PRIMER

How to write and publish scientific papers: Scribing information for pharmacists

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Abstract: The principles of writing and publishing scientific papers are outlined.

Scientific writing can be both professionally and financially rewarding, but many pharmacists hesitate to write for publication. A primary obstacle is not knowing how to begin. Thoughtful planning is the first and most important step. Before writing a word, the writer should identify the main message, audience, target journal, resource materials, type of manuscript, and authorship. The sections of a paper reporting original research include the title, abstract, introduction, methods, results, discussion, conclusion, references, and tables and figures. Some of these elements also appear in review papers and columns. In general, information given in one section should not duplicate information in another. The writer typically drafts the methods section first, followed by the results, the discussion, and the introduction. Along with intellectual responsibility for the paper, an author must assume various ethical responsibilities, such as ensuring that it contains no plagiarism, that all sources of funding have been acknowledged, and that the paper has not been simultaneously submitted to other journals. To enhance the likelihood of publication, the writer should edit the manuscript carefully and follow the target journal's instructions to contributors. Once the writer has submitted a paper, it must pass the muster of editors and, for peer-reviewed journals, outside experts. Several revisions may be requested before final acceptance.

Pharmacists who adhere to the established pattern for writing and submitting scientific papers have the best chance of seeing their work in print.

Index terms: Authorship; Ethics; Guidelines; Journals; Pharmacists; Pharmacy; Publications

Am J Hosp Pharm. 1992; 49: 2477-84

A pharmacist can find scientific writing both professionally and financially rewarding. Publishing is a measure of productivity and may lead to raises and promotions, especially for pharmacists with academic appointments. The publicity that comes with publishing may result in consulting work and speaking engagements.[1] Pharmaceutical companies recruit pharmacists with writing skills to prepare educational materials for health-care professionals and patients, and publishers solicit them for manuscripts. Nontangible benefits also result, such as the satisfaction that comes with professional recognition.

Pharmacists develop the skills necessary for good scientific writing through schooling and job-related activities. Preparing college laboratory reports teaches organizational skills and promotes attention to detail. Many pharmacists are proficient typists, and some have advanced word-processing skills. Pharmacists are continually reviewing the medical literature, critiquing drug promotional materials, and communicating this information to colleagues and patients. Pharmacists write reviews for pharmacy and therapeutics committees, guidelines for the Joint Commission on Accreditation of Healthcare Organizations, drug-use evaluation reports, continuous quality improvement documentation, notes in patients' charts, educational materials, and performance evaluations.

Despite their abilities and the potential for rewards, many pharmacists are reluctant to write for publica-

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The contributions of my pharmacy colleagues and of Vanessa Reed-Edwards and Stephen Anderson are acknowledged.

This is article **680-204-9219** in the **ASHP Continuing Education System;** it qualifies for 1.0 hour of continuing-education credit. See page 2550 for learning objectives and test questions.

 0002-9289/92/1001-2477$02.00

The Primer *section covers basic information in various fields of knowledge of interest to pharmacists who practice in hospitals and other organized health-care settings. Within the scope of the section are reviews of fundamental concepts in, for example, pharmacy, pharmaceutics , pharmacology, physiology, therapeutics, and health-care technology. Also covered are topics somewhat out of the mainstream of hospital pharmacy (e.g., advances in nondrug health-care technology) but nevertheless of interest to practitioners.*

tion. A primary obstacle is not knowing how to begin, even though the approach to and procedure for writing a scientific paper are well defined.[2]

A scientific paper is a published report describing the results of original research.[3] However, many of the techniques for writing scientific papers also apply to other types of papers. In this primer, scientific papers include not only original research papers but reviews, cost-benefit analyses, descriptions of innovative approaches to routine procedures, and other papers likely to be written by pharmacists.

I recently shared guidelines for preparing a scientific paper with a group of clinical pharmacists who were converting an ASHP Midyear Clinical Meeting poster into a report for *AJHP*. The success of this experience prompted me to review the principles of writing a scientific paper as a means of encouraging pharmacists to write scientific materials for publication.

Planning

Thoughtful planning is the first and most important step in scientific writing[4] Before writing the first word, the writer should identify the main message, audience, target journal, resource materials, type of manuscript, and authorship.

Main message. Zellmer[5] advises, "Before beginning to write a piece for publication, be sure that you have something important to say." A good scientific paper is based on a central message, which must be sufficiently newsworthy to warrant publication. Bad research cannot be disguised by sophisticated writing because it does not support an important message.

In the planning stage, the writer should conduct a thorough literature search to assess the importance and uniqueness of the message. The search may generate questions that can be answered to create a main message for a review. For example, pharmacists regularly review new drugs. If the outcome is merely a collection of sentences detailing the pharmacology, clinical actions, and safety of a new drug, the review will be dull. On the other hand, the review that answers a trenchant question, such as the drug's role in the management of a disease, may be widely read by pharmacists who are considering the addition of this drug to their formularies. In a review of another new drug in an already crowded class, identifying a unique message can be challenging. The review can still be worthy of publication if the writer focuses on issues of interest to readers, such as cost factors.

Audience and target journal. After establishing the main message, the writer should identify the audience. Papers written for scientists are inherently different from those addressed to patients or administrators. Within the medical community, a paper may be suitable for a broad or a selected group of practitioners.

A writer can identify potential journals by browsing through journals in the medical library and by reviewing *Current Contents.* The writer should become familiar with the types of papers published in a journal to assess whether his or her effort would make an appropriate contribution. The masthead of a journal usually states the journal's purpose. In addition, many publishers encourage writers to contact the editor for help in determining the suitability of a paper. If a pharmacist writes a letter for this purpose, he or she should state the intent of the paper and provide an outline. For example, when I sent an outline of this paper to the editors of *AJHP*, they encouraged me to submit my manuscript as a primer and provided information on the distinguishing editorial features of *AJHP.*

Another factor that affects journal selection is the desired level of prestige. An official society journal is usually more prestigious and widely read than a journal published as a commercial venture. Writers can find the journal's circulation under the "statement of ownership, management and circulation," which is usually found in the November or December issue, or in a guide such as *Ulrich's International Periodical Directory.* Another means of evaluating prestige is provided by the impact factor, which reflects the number of times a journal's papers are cited by other authors. The impact factor can be found in *Citation Reports,* an annual volume in *Science Citation Index.*

The time required to publish a paper may also influence the selection of a target journal, especially if the writer is eager to disseminate the information quickly. The turnaround time depends on the quality and newsworthiness of the paper, the number of papers competing for space in the journal, and the peer-review process used, if any. Peer review promotes objectivity and quality through external review by the authors' peers but prolongs the turnaround. Peer-reviewed journals typically require 6 to 12 months to publish a paper, compared with 2 to 3 months for "rapid-turnaround" journals that hasten or omit peer review. Electronic or online journals offer another option for speedy publication by shortening the production and distribution components.

Resource materials. Writers who select the tar-

get journal early in the project can more easily take advantage of the journal's instructions to contributors. These guidelines contain valuable information on format, style, ethical issues, and procedures for manuscript submission and review. *AJHP* provides a thorough checklist that facilitates the development of manuscripts.

Many resource materials on the preparation of scientific papers are available; a small sample is summarized in Table 1. The Uniform Requirements for Manuscripts Submitted to Biomedical Journals[6] is a key resource because more than 400 medical journals comply. Instructional manuals for medical writers[3,7,8] provide tips on getting started and on developing and submitting scientific manuscripts. In developing this primer, I relied heavily on the books by Day[3] and Huth.[7] Other works address general style[9] and styles specific to scientific writing.[4,10,11]

Type of manuscript. The instructions to contributors specify the types of manuscripts that the target journal publishes. Acceptable formats often include editorials, review articles, original research articles, and various columns, such as letters to the editor. Editorials and in some cases reviews are often solicited, whereas the other types of manuscripts are usually unsolicited. Original research articles are often divided into full papers and brief communications. The shortest format that provides sufficient details to convey the main message is preferred.

Authorship. To qualify as an author, a person must be able to accept intellectual responsibility for the paper[12] Therefore, an author should be actively involved in the study, either in the design phase or in the final analysis. An author need not write the entire manuscript, but he or she should contribute to the manuscript and should be involved in the decision to publish the final draft.[6]

A team approach is useful in preparing scientific manuscripts,[13] but the trend toward multiple authorship, or "author inflation," has been criticized.[12] I use "writer" in this primer to emphasize the difference between writing and authorship. When I provided writing services to the pharmacists who converted their poster into a paper, I did not qualify as an author because I did not contribute to the design and execution of their project. Similarly, statisticians may or may not qualify as authors. The department chairman or senior research scientist who reviews and approves the protocol but does not participate in the execution of a study nor in the analysis of the results does not meet the criteria for authorship. The proper means of recognizing these contributors is through an acknowledgment.

Along with intellectual responsibility, an author accepts ethical responsibility for the manuscript. Next to tampering with data, plagiarism is perhaps the greatest sin. Original work by another author must be credited with a reference. All sources of funding should be properly acknowledged, and authors should strive to remain objective despite any financial interests. An author should not simultaneouslv submit the same manuscript to different journals without informing the editors. Techniques for camouflaging a manuscript submitted simultaneously, such as rephrasing the title, shuffling authors' names, switching the *x*- and *y*-axes in graphs, and using different languages do not render the practice any less unethical.[14]

Table 1.
Resources for Scientific Writers

Resource	Comment
How-To Resources	
Instructions to contributors (see individual journals)	Often published in first issue of new volume
Uniform Requirements for Manuscripts Submitted to Biomedical Journals[6]	Adopted by more than 400 scientific journals
Day RA. *How To Write and Publish a Scientific Paper*[3]	Extensive guidelines on preparing scientific papers; humorous examples
Huth EJ. *How To Write and Publish Papers in the Medical Sciences*[7]	Extensive guidelines on preparing scientific papers
Style Manuals	
American Medical Association Manual of style[4]	Style manual for AMA journals
The Chicago Manual of Style[10]	Time-tested, scholarly style manual
Schwager E. *Medical English Usage and Abusage*[11]	Practical examples of good and bad medical usage
Strunk W Jr, White EB. *The Elements of Sty/e*[9]	Instruction on the basics of writing; considered a classic; brief

Sections of a scientific paper

A good scientific paper is a finely tuned instrument of persuasion, but all too often the result is merely a collection of disconnected facts, like a telephone directory.[15] A paper should capture the reader's interest with the title and, with each new section, encourage continued reading. Each section has a unique role. To avoid a disjointed approach and convince readers, the writer should follow the principles of critical argument, which have been perfected in the courtroom. The trial attorney presents the problem or question, gives the evidence and relevant implications, describes the validity of the evidence and any weaknesses thereof, and makes a closing statement. If successful, this approach leads to the verdict that the attorney seeks.[7]

In a scientific paper describing original research, the stages of the critical argument translate into the introduction (problem or question), materials and methods (credibility of the evidence), results (evidence), discussion (assessment of supporting and con-

tradictory evidence), and conclusion (verdict).[7] This highly structured format can be traced to Pasteur and is almost universal in modern original research papers.[3,6] A scientific paper usually also includes a title, abstract, references, and tables and figures. Some of these elements are also found in review papers and columns.

One section of a scientific paper should not duplicate information in another, except for the title, the abstract, and occasionally the discussion, which may begin with a precis of the results. The sections of a paper are not necessarily written in the same sequence that they appear in the journal.[16] A writer may begin with the methods section because this information is readily transferrable from the protocol. Writing the results is a logical second step. The introduction and discussion are often written last because they tie the pieces together.

Title and abstract. The title is a highly condensed version of the abstract, which is in turn a miniature of the paper. The title should reflect the main message of the paper; it may or may not convey the conclusion. Abstracts are often constructed by writing a sentence or two for each of the main sections of the paper. Many writers prefer to write the abstract after they write the paper. If written first, the title and abstract can provide a convenient outline for the paper. However, this approach may necessitate several revisions of the title and abstract. In either case, a writer should ensure that any data given in the abstract match those in the text and tables.

Some journals, including *AJHP,* have a policy of using structured abstracts with sentences or brief paragraphs for the introduction (objective), methods, results, and conclusion (discussion is typically omitted).[17] The structured abstract is more informative than the conventional paragraph abstract, facilitates peer review before publication, assists readers in finding relevant articles, and allows more precise computerized literature searches.[18]

The introduction. The quality of the introduction often dictates whether the paper will be published or read. If the introduction is too short, readers may dismiss the paper because of perceived superficiality. If it is too long, readers may view the paper as boring and irritating.[7]

The introduction, regardless of whether the paper is an original research article or a review, should clearly state the problem and the reason for the investigator's approach to the problem.[3,7,16] The problem may consist of a scientific hypothesis or a question to be answered in a review (i.e., the paper's purpose or objective). The introduction should explain why the research was undertaken. The introduction need not reproduce data available in textbooks or flaunt a writer's knowledge. Specialized terms to be used throughout the paper should be defined in the introduction; abbreviations should be defined where they first arise.

The introduction may end with a description of the study design. If the description is brief, this approach does not greatly lengthen the introduction and is particularly useful if the materials and methods section is printed in small type.[7] Some writers insert the conclusion at the end of the introduction as a means of stimulating the reader's interest[3] If the paper has an abstract, however, it is redundant to place the conclusion in both the abstract and the introduction,[7] and many journals frown on this practice.

Materials and methods section. The materials and methods section should provide sufficient details to enable the reader to reproduce the experiment and validate the results.[3] The writer should describe the study's setting, subjects, equipment and materials, interventions, outcome measures, and method of data analysis. Whether written consent was obtained, the inclusion and exclusion criteria, the intended sample size, and the handling of dropouts should be specified. Information on interventions includes the randomization procedure used and drugs administered. Drugs should be indicated by generic or chemical names.[16] If relevant, the trade name and manufacturer may be designated in parentheses (e.g., Regutensin, ABC Pharmaceuticals).

Many biomedical journals are adopting rigorous policies to ensure that the statistical tests used by authors are appropriate for the study and are correctly done. When the statistical manipulation of data is complex, the author should consult a statistician. Ideally, the statistician is involved at the design stage, before the manuscript is written.

Writers often transpose information between the methods and results sections. For example, they may inadvertently insert demographic data in the methods section and place an explanation of statistical tests in the results section.

The methods section may be abridged in some types of manuscripts, such as short communications.[3] A review writer, however, should not omit a presentation of the research methods used.[19] The writer who explains the approach taken is more likely to convince readers of the validity of the main message. For example, the writer should identify the databases that were searched and the criteria used for including papers in a review. Otherwise, readers will wonder if the selection was biased.

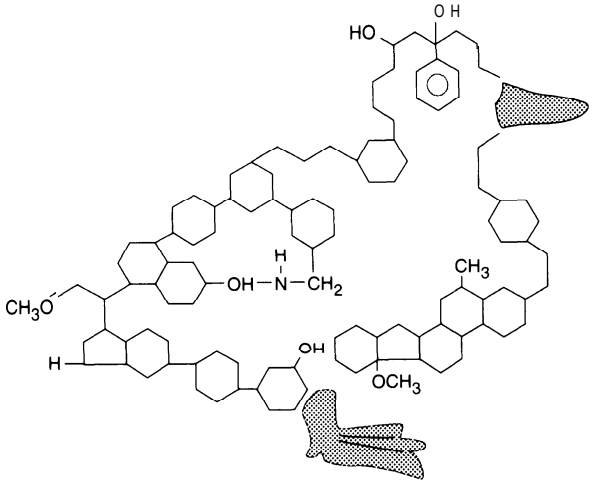
Results section. A well-written results section is one that efficiently and thoroughly reports the data obtained. The reporting of data often follows a pattern. When two or more diverse groups have been studied, the demographic characteristics of the groups should first be given (sometimes in a table). If the two groups are similar, a sentence indicating the lack of differences, or describing any minor differences, is sufficient; this assures the reader that observed differ-

ences are due to the interventions and are not subject related. The writer should account for all subjects who entered the study, including those who dropped out and other patients who were not evaluable. Next, the writer should report the data, such as outcomes in the control group (first) and test group (second).[7]

Large quantities of data are better presented in tables and figures than in the text. Some publishers permit liberal use of tables and figures,[20] while others discourage excessive use because of economic or aesthetic factors (multiple tables and graphs can be dull and present a cluttered look). A writer can ascertain a journal's posture on tables and figures by examining an issue and reading the instructions to contributors.

Tables are typically used to present numerical data that would require many sentences, or several long and awkward sentences, to describe. Graphs show relationships among sets of numerical data. Illustrations are helpful if they display results (e.g., a photograph of a unique drug reaction) or support a main concept (e.g., a representation of the interaction between a drug and its receptors). Figures that are peripheral to the main message are known as "ducks," a metaphor based on a butcher shop that was built in the shape of a giant duck.[21] In many papers, the chemical configuration is a duck (Figure 1), unless it is accompanied by a discussion of structure-activity relationships.

Figure 1. The chemical configuration is a classic example of a "duck," or a figure that fails to convey an important message.



Constructing detailed working tables and preliminary graphs during the early stages of writing can be useful. These form the basis for observational statements in the results and discussion sections. For example, a working table used in the preparation of a Regutensin review may detail published studies (Table 2). The writer may state, "Regutensin reduced supine diastolic blood pressure to ≤90 mm Hg in 80% of patients. The response rate was higher in patients treated with Regutensin than in those treated with hydrochlorothiazide ($p < 0.05$) and identical in patients treated with Regutensin or propranolol (Table 2)."

This example illustrates another important principle. The text and tables (or figures) should complement one another without presenting duplicate information. Writers should not write, "Table 3 summarizes the results of two double-blind, randomized studies. Jones (1991) found that Regutensin normalized supine diastolic blood pressure (BP) in 80% of 100 patients, while hydrochlorothiazide normalized supine diastolic BP in 60% of 99 patients ($p < 0.05$). Williams et al. (1989) reported that both Regutensin and propranolol normalized supine diastolic BP in 80% of 180 and 95 patients, respectively ($p > 0.05$)."

Table 2.
Working Table Summarizing Studies of Therapy with Regutensin[a]

Reference	Study Design	No. Patients Evaluable/ No.Enrolled	Drug Regimen(s)	Outcome(s)	Safety
Jones, 1991	Double-blind, randomized	100/120	Regutensin 10 mg/day X 6 weeks	BP[b] normalized in 80% of pts.	Adverse effects in 10% of pts.
		99/119	Hydrochlorothiazide 25 mg/day X 6 weeks	BP normalized in 60% of pts. (p = 0.002)	Adverse effects in 9% of pts.
Smith et al., 1985	Open,uncontrolled	50/60	Regutensin 10 mg/day X 4 weeks	SBP/DBP[C] lowered 15/10 mm Hg	Adverse effects in 35% of pts.
Williams et al.,1989	Double-blind, randomized (2:1)	180/200	Regutensin 10 mg/day X 6 weeks	BP normalized in 80% of pts.	Adverse effects in 11% of pts.
		95/100	Propranolol 80 mg b.i.d. X 6 weeks	BP normalized in 80% of pts. (*p* = 0.8)	Adverse effects in 20% of pts.

[a]These are not actual studies, but examples to illustrate the use of a working table.
[b]BP = blood pressure.
[c]SBP/DBP = systolic blood pressure over diastolic blood pressure.

Table 3.
Final Revision of Working Table (Table 2) Summarizing Double-blind, Randomized Studies of Therapy with Regutensin 10 mg/day[a]

Reference	Control/ Drug Regimen	No. Patients with Normal BP[b] after Six Weeks/No. Evaluable (%)		*P*
		Regutensin	Control	
Jones, 1991	Hydrochlorothiazide 25 mg/day	80/100 (80)	59/99 (60)	0.002
Williams et al., 1989	Propranolol 80 mg b.i.d.	144/180 (80)	76/95 (80)	>0.1

[a]These are not actual studies, but examples to illustrate the use of a working table.
[b]BP = blood pressure.

Studies already summarized in a table should not be abstracted in the text.

Eventually, working tables and graphs can be simplified so that the main message is evident within a few seconds.[21] In the revised version of Table 2 (Table 3), the writer made a separate column for *p* values to emphasize the main message. The writer omitted the column containing duplicate study design information and moved it to the table title. The writer eliminated the outlier study by Smith et al. and put the safety data in a separate table.

Tables and graphs must not be oversimplified. They should be freestanding, that is, contain enough information to be readily understandable without referring to the text.

The writer must request permission to use tables or figures from a published paper. The writer may wonder if it is necessary to request permission, especially if the table or figure is substantially modified from the original material. From a conservative perspective, the fact that the writer has a question is probably an indication of the need to obtain permission. Most publishers grant permission to reproduce copyright-protected material free of charge, but some charge a fee. The request should be made early to avoid delays.

Discussion section and conclusion. The discussion explores the implications of the results. Typically, the discussion begins by answering the research question that was posed in the introduction or by summarizing the findings. Additional supporting evidence is usually cited in the discussion. If previously published data contradict the writer's conclusions, the writer should assess the validity of his or her findings. The discussion section provides a forum for self-criticism-before the readers get a chance.[22]

There are several options for ending the discussion section. If conflicting evidence was not resolved, the writer may recommend a future investigation and suggest its design. The writer may discuss the degree to which the findings can be generalized to other patients with the same disease. If the writer is adhering to the critical argument analogy, he or she will close with a "verdict," which may be stated at the end of the discussion or separately as a conclusion.[7]

Writers should not hesitate to state their conclusion boldly and bluntly. Day[3] compared the shy writer to a squid. Writers who are doubtful of their facts tend to retreat behind a cloud of ink. If the writer carefully collected, analyzed, and integrated data, there is no reason to hedge or avoid making a conclusion.[19] Readers who have faithfully read the paper deserve a fitting climax.[3] On the other hand, the writer should not use this section as a platform to express opinions. The conclusion must be related to the objectives and should be adequately supported by the evidence.

References section. The references section (along with the rest of the manuscript) should be typed double-spaced to provide room for editors' and compositors' marks. The list may be alphabetized by the first author's surname (Harvard system) or may be numbered in the order in which the references are cited in the text (Vancouver system). In the Harvard system, references are indicated in the text as parenthetical interpolations of the author's name and the date of publication. For example, Regutensin has a long elimination half-life that permits once-a-day dosing (Jones, 1991; Williams et al., 1989). Numerical superscripts are used in the Vancouver system. Many medical and life sciences journals enumerate references, whereas social sciences journals prefer the Harvard system.

Some writers find it convenient to use the Harvard system during early drafts and then to convert to enumeration in the final draft. Some word-processing software programs obviate the need for using the Harvard system during the draft stage by providing an automated referencing system. However, the keystrokes required to set up and generate the references may be more time consuming than manually converting from the Harvard system to the Vancouver system.

The essential information for journal article references consists of the names of authors, the article title, the journal title, the year and volume number, the issue number or month if the journal begins each new volume with page 1, and the inclusive page numbers. Book references should give the author(s), the editor(s) if any, the title, the publisher and place of publication, the year, and page numbers unless the whole

book is being cited. Special requirements (such as giving publication numbers) apply to government and legal documents, films and recordings, and unpublished documents (which are often handled as footnotes rather than references). The instructions to contributors usually supply enough information to enable authors to prepare the reference list. The journal itself will provide useful examples, and style manuals discuss the subject in depth.

One of the author's ethical responsibilities is to check all bibliographic information against the original documents, as errors are common. Also, a writer should not cite a reference that he or she has not read.

Primary references (e.g., original research papers) are usually preferred over secondary references (e.g., reviews). If secondary references are used to identify pertinent material, the writer should retrieve the original references and verify that primary references were correctly cited.

Styling and revising the manuscript

Once a writer has prepared a draft, he or she should review the entire paper. Individual sentences should be perused, as well as the flow of logic from beginning to end. Even professional writers have to edit and revise their manuscripts several times. The writer should set the paper aside for a few days between readings. Colleagues may provide valuable suggestions. A popular technique for catching grammatical errors is reading the manuscript aloud.

Scientific writing is often marred by a needless opacity. Crichton[23] described the unwitting or deliberate veiling of meaning as "medical obfuscation." He identified recurring faults in scientific papers, such as a poor flow of ideas, verbiage, redundancy, and unnecessary complexity. Medical obfuscation can be limited by striving to be accurate, brief, and clear. Most pharmacists appreciate the need for accuracy. Brevity is crucial because every word in a manuscript adds to the cost of publishing and distribution. Clarity is its own ringing virtue.

One of the most common mistakes made by scientific writers is overuse of the passive voice, which is erroneously perceived as sounding more "scientific." The scientific literature is laden with sentences like "Blood pressure was lowered by 11/9 mm Hg in patients who were treated with Regutensin." The active voice is preferred because it is usually more precise and interesting, as well as less wordy. Thus, "Regutensin lowered blood pressure 11/9 mm Hg" says the same thing better in half the space.

The passive voice is also used to avoid the first-person pronoun. In an excellent book on medical English usage, Schwager[11] cautioned her readers about using such phrases as "it was found that. . . ." She noted that, if the study was worthy of publication, the authors should be proud to say, "We found that. . . ."

Although the basic rules of writing apply to scientific writing, some problems are unique to scientific writing. The use of tenses can be very tricky, for example. According to scientific ethics, published scientific work is accepted as established knowledge. Therefore, allusions to previous work should be in the present tense. For example, in the introduction to a paper, a writer may state, "Regutensin lowers blood pressure (Smith et al., 1985)." However, the writer's own work does not become established until after it has been published. If an investigator confirms the activity of Regutensin, he or she should write, "In our study, Regutensin lowered blood pressure." Consequently, the writer may alternate between the present tense and the past tense so that the abstract is in past tense, the introduction is in present tense, the methods and results sections are in past tense, and the discussion section is in present tense.[3]

The publication process

Writers preparing scientific manuscripts for submission should realize that publishers print only a fraction of the papers they receive.[4] To improve the chances for acceptance, a writer should carefully follow the journal's instructions to contributors. The writer should format the paper accordingly, submit the proper number of copies, and provide prescribed supportive materials (e.g., a signed copyright release statement).

Upon receipt of a manuscript, an editor (often the managing editor) categorizes the paper and assigns it to a staff editor who decides whether it should be rejected outright. If the manuscript passes this test, it may be routed to one or more outside experts for peer review.[4] During this time, the writer should receive a letter acknowledging the journal's receipt of the paper and stating how long the review process will take. For *AJHP,* the time between receipt of a manuscript and notification that the paper will be pursued for publication is 8 to 12 weeks.

Journal editors are ultimately responsible for evaluating the experts' recommendations and accepting or turning down the manuscript. Often an editor accepts a manuscript contingent on its revision. Some biomedical journals ask for several revisions before accepting a paper for publication. Indeed, writers' patience can be tried by what they perceive as unnecessary requests for changes. However, journal editors usually provide helpful, unbiased suggestions, which can both improve the manuscript and make it more suitable for publication in the journal in question. Following the editor's advice often spares the writer from embarrassing letters from readers.

Once a manuscript is accepted, a copy editor edits it for grammar, spelling, usage, ambiguities and inconsistencies, and journal style. In conventional publishing, the edited manuscript is returned to the writer

in the form of galleys, or long columns of typeset material. Many publishers take advantage of computer technology to go directly to page proofs. These publishers send photocopies of typeset material that is superimposed on pages to resemble the final published format. Some publishers, including ASHP, request computer disks to expedite this process. In either event, the writer should carefully review the typeset material and advise the journal of any necessary changes. At this point in the publication process, the journal typically only makes changes that are deemed essential.

If a paper is rejected, the writer should not be discouraged. Most good journals, including *AJHP*, reject at least 50% of the manuscripts submitted.[3] A writer can take advantage of the reviewers' comments to revise his or her paper and submit it to another journal or, depending on the tone of the rejection letter, resubmit it to the same journal.

Conclusion

In many ways, writing a scientific paper is like compounding a medication. Good scientific writing, like an extemporaneously prepared medication, requires precision, hard work, and an artistic touch.

The same ethical principles apply and the same basic writing skills are needed whether the writer is a novice or a full-time professional scribe. Good scientific writing follows a standard pattern, regardless of the audience and the publication vehicle. The journal's instructions to contributors provide practical guidelines and should be consulted frequently. The result should be a well-written paper that supports and disseminates the writer's message.

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