cited to the minimum that serve the purpose. Many journals have a limit on the maximum number of references that are allowed (usually 20-30) and you must not exceed this. If you are likely to reach the maximum limit, delete some less important references. Ensure that, unless absolutely necessary, references include only those articles published in journals found in most libraries, or which are abstracted in journal such as Index Medicus or Current Contents. This will enable a scientist anywhere in the world to review an article for her/himself.

You should ***never*** cite a reference that you have not read yourself – at the very least in an abstract form such as from MedLine or PubMed or some other information base. There are many famous examples of references having been used for decades in support of a theory, and then someone actually went to look at the original article and found what was actually written was quite different. Do not cite research data that is published in a review article – the person who wrote the review may have misinterpreted the data from the original publication – so go to the original article, verify the data and cite that original paper.

The references should be as recent as possible, unless they refer to an historical event, or a finding from some years ago that is still widely accepted. If all of your references are only from ten or more years ago, you cannot be sure that your question still needs answering – someone else may have done the same research in the meantime!

While you are actually writing your article, use the name and date style in the text - (Smith, 1998) – it is much easier to check that this is the correct reference later. This style, known as the Harvard style, then lists the authors in alphabetical order at the end of the paper. The Harvard style uses up a lot of space in the text, however, and most journals prefer a numbering system, with consecutive numbers in the text and a list of references in number order. This is the Vancouver style, and for the purposes of review, most journals have now agreed to accept this as the standard style for references in articles submitted to them, even though they may request a change to Harvard style if the paper is accepted.

The Vancouver style uses:

- Numbers in the text (usually in square brackets or as superscript so it is quite clear that this is a reference number and not a piece of data)
- Reference list in numerical rather than alphabetic order
- All authors names with minimal punctuation – no comma after a surname, no “and”, but with a full stop at the end of the list.
- Full title of the article followed by a full stop.
- Journal title in full and in italics, without a full stop, but followed by a space.
- Year of publication in full followed by a semi-colon

- Volume number in bold (no issue number) followed by a colon.
- First page number in full, hyphen, last page number.

Some examples

17. Mason PR, Wright EP. Writing scientific articles. *Journal of Medical Educational Technology* 1999; **23**:125-7

18. Wright EP, Mason PR, Vu TT. Recent changes in the epidemiology of leprosy in developing countries. *International Journal of Mycobacterial Epidemiology* 2000;**12**:129-46

For references to books, many journals have their own style and you should consult the instruction to Authors. Usually what is needed is:

- The name(s) of the author (s) or the editor (s)
- The title of the book
- The name of the publisher and the city where the book was published
- The year of publication

For example:
12. Annan, FJ, Gwanzura L. Parasitology in Africa. Harare. NUST University Press; 1993

If the reference is to a particular chapter in a book, or an abstract published at a conference, the reference must include:

- The name (s) of the author (s) of the chapter or article
- The title of the chapter or article
- Followed by “In ……” with the same information given above for books.

For example:
14. Wright EP, Gwanzura L, Mason PR. The impact of bacterial vaginosis on HIV transmission from men to women. In Latif AS (Editor), HIV Infection in Africa. Harare, Pelham Books; 2001.

Remember that these are only guidelines, consult the journal and follow the style they require exactly. Editors are busy people and if

you have bothered to make the references in the correct style, this may make the Editor more positive about your paper.

If you use a reference management program such as Reference Manager or Endnote, they can adapt the style according to the requirements of the journal in a consistent way – but only if you have downloaded or provided the correct reference in the first place.

Acknowledgements

This ***short*** section is the place to mention financial support from internal or external sources, as well as help that you received from people who provided materials or samples, or who carried out an important part of the study. Technical assistance should also be acknowledged where this is merited. But there has to be a limit. Secretaries, the names of drivers, and the people who prepared lunch for you – these are not normally included!

Particularly in studies carried out in specific communities, you may wish to thank the people from that community who contributed their time, perhaps physical samples or other contribution they made to the successful implementation of your study.

General points

The length of an article may be significant in determining acceptance. For most journals, the usual article is 3-4 printed pages long (equivalent to 12-15 typed pages) plus 2-3 tables and figures. If your manuscript is considerably longer than this, you may be asked to shorten it before it can be considered. Similarly if your article is much shorter than this, consider whether it is really of a standard for international publication. According to Tim Albert, who carried out a study of the structure of papers published in a selection of international journals, the magic number is “2 7 7 6” – two paragraphs in the Introduction, seven in Methods and Results, six in Discussion. It must be emphasised that it is the content of these paragraphs that is much more important – but nevertheless, knowing what the most acceptable structure is gives you some idea on how to structure your paper.

Many journals are reluctant to publish negative findings – though is a lot of criticism of this practice as discussed in the next chapter,

on publication. So a report on the "*Absence of Lyme borreliosis in Africa*" may be more suitable as a letter or a short communication. There are demands from many sources that failure to publish negative findings in clinical trials may result in information, particularly about drug-related side effects, being suppressed. The ICMJE is now considering a proposal that requires that the sponsors of clinical trials must deposit all trial-related data, negative as well as positive, in a national registry, accessible to all, as a condition of potential publication.

REMAINING POINTS

Key points

1. *Use recent, relevant references to back up important statements in Introduction, Methods and Discussion. Only use those papers you have actually seen for references, and avoid the use of review papers.*
2. *During writing use a simple reference style that it is easy to keep track of – names and years for example. For the final draft, change the style to that required by the journal or to Vancouver style.*
3. *Keep the overall length of the paper, without references, to a maximum of 15 printed pages plus 2-3 tables and figures. Remember the number "2 7 7 6"*
4. *Check the exact requirements of the journal with regards to overall length, the abstract word count, the allowed numbers of tables and figures etc.*

SECTION 8. PUBLICATION ETHICS

We have discussed previously some of the issues surrounding the ethical conduct of research, including the need to obtain ethical approval for any research involving human or animal subjects, and in the case of human subjects to specifically state that informed consent was obtained for the inclusion of human subjects in any study. In most cases, while ethical review committees can examine research proposals, they do not have resources to ensure that ethical guidelines are followed. To some extent, this task may be passed on to the editor of a journal who can consider that a research project was conducted unethically, even though ethical approval may have been obtained, and refuse to publish on these grounds. To help you with ensuring that any research you have carried out has been within international ethical guidelines consult some of the literature, such as the CIOMS Guidelines of the WHO, or the guidelines of the Nuffield Council on Bioethics – both of these guidelines are issued free of charge to researchers in developing countries.

The ethical issues that surround publication, rather than conduct, of research are issues concerned not with protecting research participants from undue harms, but are concerned more with upholding the status of scientific research as a source of reliable evidence to use in health practice – whether the evidence is used for patient care, for public health or for health planning. There are only a few countries that have the resources to monitor the conduct of scientific research – in the US for example there is the Office of Research Integrity – and so again reliance is often made on journals, their editors and their readers to fulfil this task. Because we rely so much on the personal integrity of scientists to be honest in their research work, whenever that trust is found to have been broken the consequences for that scientists may be severe.

The major ethical issues in publication are probably those of:

- authorship – deciding who is and who is not an author
- submission – the requirement to submit a paper to only one journal at a time
- plagiarism – the use of someone else's words in an article for which you claim to be the author. There is also self-plagiarism, where an author

repeats parts of previous papers, so the words are their own but they have been published elsewhere.
- conflict of interest – usually involving a financial interest in having certain results published and other results suppressed
- fraud – the deliberate falsification of data

Guest authors and ghost authors

We have discussed above some of the criteria, recommended by the ICJME and WAME that should be used in determining whether or not someone is an author, and particularly the desirability of getting agreement very early in the research study on the criteria that will be used to determine authorship in any publication resulting from a particular research programme. Such agreements may help to avoid disputes later. Of particular concern here are the notions of a "guest" author and the "ghost" author.

There are times when research groups consider that their paper may have greater chance of being accepted for publication if the name of a prominent scientist is included in the authorship. Regrettably there some evidence of bias amongst reviewers when such a name appears, and so this notion may have an element of truth in it. The inclusion of such "guest" authors runs contrary, however, to accepted guidelines on ethical authorship – that only those who have made a significant contribution should be considered as an author. Note that this is quite a different situation from that of including the head of a laboratory or a research team as the last author – such authors often have given advice on design and on writing the final paper, even if they have not contribute specifically to the conduct of the research and so they may well merit authorship according to WAME guidelines.

Of much greater concern are "ghost" authors, since these situations may well contribute to reducing the value of journals as sources of evidence. Many commercial health care companies, providing materials for health care such as drugs or diagnostics, employ medical writers whose task it is to provide information about company products. While the information they produce may be based on published medical literature, it may also of course be biased to show the products of their own company in the best light. Health care journals, being aware of such bias, may be reluctant to publish research or review articles from these authors. In order to get around this problem, some medical writers invite an apparently unbiased academic in a university or research institution, to

publish the paper under their name. The invitation may be presented in a subtle way – such that "knowing how busy you are as an academic researcher, the company will provide an assistant for you who will conduct all the necessary abstract searches, and will provide a draft of the article on your behalf." The author is happy, because he or she gets another publication, the journal is happy because it gets what appears to be a good article, the company is happy because they have been able to promote their products without the cost of advertising. The only person who loses is the reader – who may be influenced to change the management of patients or of health problems on the basis of the article, believing the recommendations to be those of an unbiased academic. Clearly this is an unethical approach to authorship of a paper.

Duplicate submission

Of course when you submit a paper to the journal, there will be a delay in hearing whether or not the paper is accepted. Sometimes there may be 6 months from the time of submission to the time of decision, and that decision may be to reject the paper. It is quite a common practice in some countries to submit the same, or almost the same, paper to two different journals at the same time, so that if one journal turns it down, the other may accept it and no time is lost in resubmission. If one journal accepts the paper, the author may contact the second journal and withdraw the paper from their consideration. So the second journal may have gone to considerable trouble and expense in getting a peer review completed, only for the paper to be withdrawn. To avoid this, most journals require a statement that a paper submitted to them is not under consideration by any other journal. Such a statement is not to be made lightly, as evidence of duplicate submission is again regarded as a breach of ethical conduct in publication.

Plagiarism and the salami technique

Plagiarism is the use of another person's words as if they were your own. It is quite acceptable in a research paper to quote the words of others, but due acknowledgement must be always be given to the original author. Failure to do so may lead to an accusation of plagiarism. There has very recently been the case of a prominent British psychologist who clearly plagiarised the works of an American colleague, and despite claims that due

acknowledgement had been omitted in error at the printing stage, the journal publishing the article had to withdraw it and make a public apology.

Perhaps more common are cases of self plagiarism – and this usually is associated with what is known as the "salami technique" of publication. In this technique, one study (the salami) is conducted, but several papers (the slices of thin salami) are written from it, each paper dealing with one particular aspect. For example, a survey of parasites in a community could be written up as protozoa in the adults, protozoa in the children, helminths in the men, helminths in the women and helminths in the children – so there are 5 papers from one small study. While this may be frowned on, more serious is that often exactly the same words are used in the Introduction and Methods sections of the papers, because of course the background and techniques of sample collection are virtually the same in each. All subsequent papers may therefore "self-plagiarise" the first paper published. Some would regard self-plagiarism as much an example of unethical research conduct as is plagiarism of others.

Conflict of interest

Conflict of interest refers to a situation in which there may be undue benefit that results from publication. Of course all authors gain benefit from a publication – we have already discussed that the publication record is one of the criteria commonly used for assessing academic status, and a good publication record would certainly increase the probability of a major grant award. Where there may be additional benefits, in particular financial benefit, from a publication then the reliability of the data in the publication may be brought into question. The conflict is between the financial interest that may pressure an author to present data in a way that is biased, and academic interest which assumes that a researcher presents the data in an unbiased way. The issue here is not one of whether such a benefit is in itself ethical, but one of transparency – that any potential conflict of interest should be explicitly stated so that readers may judge for themselves whether there has been bias in the data presentation.

A fairly straightforward example is that of research commissioned by a drug or diagnostic company. Clearly such a company has a financial interest in the data produced by the study since it would influence potential profits. Legally, the sponsor of a research project is entitled to ownership of all of the data that the research

generates, and in most contracts between drug companies and independent researchers, it will be explicitly stated that publication of any data requires the prior approval of the company. In some cases this may be necessary, for example to protect any patent rights attached to the drug or device under investigation. In most cases, though, the more pressing reason is to protect the company against adverse outcomes – that the drug under investigation has a lower efficacy than others, or that serious side effects may occur during its use. Clearly a company that had sponsored research with such outcomes would have a financial interest in suppressing the publication of these data. This is the so-called “file-drawer syndrome” in which negative data are simply filed away and never published. The problem about this is that systematic reviews are based on published data only, and so negative data that remain unpublished may not be included in a systematic review.

Under a new system introduced recently, some journals require the deposition of all data, positive and negative, before allowing publication of a clinical trial in their journal. Such a system has been recommended by the ICMJE in response to a number of legal cases showing deliberate suppression of some data. If your paper is one resulting from a sponsored drug trial, check whether the journal you want to publish results in is one with such requirements and convince the company to follow these requirements.

Note that the great majority of drug companies comply fully with good research practice, with complete and honest collection of data. They use care in study design (the “double-blind” trial for example) and care in data collection (the use of ink rather than pencil for recording data) to avoid the possibility of falsification of data. Usually, then, what is presented in a paper is perfectly true, but it may not be the complete truth, and that lack of completeness may make the publication unethical. The Attorney General of New York recently sued the pharmaceutical manufacturer Glaxo-Smith-Kline for fraud, alleging they deliberately suppressed data about one of their antidepressant drugs. Research studies had suggested that young adults showed an increased risk of suicide after taking the drug, but these studies were never published by the company and it was only after a number of suicides had been investigated that the negative effect of the drug became public knowledge. The anti-inflammatory drug Celebrex, manufactured by Pfizer, was advertised as being safer than rivals following an article published in 2000 that showed fewer gastrointestinal complaints than many other drugs during the first 6 months of use.

Only later was it revealed that the original protocol required a comparison of intestinal symptoms in the first 12 months of use, and in this time period there was no difference between Celebrex and its rivals. Pfizer preferred to suppress these data and promote the 6-month data because of the obvious marketing advantage to them. In both examples, there was no falsification of data, only suppression of those data that may have negatively affected sales of the product. In the case of Pfizer, it was the shareholders who accused the company of failing to disclose potential risks to their investment!

Of course it is usually quite clear that drug efficacy studies are sponsored by a particular company, and most researchers would be well aware of the potential for conflict of interest, and regard such publications with scepticism.

So what can a young researcher do? Being involved in the conduct of a drug trial, particularly one that has international advisors, is an excellent way of gaining experience in good research practice and in developing writing skills. Often as well there may be financial benefit to individuals or to institutions, and there may be sponsorship to present a paper at an international research meeting. So these are important opportunities for career development, and are not to be missed. Always try to negotiate for academic freedom, the right to publish papers without having to obtain specific consent. You may agree for example for a paper to be reviewed by the company before submission so that any actual errors or potential areas where confidential information has been disclosed can be brought to your attention. Always, of course, state in your paper the potential conflict of interest – that the publication contains data that were obtained while in the employ or sponsorship of the company. Remember the unethical aspect is that of failure to disclose all interests, not in having an interest at all.

Sometimes, though, it is not the drug company that may be at fault but rather those trying to take action against the company. A research group based in Britain recently published a paper in *The Lancet* indicating that the Measles-Mumps-Rubella (MMR) vaccine could induce autism in children. The principal author of the paper failed to disclose that some of the children on whom he reported were members of a pilot project, in which he was the principal investigator, to determine if there were legal grounds for mass action by parents of children who had received MMR and who had subsequently developed autistic behavioural problems. The Legal

Aid Foundation had given substantial support towards this project, and if a decision were given in favour of the parents, there were clear potential financial benefits to the group. While the author denied that there was a conflict of interest, *The Lancet* decided that his failure to declare his association with the project meant that the results published in his paper had to be regarded as unreliable, and so were withdrawn. Further studies, published in the *British Medical Journal,* have failed to find any link between MMR and autism in children. Again note it was the failure to disclose potential conflict that was regarded as unethical.

Research fraud

It is, of course, impossible to repeat every experiment or study that is published in order to determine whether there has been falsification of data. As noted previously, science relies on the integrity of scientists – scientists are supposed to be in the honest pursuit of truth. When evidence of fraud does happen, it has to be regarded as a very serious breach of research ethics, and there may be dire consequences. Remember that one of the founding principles of ethical research is respect for persons, and exposing persons to the risk of research harm, however small that may be, when there is no honest pursuit of truth, fails in showing respect and therefore the whole study is unethical. Proven cases of research fraud, involving actual falsification of data, are few and far between but they do occur as evidence from the Office of Research Integrity (ORI) in the USA shows. The ORI publishes a regular newsletter that gives details of misguided, reckless or fraudulent research studies that have been brought to their attention.

So do not be tempted to try and “improve” your study by making data fit your own hypothesis, however tempting that may be. We have noted previously the need for honesty in data presentation – remember that even if the data do not fit your hypothesis, if the study has been done well, the data have validity and may well support a different hypothesis.

PUBLICATION ETHICS

Key points

1. *Remember that in addition to the ethical conduct of their studies, researchers are expected to follow ethical principles in publication.*
2. *Avoid the use of important names as invited authors on your papers. Follow the accepted code for authorship and agree the criteria that will be used for authorship early in the research.*
3. *Be wary of offers in helping you to write papers, and do not allow a "ghost writer" to prepare a paper under your name.*
4. *Avoid the use of the "salami technique" to get multiple small papers from one study. Beware of self-plagiarism – do not use the same phrases or paragraphs in different papers.*
5. *Declare any conflict of interest, particularly financial interest that may have introduced bias into your interpretation of data.*
6. *Under no circumstances change any of your data to fit a pre-existing hypothesis. Maintain a high regard for integrity in scientific endeavour.*

SECTION 9. THE PROCESS OF PUBLICATION

The final stage of writing the paper is, of course, to send to the journal that you want to publish in. There are, though, a few things to do.

Before submitting

Before you send your paper off to the journal editors, first do three things:

- Ask at least one colleague to read your manuscript and tell you ***honestly*** what he/she thinks about it. It is better if the colleague was not directly involved in the work, so that she/he can tell you whether everything is clear to an outsider reading the article. If you read an article for a friend, it is absolutely necessary that you give your honest criticism, otherwise you are not a real friend! It can also help to present your paper as a short talk to your colleagues, who can then give you feedback immediately and all together.
- Check that you have followed all of the instructions to authors – ***again***.
- Go through the article carefully and correct any spelling mistakes. These days, most scientists use a computer to generate their manuscript, so use the spell check programme to make sure you have eliminated spelling mistakes. For a reviewer, it is very annoying to see a lot of mistakes – it makes the reviewer think - “If she has been so sloppy with spelling, how can I trust the data?”

Then, when you think everything is ready, send the manuscript, in the required number of copies, to the editor as instructed by the journal. Many journals now require or allow online submission of manuscript. Go to the website, click on submission and follow the

instructions **exactly**. Often there are different editors for different geographical regions, or for different areas of specialisation, and make sure you send it to the correct one. The article should be accompanied by a letter, which should state two important points:

- In multi-author papers, that all of the authors have agreed with the content of the paper and they agree to submission to that particular journal
- That the paper has not been submitted to any other journal for publication.

Put this together with the copies of the paper and send it off. These days, when submitting a manuscript on paper, we prefer to send by courier – it is more expensive, but at least you can be sure that the paper, in which you may have invested several months or years of time and effort, gets to the journal quickly and safely.

Then you wait.

After submitting

Some journals will send a short letter or e-mail to tell you that they have received your manuscript.

Still, you wait.

Usually the editors first decide whether they will consider the manuscript at all. Sometimes they send it back because they feel that it is not suitable for their journal, or because you have not prepared it according to their style rules. In the first case you just have to try another journal. In the second case, you can rewrite it to fit the journal's requirements and submit it again, but this does not increase your chances of acceptance. Hopefully, though, they will decide to consider it for publication.

Still you wait.

The editors will ask two or three reviewers to read your paper and give their recommendation about publication. That takes time, to send the manuscript to all the reviewers/referees (who are experts in the field) and to receive their responses. When the editors have the responses from the reviewers, they will inform you of their decision. There are different possibilities, for example:

- The article is accepted without modification (this happens rather rarely).
- The article is accepted with minor modifications, according to the comments of the reviewers. You only have to change or add or delete parts according to the comments and then send it back to the journal (this happens more often).
- The article is not accepted, but the journal says it will consider it again if you make some major modifications, as recommended by the reviewers and/or editors (this is perhaps the most common response).
- The article is not accepted, because although they say it is interesting it does not have priority enough to be published in their journal. (this happens often, too) Then you should submit it, after considering the referee's comments, to another journal, making sure that you have changed the style of the manuscript to fit the new journal's requirements.
- The article is rejected, because of some serious flaws. You should consider these flaws and whether you can do anything about them, such as repeating some experiments or collecting more data. Otherwise you can try to publish the article somewhere else and hope that they don't mind these flaws!

After review

It is important that you respond to reviewer's comments quickly. Often the letter from the editor will give you a deadline, and if you have not submitted a revised script by then, the article will be considered as a new submission and go through the whole process again. Often the editor will give an indication of the likelihood of acceptance – "*This is an interesting article that you may want to improve by …..*" is a very positive sign. When revising an article, make careful note of the changes you have made, and send a covering letter stating what has been your response to the comments of reviewers, point by point and using the same notation as the reviewer. This need not be very long – for example:

1. *Page 4, line 7 – the reviewer commented on the reliability of the techniques used. We have included an additional reference showing that this method has a sensitivity of 89% compared with other methods.*

2. *Page 10, line 11 – we have changed the text to include the comment noted by the reviewer.*
3. *Table 3 has been removed in accordance with the recommendation of the reviewer.*

If you really feel that the referees have been unfair or have not understood something in your article it is possible to reply to their comments, explaining why you did not do what they recommended, when you return the adjusted manuscript to the editor. But you should always consider their comments carefully because most reviewers have honestly tried to read and understand the article and if they did not succeed, the fault may be yours.

If your article is accepted for publication, then they will prepare it for the journal. Often they will also send you a copy that is ready for printing, called the ***proofs*** and ask you to check that they have not made any mistakes, such as mistakes in names, numbers or words, before they print it. It is always required for you to check and return the corrected manuscript immediately. Do this very carefully, reading every word, as it is the last chance to correct a mis-spelling or a wrong reference. You cannot make changes to the text at this stage, though, only correct the errors that have crept in during the preparation for printing. To those whose native language is English, we suggest you read the article backwards – this makes you check each word! For those who are not so familiar with English, have someone who knows the language well assist you. There are many words in English where a small change in spelling may completely alter the meaning.

After another month or two you will see your article appear in print or online and everyone interested in that field can see what you have done and what you found out! It is time to break open a bottle of champagne and share with your colleagues the enjoyment of the first of hopefully very many international publications.

THE PROCESS OF PUBLICATION

Key points

1. *Ask a colleague to read through the paper in its final version, check for spelling errors and make sure you have followed the instructions to authors*
2. *After submitting the paper there will probably be both an editorial review and a peer review, and this may take several weeks.*
3. *It is unlikely that the paper will be accepted without any changes; the great majority of papers are accepted only after attending to the review comments. Remember that this must be done as soon as possible, with attention to each of the points raised by the reviewers.*
4. *In your reply to the editor, indicate what changes you have made, using the same numbering system as the reviewers.*
5. *The objective of course is success – and success deserves a celebration.*

USEFUL READING AND REFERENCES

A number of very useful tips on the writing of research articles and on editing skills for editors of medical journals have been given by Tim Albert. See the website, *www.timalbert.co.uk*, for information on these. On the website you can also find links to a newsletter "Short Words" that describes some of the new developments and changes in writing for health journals.

The International Committee of Medical Journal Editors published an updated (2006) version of the requirements for manuscripts submitted to biomedical journals. Visit their website at *www.icmje.org* for details on these requirements. The website also provides recent editorials on issues such as authorship and the need to register clinical trials before they are submitted for publication.

The World Association of Medical Editors also gives advice to the editors of medical journals, especially on aspects of publication ethics. On their website, *www.wame.org* you can find information on the ethics of authorship, dealing with "salami publications" and plagiarism. This is very useful information for writers of papers as well as editors of journals.

The Office of Research Integrity can be contacted through the internet at *http://ori.hhs.gov* and you can register to receive the newsletter via e-mail. As well as giving information on research misconduct it also gives information on training opportunities.

Some very useful ideas on writing styles and organizing manuscripts into the most readable format can be found in a number of articles in both on-line and paper journals.

Lundberg GD. How to write a medical paper and get it published in a good journal. Medscape General Medicine 2005;7:36

Rosenfeldt FL, Dowling JL, Pepe S, Fullerton MJ. How to write a paper for publication. Heart, Lung & Circulation 2000;9:32-37

Welch HG. Preparing manuscripts for submission to medical journals: the paper trail. Effective Practice 1999;2:131-137

Some useful ways of writing particular sections may also be found in the literature, for example:

Alexandrov AV, Hennerici MD. Writing good abstracts. Cerebrovascular Diseases 2007;23:256-59

Newman A., Jones R. Authorship of research papers: ethical and professional issues for short-term researchers. Journal Of Medical Ethics 2006:32;420-23

*Barelocher MO, Newton M, Gautam T, Tomlinson G, Detsky AS. The meaning of author order in medical research. Journal of Investigative Medicine 2007;**55:**174-80*

The experiences of writing papers from a developing country perspective are given by a number of authors. See for example:

Keiser J, Utzinger J, Tanner M, Singer BH. Representation of authors and editors from countries with different human development indexes in the leading literature on tropical medicine: survey of current evidence. British Medical Journal 2004;328:1229-32

Glover SW, Bowen SL. Bibliometric analysis of research published in Tropical Medicine & International Health. Tropical Medicine & International Health 2004;9:1327-30

Sumathipala A, Siribaddana S, Payel V. Under-representation of developing countries in the research literature: ethical issues arising from a survey of five leading medical journals. BMC Medical Ethics 2004;4:5

Anya I. Representation of authors and editors from poor countries: partnerships may well be unequal. British Medical Journal 2004;329:110

Langer A, Diaz-Olavarrieta C, Berdichevsky K, Villar J. Why is research from developing countries under-represented in

international health literature and what can be done about it? Bulletin WHO 2004;82:802-3

Kotur PF. How to write a scientific article for a medical journal. Indian Journal of Anaesthetics 2002;46:21-25

Writing good papers is a skill that can be acquired by learning from the experience of others. See for example:

Tomsaka L. Teaching how to prepare a manuscript by means of rewriting published scientific papers. Genetics 2007;175:17-20

Szklo M. Quality of scientific articles. Revista de Saude Publica 2006;40:30-35

Byrne DW. Common reasons for rejecting manuscripts at medical journals: a survey of editors and peer reviewers. Science Editor 2000;23:39-44.

Finally remember that you can use on-line databases, such as PubMed – www.pubmed.gov - to search for and identify other sources of information on publishing papers in health journals.