

Teaching and Learning Publishing Skills in Biomedical and Clinical Sciences: A Guide to Setting Educational Priorities

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Introduction

The reporting of research activities and results in scientific articles is essential for the professional success of every researcher. Publishing in internationally read journals provides visibility and documents the researcher's capabilities. Researchers who aspire to publish in leading journals must know how to structure a research paper, how to clearly express scientific concepts, and how to prepare their manuscripts for favorable outcomes at editorial peer review. Nonetheless, most researchers begin their careers without having had any training in scientific reporting. Considering the great importance that is placed on publishing the results of scientific research, it is perplexing that so little attention is given to teaching young researchers the necessary skills.

There is some confusion regarding what skills need to be taught so that researchers, especially non-native English speaking (NNES) researchers, can publish effectively throughout their careers. Since most scientific reporting is done in English, it is common in some non-Anglophone countries to confuse knowledge of scientific English with knowledge about communicating science in written English, which requires a series of publishing skills. Scientific reporting today is done according to a formal structure that has evolved over time and that continues to evolve in order to meet the increasing requirements for clarity and transparency. Therefore, a successful researcher-author not only knows the basic principles of scientific writing as they have developed over the past decades but also stays up to date in reporting trends, in order to meet the high standards of selective journals, i.e. journals that accept for publication only a small fraction of all received manuscripts.

With this guide, I aim to clarify the main issues of teaching and learning publishing skills, by defining the various skills and proposing educational priorities from a researcher's viewpoint. These recommendations are based on my education and training as a biomedical researcher at major US universities, a 13-year experience as author's editor¹ in Italy, and participation in international editing associations and their meetings. This white paper, written for educators and organizers of continuing professional development activities, aims to promote informed decisions about acquiring and developing training programs in written scientific communication, for NNES students and researchers in biomedical and clinical sciences.

Requirements for publishing in selective journals

The main requirement for the successful publication of a research paper is the quality of the research itself. The hypothesis that was investigated must be pertinent to the advancement of scientific knowledge: research questions that are banal or of little importance to the current day will

¹ An editor who improves the language and communicative properties of a manuscript that has not yet been accepted for publication, by working with the authors rather than for the publisher.

not entice the interest of leading journals. Moreover, the experimentation must be sufficiently rigorous to substantiate the validity of the data being reported. Assuming, then, that a study's scientific hypothesis is relevant and its methodology is solid, the key to publishing success is an effective communication of the research activities and findings. Excellence in research reporting is achieved with a series of publishing skills, summarized in the following paragraphs.

Familiarity with scientific publishing

Research journals, especially those indexed in Medline, choose manuscripts through a collaborative process called peer review that involves the evaluation by other researchers in the same field. Understanding how this process works is important, especially for researchers who aim to publish in selective journals. Also important is understanding how readers access the literature and how they choose between online and print and between free and subscription journals. The biomedical publishing industry is a dynamic sector that is undergoing rapid evolution as a result of innovations in digital technologies, demands for open access, increasingly stringent ethical requirements, and the economic repercussions of globalization. Authors who follow these developments are best able to position their texts in journals that guarantee visibility and scientific impact.

Confidence with reading and critical appraisal

My experience as both researcher and editor has taught me that the foundation of proficient written scientific communication is a competent reading habit. Only by being a regular, savvy “consumer” of the scientific literature can one appreciate what is required to “produce” a research paper suitable for publication. A competent reading habit is much more than being able to read scientific English. It means being able to navigate with agility within a paper's contents to find needed information, evaluate papers rapidly for relevance and quality, interpret data in tabular and graphic form, determine the strength of the evidence, and spot red flags of poor quality. It also means feeling comfortable finding both strengths and weaknesses of published works, i.e. having a culture of critical appraisal. Being a demanding reader helps one appreciate the need for rigor, precision and information richness in scientific communication; this positively impacts upon one's writing.

Regular reading of research papers in one's own field is also important because it exposes the reader to the specific language and style of that field. This familiarity through reading is the basis for the genre approach to teaching scientific writing, in which novice authors study a corpus of high-quality articles and identify patterns on which they can model their own works.

English grammar and style

The communication of research findings is invariably done in English. Writing in English requires knowledge of English grammar, a large vocabulary, and an understanding of how English academic texts are structured. Ideally, researchers are already fluent in English when they begin their careers, having studied the language in public schools and during study abroad programs. Given the importance of reading the scientific literature for a career in medicine or biology, English proficiency should be a prerequisite for entering these degree programs. Researchers with poor English language skills are disadvantaged, both in interpreting the research literature and in contributing to it.

Systematic approach to scientific writing

The research paper is structured into four main sections (Introduction, Materials and methods, Results, and Discussion; IMRAD) plus several smaller, yet not less important text elements. Altogether, this articulated structure plays an important role in writer-reader communication, since it guides both authors (in organizing their information) and readers (in finding needed information). The correct distinction between a method and a result and between an introductory statement and an interpretive comment makes an article easy to be evaluated and increases its scientific impact.

Scientific writing, like scientific reading, is not tied to the linear order of the text. A research paper is not written, nor read, from abstract to conclusions. It is composed according to a systematic process that comprises a general approach to composing a research paper and particular strategies for the main sections and other text elements. Mastering these writing procedures minimizes the likelihood of inserting numerical errors and conceptual inconsistencies, and facilitates the production of a coherent text.

Appreciation of international reporting standards

Since 1964, the Declaration of Helsinki has provided ethical guidance for conducting clinical studies that are useful, safe and respectful of the human subjects who are investigated. The Declaration of Helsinki is produced by the World Medical Association, a federation of national medical associations of almost all nations of the world. Over the years, the Declaration has undergone several revisions which extended its scope, so that today it sets standards not only for ethical research practice but also for transparent research reporting, such as the need to indicate sources of funding and to declare conflicts of interests.

Alongside the Declaration of Helsinki, numerous other guidelines promote quality reporting. The most known is the Uniform Requirements for Publishing Manuscripts in Biomedical Journals. Like the Declaration of Helsinki, the Uniform Requirements have expanded in scope over the years, so that today this document deals with authorship, conflicts of interest, privacy, overlapping publications and more. Other examples of such guidelines are the CONSORT statement for reporting randomized controlled trials and the PRISMA statement for writing systematic reviews and meta-analyses. Understanding and adhering to these standards, independently of national requirements, are essential parts of the research-publication process.

Attribution through citation and paraphrasing

In a research paper, much of the content of the Introduction and Discussion sections is based on already published works. Proper attribution to the original sources is a fundamental aspect of written scientific communication, for both creating an accurate, solid evidence base for the new text and respecting the achievements of others. Authors need to know what are citable documents and how their selection impacts upon the quality of a manuscript, how to place citations within the text to substantiate statements and help readers retrieve the source materials, and what are the repercussions – both professional and scientific – of failing to attribute correctly. Moreover, they must know how to reproduce the ideas of other authors through paraphrasing, a type of rewriting in which selected content is summarized using an original word choice and linguistic structure.

The skills of citation and paraphrasing are receiving renewed interest because of the increasing awareness that manuscripts of inexperienced writers often contain plagiarism. Plagiarism is a broad term

that encompasses several poor writing practices that vary in severity. Author plagiarism, which means taking a published document, substituting the author's name with one's own, and republishing it as original, is intentionally deceitful yet rare. Surprisingly frequent, however, are other less serious forms of plagiarism, such as self-plagiarism (presenting parts of one's own published texts as original content) and microplagiarism (“copy and paste” writing). Although copy-paste writing may seem to help create a document with correct grammar, the microplagiarized parts of text are not original – a fundamental requirement for any article to be published as an “original report” – and do not always integrate into the flow of the arguments, creating a problem in logic that readers readily perceive. The availability of software that can identify pieces of text copied from already published works is an additional reason to avoid this poor writing “shortcut”.

Challenges for Italian authors

Italy is a scientifically advanced country with a long tradition of research, especially in the biomedical and clinical sciences. In Italy, there are excellent research centers as well as research groups that publish in the most prestigious international journals. Since late 2008, some of the best research papers from Italian scientists have been highlighted in my blog “Highlights of Italian biomedical research: recent publications” (http://www.uptoit.org/Italian_research/highlights.htm). Nonetheless, a significant number of Italian researchers struggle to publish in selective journals, with the consequence that interesting and important studies do not receive the necessary visibility.

As editor and writing coach working in Italy since 1997, I have been in a position to observe the difficulties that many researchers have with scientific reporting. The most recognized problem, for which many authors come to editors like me, is difficulty with English. Linguistic editing of a manuscript that is written in a poor English but that nonetheless is well organized and logically argued is a valid phase of the publication process, and aims to improve the communication of scientific information and increase the impact of the article.

During editing, however, it is common to encounter other problems of scientific writing that are more difficult to resolve at this late stage. The most serious problem is authors' lack of knowledge on how to organize and present scientific information, with the result that many research papers are confusing and incoherent. Another issue is the frequent failure to correctly acknowledge, through citing and paraphrasing, other researchers' contributions to scientific knowledge. This is, in fact, a neglected area of scientific writing among NNES authors (not only in Italy), with the result that many manuscripts have an inadequate evidence base and a high content of microplagiarized text. Finally, even international standards for scientific reporting – which exist for the exact purpose of promoting quality and ethics – are often ignored. It is surprising that, still today, clinical studies not adhering to the Declaration of Helsinki are conducted in Italy. Altogether, these issues represent major obstacles to many Italian researcher-authors in their quest to publish in selective journals.

Teaching scientific writing to NNES authors

Publishing skills can be taught in formal and informal settings, through classroom activities, seminars, distance learning and one-on-one consultancy. Basic techniques of original professional writing can be introduced in secondary school, while specific scientific communication skills are matured during the university years and afterwards. From the researcher's viewpoint, the key issue

is to be in control of the content. All other issues are secondary. The following paragraphs present recommendations for the priorities and modalities of teaching publishing skills, according to the professional profile of the target learner.

The educational priority: teach researchers to be in control of their content

At the end of a period of experimentation and data analysis, the researcher proceeds to write an article that relates what was done and how this has advanced scientific knowledge. The most critical aspects of this writing process are the selection of content for the article and its organization and presentation according to the expectations of the scientific community (and of selective journals). To do so correctly requires skills the **systematic process of scientific writing**. It also requires an accurate technique in **attribution through citation and paraphrasing**, so that the new research is properly discussed in light of what is already known.

The ideal moment to learn these key publishing skills is during the doctoral studies, because this knowledge is fundamental both for completing the degree and starting a successful research career. Therefore, it is suggested that all doctoral students be offered a scientific writing course that teaches theoretical concepts and provides ample opportunity to practice specific skills. Young researchers who have not had such an opportunity may also find useful an intensive, full-immersion writing course or, alternatively, a series of workshops covering the major topics. Both doctoral students and researchers will benefit from being required to prepare periodical reports on their research activities for internal use and evaluation: although these reports are not full research papers, they nonetheless provide an opportunity to practice organizing and explaining content in the IMRAD scheme.

To be completely in control of their content, researcher-authors must also understand and adhere to **international standards of scientific communication** for quality and ethical reporting. Learning about this topic is appropriate and feasible in seminar format within research institutes. An online resource designed to help authors stay updated in this area is www.equator-network.org. Italian translations of the Declaration of Helsinki and the Uniform Requirements are available, facilitating personal study.

Auxiliary skills

Mastering the process of written scientific communication is easiest when accompanied by a regular **reading habit**, which exposes new authors to the needs of readers and to the specific genre of writing. Senior undergraduate students can be offered a seminar on reading the scientific literature, and they can discuss some research papers in advanced laboratory courses. Graduate students and researchers just starting their career can be taught an efficient reading practice such as browsing, a fast method by which one identifies key points of a paper, makes a preliminary assessment of quality, and decides if the paper is worth reading in detail. To help researchers master the skill of **critical appraisal**, institutes can organize regular (weekly) journal clubs in which published papers are presented and critiqued (this is standard practice in many US institutes, with participation by all faculty, staff and students).

Familiarity with scientific publishing (e.g. editorial processes, open access, literature databases) provides useful support for effective scientific communication. Young researchers agile with Internet are exposed to these issues while older researchers may struggle with the fast technological evolution of publishing. In these areas, medical librarians and authors' editors can provide training

and support.

Finally, fluency with **English grammar and academic writing style** is essential for NNES authors to be fully independent, but achieving English proficiency after the completion of formal education requires a substantial expenditure of time and effort that established researchers usually cannot afford. Those not fluent in English are more effectively served by individualized writing help rather than by formal linguistic education. Writing assistance can be provided by language support departments within research institutes, although only a few, well funded universities (rarely in Italy) offer their staff this kind of a facility. In absence of internal writing support, researchers can overcome problems with English in several ways, such as inviting the collaboration of younger colleagues skilled in English as well as engaging an independent translator (when authors write in native languages) or author's editor (when manuscripts are drafted in English). Skilled language professionals can be found among the members of associations such as the European Association of Science Editors, the European Medical Writers Association, and Mediterranean Editors and Translators; this last association offers an online guide to choosing an English language consultant.

Learning opportunities for Italian authors

The diverse publishing skills needed to achieve excellence in research reporting are taught and reinforced at different stages of a researcher's development, through courses, workshops, seminars, journal clubs and consultancy with scientific writing professionals.

Formal coursework is appropriate for graduate students, who will be able to directly test their new knowledge of scientific writing when reporting their own data in posters, research papers and doctoral theses. One course designed specifically for graduate students is ***Effective (Bio)-Medical Reading and Writing***, a 45-hour program in which participants are guided through each step of writing a research paper using their own experimental data. During the course, participants also learn a fast reading method (browsing), begin to develop critical appraisal skills, and experiment with peer review – all skills necessary for a successful research career. Each edition of the course is tailored to the specific research interests of the participants.

Established researchers with limited time for a complete course may prefer to attend one of the **half-day workshops** derived from *Effective (Bio)-Medical Reading & Writing*. Currently available workshops are: (i) IMRAD as a Guide for Reading and Writing, (ii) Citation and Paraphrasing, to Avoid Microplagiarism, (iv) Writing the Results, and (v) Writing the Introduction.

Finally, busy clinicians and researchers who desire personalized publishing assistance can consider a **one-on-one consultancy** with a writing coach, such as the ***Team Research Writer***. This service facilitates the production of one or more research papers while simultaneously teaching writing strategies, with the aim that the researchers become independent authors at the end of the consultancy. These goals are achieved with a mix of personal visits to the laboratory or clinic (to discuss the research and outline the paper) and distance work (to edit and help write the texts in production).

For more information on the course *Effective (Bio)-Medical Reading & Writing*, its derivative workshops and the personalized *Team Researcher Writer* consultancy service, please visit www.uptoit.org or contact Valerie Matarese, Ph.D. (+39-0423-985191 or info@uptoit.org).

Suggested reading

MET (2008) How to choose an English editor, translator or similar service provider. Mediterranean Editors and Translators, Barcelona. <http://www.metmeetings.org/index.php?page=guidelines>

Matarese V (2008) Relationship between quality and editorial leadership of biomedical research journals: a comparative study of Italian and UK journals. PLoS ONE 3(7):e2512. <http://www.plosone.org/doi/pone.0002512>

Matarese V (2006) An introductory course on getting to know journals and on "browsing" a research paper: first steps to proficiency in scientific communication. Croat Med J 47:7657-775. <http://www.cmj.hr/2006/47/5/17042069.htm>

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