

How to present the findings of research

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Providing an account of research involves telling a story during which four key questions are answered: why did you start, what did you do, what did you find out and what does it mean? It is the third of these — what did you find out — that is at the heart of any research paper. Ensuring that the key messages emerge from the data is the duty of the author and requires considerable skill and craft.

INTRODUCTION

With many hundreds of journals now in circulation and tens of thousands of research papers published each year, consumers of medical knowledge need all the help that they can get. The clear presentation of research findings improves communication of key messages and aids the digestion of new medical knowledge. This article aims to guide those who wish to explain the findings from research studies in print. In doing so, it focuses largely on the presentation of data from quantitative research methodologies. Although many of the key messages are similar for the presentation of qualitative research findings, there are also additional difficulties which are not covered here — see Dey (1993), Silverman (2000) and Powell and Davies (2001) for further guidance.

Before beginning to communicate research findings on paper, it is worth asking oneself two questions:

- Can I state in a single sentence the key message of my proposed paper?
- Can I summarize in a few words why the research findings matter?

The discipline of trying to answer these questions with plausible, succinct and even elegant answers can do much to refine and focus what needs to be presented. A major difficulty in writing up any piece of research lies not in deciding what to say but in deciding what to leave out (Crombie and Davies, 1996).

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THINGS IN THE RIGHT PLACE

What follows focuses mainly on the presentation of research findings. This task is greatly eased, however, if the overall structure of a research article is well planned, with clearly delineated sections. Traditionally, research papers have followed the IMRaD format: introduction, methods, results and discussion. These sections answer, in turn, the four key questions asked of any research project (Crombie and Davies, 1996):

- Why did you start?
- What did you do?
- What did you find out?
- What does it mean?

Making sure that the right information is included in each of these sections and appreciating that each has a separate function to perform helps ensure a crisp and coherent presentation of the key research findings.

Introduction

The introduction, obviously enough, introduces the area of study by identifying why it has importance, the state of current knowledge and the presence of any important gaps in that knowledge. Finishing off the introduction with a clear statement of the main research question helps prepare the reader for the findings — it sets an expectation of what will be presented as well as emphasizing why it matters.

Methods

The methods section usually begins with a brief statement of the overall research design, e.g. retrospective or prospective; experimental or observational; case report, survey, cohort, case-control or trial. This section

should then describe the source of study subjects, the nature of their recruitment, the data collected and the means of analysing them. Clear expositions at this point mean that the flow of findings in the results section does not need to be interrupted by further explanations about how data were gathered and processed. Crucially, data should not be introduced at this point.

Results

The purpose of the results section is to provide an account of the findings from the research. Like all good accounts, it should have a logical structure and should be selective in what is covered. These issues will be explored in more detail later on. Significantly, the results section should not require any additional explication about data sources, processing or analysis, and nor should it stray into issues of meaning or inference — these are best left to the discussion section.

Discussion

This section often starts with a brief recap of the key findings (that one sentence statement prepared earlier, perhaps) and begins to outline their meaning and significance. It is here that the results are placed in the context of other published research (either confirming or contrasting), and it is in this section that the authors develop a critique of their own methods and data. Understanding the role and content of the discussion can assist in keeping extraneous material out of the results section.

Thus, a clear and coherent presentation of research findings is greatly aided by:

- A clear and focused research question, plainly presented in the introduction
- A logical and precise explanation of data sources, processing and analysis (in the methods section), which sets a framework for the explication of the findings
- A well-structured discussion, which gathers interpretation and critique properly separated from the data presentation.

STRUCTURING THE PRESENTATION OF DATA

The presentation of research findings should be done in such a way that the reader is guided through what will often be a dense maze of data. From these data, information must be extracted which will then be placed in context and interpreted for meaning in the discussion. Thus, all data are not equal in the eyes of the reader, and it is the job of the author to construct a path through the data maze in such a way that the story of interest can emerge. The first task is to develop a structure for introducing data and analyses.

Quantitative research in biomedicine almost always involves study subjects of one sort or another. Often these will be patients; sometimes they will be other individuals, such as members of the public or staff. In either case, a good beginning for any results section is some descriptive data on the individuals and their characteristics. From this simple beginning, data pertaining to the key research questions can begin to be introduced. In doing so, it is better to have some logical rationale underlying the sequence of introduction: sometimes this will be suggested by the way in which research questions are cast; at other times the logic will have been laid out in the methods section.

Often the research design itself imposes a discipline on what data should be presented and in which order, e.g. with a survey one would expect some initial data to allow an assessment of the representativeness of the sample; with a trial the initial analysis should compare the two groups at baseline. Whatever, the ratio-

nale should be explicit, and it should be consistent between the different sections of the paper. Further, it is better to start with simpler analyses, e.g. a univariate approach, and gradually develop more complex ideas, e.g. multivariate analyses.

DESCRIBING DATA

The results section of most research papers consists of two key elements:

- The presentation of data in tables and figures
- The accompanying prose narrative.

It is a mistake to think either that these should duplicate each other or that they should simply cover complementary parts of the analysis. In truth, they serve different functions, and ideally each element should more or less be capable of comprehensible consultation in isolation.

The tables and figures should provide a comprehensive view of the data. By using short but informative titles and legends, it should be possible for a reader to understand the nature of the analysis and the key findings simply by consulting the tables and figures in sequence. In complementary fashion, the accompanying narrative should guide the reader through the tables/figures, highlighting their salient features and drawing attention to the threads of the arguments that make the findings interesting. Thus, while the narrative will contain many references to the tables and figures, such references do not stand instead of providing an account — they refer to the tables and figures as supporting evidence for the arguments explicated.

DATA PRESENTATION

Data in tables need to be presented using measures of average (mean, median or mode) and spread (range, interquartile range or standard deviation). Different data require different presentations, and the mean \pm standard deviation may not always be appropriate (Davies, 1998a,b). Tables themselves should be constructed with a minimum of horizontal ruling and no vertical rules. All column headings and row identifiers should be readily intelligible; table items should be presented

in both absolute (number) and relative (e.g. percentage) form. The use of row and/or column subtotals may also be helpful. The intention is to provide a complete picture, fit for the purpose, without overloading the reader with extraneous detail.

Inferential statistics should be used sparingly, consistent with the research questions that are being posed. Current usage of statistics in medicine is now beginning to favour the presentation of confidence intervals over hypothesis testing with *P* values (Gardner and Altman, 1986; Davies, 1998c; Sterne and Davey-Smith, 2001). In either case, however, the analysis strategy, with prior reasons for selected comparisons, needs to be explained in advance — to avoid accusations of fishing or data dredging. A common error is to present data with insufficient information for their interpretation. For example, numbers alone are often uninterpretable — they may have to be expressed as some sort of rate or ratio to make them so. Likewise, numbers that do not take into account chance variability are unsatisfactory.

AIDING CRITICAL APPRAISAL

The development of critical appraisal (Davies, 2000) as part of evidence-based medicine has highlighted the sorts of information that should be covered in the presentation of research. A good discipline then is to apply critical appraisal skills to any paper under development. The existence of numerous checklists for specific study designs can greatly help this process (see Crombie, 1996; Greenhalgh, 1997; Sackett et al, 1997), and further guidance can also be found in the users' guides developed by the Evidence-Based Medicine Working Group, which are available on the Internet (<http://www.cche.net/>).

The intention in using critical appraisal during the authoring process is to identify whether sufficient data and detail are provided to allow any reader to assess both the internal and the external validity of the findings. This approach can help highlight any unfortunate confusion or omissions.

CONCLUSION

The primary purpose of research papers is to communicate worthwhile messages in such a way that they are open to critical scrutiny. Good data do not necessarily speak for themselves. Clearly written and well-presented research findings can greatly aid the easy interpretation of important new data.

In presenting new data, the author(s) need to act as 'expert guides' through complex terrain. This requires considerable skills in selecting, structuring and explaining: it is insufficient simply to 'dump' all the data into tables and to force the reader to find their own way through. Further, reflective reading of drafts in the light of critical appraisal checklists can also help produce more robust and intelligible accounts of research. Such improvements in the presentation of research findings not only assist readers but also increase the likelihood of publication in the first place. **HM**

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KEY POINTS

- Coherent presentation of research findings begins with a crisp explanation of the main research question(s). It is then the authors' task to tell the story of how this question was addressed.
- Clarity in presentation is greatly aided by a clear separation of material between the different sections of the paper: introduction, methods, results and discussion.
- The role of the results section is to guide the reader through the data, highlighting the key features of interest.
- The tables and the prose in the results section should each provide an account of the data, separately intelligible yet nonetheless complementary.
- Data presentation should begin with basic descriptions of study subjects and simpler analyses before going into greater detail.
- The structural logic and the choice of content in the results section can be guided by an awareness of what should be included to facilitate critical appraisal of the research.