Dear Editor,

Publishing medical research is a booming business. Every month around 73,000 new articles are indexed in PubMed [1]. Unfortunately, the quality of reporting remains insufficient in some cases, in some aspects, to some extent [2]. Poor-quality reporting is problematic because it encumbers critical appraisal of studies, limits reproducibility, and thus may indirectly negatively affect patient care [2]. Therefore, several international initiatives have been launched to improve the quality of health publications by promoting transparent and accurate uniform reporting. Over time, reporting guidelines have been published for randomized controlled trials and for other categories of medical research that influence clinical practice and policy; such as systematic reviews, diagnostic [3], epidemiologic [4], tumour marker prognostic [5], and genetic risk prediction [6] studies. The EQUATOR (Enhancing the QUAliity and Transparency Of health Research) Network offers public, accessible links to published guidelines [7]. Recently, publisher PLOS launched a "Reporting Guidelines Collection", an open access collection of reporting guidelines, commentary, and related research on guidelines [8]. Concomitantly, the British Medical Journal announced the "BMJ Open Data Campaign", a new policy on sharing data from clinical and medical device trials to increase transparency in research [9]. Whilst these guidelines and open data campaigns [10, 11] are a major step forward, the costs of research are not included in reporting guidelines. We propose that expenditure on research is important information that warrants inclusion into publication.

Costs of Published Research Increasingly Important for Decision-making in Research Planning

Medical researchers conducting experiments must consider which of the available methods are most appropriate for answering the questions and hypotheses investigated. The choice of methods and the way they are employed will largely be determined by scientific arguments in favour of, or against, a research method, but will also be influenced by practical considerations, such as the availability of financial resources. As a result of worldwide cutbacks in government spending and research funding for medical research, this financial factor becomes increasingly important in the decision making process [12]. Accurate and full reporting of research methodology costs is indispensable when investigating and developing novel study methods or analysis techniques for evidence synthesis and informed decision-making. It is therefore pivotal that financial aspects of research are transparently reported.

Publishing Costs of Research

Sharing information facilitates open science. Research costs incorporated in scientific publications may allow for this valuable information to contribute far beyond its respective original context [13]. A transparent financial overview can contribute to considerations based on reliable data in estimating costs of research for future planning.

Reporting of Medical Research Costs

Improving Transparency and Reproducibility of Medical Research

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Summary
Increasing numbers of research reporting guidelines are being published. These guidelines facilitate rigorous and complete reporting, and presentation of published studies. However, current reporting guidelines do not address issues related to costs of research methods. We propose to publish costs of research in order to increase transparency, efficiency, quality and ultimately reproducibility of scientific studies.

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tecture experiments and to properly negotiate budgets for research studies. This will ease the process when applying for new or additional funding. For funding organizations, sharing costs of research promotes the most prudent use of public resources [14]. Furthermore, reporting of costs accrued at experimental stage may help shaping subsequent research steps. Reproducibility as cornerstone of science could be improved [2]. To illustrate this, one could consider for example medicine quality surveys in low-income countries. These studies are generally assumed to be expensive, in part because of travelling and personnel costs, but mainly because of the purchase of samples and the costs of chemical analysis. If information on cost of research for this kind of studies would be available, more evidence-based decisions could be made whether to reproduce or start a certain study in a certain region. Another example would be research utilizing imaging. If the costs of certain imaging techniques are specified, for example that of very costly MR imaging compared to cheaper CT imaging, one could outweigh the advantages of more detailed anatomical information with higher research costs.

Additionally, financial data can be used to explore related or new research methods which may be more cost-effective, particularly when combined with other published research costs data. It is also helpful in the education of new researchers and policy makers [15], especially when discrepancies between project proposals or budgeting exercises and the real published costs are observed. It has been demonstrated that making detailed research data (e.g. original data sets) publicly available increases the citation rate of these publications [16]. Our hypothesis is that this would also apply to information on costs. In addition, publishing costs of research can encourage public understanding of research, evidence based advocacy or citizen-science initiatives [14] (see Box 1 for an overview of potential advantages of published costs of medical research).

**Potential Barriers and Solutions**

Reporting costs of research will not always be an easy task, and barriers exist [17]. Firstly, research costs can be challenging to calculate as some experiments involve highly skilled and trained personnel, which is difficult (but not impossible) to include in a financial overview. Likewise, the time, place and facility where the study is conducted accounts for a considerable part of research costs and can be hard to quantify. Prices of medical technology often fluctuate rapidly and can vary widely. Moreover, many research projects and scientific publications profit from in-kind or voluntary contributions which can distort the picture of the actual costs. As well, time- and place-specific investigations may make it difficult to extrapolate to other settings.

Additionally, one can argue that information regarding research costs should not be made publicly available because there might be disputes about interpretation; perhaps too much focus will be placed on the financial part of a study and may positively or negatively influence peer-reviewers when appraising a research paper. A very expensive study does not necessarily mean its quality is superior to a less-expensive study and vice versa. Another potential reason to object to our proposition from a (fellow) researchers’ point of view may be the wish to not exactly having to specify all research costs, because it discourages making “the best out” of grant money; e.g., applying for grants and using leftover money for smaller studies which otherwise could not have been financed.

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<th>Table 1</th>
<th>Potential advantages of publishing costs of research</th>
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<td>Improves transparency, quality and reproducibility of published research</td>
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<td>Time- and cost-efficient for planning new experiments or developing novel methods that may be more cost-effective</td>
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<td>More evidence-based financial estimations when applying for funding or negotiating budgets for research studies</td>
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<td>Implementing methodology into policy</td>
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<td>Encourages researchers to utilize grants according to application</td>
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<td>Helps unmasking unreported financial conflicts of interests</td>
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<td>Greater visibility; increases citation rate and literature impact</td>
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Ethical or legal constraints can exist for individual researchers, as it is not always obvious who owns the data and whether they are allowed to publish this financial information. Although it is increasingly recognized that research data are an important long-term resource, and making them publicly available is an approach to realise their potential value, researchers may not necessarily share this view. This may partly be because the culture of sharing data in health research is less common and less structured than in other disciplines (such as astronomy) [17] or because publicly available data sets are difficult to find. For sure, it is not necessary to provide the costs of research for every type of publication. For example, providing costs of a new research method is much more valuable than reporting costs of a literature review. However, this interpretation depends on the perspective of the reader. Therefore, a standard scheme for reporting costs would be needed for different types of studies. Practically, lack of expertise or experience with reporting such financial data can exist. A clear, concise checklist with guidance should be developed to extend current guidelines.

**Implementation**

For what types of research should the costs be reported, and in what form? Is there a need to develop another guideline to do justice to the cause? Developing a guideline is a complex and time consuming process. Therefore, financial information should be considered for inclusion by respective guidelines. As it is a considerable challenge to implement a new guideline into practice, it may be more efficient to extend existing guidelines. A next step at this early stage could be that a working group sets out their objectives clearly. A stakeholder’s debate should guide such a working group with respect to useful aspects of research costs that should be published. Concomitantly, individual researchers can start publishing their costs of research, while awaiting standard schemes to properly do this. It is important to note that one size does not fit all. There are many different types of research, journals and funders who all have different reporting needs. However, there are regular
core financial components to report such as supplies, (laboratory) equipment etc. To encourage researchers to publish data on the cost of research, evidence should become available that demonstrates the benefits of publishing these data and standard working mechanisms for reporting and citing these data should exist.

Conclusion
Reporting research costs in medical publications is not merely an additional tick box exercise. Rather, it can help to improve transparency, efficiency and reproducibility of medical research. Conjointly with the question whether we should publish research costs, we should seek answers to which costs exactly should be reported. We do not underestimate the practical challenges associated with this proposal; however, we argue that the benefits outweigh the costs for researchers and the broader scientific community. Advocating reporting the costs of scientific experiments is an important step towards more transparent and efficient biomedical research.

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Author Statements
BJV conceived the paper. All authors contributed to the concept of the paper and all have been involved in drafting and revising the manuscript; all have given final approval of the submitted final version; and all have agreed to be fully accountable for all aspects of this work. All authors read and approved of the final manuscript.

References