Communication of Results of Research

John P. Geyman, MD, and Martin J. Bass, MD

Earlier papers in this monograph have focused on the context and the need for research in family practice, research design, and analysis and interpretation of results obtained. The next stage in this process is necessarily that of communication of the results of one's work to others involved in the field. Communication can take two forms—verbal and written. While verbal reports through such methods as presentation of papers at professional meetings have an important place, their long-term impact is quite limited, due both to the limited audience reached and to the lack of opportunity of the audience to retrieve the content for review and study. Results of research studies must ultimately be published in journals listed in *Index Medicus* in order to be accessible to future investigators and students interested in the particular content area concerned.

Publication must be considered an integral part of the research process, for as Byrne has pointed out, "unpublished research has never been undertaken as far as anybody else is concerned."[1] The literature serves as the cutting edge of an advancing specialty, and it is the researcher's obligation to contribute to this forum presuming, of course, that an important subject has been addressed and significant results obtained.

The development of a written report of one's research which is concise, accurate, and interesting presents a challenge to the researcher which must be addressed as carefully as the research project itself. Physicians and others involved in medicine have not usually been known for their capabilities with the use of language in written form. As Director of Medical Sciences for the Rockefeller Foundation, Gregg made these comments in 1943, and they are equally true today: "The common level of medical and scientific writing in our professional books and journals already constitutes the most serious internal limitation to medical education and research. The usual level of professional writing is painful not merely to editors. Even after passing editorial filters, the virus of wretched writing can inflame, insult, and exhaust a clearminded man. Such writing is verbose and repetitious. It is awkward and tiresome. What time it can spare from being vague it devotes to being inaccurate. By sheer carelessness of phraseology, the author belies his probable meaning by actual misstatement. Such writing defeats the very purpose of communication—to convey information clearly."[2]

Just as there are basic principles which assist in the conduct of a research project, the preparation of a written report of such a project can also be facilitated by some fundamental guidelines. The purpose of this paper is fourfold: (1) to present an organized approach to the writing of a scientific paper; (2) to illustrate principles and pitfalls in the display of data; (3) to discuss editorial review of the completed paper; and (4) to summarize some recommendations which are useful in reporting the results of research in written form.

An Organized Approach

While there may be a tendency for some to regard the writing of a scientific paper as an onerous and tedious task not deserved after the completion of a challenging research project, such an attitude is counterproductive and makes the important final step leading to publication even more difficult than it otherwise would be. A 12-step approach will be described which can facilitate the process of preparing a manuscript. At least the first five of these steps should take place early in the planning for the research project, during the period of germination of the researchable idea(s) and initial research design.

1. Select an Important Research Project

It may seem surprising to start with this step as the first in the process of manuscript development, but it is unfortunately not uncommon for editors to receive completed manuscripts, albeit well written, which report an elegant study of an unimportant subject. The researcher must therefore assure himself early that the subject of study is important and worth reporting at the conclusion of the project.

Dr. John P. Geyman is Professor and Chairman, Department of Family Medicine, University of Washington, Seattle. Dr. Martin J. Bass is Director of Graduate Studies, Department of Family Medicine, University of Western Ontario, London.

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2. Review the Literature

A careful review of the literature is likewise essential early in any research project. The objectives of this search are several: (1) to learn what has been done by others in the area of one's interest; (2) to assess the methods, validity, and results of previous studies; (3) to identify areas of controversy; (4) to identify discrepancies between the literature and patient care guidelines; and (5) to confirm that one's research project is actually needed.

3. Select the Potential Readership and Journal(s)

If the study is important and worth doing, its results should be of interest to others in the field. Once the specific target group is identified as closely as possible, the journal(s) serving this readership can readily be identified. A recent paper by Kirkpatrick and Roland provides an excellent discussion of the various considerations involved in deciding where to submit a manuscript; they urge that authors select the intended journal before the paper is written.[3]

4. Become Familiar with Style and Content of Journal(s)

Review of past issues of pertinent journals is helpful in three important ways: (1) to learn to what extent the subject has already been presented to the readership; (2) to better understand the scope and outlook of the journal(s) by review of the subjects of the papers, their organization and lengths, and the extent of documentation; and (3) to become acquainted with details of style and organization required by the journal(s) through published *Information for Authors*.

5. Decide on Number and Types of Tables and Graphs

Early concern with this step is also relevant to the initial process of research design because it helps to clarify the categories of results which will be important outcomes of the study. In addition, questions of the adequacy of numbers, the need for statistical help, and how best to display the results often surface at this point when the design of the study can be modified as needed.

6. Prepare an Outline for the Paper

The first consideration at this point is to formulate a title for the paper which relates directly to the subject. The title should create interest in the paper if possible, but colloquial, "catchy" titles which stray from the content should be avoided. It is worth remembering that the full titles of papers published in referenced journals are recorded without alteration in *Index Medicus*, and only titles which accurately describe the content of papers will allow other investigators to locate a particular paper within their area of interest.

Although some expository papers require major headings keyed to their specific content, most papers describing original work should be organized under the traditional major headings of *Introduction, Methods, Results, Discussion,* and *Summary/Abstract*. The Introduction should outline why the problem is important, identify the specific issues addressed, and state clearly the purpose of the paper. The Methods section should provide enough detail so that the study can be replicated elsewhere and should also clarify procedural methods, including statistical techniques. The Results section should describe the results of the study in sufficient detail to be understood, clarify data which are presented in tables and figures, and mention the results of statistical testing, if used. Duplication between the narrative and tables and figures should be avoided, as should the temptation to prematurely interpret the results. The Discussion section should interpret the results; discuss considerations of bias and study problems, if present; compare the results with previous work in the field; and discuss the generalizability of results and avenues for future research. The requirements for the Summary/Abstract vary considerably among various journals, and should be followed closely in response to the needs of the journal involved.

A common question relates to the optimal number of references which should be cited in a paper. The best advice here is to include a sufficient number of references to place the study in perspective with respect to previous work in the field. Some judgment is necessary in this regard—a paper is not necessarily more scholarly because it cites a large number of references; a paper without any references, however, represents inadequate scholarship unless there is a total absence of previous work related to the subject. The requirements for the form of references vary somewhat among journals, and should be carefully

followed for the particular journal involved.

There is considerable advantage to thinking through the outline in further detail if possible, including those minor headings which may be useful under any of the major headings, and whatever specific ideas should be included at various points in the article. Attention to this step will be amply rewarded by sharper clarity of thought and more logical flow of ideas through the paper, resulting in a paper which is easier to read and better understood by the intended readership.

7. Write the First Draft

A common problem at this stage for many is inertia in actually writing the paper. The first paragraph or page is often the hardest. One must resist the temptation to delay, for tomorrow will be no easier. Quince advises one to start the paper at that point in the paper which is most in mind, whether at the start or in the middle, and to complete the first draft in whatever sequence meets the interest and path of least resistance for the writer.[4] This may be sound advice if preceded by a carefully considered outline. At any rate, it is preferable to write the first draft with some dispatch, to "get it down on paper" without undue initial concern with details of sentence structure or style. Those details can be edited later.

With regard to specific considerations related to writing the paper, the following recommendations can be made:[3,5,6]

a. Write directly for the intended readership, keeping in mind the reader's anticipated background or knowledge of the subject.
b. Attempt to "package" the entire paper in an interesting and informative way for the reader.
c. Use language which is simple, concise, and clear; avoid jargon and clichés.
d. Use short sentences and avoid repetition of thoughts.
e. Avoid excess use of qualifying statements; take responsibility for what you write.
f. Avoid overstatement of conclusions not soundly based on results obtained.

8. Revise and Shorten First Draft

Once a typewritten (double-spaced) first draft has been completed, it is essential to carefully review the paper for clarity, logical flow of ideas, integrity of paragraphs, and sentence structure, grammar, and punctuation. One must avoid any "ego-investment" in the first draft and be willing to delete unnecessary sections as well as revise or rewrite entire sections of the paper. Charles Roland, an experienced editor and Chairman of the Department of Biomedical Communications at the Mayo Foundation and Mayo Medical School, urges authors to delete all words and phrases that are not essential to the meaning intended.[6] If one has access to editorial assistance at this stage, it is often helpful to ask the advice of such a person in revising the first draft.

9. Seek Critique by Colleagues

Honest critique by respected colleagues with expertise in the subject at hand is an important part of the process of writing a scientific paper. One should not be seeking approval of what has been written, but blunt criticism of its content and clarity. Some find it helpful to read a paper aloud to colleagues. Ideas that cannot be made clear to an audience are not clear to the writer. Every paper should have one or more major points to make; assure that they are clearly addressed.

10. Write the Final Draft

The final draft of the paper can now be undertaken, incorporating relevant input from colleagues and paying particular attention to the editorial requirements of the journal involved. All of the details of manuscript preparation which are published by the journal as *Information for Authors* should be meticulously followed, including those relating to tables and figures, references, and to typing itself. Reference to style books are frequently of value at this stage; two particularly useful manuals are those by Strunk and White[7] and the American Medical Association.[8]

11. Proofread the Final Manuscript

This step should also be meticulously done. Careless omission of portions of the manuscript, and spelling and punctuation errors compromise the receptivity of editorial boards to the completed work.

12. Submit the Paper for Publication

The completed manuscript is then submitted to the journal which has been selected, with the appropriate number of copies and with all illustra-

Table 1 (a). Illustrative Table—FAULTY Version

Peptic Ulcer Status by Provider

	No Change	Slight Improvement	Moderate Improvement	Marked Improvement
1st year residents	6	7	3	3
2nd year residents	7	11	8	4
3rd year residents	10	5	18	6
Faculty	4	3	12	5
	P<.05			

Problems
1. *Title unclear*
2. *Difficult to make comparisons*
3. *Too many columns for conclusions*
4. *Numbers in several cells are very small*
5. *Reader has to add up values to determine totals*
6. *Statistical detail lacking*

Table 1 (b). Illustrative Table—MODIFIED Version

Outcome of Peptic Ulcer Patients Cared for by Providers with Different Levels of Training*

	No. of Patients	Percentage of Patients Unchanged	Improved	Total
Provider				
1st year residents	19	68.4	31.6	100
2nd year residents	30	60.0	40.0	100
3rd year residents	39	38.5	61.5	100
Faculty	24	29.2	70.8	100

*χ^2=9.81 df=3 P<0.05

tions in a form required by the journal. A simple letter of transmittal is all that is needed. The paper should speak for itself, and requires no attempt to document its relevance or importance in the letter of transmittal.

Display of Results

The Results sections is the core of an original paper. Here the evidence is presented through tables, graphs, and histograms with appropriate statistical testing. The reader should be given enough detail so that he/she can draw his own conclusions, yet not so much detail that it affects his understanding or willingness to proceed.

A well-constructed, adequately labeled table or figure will need little written description to get its essential information across. While every table and figure should present at least one key result, not all results must be shown. Less important findings can often be stated in one or two summary sentences.

Suggestions for Effective Tables

1. Construct the table with its purpose in mind. If it is to compare experimental and control group findings, then the data should be aligned for easy visual comparison and in a form that will allow comparison (percentages, averages, etc).
2. Show the numbers on which the results are based.
3. Make it clear which way percentages run.
4. Use mutually exclusive categories. If categories are not mutually exclusive, state this at

Table 2 (a). Second Illustrative Table—FAULTY Version

Immunization Status (Number and Percent) of Family Practice Center Patients, and Number and Percent of Patients for Whom the Center Has No Immunization Records

		Age 3-4 mo.	5-6 mo.	7-15 mo.	16-18 mo.	19 mo.-9 yrs.	10 yrs. +
DPT	Yes	0	7	22	11	115	29
2 mo.	No	1	2	0	0	9	8
	%	0	77	85	65	63	48
DPT	Yes	0	6	21	10	104	28
4 mo.	No	1	3	1	1	16	9
	%	0	66	81	59	57	47
TOPV	Yes	0	7	22	11	113	33
2 mo.	No	1	2	0	0	1	4
	%	0	77	85	65	62	55
TOPV	Yes			14	9	100	30
6 mo.	No			7	2	16	7
	%			54	53	55	50
MMR	Yes			5	8	100	32
12 mo.	No			17	3	21	5
	%			19	47	55	53
DPT/TOPV	Yes				8	96	29
Booster	No				3	29	8
18 mo.	%				47	52	48
DPT/TOPV	Yes					52	26
5 yr.	NO					26	11
	%					28	43
No	No	0	0	4	6	59	23
Record	%	0	0	15	35	29	38

Problems

1. *Titling confusing*
2. *Too many numbers in each cell*
3. *Total number of patients in age group is missing*
4. *Too many columns and rows*
5. *Age divisions are unequal in size and unequal in total numbers and with no clear basis*
6. *Values are recorded for individuals some of whom would not qualify (eg, 12-month MMR in 7-15 months age group)*
7. *Last category is open ended (10 + years)*

the bottom of the table.

5. Keep rows and columns to a minimum. If necessary, use several small tables, rather than one large complex one, or limit the number of categories for easier understanding.

6. The title should allow table to be understood without consulting the text.

7. Indicate details of statistical testing (eg, $\chi^2=4.03$ df=1 $P<0.05$).

8. It is customary to list the independent variable on left, with the dependent variable on the right acting as the heading for the columns.

Examples of tables gone awry and modified versions are presented in Tables 1 and 2.

Table 2 (b). Second Illustrative Table—MODIFIED Version

Recorded Immunizations for Different Age Groups

Age	No. of Patients	Percent of Patients: Record Absent	DPT (2mos.)	DPT (4 mos.)	DPT (6 mos.)	MMR (12 mos.)	DPT-TOPV Booster (18 mos.)	DPT-TOPV 5 yrs.
5-6 mos.	9	0	77	66	—	—	—	—
7-15 mos.	26	15	85	87	62	—	—	—
16-18 mos.	17	35	65	59	53	47	—	—
19 mos.-9 yrs.	183	29	63	57	54	55	52	—
10-14 yrs.	60	38	48	47	45	53	48	43

Modifications

1. Title shortened

2,3. Only the percent of patients immunized has been included by eliminating Yes and No rows and stating total number of patients in each group

4. Data on the three TOPV rows which is similar to the DPT data has been shifted to one sentence in text. The 3-4 month group which included only one patient has been eliminated

5. Ambiguous values have been eliminated

6. The category has the upper limit of 14 years specified

7. Further modification (not illustrated) should show a division at 5 years.

Figures

While exact data are best displayed in tables, trends over time and visual comparisons between groups are best shown in figures. For maximum impact of a figure, it must be uncluttered, the components clearly identified, and the title informative. Most journals require professional quality figures and will not accept the home-drawn variety.

The commonest faults with figures are:

1. Titling is too terse and text must be relied on before the figure can be deciphered.
2. Too much information is presented in the form of too many lines, or three or four variables are portrayed simultaneously.
3. Scales do not start at zero or the middle of a bar has been cut out so that insignificant differences are magnified.
4. Points are connected with an approximate freehand line rather than with a calculated regression line or simply with straight lines between points.
5. Units along axes are unclear.
6. Sample size and statistics are not included where appropriate.

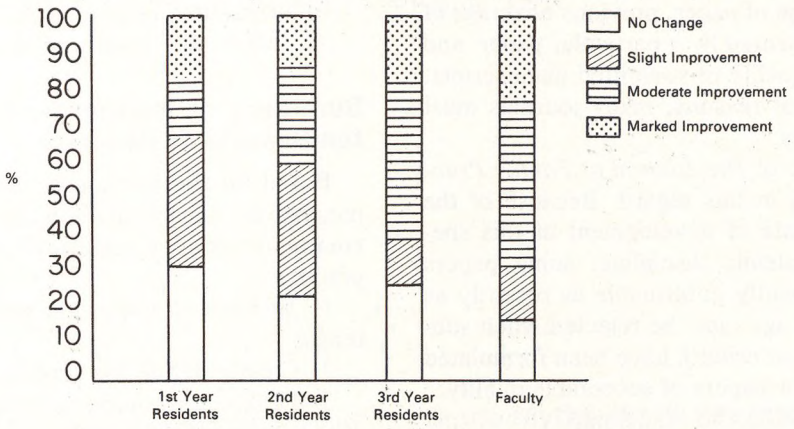
Figure 1(a) illustrates some of the above problems, while Figure 1(b) shows one approach to modifying the problems.

Editorial Review of Manuscripts

Criteria vary considerably among different journals as to how manuscripts are reviewed. *Information for Authors* as published by journals often outlines the major goals and concerns of any particular journal by content. Four criteria are usually used by editorial boards of journals stressing the publication of original work. Manuscripts

Figure 1(a). Sample Figure—FAULTY Version

Peptic Ulcer Status by Provider

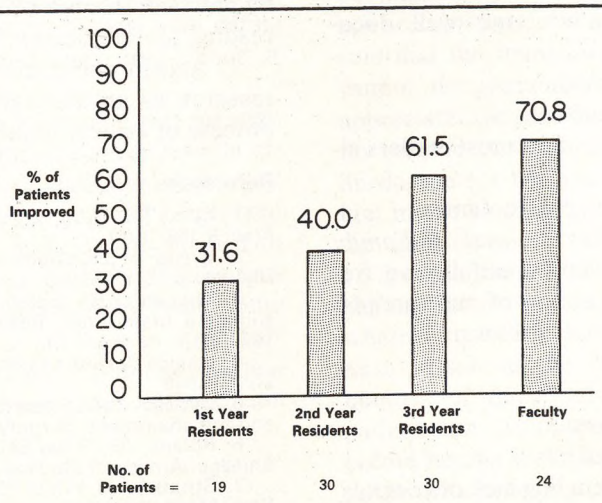


Problems

1. Title too terse
2. Sample sizes omitted
3. Statistical significance omitted
4. Difficult to make clear comparisons because of different categories
5. Vertical axis label is unclear

Figure 1(b). Sample Figure—MODIFIED Version

Outcome of Peptic Ulcer Patients Cared for by Providers of Different Levels of Training*



*χ^2=9.81 df=3 P<0.05

are evaluated by the extent to which they present material which is: (1) *new*, (2) *true*, (3) *important*, and (4) *comprehensible*.[9]

There are, however, other factors inevitably involved in the editorial decisions of journals. These include constraints of space, balance by both content areas and type of paper, previous coverage of the subject represented by a particular paper, and the volume and quality of submitted manuscripts. For these kinds of reasons, many journals must reject good papers.

The experience of *The Journal of Family Practice* is interesting in this regard. Because of the relatively rapid rate of development of this specialty as an academic discipline, some papers which were eminently publishable as recently as one or two years ago must be rejected when submitted today. Other criteria have been formulated by *The Journal* for papers of acceptable quality:

1. Subject relevant to readership
   a. Of value
   b. Of interest
   c. Not previously available to readership
   d. Presents new material or important material not sufficiently recognized, or "new" look at "old" problems
2. Adequate rationale for article
3. Appropriate title
4. Well organized
5. Strong introduction (keyed to readership)
6. Objectives stated and met
7. Clear and readable
8. Accurate, authoritative, and well documented
9. On target for readership
   a. Tells what's important
   b. Avoids truisms or what most readers already know
10. Illustrations complement content

In the experience of *The Journal of Family Practice*, a number of common pitfalls are frequently responsible for rejection of manuscripts. Some of these can be listed as follows:

1. Excess "philosophy"
2. Loose organization
3. Not sufficiently important
4. Not easily generalized
5. Unclear methods (including lack of controls where appropriate)
6. Unclear results (including poor display through tables)
7. Faulty use of statistics
8. Inadequate sample size
9. Conclusions unwarranted from results
10. Results not compared with other studies' results
11. Inadequate period of observation, of use, or of evaluation of method being described
12. Inadequate review of literature

Summary of Recommendations for Written Reports of Research

Based on the foregoing, the following recommendations can be made with respect to written communication of results of research in family practice.

1. Address an important subject of general interest.
2. Clearly define the problem being reported.
3. Obtain consultation during the initial design of the study with respect to such matters as selection of sample size, use (or non-use) of statistics, and display of results.
4. Follow an organized approach to planning, writing, and finalizing the manuscript; a 12-step process has been outlined.
5. Do not become discouraged if your paper is rejected by a journal; you may decide to resubmit the paper elsewhere, with or without modification, but in any event you should learn from the process of editorial feedback.
6. Work toward improvement of writing skills by practice, through critique of colleagues, and by reading the literature.
7. Accept publication of the written reports of research as an integral and essential part of the process of critical inquiry and research.

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