



Training and Professional Development

A Step-by-Step Guide to Writing a Scientific Review Article

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Abstract

Scientific review articles are comprehensive, focused reviews of the scientific literature written by subject matter experts. The task of writing a scientific review article can seem overwhelming; however, it can be managed by using an organized approach and devoting sufficient time to the process. The process involves selecting a topic about which the authors are knowledgeable and enthusiastic, conducting a literature search and critical analysis of the literature, and writing the article, which is composed of an abstract, introduction, body, and conclusion, with accompanying tables and figures. This article, which focuses on the narrative or traditional literature review, is intended to serve as a guide with practical steps for new writers. Tips for success are also discussed, including selecting a focused topic, maintaining objectivity and balance while writing, avoiding tedious data presentation in a laundry list format, moving from descriptions of the literature to critical analysis, avoiding simplistic conclusions, and budgeting time for the overall process.

Key words: manuscript; research; scientific review article; writing.

Introduction

The process of researching and writing a scientific review article can be a seemingly daunting task but can be made manageable, and even enjoyable, if an organized approach is used and a reasonable timeline is given. Scientific review articles provide authors with an opportunity to synthesize the available evidence about a specific subject, contribute their insights to the field, and identify opportunities for future research. The authors, in turn, gain recognition as subject matter experts and thought leaders in the field. An additional benefit to the authors is that high-quality review articles can often be cited many years after publication (1,2). The reader of a scientific review article should gain an understanding of the current state of knowledge on the subject, points of controversy, and research questions that have yet to be answered (3).

There are two types of review articles, narrative or traditional literature reviews and systematic reviews, which may or may not be accompanied by a meta-analysis (4). This article, which focuses on the narrative or traditional literature

review, is intended to serve as a guide with practical steps for new writers. It is geared toward breast imaging radiologists who are preparing to write a scientific review article for the *Journal of Breast Imaging* but can also be used by any writer, reviewer, or reader. In the narrative or traditional literature review, the available scientific literature is synthesized and no new data are presented. This article first discusses the process of selecting an appropriate topic. Then, practical tips for conducting a literature search and analyzing the literature are provided. The structure of a scientific review article is outlined and tips for success are described.

Selection of a Topic

Scientific review articles are often solicited by journal editors and written by experts in the field. For solicited or invited articles, a senior expert in the field may be contacted and, in turn, may ask junior faculty or trainees to help with the literature search and writing process. Most journals also consider

Key Messages

- Scientific review articles provide a focused and comprehensive review of the available evidence about a subject, explain the current state of knowledge, and identify gaps that could be topics for potential future research.
- Detailed tables reviewing the relevant scientific literature are important components of high-quality scientific review articles.
- Tips for success include selecting a focused topic, maintaining objectivity and balance, avoiding tedious data presentation, providing a critical analysis rather than only a description of the literature, avoiding simplistic conclusions, and budgeting time for the overall process.

proposals for review article topics. The journal's editorial office can be contacted via e-mail with a topic proposal, ideally with an accompanying outline or an extended abstract to help explain the proposal.

When selecting a topic for a scientific review article, the following considerations should be taken into account: The authors should be knowledgeable about and interested in the topic; the journal's audience should be interested in the topic; and the topic should be focused, with a sufficient number of current research studies (Figure 1). For the *Journal of Breast Imaging*, a scientific review article on breast MRI would be too broad in scope. Examples of more focused topics include abbreviated breast MRI (5), concerns about gadolinium deposition in the setting of screening MRI (6), Breast Imaging Reporting and Data System (BI-RADS) 3 assessments on MRI (7,8), the science of background parenchymal enhancement (9), and screening MRI in women at intermediate risk (10).

Scientific Literature Search and Analysis

Once a well-defined topic is selected, the next step is to conduct a literature search. There are multiple indexing databases that can be used for a literature search, including PubMed, SCOPUS, and Web of Science (11–13). A list of databases with links can be found on the National Institutes of Health website (14). It is advised to keep track of the search terms that are used so that the search could be replicated if needed.

While reading articles, taking notes and keeping track of findings in a spreadsheet or database can be helpful. The following points should be considered for each article: What is the purpose of the article, and is it relevant to the review article topic? What was the study design (eg, retrospective analysis, randomized controlled trial)? Are the conclusions that are drawn based on the presented data valid and reasonable? What are the strengths and limitations of the study? In the discussion section, do the authors discuss other literature that both supports and contradicts their findings? It can also be helpful to read accompanying editorials, if available, that are written by experts to explain the importance of the original scientific article in the context of other work in the field.

If previous review articles on the same topic are discovered during the literature search, then the following strategies could be considered: discussing approaches used and limitations of past reviews, identifying a new angle that has not been previously covered, and/or focusing on new research that has been published since the most recent reviews on the topic (3). It is highly encouraged to create an outline and solicit feedback from co-authors before writing begins.

Structure of a Scientific Review Article

Writing a high-quality scientific review article is “a balancing act between the scientific rigor needed to select and critically

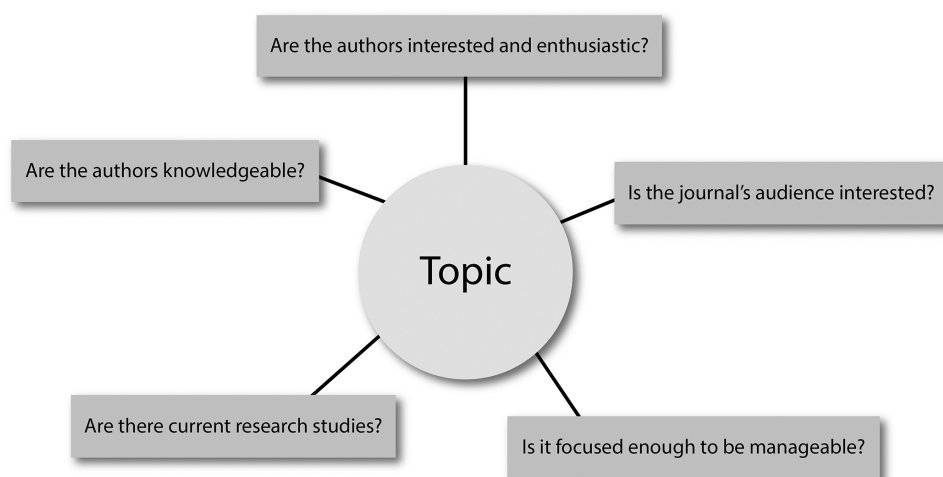


Figure 1. Summary of the factors to consider when selecting a topic for a scientific review article. Adapted with permission from Dhillon et al (2).

appraise original studies, and the art of telling a story by providing context, exploring the known and the unknown, and pointing the way forward” (15). The ideal scientific review article is balanced and authoritative and serves as a definitive reference on the topic. Review articles tend to be 4000 to 5000 words in length, with 80% to 90% devoted to the body.

When preparing a scientific review article, writers can consider using the Scale for the Assessment of Narrative Review Articles, which has been proposed as a critical appraisal tool to help editors, reviewers, and readers assess non-systematic review articles (16). It is composed of the following six items, which are rated from 0 to 2 (with 0 being low quality and 2 being high quality): explanation of why the article is important, statement of aims or questions to be addressed, description of the literature search strategy, inclusion of appropriate references, scientific reasoning, and appropriate data presentation. In a study with three raters each reviewing 30 articles, the scale was felt to be feasible in daily editorial work and had high inter-rater reliability.

The components of a scientific review article include the abstract, introduction, body, conclusion, references, tables, and figures, which are described below.

Abstract

Abstracts are typically structured as a single paragraph, ranging from 200 to 250 words in length. The abstract briefly explains why the topic is important, provides a summary of the main conclusions that are being drawn based on the research studies that were included and analyzed in the review article, and describes how the article is organized (17). Because the abstract should provide a summary of the main conclusions being drawn, it is often written last, after the other sections of the article have been completed. It does not include references.

Introduction

The introduction provides detailed background about the topic and outlines the objectives of the review article. It is important to explain why the literature on that topic should be reviewed (eg, no prior reviews, different angle from prior reviews, new published research). The problem-gap-hook approach can be used, in which the topic is introduced, the gap is explained (eg, lack of published synthesis), and the hook (or why it matters) is provided (18). If there are prior review articles on the topic, particularly recent ones, then the authors are encouraged to justify how their review contributes to the existing literature. The content in the introduction section should be supported with references, but specific findings from recent research studies are typically not described, instead being discussed in depth in the body.

In a traditional or narrative review article, a methods section is optional. The methods section should include a list of the databases and years that were searched, search terms that were used, and a summary of the inclusion and exclusion criteria for articles (17,19).

Body

The body can take different forms depending on the topic but should be organized into sections with subheadings, with each subsection having an independent introduction and conclusion. In the body, published studies should be reviewed in detail and in an organized fashion. In general, each paragraph should begin with a thesis statement or main point, and the sentences that follow it should consist of supporting evidence drawn from the literature. Research studies need not be discussed in chronological order, and the results from one research study may be discussed in different sections of the body. For example, if writing a scientific review article on screening digital breast tomosynthesis, cancer detection rates reported in one study may be discussed in a separate paragraph from the false-positive rates that were reported in the same study.

Emphasis should be placed on the significance of the study results in the broader context of the subject. The strengths and weaknesses of individual studies should be discussed. An example of this type of discussion is as follows: “Smith et al found no differences in re-excision rates among breast cancer patients who did and did not undergo preoperative MRI. However, there were several important limitations of this study. The radiologists were not required to have breast MRI interpretation experience, nor was it required that MRI-detected findings undergo biopsy prior to surgery.” Other examples of phrases that can be used for constructive criticism are available online (20).

Conclusion

The conclusion section ties everything together and clearly states the conclusions that are being drawn based on the research studies included and analyzed in the article. The authors are also encouraged to provide their views on future research, important challenges, and unanswered questions.

References

Scientific review articles tend to have a large number of supporting references (up to 100). When possible, referencing the original article (rather than a review article referring to the original article) is preferred. The use of a reference manager, such as EndNote (Clarivate, London, UK) (21), Mendeley Desktop (Elsevier, Amsterdam, the Netherlands) (22), Paperpile (Paperpile LLC, Cambridge, MA) (23), RefWorks (ProQuest, Ann Arbor, MI) (24), or Zotero (Corporation for Digital Scholarship, Fairfax, VA) (25), is highly encouraged, as it ensures appropriate reference ordering even when text is moved or added and can facilitate the switching of formats based on journal requirements (26).

Tables and Figures

The inclusion of tables and figures can improve the readability of the review. Detailed tables that review the scientific

literature are expected (Table 1). A table listing gaps in knowledge as potential areas for future research may also be included (17). Although scientific review articles are not expected to be as figure-rich as educational review articles, figures can be beneficial to illustrate complex concepts and summarize or synthesize relevant data (Figure 2). Of note, if nonoriginal figures are used, permission from the copyright owner must be obtained.

Tips for Success

Select a Focused but Broad Enough Topic

A common pitfall is to be too ambitious in scope, resulting in a very time-consuming literature search and superficial coverage of some aspects of the topic. The ideal topic should be focused enough to be manageable but with a large enough body of available research to justify the need for a review

Table 1. Example of an Effective Table From a Scientific Review Article About Screening MRI in Women at Intermediate Risk of Breast Cancer.

First Author, Year	Number of Patients	Number of MRI Examinations	CDR per 1000 MRI Examinations ^a	Sensitivity of MRI	PPV of Biopsies Performed (Lesion Level)
Port, 2007	182	478	10.5 (5/478)	71.4% (5/7)	13.0% (6/46)
	LCIS, ALH, ADH				
Friedlander, 2011	133	307	16.3 (5/307)	NR	22.7% (5/22)
	LCIS				
Sung, 2011	220	840	14.3 (12/840)	70.6% (12/17)	20.0% (12/60)
	LCIS				
King, 2013	455 ^b	NR	NR	NR	NR
	LCIS				
Schwartz, 2015	48	62	16.1 (1/62)	NR	20.0% (1/5)
	LCIS				
	131	180	11.1 (2/180)	NR	14.3% (2/14)
	ALH, ADH				
Chikarmane, 2019	145	264	22.7 (6/264)	NR	28.6% (6/21)
	LCIS, ALH, ADH				

Abbreviations: ADH, atypical ductal hyperplasia; ALH, atypical lobular hyperplasia; CDR, cancer detection rate; LCIS, lobular carcinoma in situ; NR, not reported; PPV, positive predictive value.

NOTE: The Detailed Table Provides a Summary of the Relevant Scientific Literature on Screening MRI in women with lobular neoplasia or ADH. Adapted with permission from Bahl (10).

^aThe reported CDR is an incremental CDR in the studies by Friedlander et al and Chikarmane et al. In all studies, some, but not all, included patients had a prior MRI examination, so the reported CDR represents a combination of both the prevalent and incident CDRs.

^bThis study included 455 patients with LCIS (some of whom had concurrent ALH or ADH). Twenty-nine cancers were MRI-detected, and 115 benign biopsies were prompted by MRI findings.

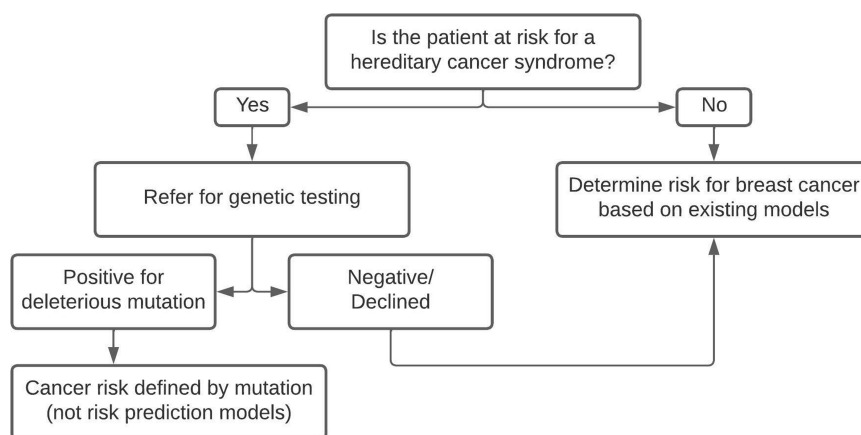


Figure 2. Example of an effective figure from a scientific review article about breast cancer risk assessment. The figure provides a risk assessment algorithm for breast cancer. Reprinted with permission from Kim et al (28).

article. One article on the topic of scientific reviews suggests that at least 15 to 20 relevant research papers published within the previous five years should be easily identifiable to warrant writing a review article (2).

Provide a Summary of Main Conclusions in the Abstract

Another common pitfall is to only introduce the topic and provide a roadmap for the article in the abstract. The abstract should also provide a summary of the main conclusions that are being drawn based on the research studies that were included and analyzed in the review article.

Be Objective

The content and key points of the article should be based on the published scientific literature and not biased toward one's personal opinion.

Avoid Tedious Data Presentation

Extensive lists of statements about the findings of other authors (eg, author A found Z, author B found Y, while author C found X, etc) make it difficult for the reader to understand and follow the article. It is best for the writing to be thematic based on research findings rather than author-centered (27). Each paragraph in the body should begin with a thesis statement or main point, and the sentences that follow should consist of supporting evidence drawn from the literature. For example, in a scientific review article about artificial intelligence (AI) for screening mammography, one approach would be to write that article A found a higher cancer detection rate, higher efficiency, and a lower false-positive rate with use of the AI algorithm and article B found a similar cancer detection rate and higher efficiency, while article C found a higher cancer detection rate and higher false-positive rate. Rather, a better approach would be to write one or more paragraphs summarizing the literature on cancer detection rates, one or more paragraphs on false-positive rates, and one or more paragraphs on efficiency. The results from one study (eg, article A) need not all be discussed in the same paragraph.

Move from Description (Summary) to Analysis

A common pitfall is to describe and summarize the published literature without providing a critical analysis. The purpose of the narrative or traditional review article is not only to summarize relevant discoveries but also to synthesize the literature, discuss its limitations and implications, and speculate on the future.

Avoid Simplistic Conclusions

The scientific review article's conclusions should consider the complexity of the topic and the quality of the evidence. When describing a study's findings, it is best to use language that reflects the quality of the evidence rather than making

definitive statements. For example, rather than stating that "The use of preoperative breast MRI leads to a reduction in re-excision rates," the following comments could be made: "Two single-institution retrospective studies found that preoperative MRI was associated with lower rates of positive surgical margins, which suggests that preoperative MRI may lead to reduced re-excision rates. Larger studies with randomization of patients are needed to validate these findings."

Budget Time for Researching, Synthesizing, and Writing

The amount of time necessary to write a high-quality scientific review article can easily be underestimated. The process of searching for and synthesizing the scientific literature on a topic can take weeks to months to complete depending on the number of authors involved in this process.

Conclusion

Scientific review articles are common in the medical literature and can serve as definitive references on the topic for other scientists, clinicians, and trainees. The first step in the process of preparing a scientific review article is to select a focused topic. This step is followed by a literature search and critical analysis of the published data. The components of the article include an abstract, introduction, body, and conclusion, with the majority devoted to the body, in which the relevant literature is reviewed in detail. The article should be objective and balanced, with summaries and critical analysis of the available evidence. Budgeting time for researching, synthesizing, and writing; taking advantage of the resources listed in this article and available online; and soliciting feedback from co-authors at various stages of the process (eg, after an outline is created) can help new writers produce high-quality scientific review articles.

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Conflict of Interest Statement

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