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Editorial

Scientific writing, a neglected aspect of professional training☆

La escritura científica, un aspecto olvidado de la formación profesional

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Scientific writing in medicine is a style that dates back to the 14th Century A.D. It initially evolved in every language through the inclusion of medical terminology adopted from Latin, and then developed on the basis of new findings and constant scientific advancement.[1] This editorial article is intended to take a closer look at the relevant aspects of scientific writing and expects to motivate the reader to review the references, seek new knowledge and debate or argue the arguments herein presented.

The process of scientific writing is based on fundamental principles that go beyond submitting the results of a research undertaking. It is intended to convey these results to the reader in a way that facilitates the reader's understanding.[2] Gopen suggests writing "with the reader in mind" so that in the course of writing, the best expected understanding of the text being written is anticipated. Additionally, Gopen gives examples of the level of understanding based on the way data and text are presented.[2] A statement that exemplifies the concept is: Information is interpreted more easily and more uniformly if it is placed where most readers expect to find it."[2] With this idea in mind, the logic of standardizing biomedical scientific articles according to a similar anatomy, a similar quotations pattern and a uniform format of tables, figures and images, is intended to facilitate the readers' understanding. Readers have definite expectations regarding an article that meets the minimum structure according to this standard format.

Hence, the anatomy of a scientific manuscript is expected to include an initial *summary* that concisely states the contents of the research. Then follows the introduction, materials and methods, results and discussion accompanied by figures, pictures or explanatory tables and finally the bibliography.[3] However, the order in which the various anatomical parts of the manuscript are presented may vary depending on the particular journal. In some cases, the materials and methods section may be found after the discussion or the references. Likewise, the results and discussion sections may be combined into one.

The *introduction* highlights the importance of the topic studied, the existing gap in the knowledge about the subject matter and the opportunity or the need for further study. The

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introduction shall also include the purpose of the study and the underlying hypothesis, provides a justification for doing the study and the importance of the new scientific and technological knowledge, in addition to the benefits to society. The *materials and methods* section provides a detailed description of the design of the study, the techniques, materials and reagents used so that another researcher may be able to replicate the complete research. It is critical to mention in this section the type of analysis used to interpret the results, specifically the statistical analysis. The *results* section, that many researchers use as the starting point to write a scientific manuscript, lists the findings and their logical order which are not necessarily written in chronological order. For the sake of clarity and objectivity of the results, the researcher shall include comparative controls and avoid interpretations of the results. These shall be part of the discussion.

In the *discussion* section, the author may summarize his/her findings and the interpretation of the results, indicating whether the initial hypothesis is confirmed or not. This section is intended for the researcher to discuss the mechanisms or factors explaining the results obtained and to compare against similar findings published by other researchers, either to confirm or to generate new theories. As part of the discussion, the researcher may then suggest models, algorithms, mechanisms, etc., to explain the new findings or suggest new diagnostic, treatment or prevention guidelines. The conclusions of the complete study and their importance are presented at the end of this section. Finally, the article ends with the *bibliographic references* that allow the reader to further investigate or ratify the information presented in the manuscript, whether in the introduction, materials and methods, results or in the discussion.

The process of scientific writing is a dynamic process over time.[4] For instance, since 1960 there has been a change in preference to use the first person singular and occasionally the first person plural rather than the passive voice.[4] Actually, as already mentioned, some journals use their own preferred patterns, increasing the complexity of the process for writers who are unfamiliar with them and so they provide *templates*.[5,6] However, a number of biomedical scientific journals have adopted similar standards that facilitate the process of scientific writing on biomedical topics, for instance, the Uniform Requirements for Manuscripts Submitted to Biomedical Journals.[7] Recently, the *International Committee of Medical Journal Editors (ICMJE)* that promotes these standard criteria, adopted the requirement to register the research protocol under a protocol database whenever an experimental design in humans is involved, thus preventing the editors of affiliate journals from publishing this type of articles unless the document submitted includes such registration.[8] Although such requirement is intended to provide a more transparent methodological design (avoiding potential *post hoc* analyses), if affects scientific writing in as much as this type of design may not be published in ICJME journals unless the standard is met.

Lindsay says that although scientific writing is part and parcel of the background that every health researcher and professional should have – though 99% of them say that it is a key component of their work – less than 5% acknowledge having received scientific writing training as part of their basic education and that their learning experience has been based on articles they have read,[4] while only 10% say they enjoy writing.

Consequently, it is highly relevant to avail health professionals interested in disseminating the knowledge they generate, or in rebutting the current knowledge, with the training tools in scientific writing that facilitate the process of publication.To this end, the scientific community disseminates information to complement professional training and help in structuring the potential articles that researchers and professionals intend to publish; i.e., criteria such as CONSORT, STROBE, PRISMA, STREGA, STROBE-ME that are useful to structure publications related to clinical experimentation, observational studies, systematic reviews, genetic-association studies and molecular epidemiology.[9–14]

Thus, the anatomy of the article, in addition to generalized standard criteria and some specific design guidelines are useful in setting up the overall structure upon which the author may write the article. Additionally, the sources of information should be quoted. The ICJME associated journals and most biomedical journals follow the Vancouver style.[15]

The "science" of the scientific article lies in what the author writes, how the title is structured, the summary, the introduction, the methodology, the results, the discussion and the conclusions, in addition to the use of tables, figures and pictures for improved understanding,[16–24] always with the reader in mind, as Gopen suggests.[2] This is really the key contribution of the researcher. Ethical considerations are critical to present the data in the most neutral and truthful manner[25,26] avoiding any biases influenced by the author's own passions, carefully quoting any statements by others so as to prevent plagiarism,[27,28] and being as concise as possible. Lindsay refers to three attributes of a scientific publication: precise, clear and brief.[4] However, other key attributes are missing: transparent, neutral and properly referenced. In the scientific community everything should be addressed to peers who are the expected readers of this type of publications.

The inclusion of training strategies for scientific writing as part of the undergraduate biomedical programs, in addition to professional continuous education courses on the topic are fundamental to expand the critical mass of writers in our disciplines.

This editorial is intended to highlight the critical aspects of building the general structure of a scientific article and encourage the researcher to write science with the reader in mind, trying to explain the information in a precise, clear, brief, transparent, and neutral manner, with adequate references. All of these aspects and their underlying premises (ethics, no plagiarism, no bias) shall be included in the core strategies of professional training.

Finally, it should be noted that scientific writing must not necessarily be an individual and solitary endeavor. The recommendation to the researcher is to rely on his/her colleagues and reviewers to read the manuscript and express their opinions, comments and corrections.[29] The quality of a manuscript is proportional to the number of evaluations and corrections that the researcher and colleague reviewers make about every aspect including style, content, structure, spelling and scientific quality leading to the acceptance for publication in a scientific journal.[30,31] Just as a gem must be carved from the rock and finely polished to become a beautiful engagement

ring in the hand of a lovely bride, the results of research should become scientific jewels that deserve to be published.

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