The reading, writing, and arithmetic of the medical literature, part 1

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Objective: To offer suggestions that will help clinicians improve their scrutiny of the medical literature and apply these suggestions to their own medical writings.

Data Sources: Literature searches began at the National Library of Medicine’s online database and were traced to primary sources.

Study Selection: All referenced information in this article was cited from primary sources.

Results: Objective criteria should be used when assessing the quality of clinical research reports and writing accurate, substantive reports. When reading or writing a journal article, authors should ask themselves if it meets the following standards of high quality: Is the topic or problem important and relevant to current practice? Is the stated reason for the study design valid? Is the description of the study methods clear enough to allow for replication by other researchers? What interventions are being compared, and is the comparison reasonable? Is the number of patients in the study sufficient to show a statistically significant difference? Do the study results have clinical relevance? Are new findings described in relation to the literature? Are both positive and negative aspects of the study addressed? Is the existing literature cited sufficiently? Do the results support the conclusions?

Conclusion: Reading and interpreting the medical literature require a set of skills that can be learned. Similarly, good medical writing skills can be developed. Achieving these skills should enhance the clinician’s practice of medicine.


INTRODUCTION

This article is the first of 3 that will examine reading, interpreting, and writing scientific medical literature. In this article, we present objective criteria to evaluate the quality of information presented in clinical research studies and reviews. Literature searches began at the National Library of Medicine’s online database and were traced to primary sources. All referenced information in this article was cited from primary sources. The second article in this series will discuss issues of study design and statistical analysis, and the third will examine the role of evidence-based medicine in practice and the appropriateness and validity of the authors’ conclusions.

Egyptian priests may have been the first to record observations on disease states and recommended treatments. Their documentation of these efforts represented a quantum improvement over the oral tradition of passing on knowledge of medical care. Some advantages of this development included an increased number of observers and a pool of knowledge that could be passed from healer to healer.

Hippocrates, the ancestral father of Western medicine, recorded his observations and treatments, which have influenced generations of physicians and have had a long-term impact on patient care. Other notable physician writings that influenced medical care were those of Galen, who also served as physician to the gladiators in Rome; Avicenna, who compiled the largest medical volume to date in the first century
and Maimonides, whose classic treatise on asthma remains a useful source of observations and principles. The scientific revolution of the Renaissance, along with the introduction of the printing press, increased the output of information in the medical literature. However, medicine and its practice remained an observational art, and the medical literature, although generally written by intelligent, articulate people, maintained this bias. Indeed, some prolific and talented orators and writers were so influential that they were able to promote (unknowingly) inappropriate, ineffective, and sometimes dangerous medical therapies. Fortunately, many of the early contributors were astute observers who provided accurate and useful information.

Scientific-based medicine was initiated in the late 19th century with the discovery of bacteria and their role in human disease. Koch's postulates were an early model for proof of cause and effect in the pathogenesis of disease. Our present medical literature is indebted to Galileo's initial calculations regarding gambling with dice. Thinkers such as Pascal, Cardano, and Huygens expanded the application of probability laws to more constructive aims. Later, pragmatic men of the business world would apply statistics to forecasting and quality control. Medical researchers and writers were slower to adopt these methods. In the last half of the 20th century, an increasing emphasis arose on proper research study design, including statistical analysis. Today, any meaningful clinical advance must be reported with statistical evaluation to have our confidence.

SHOW ME THE EVIDENCE!

Evidence-based medicine provides helpful guidelines for assessing the true quality, appropriateness, and validity of information. Consider the evidence from one of the earliest clinical trials: James Lind's 1747 comparison of cider, vinegar, sea water, citrus fruit, and other elixirs as treatment for 12 British sailors with scurvy. Citrus fruit treatment proved effective, so the British Admiralty mandated providing lime juice to all sailors. No one criticized the small sample size, the lack of informed consent, or the failure to control confounding variables. But that was then, when physicians often acquired medical information from sources other than journals and books.

Indeed, the first medical journal published in the United States did not appear until 50 years after Lind's report. The 1797 introduction of the quarterly Medical Repository was a pioneering attempt to present the relation between science and clinical practice in a serial format that permitted response and interactive communications. The journal initially had only 266 subscribers.

It was not until much later, in the 1940s, that results from the first randomized clinical trials were published. Given the relatively small size of the scientific medical literature, physicians were able to find, evaluate, and incorporate new knowledge into their everyday practice in an efficient manner. However, since then, results from more than 100,000 controlled clinical trials have been presented in a continually expanding universe of medical journals. By the late 1990s, approximately 25,000 medical journals were in print, and biomedical information was projected to double in only 19 years.

This information explosion spurred physician leaders to seek objective scientific criteria to evaluate and compare the often conflicting research evidence and then to apply their findings to patient care. Publication in a medical journal no longer guarantees that research findings are credible enough to apply in practice. Evidence-based medicine demands better evidence—indeed, the highest-quality evidence—from systematic research.

"The extent to which beliefs are based on evidence is very much less than believers suppose."—Bertrand Russell, "Sceptical Essays"

As you read or write a journal article, ask yourself if it meets the following standards of high quality:

- Is the topic or problem important and relevant to current practice?
- Is the stated reason for the study design valid?
- Is the description of the study methods clear enough to allow for replication by other researchers?
- What interventions are being compared, and is the comparison reasonable?
- Is the number of patients in the study sufficient to show a statistically significant difference?
- Do the study results have clinical relevance?
- Are new findings described in relation to the literature? Are both positive and negative aspects of the study addressed? Is the existing literature cited sufficiently?
- Do the results support the conclusions?

A recent survey reported that 64% of more than 2,000 published controlled trials on the treatment of schizophrenia were rated 2 or less on a scale ranging from 1 (lowest quality) to 5 (highest quality). Based on a high percentage of errors, the survey authors concluded that the results from many of these trials led to overestimating the benefits of medication treatments, a critical consideration for the practicing physician.

ASSESSING SCIENTIFIC ACCURACY AND INTEGRITY

The word errata entered into the National Library of Medicine PubMed search engine turned up approximately 1,000 corrections published recently in medical journals. Some errata are small imprecisions or inconsequential typographic errors, but others are significant errors, with potentially serious consequences. Significant errata qualify for published correction.

In an article on cancer medication, 2 different dosages were reported—"every day for 28 days" in the abstract vs "once every 28 days" in the text. In another article, radiation treatment doses of 3,000 and 6,000 Gy should have been 3,000 and 6,000 cGy. According to the erratum notice for this article, published several months later, treatment at the incor-
rect dose levels “is not compatible with patients’ survival.” Errors are reported even in multi-authored articles. In a recent review of 100 such errors, researchers found that 10 were significant enough to affect interpretation of the clinical trial results but not to affect a meta-analysis that included many other trials. However, 5 of the errors were able to change the final conclusions of a meta-analysis. Articles that must later be retracted can have even greater consequences. A retraction, as defined by the National Library of Medicine, is a letter to the editor or an editorial that indicates that a published article was based on fraudulent research—that is, research in which deliberately falsified or unsubstantiated data were used. Research fraud is not new, but recent cases have assumed different and subtler forms. A 1998 article, for example, raised the possibility that the combined measles, mumps, and rubella (MMR) vaccine might increase children’s risk for autism. After the article was published, many parents refused to let their children receive the combined vaccine, and a major public health hazard developed. However, a chief author had had a serious conflict of interest that was not disclosed at the time of the study: he received funding from lawyers contemplating action on behalf of children allegedly harmed by the vaccine. Six years later, after learning of the conflict of interest, the journal editors retracted the article. Ten of the original authors who could be contacted retracted their initial position and admitted that the data were insufficient to establish a causal link between the MMR vaccine and autism.

THE NEED FOR HEALTHY SKEPTICISM

Authors’ affiliations with prestigious medical schools and universities used to lend credibility to their articles, but the publish-or-perish imperative has driven up the number of authors per article and led to a corresponding decrease in accountability. A famous name appearing on a research article no longer guarantees that the individual actually contributed to the research or even read the manuscript. In one case, most authors of an article published in a prominent medical journal retracted their article because they had not reviewed or verified the data or read the manuscript before submission. This incident explains why many journals have adopted new rules to make authors more accountable. When you read an article, check for a list of the tasks performed by each author if it is available. Most journals also require disclosure of research support and potential conflicts of interest. Clearly, today’s editors, reviewers, and contributors recognize the need for healthy skepticism.

READING, WRITING, AND TRANSLATING THE LITERATURE

Physicians are part of a longstanding tradition that states that scientific medical advances must be shared with colleagues around the world. Almost every clinician has made observations that could be worthy contributions to the advancement of knowledge in his or her specialty. Unfortunately, many potential authors never commit their findings to paper. Time pressures, uncertainty about the publication process, perfection paralysis, or fear of rejection may be to blame. In a survey of authors whose papers had been published in a psychotherapy journal, most of the 50 respondents said that reading other journal articles had been a major factor in helping them write their own. Thus, a key to writing good articles is reading good articles.

Helping colleagues prepare their manuscripts for publication is another way to ease into the writing process. Careful reading, criticizing, and revising involve learning from others’ mistakes, while performing an important professional courtesy. Serving as a peer reviewer for a medical journal is an excellent way to obtain firsthand knowledge of standards for accepting and rejecting submitted manuscripts while giving something back to the research community. Nevertheless, writing scientific articles is rarely easy. A survey of rejection letters illustrates what often goes wrong:

- The study did not address an important scientific issue.
- The study was not original.
- The relevant literature was not adequately covered.
- The description of treatments was insufficient.
- The sample size was too small.
- The study was poorly controlled (confounding variables were not eliminated).
- The statistical analysis was incorrect or inappropriate.
- The presentation of findings was confusing.
- The data were insufficient.
- The conclusions drawn from the data were unjustified.
- The authors or sponsors had a significant conflict of interest (eg, publication might benefit them financially).

Outlining the basic components of a journal article well before completing a study is a simple step that might help you avoid such issues. If you document your methods while conducting the study, you can avoid omitting important information when you write your paper months later. Similarly, laying out templates for tables and figures can help identify key data that should be highlighted in the report. During a research study, many investigators repeatedly ask themselves what they have done, why they have done it, what they have found, and what the findings might mean. Readers of scientific articles should ask the same questions of the authors.

THE FORMAT OF JOURNAL ARTICLES

Most research articles published in medical journals adhere to a basic format: abstract, introduction, methods, results, discussion, and conclusion. What is the best way to evaluate the quality of each component? Whether you are an interested reader, a reviewer, or a writer, the following guidelines should help sharpen your skills.

The Abstract: Read Skeptically; Write Carefully
A summary of all the important components of the research article, the abstract is meant to pique the curiosity of potential readers. It is usually the first thing most people read—and
often the only thing. The abstract may be the only part of the article to be made electronically accessible through MEDLINE or other search engines, so accuracy is extremely important.  

Unfortunately, inaccurate abstracts are much more common than one might think. Pitkin et al.19 analyzed a random sample of articles published in 6 major general medical journals. The proportion of "deficient" abstracts (those with inconsistencies, omissions, or both) ranged from a low of 18% in one journal to a high of 68% in another. Inconsistencies between the abstract and the body of the article (eg, different data) were more common than omissions (eg, abstract data not in body). Although most errors were minor, some were potentially serious.

Researchers are advised to prevent such errors by writing the abstract only after writing the body of the article. The order of writing ensures that important facts are extracted only from the final version of the text. Many journals require a structured abstract, with subheadings such as objective, design, main outcome measures, results, and conclusion. Subheadings help writers organize their data succinctly and check their facts carefully and can help readers quickly identify their own points of interest in the article. If you find an important fact or conclusion in the abstract, a critical next step is to check it against the design parameters and fully reported findings in the body of the article.

The Introduction: Why Should Anyone Read This Article? The introduction should motivate readers to read the entire article and to care about the findings being reported. Here the authors should explain why the research was conducted and what it adds to the body of evidence in the field.  

A critical reading of the introduction considers whether the research being reported is innovative, well justified, or perhaps trivial. Do the authors present a new medication, a new procedure, a new device, a unique case, or an unusual patient population? Most research studies add a small finding to all those that have come before. This finding simply helps to show whether a hypothesis is more or less likely to be correct. So, the question that should usually be asked is whether a similar study has ever been conducted, but whether this latest study can add anything meaningful to what is already known:

- Is the clinical issue addressed in this study sufficiently important, and do key decision makers have sufficient doubts about the issue?
- Only 3 or 4 paragraphs are needed to convey all this information, and citing relevant prior studies is an important part of the introduction. Most authors research the important articles by searching MEDLINE. Generally, references should be up to date, but they may include older, classic articles. Of note, articles in which authors fail to include 1 or more key citations should cause concern about the level of rigor involved in writing the report.

The Methods Section: How to Evaluate Results Seemingly the least interesting part of the scientific article, the methods section should provide a clear overview of what was done in the study being reported. The importance of this section becomes more apparent when one considers that study methods determine study results. For example, if researchers use too low a dose of a particular medication, patients may show no change in their condition. Or, if researchers include too few patients in their study groups, a statistically significant difference may be impossible to demonstrate. Without careful attention to these methodologic details, it will be difficult to evaluate what is reported in the results section.

Most methods sections include descriptions of the following basic study elements  
- Methods and treatment interventions used—in sufficient detail to permit other scientists to evaluate and duplicate the study
- Materials, agents, and devices used
- Subjects (including controls), selection criteria, sample sizes, methods of assigning subjects to treatments, and discontinuation of the protocol (eg, randomization, blinding, matching criteria)
- Statistical analyses and other methods used to analyze results, including a description of subjects and results to be excluded from the analysis
- Consent procedures, ethics review, and rules for stopping the study

The experimental design is another important methodologic element that must be specified. Most of the research reports published in medical journals fall into the following design categories:

- Experiments (treatment is administered to animals or patients in artificial, controlled surroundings)
- Clinical trials (medication, surgical treatment, or another intervention is given to a group of patients who are then followed up and observed)
- Secondary research (data are obtained from several studies, eg, economic analyses, decision analyses, guidelines, systematic reviews, overviews, and meta-analyses, and analyzed)
- Qualitative research (subjective rather than quantitative information is obtained from interviews, observations, or surveys)
Because clinical trials often change the course of clinical practice, their methods deserve special attention. To ensure that important clinical details are not omitted from articles that describe these trials, many journal editors abide by the Consolidated Standards of Reporting Trials (CONSORT) statement regarding format of the methods section. In this format, a separate subsection is devoted to each protocol aspect (eg, subject assignment, blinding mechanisms).24

The methods section should mention whether the clinical trial or other study being reported was double-blind, single-blind, or placebo controlled; whether measurements were parallel-group, paired (or matched), or within-subject comparisons; whether each patient received both the intervention and the control treatment (crossover design); whether the study permitted investigation of the effects of more than one independent variable on a given outcome (factorial design); and whether the researchers controlled or accounted for potentially confounding variables, such as dietary factors and changes in patients’ daily activities. After reviewing all these issues, readers should ask whether the design used by the authors was the most appropriate one for testing the hypothesis under study. (The subsequent articles in this series will address the aforementioned study design considerations.)

Because methods determine results, there are still more issues to consider. The following is a list of the 6 essential questions that should be asked about a research study.

- What is new about the study?
- Who were the subjects?
- Was the study design appropriate for answering the research questions?
- Were the methods clean, and was systematic bias avoided?
- Was the study large enough and continued long enough to make the results credible?
- Do the methods point clearly to the results?

Subjects. To find out if the results of a study are applicable to clinical practice, you must determine if the study participants are similar to your patients. Were the participants inpatients or outpatients? Were they randomly selected or recruited through an approach such as a newspaper advertisement? (The latter subjects might be unusually motivated to follow treatment guidelines.) Were subjects of varied age, ethnic, and socioeconomic groups included, and are these groups representative of the population of interest? (If a certain medication is tested only in healthy white men, for example, the results may not be applicable to women, elderly patients, or African American patients.)

If a study compares groups of subjects, consider how subjects were assigned to those groups and make sure there was no selection bias. If control subjects were used, they must be “good controls” — equivalent to the experimental subjects in all relevant aspects. For example, all groups being compared must be equivalent in age distribution, illness severity, and comorbid conditions.

The methods section must also mention any ethical or privacy issues. It should specify that research involving human subjects was conducted according to the World Medical Association Declaration of Helsinki guidelines, which were designed to protect the life, health, dignity, and privacy of all subjects. In addition, physicians and hospitals in the United States must now ensure that patients’ privacy is protected under the terms of the Health Insurance Portability and Accountability Act of 1996.

Procedures, Medication Doses, and Other Details. Reports of studies of procedures, techniques, diagnostic tests, and other interventions must include sufficient description of the methods involved so that readers will be able to evaluate and use these modalities. Factors important in preparing patients (eg, diet, medications to avoid, posttest precautions), performing procedures (eg, technique, possibility of pain), and analyzing and interpreting results should be described.

The methods section in reports on medication studies should specify the generic names of all agents and the dosages used. If dosages were titrated, the method of titration must be indicated. Other important questions that might be addressed are as follows:

- Were pharmacokinetic and pharmacodynamic measures used to evaluate efficacy and safety?
- Were assays performed to measure medication concentrations in body fluids? Were specificity and sensitivity of these assays indicated?
- Were medication histories taken, and, if so, were patients asked about nonprescription agents and “complementary” therapies?
- Was the potential for medication interactions considered?
- How was adherence to treatment regimens measured?
- Were adverse reactions to medications evaluated by questionnaire, patient interview, or physical examination?

Clinical vs Surrogate End Points. When you read a study about a new medication or procedure for treating seasonal allergies, for example, you also want to know if the treatment will ease your patients’ symptoms or prevent recurrences. Those are clinical end points. Clinicians are probably less interested in the effects of the treatment on tissue levels of related antigens or in other measures that do not directly reflect either clinical benefit or harm to patients. These indirect measurements are known as surrogate end points.

In therapeutic trials, surrogate end points are often used as a substitute for a clinically meaningful end point that directly measures how a patient feels, functions, or survives. An effect on a surrogate end point is not of any obvious value to the patient but may be valuable if it is part of the causal chain that leads to the clinical outcome. Using an antihypertensive medication that lowers blood pressure (surrogate end point) may not change the way a patient feels, but it may help prevent strokes (clinical end point). On the other hand, measurement of the blood concentration of an antibiotic is not a valid predictor of clinical cure of an infection.

In many medication studies, surrogate end points are used because they are relatively easy to measure and can show statistically significant changes quickly—well before any clinical benefits are observed. If a study relies on these
surrogate factors, readers should ask themselves whether they are valid and reliable predictors of the treatment goal.²⁹

**Statistical Analysis.** Just tabulating the results of a research study and describing what was found will not qualify a paper for publication in most journals. Investigators must also mention which objective, quantitative measures (statistical tests and software) were used to calculate any treatment effects and indicate why those measures were the most appropriate.

Furthermore, choosing the correct statistical tests and interpreting their results are not easy. The second and third articles in this series provide helpful guidelines for evaluating the quality and appropriateness of statistical analyses, evaluating the validity of conclusions drawn from these analyses, and recognizing the difficulties inherent in presenting results from biomedical research.

**The Results Section**

In contrast to considering all that goes into preparing a methods section, a good results section is short and succinct. Generally, results data are consolidated and illustrated in tables and figures, and the text simply tells readers what to look for there.¹⁶

"Everything should be made as simple as possible, but not simpler."—Albert Einstein, Style: Toward Clarity and Grace

Generally, the results section includes 3 subsections: patient information (characteristics and disposition), efficacy analysis, and safety and tolerability analysis.

Patient Information. This subsection should indicate, perhaps in flowchart form, the following:³⁰
- Number of patients in each treatment arm or study group
- Number of patients lost to follow-up and number excluded or withdrawn (with reasons)
- Duration of trial and follow-up
- Any deviations from planned protocol (with reasons)

Efficacy Analysis. This subsection should begin with statements about estimated effects found on primary outcome measures and on any secondary measures. If possible, absolute numbers should be used (eg, 10/20, rather than 50%), along with variability measures such as ranges and standard deviations.

If a difference is statistically significant, both P values and confidence intervals should be indicated. Be sure you understand the nature of the difference. Is it between a baseline value and a posttreatment value (within-treatment difference) or between 2 treatment arms at a given point (between-treatment difference)? Statistical comparisons should be explained in sufficient detail to permit replication and alternative analyses.²⁴,³⁰

The efficacy subsection should follow the same format as the methods section. That is, efficacy data should be presented for all methods described earlier—and in the same order. Even results that are normal or did not change should be included (eg, "All blood counts were normal").²¹

**Safety and tolerability analysis.** Generally, the incidence of adverse events or adverse changes in laboratory values is listed in a table in this subsection. The text should summarize the most commonly reported adverse events and should include an explanation regarding any adverse event that seems to be related to treatment. Any deaths or unusual reactions to treatment should be described in full, although detailed interpretations and explanations should be saved for the discussion section.³⁰

**Tables and Figures.** Tables and figures can be used to minimize the amount of text needed and to make findings more understandable. Use a table to organize different groups’ numerical data, such as patients’ ages, ethnic group data, baseline measurements, and follow-up measurements. Use a figure to graphically present such data as time curves and differences in effects between subject groups. As you scan a table or figure, make sure its data match the data in the text.²¹

Many journals have guidelines regarding the number and size of tables and figures but nothing regarding their quality. Tables should be as clear and simple as possible. Table footnotes should be kept to a minimum so that readers will not have to look back and forth just to understand the table.²¹ Figure 1 shows how a difficult-to-understand table can be simplified and improved. Likewise, figures should be understandable at a glance. If they are too complex and difficult to interpret, omit them. Be skeptical in your information. Figure 2 is an example of a difficult-to-read figure.

**The Discussion Section: So What and Who Cares?**

In the discussion section, authors should explain what they have found rather than just enumerate results. The first thing

| Table A. Pancreatic Function and Serum Enzyme Levels in CF Patients |
|------------------------|-----------------|------------------|
| **Group**              | **Age in Years**| **Number of Patients** | **Serum Enzyme Activity (Units/Liter)** |
| CF-A¹                 | 6-27            | 6                | 1.6 ± 0.7³   |
|                       |                 |                  | (0.6-2.7³)  |
| CF-B²                 | 5-27            | 6                | 12.6 ± 6.0³  |
|                       |                 |                  | (4.6-21.0)  |

¹CF patients with pancreatic insufficiency confirmed by provocative secretory studies with duodenal intubation.
²Mean ± SD.
³Numbers in parentheses, range.

| Table B. Pancreatic Function and Serum Enzyme Activity in Patients With Cystic Fibrosis |
|----------------------------------|------------------|--------------|
| **Group**                        | **Mean**        | **SD**       | **Range**   |
| Pancreatic insufficiency         | 6-27            | 6            | 1.6 ± 0.7³  |
| Pancreatic sufficiency           | 5-27            | 6            | 12.6 ± 6.0³ |

¹P<0.001, Wilcoxon rank sum test.

Figure 1. A difficult-to-understand table (Table A) can be simplified and improved (Table B). Reprinted from Garfunkel and Merrill.²¹
to look for is a clear introductory statement about major findings and their clinical importance. The rest of this section should be a succinct presentation of the principles, relationships, and generalizations derived from the results. Length is not a virtue here; clarity is.\textsuperscript{16,30}

"The improvement of understanding is for two ends: first our own increase of knowledge; secondly to enable us to deliver that knowledge to others." — John Locke, Style: Toward Clarity and Grace

The most important question to be answered in the discussion section is whether the results support the initial hypothesis—and, if not, why not? Authors should also discuss how their results agree or contrast with previous findings. Unlike the brief introduction, the discussion section usually includes a thorough review of relevant literature. This is also where authors can introduce possible implications and practical applications of their results. But, beware of overspeculation.\textsuperscript{16,30}

What happens if results are negative—if authors do not prove their hypothesis? This situation is fairly common, and, though published less often than positive results, reports of negative studies with accepted hypotheses can be equally valuable contributions to the advancement of knowledge. However, authors commonly deemphasize negative results regarding their primary outcome measure by focusing on the positives regarding secondary measures. According to a study of more than 200 articles that presented negative results, information provided in the articles was often insufficient for assessing the validity of those results.\textsuperscript{31}

"Good things, when short, are twice as good." — Gracián

Every study has its limitations—uncontrolled variables, patient nonadherence, missing data, and so forth. These should be mentioned in the discussion section and, if possible, explained or rebutted. It is up to authors to express confidence in significant results and to ease doubts about discrepancies.\textsuperscript{16} Similarly, it is up to readers to scrutinize what is written—and to read between the lines. For example, did the authors minimize safety concerns to present a medication or procedure in the best possible light? Did they account for all patients in the study results? Did they overlook critical findings?\textsuperscript{27} In the final paragraph of the discussion section, authors should briefly restate their major conclusions and the implications of these conclusions for future research.

The Conclusion

To conclude is to end, not to begin. This section should not repeat the introduction, and it should not introduce new information. In the conclusion, authors should sum up the article with 1 or 2 succinct sentences.

References, References, References

Most journals have a set format for listing references. Researchers should cite primary (original research) publications rather than secondary sources. Keep in mind that an overlong reference list does not improve the credibility of a paper.

Did you ever begin searching for a cited reference only to discover that its article title or volume number was incorrect? Results from studies of journal articles have shown that more errors appear in references than in any other section. Of a random sample of more than 2,000 references from 3 journals, 23% had errors.\textsuperscript{32} Incorrect author names and incorrect or missing volume or issue numbers—the 2 most common mistakes—accounted for 61% of errors. Many of these errors occur when authors copy references from secondary sources and fail to check the primary ones.

CONCLUSION

This report identifies objective criteria to use when assessing the quality of clinical research reports and writing reports that will be accurate, substantive additions to the scientific literature. The next report in the series describes how to evaluate the quality and appropriateness of the statistical analyses used in research studies.

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REFERENCES


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**Objectives:** After reading this article, participants should be able to demonstrate an increased understanding of their knowledge of allergy/asthma/immunology clinical treatment and how this new information can be applied to their own practices.

**Participants:** This program is designed for physicians who are involved in providing patient care and who wish to advance their current knowledge in the field of allergy/asthma/immunology.

**Credits:** ACAAI designates each Annals CME Review Article for a maximum of 2 category 1 credits toward the AMA Physician's Recognition Award. Each physician should claim only those credits that he/she actually spent in the activity. The American College of Allergy, Asthma and Immunology is accredited by the Accreditation Council for Continuing Medical Education to sponsor continuing medical education for physicians.

**CME Examination**

**CME Test Questions**

1. When you read a medical article, you should ask questions about:
   a. the clinical importance
   b. the study design
   c. the study methods
   d. statistics
   e. all of the above
   f. a, b, and c
2. Articles are retracted because of:
   a. fraudulent research
b. reevaluation of data, revealing errors or insufficiencies
c. none of the above
da. all of the above

3. Which of the following are criteria for a creditable scientific paper?
   a. a famous author
   b. a famous institution
   c. a famous journal
   d. all of the above
   e. none of the above

4. Common reasons for articles being rejected for publication include which of the following?
   a. the study was poorly controlled
   b. the presentation of findings was confusing
   c. the conclusions drawn from the data were unjustified
   d. all of the above
   e. none of the above

5. Abstracts of manuscripts should be written:
   a. before the manuscript
   b. after the manuscript
   c. it doesn’t matter

Answers found on page 166.