

WRITING A RESEARCH REPORT IN MEDICAL SCIENCES

Chapter 3

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Introduction

The research report (or manuscript) is the way by which scientists communicate the importance and relevance of their work to their colleagues. All members of the sciences must master the skill of research writing to share their work with colleagues, to obtain grants for their research, and to achieve promotion. This chapter will review the steps and the order to writing a research report. The authors have extensive experience writing in the field of medicine specifically, but we attempt to broaden the topic to scientific writing in general. Specific scientific fields will have significant differences in style, article length and methodologic detail that are beyond the scope of this article.

Definitions

A research report is a specific form of technical writing in which scientists convey the results of research to other members of the scientific community. It is a way of exchanging information at scientific meetings and in published literature.

Although different scientific disciplines have different styles and formats, what is common to all research reports is that they should allow the reader to



understand the importance of the question asked, to reproduce the research performed and to comprehend how the findings are important to the field.

We live in a connected world full of opinions on a plethora of topics. The majority of these opinions come in the form of summarized reports: books, movies, recipes, TV shows, video games, music, fashion, and much more. These personal perspectives help others decide whether to make a purchase, accept a proposal, read a paper, or incorporate particular research into their work.

Research reports can be found in all scientific publications, abstracts, theses, and grant requests. Posters and oral presentations are also a form of presenting research at scientific meetings, and presentations follow similar guidelines and structure.

Chapter Objectives

- List one pitfall in research report writing
- Describe the rationale for the order of writing a successful manuscript
- Name three key style points in research report technical writing

Importance of Writing a Good Research Report

For students studying science, learning how to write research reports in the sciences is not only critical for graduation, but is an integral part of sharing your research with others. For those in research professions, research writing skills are a must for obtaining grants and academic promotion. For clinician-educators, research reports are written to share interesting findings in case reports and case series, systematic reviews, and results of clinical

trials. For medical practitioners, passive exposure to research occurs in medical school and during residency, however active performance of research studies is helpful and sometimes necessary to distinguish one's record to obtain more competitive specialty placements.

Answering a high-quality research question or testing a hypothesis is one of the most important parts of research. However, it is equally important to present your question and your findings in a way that is easy to understand. An unclear question and a disorganized presentation of research data are two of the more common reasons given for editors to reject a manuscript.¹



Chapter Outline

- **The Ingredient List: Before you start writing**
- **Assembling Your Recipe: Writing while you research**
- **Into the Oven: Perform your research**
- **Decorate/Garnish: Presenting your results and discussion**
- **Packaging and Shipping**
- **Other Considerations**
- **Discussion Questions**
- **Writing Activity**
- **Helpful Resources**
- **Glossary**

The Ingredient List- Before You Start Writing

Ben Franklin once said, “By failing to prepare, you are preparing to fail”. The natural urge of all beginning writers is to immediately start stringing together sentences. However, much like creating your own new cake creation, there must be careful preparation if you are to be successful- and more importantly, you must carefully detail the steps so others can understand and follow your recipe.

First step- choosing a topic

Earl Nightingale once said, “Everything begins with an idea.” This is also true for your research report. Before you embark on the journey of publication, it is important to find a good question to study. As easy as it may sound, this is the toughest phase and decides the future of your project. You may have made an interesting observation or have a question that piques your curiosity.



The first step is to find out what is already known on the subject. How would your question meaningfully change what is currently known? This may lead to more questions, or further refinement of your original question. As you are defining the question, consider the SMART framework.²

First described by Doran in 1981 in context of management goals, the SMART framework is an important tool that could give you better idea if the project you are undertaking is achievable. SMART is an acronym that stands for specific, measurable, attainable, realistic, and time bound.

For example, my co-author and I once read an article characterizing an interesting phenomenon of professionals called impostor syndrome. We found the concept interesting and wondered if we could ask a good question around it. Using the SMART paradigm, we came up with:

Specific: What was the prevalence and associated factors with impostor syndrome in practicing hospitalists?

Measurable: We found that there was a validated scale to measure and quantify this phenomenon.

Achievable: We knew we had a large hospitalist department that could get us an adequate sample size in a reasonable time.

Relevant: Given a wide variety of males and females and U.S. trained and international doctors, we thought this question was relevant to a hospitalist audience; given the recent emphasis on burnout, we thought this represented an important question to our community of hospitalists.

Time-bound: We believed that we could accomplish within 6-9 months.

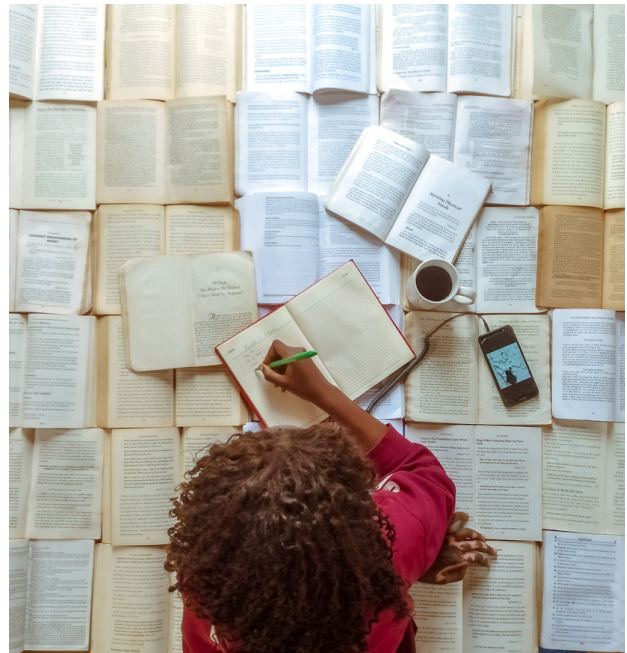


Perform Your Literature Search

Bernard of Chartres once said, “if I have seen further, it is by standing on the shoulders of giants.” All successful scientific research is built upon the studies that came before it. Incomplete or inaccurate literature searches are some of the most common reasons to have a paper rejected.³ Chances are an editor who knows the literature will spot the absence of an important paper- especially if it is theirs!

Literature searching could be an entire chapter of its own. Since it is beyond our scope to detail every aspect of it, we suggest you take help from a trained librarian or enroll in free online courses on advanced search. This is especially important if you are writing a review article or designing a systematic review.

The goal of literature search is to make sure your question is novel and answers an important question. It is important to take copious notes so that you can quickly access the key materials so you can more easily organize what is known and cite that work. Highlight the type of study, subjects and important results. Note study design, measurement tools and unusual findings that you might also consider investigating. While searching for literature, build a database using a citation manager. This saves time and you can efficiently cite your paper if you prepare well and compile a bibliography. Dive deeply and analyze your research question. Where would your findings fit in the grand scheme of what is known in the literature? What might others have found that you could possibly investigate further, and what did the authors believe were the “next steps” for the field? Use this information to further refine your question.



Designing Your Study

Now that you have a good knowledge of your field of study and what is currently known, the next step is to organize your question into a hypothesis. There can be more than one question or research hypothesis. After analyzing your results, you may realize you possibly have more than one research report. Who will you study, and will that population have the outcomes you seek? Will you collect data retrospectively or prospectively? Are there validated tools that can help you determine your primary outcome? What other confounding data do you want to collect, and what other factors may be associated with your outcome?

In the case of our study, we wanted to study hospitalists in one large tertiary institution for evidence of impostor syndrome. We hypothesized that impostor syndrome was as or more prevalent than other fields and would be more common in new and international graduates and those without a mentor. We decided on a cross-sectional study, and decided to perform the study in winter (to avoid bias of very recent graduates who had not acclimated). We identified a validated tool that the original author created for her description of impostor syndrome that had been studied in many other populations (but not hospitalists).



Get Feedback

If you have not already discussed your idea with a more senior mentor, now is the time to do it. Consider sharing some sentinel articles with them so that they can understand enough of the background to speak intelligently about your topic in case they do not already know the specific topic area. Pitch your question, your study type, and your methods to them. Be ready to discuss feasibility, study power, number of outcomes and ability to retrieve the data in an efficient manner. This is a great time to identify studies that should not go forward any further and drop them right here, or to come up with a different idea that may be more feasible or answer a better question. It is far better to end an idea at this stage than to carry on an “albatross” study that is doomed to suck away time with little chance of success.

We reviewed our study idea with our team, including our statistician. We decided we had enough sample size to likely obtain meaningful results if we could receive responses from most of the hospitalists. We decided to offer a drawing for a gift card to increase participation.

Building Your Team

It is entirely possible that you will need more than one set of hands for your project, especially if you are performing a systematic review or retrospectively analyzing a large dataset. You should also consider offering authorship to mentors that guide you (but only if they meaningfully participate in the work).

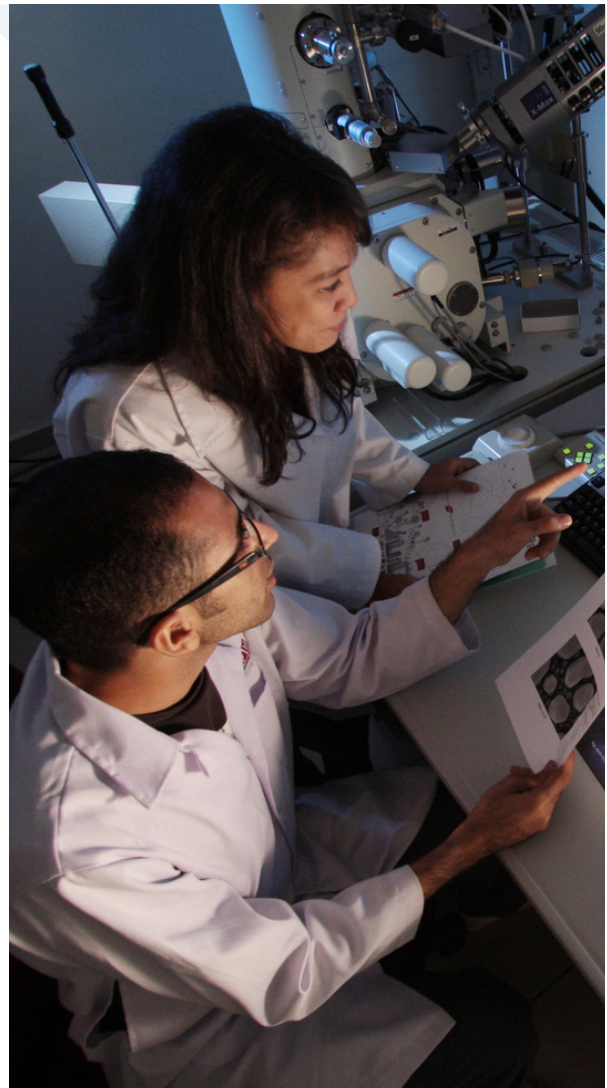
Decide early on what responsibilities team members will have. If this is your project, it can be assumed that you will be the first author- but make that explicit to all. This will save lot of heartache and confrontations in the end. The last author is typically the senior member of the team. The second author would be expected to have significant writing responsibilities, with the others less so. Get agreement from the team about turnaround times for tasks and responses to queries and drafts. Get clear commitments for those expectations, and let colleagues know that they may not be co-authors on the final project if they cannot follow through. Statisticians and research assistants are often co-authors if they contribute significantly to the paper. (The “instructions for authors” section of all journals will define “significant contributions”.) Authors who do not qualify for authorship can have their contributions acknowledged at the paper’s conclusion.

For our study, we decided that we needed only my co-author and a statistician. We decided on tasks, most of which were assumed by the first author, and a timeline was laid out.



Assembling Your Recipe: Writing While You Prepare

The next important step now is to select your target journal to identify word limits and formatting for your research report. Often a review of your selected articles will show you where similar articles are published, and those are typically your best targets. While your mother may believe that your article belongs in the *New England Journal* and your recipe on the *Food Network*, it is highly likely for most articles that their editors will disagree, costing you valuable time in the case of a rejection. As a general rule, consider sending to one of the more competitive journals from your bibliography first, as even a first rejection will often give you good feedback. The JANE website (<https://jane.biosemantics.org/>) can be a helpful tool to choose a journal site to send also. When you have identified a target journal, review their “information for authors.” Specifically look for word counts, tables and figures, headings, font type and size, maximum citation number and formatting style. Start preparing the article in that format. The IMRaD format has been accepted as an international study for writing manuscripts for most disciplines. IMRaD stands for Introduction, Methods, Results and Discussion. Introduction and Methods section can be used to submit it to IRB. This saves you time for reduplicating your efforts by writing your proposal for IRB and writing Introduction and Methods for your research. Figure 1 shows the overview of this methodology (see page 7).



Keys to Writing the Introduction

The first paragraph of your introduction should be the “hook” that gets others to read on. It is typically 4-5 sentences and no more than 15 lines. Cite the literature as you write, or at least mark it for citation in your draft so you can cite it later. The opening sentence of each paragraph should describe the key point in the paragraph. The first paragraph should include an overview of what is known in field that is directly relevant to your question. This should be followed by a second paragraph that clearly delineates the specific gaps in the current research (that are about to be answered by you!). End the introduction with a third paragraph that clearly describes your research question or hypothesis. Do not include results here! Write in the past tense, with an active voice.

Figure 1



* * Refer to journal guidelines.

** The EQUATOR Network | Enhancing the Quality and Transparency of Health Research (equator-network.org)

*** JANE: [Journal / Author Name Estimator \(biosemantics.org\)](http://Journal / Author Name Estimator (biosemantics.org))



Keys for Writing the Methods Section

Now is the time to spell out the “recipe”. One of the core tenets of science is that findings can be reproduced. Tell them exactly what you did, with enough detail that they could also do it.

Essential components are:

Study type: Clarify your study design.

Subjects: Clarify inclusion and exclusion criteria. Who did you keep in the study? How did you recruit them?

Study procedures: We suggest reviewing a reporting guidelines checklist specific for your study type to make sure all components are present. Journal editors will do the same. The EQUATOR network is an excellent website to find reporting guidelines for all study types and is an international standard.

(<https://www.equator-network.org/reporting-guidelines>)

Randomization: For randomized controlled trials, how did participants get assigned to groups?

Outcomes: Clarify what it was that you sought to measure. Describe any measurement tools (assays, lab tests, manufacturers) and if necessary, how the data was found, extracted and validated.

Statistics: Clearly describe how you analyzed your data, what software you used, how data points may have been combined, how you handled missing data, what you determined was a significant p- value. Report study size and power analysis if relevant.

Regulatory approval: If applicable, tell them which Institutional Review Board looked at your protocol and whether you had registered your trial.

Seek Regulatory Approval (IRB, Clinical Trials Registration), If Required

If you have written the introduction and the methods, you have most of the hard work done for this step. Include this using the templated format that your Institutional Review Board and registration site recommends. Consider having someone in a regulatory office look over your consent forms to make sure the correct verbiage is present. Develop any needed recruiting materials and consent forms now and submit to the IRB also. If performing a randomized, controlled trial or a systematic review, consider registering your trial or study (clinicaltrials.gov, [Cochrane collaboration](http://Cochrane.org) or [PROSPERO](http://PROSPERO.org)).

Fortunately, our introduction and methods were the majority of the information we needed for the IRB, and the IRB office helped us with the appropriate verbiage for our consent form and our recruiting tools.

Into the Oven-Perform Your Research

This is the phase of data collection and analysis. We suggest exhaustively collecting all potentially necessary data. It is probably better to err on the side of collecting too much data than having to go back to study subjects (or charts) again. Consider testing your collection devices to make sure there is no ambiguity between chart extractors that may introduce bias. Data fields should have only one data point, and numerical and ordinal data should be in separate fields for ease of later analysis. When in doubt, run your data collection tool by your statistician.

We chose to use an online survey tool that could be sent by e-mail. We tested it several times on our co-authors to make sure it would work and that it had all the data we needed in the correct fields.



Review Your Data/Statistical Analysis

This is the “toothpick testing” time! Science is not more forgiving than cooking, nor are editors any kinder than your stereotypical mother-in-law's cooking feedback. However even if you do not have the results you expected, you can still feed a hungry family. The uniqueness of your question and your experiment is what makes it important, and even “negative” results can advance the field.

At this point you should create graphs and tables of your results. Discuss with mentors and your team about how the results confirmed or were discrepant from your original hypothesis and consider explanations for why. Even discrepant results that are different than what was previously known may add meaningfully to the literature. You may need to explicitly share the current literature with your mentor and team again before this discussion.

We were surprised to find that the rate of impostor syndrome was not higher in women, was not higher than other specialties and was lower in international graduates. We discussed possible reasons with our team.

Decorate/Garnish- Presenting the Results and Discussion

Keys for Writing the Results Section

Use tables and figures in places where it more efficiently presents your data than words alone. Do not repeat material from tables into text. Do not interpret results. Save interpretation for the discussion and conclusion sections. Tables and figures should be self-explanatory enough to stand on their own without a legend. It is important to use the word “significant” to mean “statistically significant” only. Do not use the word “significant” to assign importance.³ Avoid describing trends (avoid “we note a trend toward significance”). Avoid unnecessary intensifiers, such as “very”, “great”, “fundamentally”, “virtually”, and “quite”.

Your desire to cheerlead your own findings will come off as a bias to reviewers. Remember that the word “data” is plural (“our data are”, not “our data is”).

Keys for Writing the Discussion Section

Follow the notes you took during your team meetings and discussions regarding the expected and unexpected results. Using a whiteboard, outline the written introduction, then the discussion side- by -side. Build from the introduction, but do not repeat sentences from there in the discussion. Cite as you go, or at least mark sentences for later citation in your draft.



1st paragraph: Recap your important findings, place your results in context and describe them in light of your original hypothesis. Did it prove or disprove your what you hypothesized? Discuss the importance of what you found.

2nd paragraph: Compare what you found to what is known in the literature and try to explain why the results are different if they are discrepant.

3rd paragraph: Describe the strengths and limitations of your study. Be thorough with the limitations so that reviewers do not believe that you were unaware of them.

Conclude by summarizing the “take-home” message and suggesting next steps for the field or this line of research. Avoid any urges to over-reach. Do not say “this the first ever study to...” unless, you are sure; otherwise, the real “first ever” is likely to be your reviewer (and will hand you your “first ever” rejection!).

Packaging and Shipping

Keys to Adding Citations

Hopefully at this point you already have collected your literature search using a citation manager system. Both Zotero and Mendeley are free and easy to use, while others come with a cost. Using a citation manager both cuts down on errors as new citations are added and allows for simple changes in formatting if resubmission is required. Cite only the original work, not a secondarily cited paper. Make sure you do not have more citations than the journal allows.

We used a citation manager to quickly place citations and build a list of references in the manner dictated by our intended journal.

Keys to Writing the Abstract

Most people will never read your full article, but many may find your abstract on a free search engine. When you are submitting to scientific meetings, abstracts are typically all that they ask for. Editors may make their decision to read further or immediately reject after reading the abstract. Write it last. Read your whole paper and create the abstract as its summary. An abstract is usually written as three paragraphs- Introduction/Background (1-2 sentences), Results (3-4 sentences) and Discussion (1-2 sentences). Use the framework and headings recommended by the journal's "information for authors". Be concise, and do not over-reach.



Keys to Final Review Before Submission

Writing your cover letter

Address your cover letter to the journal editor by name if it is listed. Tell them why your article is important to their audience and their journal's mission. Explain why you specifically chose that journal. Choose three to four keywords that describe the content of your article (these are typically medical subject headings that can be found on PubMed for the similar articles already in your bibliography).

Before Submission:

Take a final look at information for authors and your study-specific EQUATOR checklist guidelines to make sure you included everything. You will also need your co-authors' e-mail contact information. Consider reading your paper out loud, as compound sentences and unclear verbiage are often more obvious orally. Consider asking someone not on the research team to review, especially if you are a non-native speaker of the language you are writing. Scan for changes in font type and size and correct them. Use a spell-checker and review all highlighted findings.



Keys to the “Response to Reviewers”

Count yourself lucky if you make it to a stage requesting a revision, as your publication chances have improved. Reviewers are unpaid volunteers with experience in publishing. Make their job as easy as possible. Consider the following tips:

- If reviewers have specific questions, address them completely.
- Consider building a table with two columns and place each of their specific comments on the left half and your responses on the right half so that they can easily see your individual responses.
- For reviewers comments where you have made changes, place those changes in the response section also so they can view the changes easily. Include every slight change including format or grammar.
- Journals often ask for a copy with changes visible as well as one with changes accepted; provide both.
- Always thank the reviewers for their time in helping make your paper better.

Although we were not successful with our first journal choice, we received some helpful tips to modify, and were successful in our second journal after minor revisions.

The full text of our article can be found here:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8043605/>

Format & Appearance

Adhere strictly to the format advised in the “information for authors” section. Avoid unnecessary headers that are not called for by the journal’s formatting suggestions.

Voice/Tone/Language Expectations

Attempt to avoid passive voice. Write the methods section in the past tense, but otherwise stay in present tense. Write both precisely and concisely. Attempt one concept per sentence. Avoid complex sentences that readers will struggle to understand.

Style Expectations for the Discipline-Specific Document (example: MLA, APA, Chicago, CSE/CBE, AMA, ACS, Bluebook, ALWD, etc.)

Style expectations vary widely by journal. Pick your initial target journal early and write in that format. Using a citation manager can save hours by allowing for quick format changes. Follow the explicit style instructions of the journal.

Supplemental elements of the discipline-specific document (if appropriate)

Posters and Oral Presentations:

At large scientific meetings, your abstract can be accepted as a poster or as an oral presentation. Posters are abstracts made into large posters. We suggest making posters in Microsoft PowerPoint or an equivalent software and printing it to size using large color printers. Please look for font size and poster size guidelines as specified by the meeting guidelines. Use the center of the poster for tables or graphs of your results. Tables should be able to be understood easily without legends. Oral presentations are also abstract data presented in a small or large group event. You will have to create slides for this presentation. Do not include every detail on the slide. Try to keep it engaging with pictures, tables, and graphs.

Since the pandemic, there have been more online posters and virtual presentations that are pre-recorded. Watch your pre-recorded slide show for any errors. You will be required to record your voice in a slide show. You may log in and be available for questions while your voice is being played.

- Original sample of the discipline-specific document type is found and cited above
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8043605/>

Discussion Questions

1. List two important components of planning your research paper that are important steps before writing.
2. Outline the order of steps for a research paper and describe why that order is important.
3. If you ever have failed at getting a manuscript published, find and critically appraise that project. What could have been done in the planning phases? Review the text. How does the introduction clearly lead to your hypothesis? What detail should you have added in the methods? How did you organize the discussion, and how could it be improved?
4. Identify one sentinel article in your field, and dissect it using the above framework. How did the authors use the introduction paragraphs to describe their question? Are all of the relevant EQUATOR framework recommendations implemented? How did the authors organize the discussion section using the above framework?



Writing Activity

Take one important idea you have recently considered and attempt to develop it using the SMART paradigm. Perform a rudimentary literature search and use this to write a three-paragraph introduction that concludes with your clinical question. Have this critically appraised by a mentor or content expert in the field.

List of helpful resources:

- Huth EJ. *Writing and Publishing in Medicine*. Williams & Wilkins; 1999.
- Hulley SB. *Designing Clinical Research*. Lippincott Williams & Wilkins; 2007.
- Browner WS. *Publishing and Presenting Clinical Research*. Lippincott Williams & Wilkins; 2012.



Glossary

EQUATOR network: Enhancing the QUALity and Transparency Of health Research

JANE: Journal/Author Name Estimator

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