

The craft (and art) of scientific writing



What are the elements of a well-written, informative and widely accessible paper?

What will the scientific paper of the future look like? Will we cease to read long-form written manuscripts and instead consume research findings as we do news, through a mix of data, text, videos and animations to be synthesized and interpreted by the beholder? It will be exciting to see science communication reshaped as technology and digital integration continue to develop. But while the traditional form of the scientific manuscript still stands, it is important to consider how to write it in a manner that balances informativeness with accessibility and that does justice to the complexity of the data while keeping the reader engaged.

If planning to submit to a specific journal, authors should be aware of that outlet's guidelines and formatting requirements. Although at *Nature Cancer* we do not require that manuscripts conform to our format guidelines on first submission (on the contrary, formatting does not factor into our editorial assessment at all), this may not be the case for other journals. Even if authors have not yet decided where to submit when they start writing (as is the case in many, if not most cases), it is still important to be aware of discipline-specific considerations and to have a general view of expected manuscript sections and typical length and referencing limits as these are some of the most laborious and time-consuming issues to fix later in the pre-publication process. In addition, certain types of work, for instance clinical research, must conform to very specific reporting and formatting guidelines that constrain the way in which the manuscript must be written. This Editorial will not cover clinical studies and will instead focus on writing laboratory-generated research.

The first step to writing a manuscript does not involve any writing at all. Instead, it requires objectively considering the collected data in toto to identify the key scientific messages that emerge, as these will be the crux of the manuscript. During this process it is essential to take a step back and critically evaluate the conclusions that can be drawn

from the data to guard against building a story around preferred but not validated hypotheses. The text should always stay true to the data, but that does not mean that data should be described in a dry manner or in the chronological order in which experiments were conducted. On the contrary, it is important to also identify the narrative thread that connects the key pieces of data that support the main findings, so that these may be presented in a logical manner that readers will be able to follow. This process includes formulating the figures in their basic, functional, if not polished form, and once this is completed, one can get to the writing part.

The typical scientific manuscript at *Nature Cancer* and elsewhere includes introduction, methods, results and discussion sections. It may help to think of the paper as an information sandwich: the most important, richer parts are the results and methods sections, held together by the less complex (but no less important) introduction and discussion sections. Thus, one should start by writing up the results, picking up the narrative thread of the dataset and describing the experiments that together support the main findings in appropriately entitled subsections. The results section should describe all the data presented in the figures in the correct order but should not be a laundry list of lengthy experimental descriptions. Rather, it should highlight the key features of the data presented in the figures in a way that complements the visual representation and guides the reader through the complexity of the dataset.

Next up is writing the introduction, the section that not only introduces the main question the paper seeks to answer but that provides context by covering the literature that is relevant to the study, and through this prism presents the rationale and objectives of the current research effort. Here too it is essential to be selective and concise. Rather than exhaustively discussing every paper that might be linked to the topic under study, it is important to identify and synthesize the most pertinent primary research, without shying away from conflicting findings, controversies in the field or similar conclusions published elsewhere. Rather, such aspects are always best presented clearly and addressed head-on. To do this it is necessary to be diligent about

staying up to date with the published literature and compiling a comprehensive list of references relevant to the project that can be whittled down to the essential references to be included in the manuscript as writing progresses. The main point to remember is that the introduction should not only permit the non-expert reader to understand the broader topic, the key prior art and the specific questions that the manuscript seeks to answer, but also help them appreciate why these questions are important and spark the reader's interest in reading on.

With the results and introduction written, it is time to write the discussion – the section that puts the presented findings in perspective by going over their key elements, connecting them to existing knowledge and highlighting implications, outstanding questions and future paths of study. This section too relies on a strong knowledge of the related literature and good citation practices, as the most closely connected prior studies (that should have been already mentioned in the introduction) should be discussed here in more depth. Brevity is again essential, as is avoiding hype. Highlighting the importance of findings while acknowledging their caveats and limitations is key.

And what of the methods? This section is crucial and should be written in as much detail as would permit others to replicate experiments and analyses to reproduce results. Ideally it should develop in an organic manner, as experiments are being conducted and reagents and tools used. It should also be written in line with journal policies and thus merits a separate Editorial.

The final two things to write are arguably among the most important – the title and abstract are the face of the paper, the elements that readers first encounter when they survey the literature or the journal's table of contents. Hence, they should state the main findings of the study in a clear, specific and engaging manner, with the abstract essentially being a mini version of the paper. The reader should know what to expect from the paper and should be enticed to find out more.

As with any piece of writing, especially when it comes to collaborative efforts, it is essential (and mandated by our [authorship policy](#)) to have the input of all co-authors, even if one

or a few contributors have taken on writing responsibilities. It is good general practice when writing anything to seek comments from others, especially non-authors whose judgement can be trusted and who are not too close to the subject to be able to provide an objective and constructive critique. Stepping away

from one's own writings and revisiting them later is also helpful to gain more objectivity. Manuscripts go through several iterations before publication, and while retaining one's own voice is key, it is helpful to remain open to changes suggested by collaborators, referees and editors as the manuscript develops

through the peer-review and revision process. The one principle to stick to when writing, is that the data should always be the lodestar.

Published online: 26 May 2023