

# Supporting open science: *Advances in Clinical and Experimental Medicine* and preprints

Marek Misiak<sup>1,A–F</sup>, Donata Kurpas<sup>2,A,E,F</sup>

<sup>1</sup> Managing Editor, Wrocław Medical University Press, Poland

<sup>2</sup> Division of Research Methodology, Department of Nursing, Faculty of Nursing and Midwifery, Wrocław Medical University, Poland

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;

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## Address for correspondence

Marek Misiak

Email: [marek.misiak@umw.edu.pl](mailto:marek.misiak@umw.edu.pl)

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## Abstract

This editorial outlines the issue of preprints in scholarly communication. It presents the policy regarding them in *Advances in Clinical and Medical Problems* and a summary of papers released as preprints and subsequently published in this journal or rejected until July 10, 2024. The introduction discusses the definition of preprint, and leading preprint servers are listed. Policies of 2 such services – Research Square and medRxiv – most frequently chosen by *Adv Clin Exp Med* authors are then described, followed by a broad outline of the advantages of preprints and controversies surrounding them, based on selected literature on this topic. The next section discusses the policies of most renowned medical journals and publishers regarding preprints. The preprint policy of *Adv Clin Exp Med* is then thoroughly explained, as well as its reasons. All papers previously released as preprints and published in this journal in 2021–2024 are presented, focusing on meaningful differences between them. Rejected papers previously released as preprints, submitted to *Adv Clin Exp Med* in 2022–2024, are also listed and discussed. The conclusion is that the basis for endorsing preprints in this journal is not that they benefit this journal but that they serve the scientific community as a whole and science in general by facilitating rapid dissemination of results and fostering immediate assessment of those results by other investigators and debate around them. The most justified line of action is educating authors about the benefits and problems related to preprints.

**Key words:** policy, peer review, open science, scientific journal, preprints

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## Introduction

One of the core rules of publication ethics in scientific journals is that a manuscript submitted to such periodical can neither be already published nor considered for publication elsewhere. In other words, it is strictly forbidden to submit the same paper to 2 or more journals concurrently (submitting an already published paper is a much more apparent case since it would mean blatant self-plagiarism). The above is called the Ingelfinger Rule after Franz J. Ingelfinger, editor-in-chief of the *New England Journal of Medicine* in 1967–1976.<sup>1,2</sup> However, a severe definitional controversy arises: Are publication and dissemination the same? Since it is understood that peer review (regardless of its specific form – double-blind, single-blind, open, etc.) is a prerequisite to consider a journal “scientific” or “scholarly”, should texts made publicly available without peer review be considered “published”? One of the first researchers to ask themselves this question were investigators from the National Institutes of Health (NIH), who in 1961 began to circulate papers before their publication within an experimental network called Information Exchange Groups (IEGs) to ensure access to information about new discoveries as rapidly as it was possible back then, well before the advent of the Internet.<sup>3</sup> This experiment was shut down in 1967 after several journals refused to accept articles circulated as preprints.<sup>4</sup>

The term ‘preprint’ originates from the epoch when manuscripts were disseminated before they were published in a physical, printed form. Nowadays, many scientific journals do not have a printed version at all, and even if they do, it plays only a minor, if not marginal, role in their dissemination, but the term itself remains unchanged (“print” is a synonym for “formal publication” in this context).

## What is a preprint? Definition attempt

Although many issues related to preprints are a subject of ongoing controversy, a clear definition of preprint may be attempted relatively easily. It is a manuscript (a paper/article means a published text in this editorial) that is:

- 1) scientific/scholarly in nature;
- 2) has not been published in a peer-reviewed scientific journal;
- 3) has not been peer-reviewed in any form;
- 4) has been released by the authors themselves, with them retaining all copyright;
- 5) has been deposited on the Internet in a freely accessible way (usually on a dedicated preprint server);
- 6) has (in most cases) a digital object identifier (DOI) assigned.

The Committee on Publication Ethics (COPE) defined a preprint as “a scholarly manuscript posted by the author(s) in an openly accessible platform, usually before or in parallel with the peer review process”.<sup>5</sup> The adverb “usually” is crucial here – an article disseminated this way may be

simultaneously submitted to a scientific journal; however, it is not an element of the definition, and some preprints are never submitted, or submitted but never accepted for publication.<sup>6</sup> Berg et al.<sup>7</sup> emphasized that preprint is a “complete scientific manuscript” and not a collection of raw data or work-in-progress (on the other hand, such “completeness” does not preclude improvements). They also pointed out that a preprint is commonly defined as being (or assumed to be) openly available online – all leading preprint servers are free of charge. Responsibility for the distribution of preprints is traditionally considered to be that of the author, a component of the definition that is often implicit in the verbs used to describe dissemination of preprints, such as, “sharing”, “posting” and “self-archiving”. The preprint definition was also discussed by Chiarelli et al.,<sup>8</sup> but without reaching any definitive conclusion.

In literature, definitions of preprints that somewhat restrict the above characteristics can be found. Blatch-Jones et al.<sup>9</sup> defined preprint as an open and accessible scientific manuscript or report shared publicly through a preprint server before being submitted to a journal (and not concurrently with submission). Chalepliglou and Koulouris<sup>10</sup> add that a preprint is an entire scientific manuscript presenting a complete work or work-in-progress, but nevertheless must be an explicit and connotative presentation of the hypothesis, the rationale, the methodology, and the resulting research evidence that supports, rejects or revises the initial hypothesis. The authors retain the right to adapt their work in the future, enrich, modify, or reproduce any part of it in another version submitted for publication elsewhere. The main differences between scientific journals and preprint servers (and thus between peer-reviewed papers and preprinted manuscripts) were outlined in a table by Alfonso and Crea.<sup>11</sup> A definition employed by medRxiv also includes a negative component, stating what characteristics do not describe preprints: “Readers should be aware that articles on medRxiv have not been finalized by authors, might contain errors, and report information that has not yet been accepted or endorsed in any way by the scientific or medical community”.<sup>12</sup>

Posting generally occurs on the day of submission or the next day (medRxiv declares 2–4 days).<sup>12</sup> There is typically no formal peer review of the article before it is posted online; however, it is checked for plagiarism and offensive/dangerous content; the only requirement is that the article be scientific (see section “Policy of preprint servers” below). Papers are neither typeset nor edited linguistically before being posted online. Preprint servers have no impact factor (IF), and authors retain the copyright of their articles.<sup>13</sup>

## The role of preprints in the scientific landscape

In the last 10 years, preprints are perceived as more and more important in the circulation of scientific knowledge, and their number is steadily rising. Large number

of deposited preprints from various fields of science shown by Chalepioglou and Koulouris<sup>10</sup> is one thing, but a survey recently conducted by Ni and Waltman<sup>14</sup> presents both the growing familiarity with preprinting and popularity of reading and posting preprints, as well as enhanced willingness to do so if a given scholar has not used this form of dissemination yet. Although preprints are more visible in physics and astronomy, followed by mathematics and computer science, and their position is much weaker in other research areas, the recent COVID-19 pandemic was met with a surge in a number of biomedical preprints – COVID-19 preprints were posted early in the pandemic, and in its early phases represented a significant proportion of the COVID-19 literature.<sup>15</sup> In more instances than before, manuscripts disseminated initially in this form or sometimes only in such a way contain important results (or at least data and hypotheses) also in the field of medicine. Therefore, it can be safely stated that preprints are becoming an important complement to published papers in the circulation of scientific knowledge, while being in no sense a dissemination mode that is to supplant or compete with established methods of scholarly communication. The usage of preprints can be seen as an attempt to (at least to some extent) alleviate the shortcomings of the peer-reviewed journal model of scientific publication – especially the long waiting time for publication and financial issues related to both high article-processing charges and paywall-mode access to published papers, employed by many journals.

## Where are preprints deposited?

Dissemination of preprints in the current sense of this term has been possible since the emergence of the Internet at the turn of the 1980s and 1990s. The first dedicated preprint archive, arXiv (<https://arxiv.org/>), was launched in 1991, with Hyper Articles en Ligne (HAL; <https://hal.archives-ouvertes.fr/>) following in 2001. A visible rise in the popularity of preprints has been observed since 2010 – all the most popular services in medical, scientific publishing were started in the last 12 years: bioRxiv (<http://biorxiv.org/>) in 2013, Authorea (<http://authorea.com/>) also in 2013, Preprints.org (<https://www.preprints.org/>) in 2016, Open Science Framework (OSF) Preprints (<https://osf.io/preprints/>) in 2017, Research Square (<https://www.researchsquare.com/>) in 2018, and medRxiv (<http://medrxiv.org/>) in 2019. All the above preprint servers allow the deposited manuscript to be assigned a DOI.<sup>16</sup> Chalepioglou and Koulouris<sup>10</sup> provided an exhaustive review of 22 preprint services and their policies, including those listed above. The most complete list of preprint repositories has been compiled (and is constantly updated) by the Directory of Open Access Preprint Repositories (DOAPR; <https://doapr.coar-repositories.org/repositories/>). This directory provides a list of preprint repositories that are available to the research community. It helps researchers find the most appropriate platform for a given manuscript,

enabling them to browse through existing repositories by discipline, location, language, functionalities, and other facets. The directory is jointly managed by Centre pour la Communication Scientifique Directe (CCSD) and Confederation of Open Access Repositories (COAR).

## Advice for researchers regarding preprints

In several popular science magazine articles, advice on disseminating one's manuscript as a preprint (and if yes – how to do it) may be found. Brock,<sup>17</sup> in an article in *Nature Index*, provided 10 tips for submitting a successful preprint, while Bourne et al.<sup>18</sup> listed and explained 10 simple rules to consider regarding preprint submission. Ettinger et al.<sup>19</sup> presented a more thorough guide to preprinting for early-career researchers, and Sarabipour et al.<sup>20</sup> described early-career researchers' perspectives on preprints. Guidelines regarding preprints were also released by, i.a., Columbia University,<sup>21</sup> University of Oxford,<sup>22</sup> UK Research and Innovation,<sup>23</sup> NIH,<sup>24</sup> University of Surrey,<sup>25</sup> University of Melbourne,<sup>26</sup> Eastern Michigan University,<sup>27</sup> Harvard Countway Library,<sup>28</sup> and University of Hong Kong Libraries.<sup>29</sup> Finally, a practical guide to the preprints has been released as a preprint in the Zenodo repository by Hettne et al.<sup>30</sup>

Since January 30, 2023, the National Library of Medicine (NLM) started to make preprints resulting from research funded by the NIH available via PubMed Central (PMC) and, by extension, PubMed.<sup>31,32</sup>

## Objectives

This editorial in an attempt to:

- 1) define preprints as a form of dissemination in the scientific milieu;
- 2) outline the advantages of preprints and controversies around them (in a general context of scientific publications) as well as policies of 2 selected preprint servers;
- 3) provide some insight into attitudes of key stakeholders within the scientific community to preprints;
- 4) present policies of leading medical publishers and journals regarding preprints;
- 5) describe the approach to this form of dissemination in 1 scientific medical journal – *Advances in Clinical and Experimental Medicine* (*Adv Clin Exp Med*) – including the preprint policy of this periodical and reasons to this policy;
- 6) present how papers which have previously been released as preprints are present in this journal;
- 7) assess whether the aforementioned policy requires modification;
- 8) discuss future directions for preprint policies and their potential evolution in the context of open science (OS);
- 9) suggest future research on preprints, including areas that require further investigation.

## Policies of preprint servers

It should be noted that although the abovementioned preprint servers do not offer peer-review services, it does not mean that everyone can post anything on such server, regardless of the quality of the disseminated material and/or its character. Preprints are approved for posting after moderation but not peer review. Policies of 2 selected preprint servers will be briefly discussed – Research Square and medRxiv. The latter has been chosen as the most respected preprint service dedicated to medical manuscripts; the former because of its popularity among *Adv Clin Exp Med* authors, though it accepts submissions from all research fields. The policies of both servers are similar, but there are some differences.

### Research Square

Research Square does not conduct peer review on preprints before posting.<sup>33</sup> Submitted manuscripts are checked for appropriate ethics and consent statements, disclosure of competing interests, absence of patient identifiers, and inappropriate, alarming, highly controversial or pseudo-scientific claims. Articles with firm conclusions, especially without fully accessible data, may also be screened out. The following manuscript types are accepted: research articles, systematic reviews, method articles, short reports, case reports, and data notes. Only research articles with complete methods and results sections will be considered for posting. Non-systematic reviews, theories and commentaries are not eligible for preprinting. Manuscripts reporting negative results are welcome. For medical research, it is considered critical that data be made fully accessible, and it is strongly encouraged. A submission already published in a journal will not be posted as a preprint. Submissions with missing figures, reference lists or other critical components may be rejected. Authors should include a competing interest statement and funding disclosure.<sup>33</sup>

Once a preprint posted on Research Square receives a DOI, it cannot be removed from the platform without cause – i.e., issues that cannot be addressed by submitting a revised version of the preprint. If a preprint is withdrawn from any leading preprint server, the content is removed, leaving behind basic metadata like title, authors, and the reason for withdrawal if the author chooses to provide it. In rare circumstances, a preprint is removed from the site altogether. In these cases, the preprint is replaced with text indicating that the manuscript has been removed. Also, in such a situation, wherever possible, the title and author list remain in place. Research Square may initiate a withdrawal on a preprint if its staff have reason to believe there are issues with research conduct or ethics associated with the work or if a later version of the article has been retracted from a journal.<sup>33</sup>

Research Square supports versions of preprints – the revision will be posted under the same DOI, and the original version of the manuscript will remain accessible. There is a limit of 5 revisions for 1 preprint (medRxiv does not limit the number of versions).<sup>33</sup>

Preprints at Research Square are indexed through Crossref, Europe PMC and Google Scholar. PubMed Central indexes a limited subset of preprints.

### medRxiv

All manuscripts posted on medRxiv are screened for plagiarism, non-scientific content, inappropriate article types (i.e., not health-related, narrative reviews and case studies, among others), and material that could potentially endanger the health of individual patients or the public.<sup>34</sup> The latter may include, but is not limited to, studies describing dual-use research of concern and works that challenge or could compromise accepted public health measures and advice regarding infectious disease transmission, immunization and therapy. Submissions are also checked for ethical oversight, clinical trial registration and information that might identify a patient/participant.<sup>12</sup> Authors should declare at submission that all relevant ethical guidelines have been followed, all necessary institutional review board (IRB) and/or ethics committee approvals have been obtained, all necessary patient/participant consent has been obtained, and the appropriate institutional forms archived. Authors should include a competing interest statement and funding disclosure.<sup>35</sup>

The manuscript must not have been posted elsewhere (including other preprint server), nor should it have been accepted for publication in a journal (medRxiv is the only leading preprint server that addresses the issue of simultaneous submissions to 2 or more preprint servers). To allow screening, medRxiv is open only to manuscripts in English. Authors must submit the appropriate research reporting checklists defined by the EQUATOR network as supplementary files. Clinical trials must be registered with an internationally recognized trial registry with the trial ID included. A manuscript posted on medRxiv can be revised at any time until it is accepted for publication in a journal, provided that the journal to which the authors submitted the manuscript does not forbid posting versions that include changes made in response to the peer review process. If authors withdraw their manuscript from the server, a statement explaining the reason for the withdrawal is posted on the manuscript page to which the DOI defaults; the original manuscript is still accessible via the Info/History tab on medRxiv, and a “Withdrawn” watermark is added to the \*pdf of all posted versions of the main text of the manuscript.<sup>35</sup> The authors may also revise a paper, but the fact that a revision (or multiple revisions) occurred is revealed to the reader – the revision will be posted under



the same DOI, and the original version of the manuscript will remain accessible.

Of note, similar policies regarding withdrawal and versioning are employed by the OSF.<sup>36,37</sup>

The medRxiv is indexed by Crossref, Google Scholar, Semantic Scholar, Europe PMC, and Web of Science's Preprint Citation Index. In addition, preprints reporting research funded by the NIH are indexed by PubMed.<sup>12</sup>

It is important to note here that neither Research Square nor medRxiv declare adherence to any COPE or International Committee of Medical Journal Editors (ICMJE) guidelines on their websites. The screening procedures employed by the preprint servers were analyzed by Kirkham et al.,<sup>38</sup> and also in a research letter by Malički et al.<sup>39</sup>

## Advantages of preprints

The advantages of preprints are, at the same time, the main reasons for their rising popularity among researchers and the broadening acceptance of this practice among journal editors and research funders. As Brainard<sup>40</sup> noted in the context of the surge in published preprints during the COVID-19 pandemic, they did not cause a revolution in scientific publishing; however, because of the characteristics discussed below, preprints are becoming more and more popular.

### Rapid dissemination

First, preprints provide an opportunity to release the results of one's research immediately, without delays caused by prolonged peer-review and editorial processes. Janda et al.<sup>41</sup> revealed in 2022 that among the preprints posted on medRxiv, 77.0% (1,077 out of 1,399) were published in peer-reviewed journals within a median of 6 months after posting, which shows that manuscripts released using this venue are indeed visible to the scientific community. The issue of the time from submission to publication has been investigated, among others, by Huisman and Smits,<sup>42</sup> Andersen et al.<sup>43</sup> (for biomedical journals), Zimmer et al.<sup>44</sup> (for genetic journals), Harlianto and Harlianto<sup>45</sup> (for urology journals), Sebo et al.<sup>46</sup> (for general medical journals), and Lee et al.<sup>47</sup> (for South Korean medical journals). All the above analyses emphasized that the waiting time for publication is considered too long by all stakeholders (according to Andersen et al.,<sup>43</sup> the mean timespan from submission to publication varies from 91 to 639 days, while the median timespan is 70–558 days). Because a preprint is only checked for its essential characteristics, not peer-reviewed, it becomes available on a preprint server after a few days. Consequently, research results may be communicated to the scientific community as soon as they are obtained, which may be crucial in rapidly developing fields of knowledge.

## Access to new data

Members of the scholarly community can use the presented data, concepts and methods in their research; in this way, preprints contribute to more robust development of science in general. Other researchers may also offer the preprint's authors a chance for scientific collaboration, which stimulates the globalization of science and academic mobility. The above is particularly important in medicine because clinical research benefits from open and timely access to new data. Preprints can “accelerate” science, particularly useful, e.g., in combatting outbreaks of diseases.<sup>48</sup> Even if the presented results are not validated yet, the idea outlined in a preprinted manuscript may inspire other researchers when rapid development of new therapies, vaccines, etc. is paramount.

It is also worth noting here that in light of studies by Janda et al.<sup>41</sup> and Bero et al.,<sup>49</sup> most clinical studies posted as preprints and subsequently published in peer-reviewed journals have concordant study characteristics, results and final interpretations – the former analyzed the preprints posted on medRxiv while the latter a sample of COVID-19-related publications. Also, Brierley et al.<sup>50</sup> showed that although preprints and their published versions differed to a certain degree, the majority of these changes do not qualitatively change the conclusions of the paper. Carneiro et al.<sup>51</sup> showed that peer-reviewed articles had, on average, higher quality of reporting than preprints, although the difference was slight. This suggests that authors tend to release the versions of biomedical papers as preprints close to the final authors' version, which is subsequently submitted to a journal (provided, of course, that such submission occurs at all). Nelson et al.<sup>52</sup> assessed the robustness of evidence reported in preprints in 100 matched preprint–journal article pairs and rated it highly. Akbaritabar et al.<sup>53</sup> analyzed the differences only in reference list between preprints and their published versions, and noted that they were more pronounced in medical publications than in other fields of science.

### Establishing priority

The most prominent advantage of preprints – rapid dissemination – is related to establishing priority (Elmore<sup>13</sup> calls it “documentation of the history of ideas”). Since preprint servers deposit a manuscript with a date stamp proving when exactly it has been submitted,<sup>8</sup> authors of the yet unpublished article can publicly declare when at least the draft/first version of their paper describing their original research was already in existence (which can also be important when applying for grant or employment). Moreover, Poremski et al.<sup>54</sup> argued that predatory journals would not be able to thrive like nowadays if authors were able to secure a legitimate place in the literature for their unreviewed work – provided that in their particular situation, DOI suffices. They are not in dire need of publishing, even in a journal of disputable quality.

## Opening science

A significant advantage is that the most popular preprint servers are not-for-profit, open-access (OA) services, allowing for free access to recent scientific developments for all interested parties, with access to the Internet as the only prerequisite. Researchers and other professionals (e.g., doctors) from low-income countries can contribute to the global scientific community by releasing their own preprints and offering comments to other investigators' manuscripts even without any institutional support. While OA is still not a default mode of scientific publishing, dissemination of preprint is barrier-free by definition (Elmore<sup>13</sup> called it "democratization of the information flow"). Sever et al.,<sup>55</sup> among others, perceive preprints as the future of OS. In this vein, preprints can be seen as a model of self-publishing and self-archiving, in which the authors present their work publicly while retaining complete control over the content and full copyright.

## Fostering debate

A preprinted manuscript can be further disseminated using social and lay media, professional Internet forums and other similar venues, allowing fellow scientists for commenting on it, pointing out its strong and weak aspects, and providing the authors with suggestions on how to improve it. Most leading preprint servers, including medRxiv and Research Square, also give the opportunity for commenting on each posted manuscript. Therefore, professional debate around its contents can be fostered before publication, enabling authors to enhance their work even before it is submitted to a scientific journal<sup>11</sup> or receive valuable feedback concerning their work in general. Authors can obtain input from a wider audience than a few peer reviewers.<sup>13</sup> Although Clemens<sup>56</sup> argues that negative comments in reaction to a preprint may discourage early-career researchers, it has to be emphasized here that critique and criticism (sometimes somewhat harsh) are a part of the scientific community, and scientists have to be ready from the beginning of their professional development to accept it.

Some researchers may also decide to release a preprint to test their peers reaction to a specific hypothesis, without the intention of submitting the manuscript to any journal in the form deposited on the preprint server. So far, no research is available showing whether such debate actually occurs and whether it has any meaningful influence on the contents of the released preprints. On the other hand, it should be noted that this does not necessarily mean that there are no researchers who benefit from such feedback; it means that this undoubtedly important issue awaits professional investigation.

## Communicating controversial or negative outcomes

Preprints also provide a possibility to present adverse or controversial outcomes that could otherwise be deemed by peer reviewers unfit for publication in a regular journal.<sup>13</sup> Negative results can also be necessary for developments in a particular field since they may prove (or at least suggest) that a certain approach or method does not yield meaningful information; therefore, other researchers may refrain from considering it and save time and money for different ideas.

## Boosting citations?

Finally, there is the open problem of whether preprints play a much more practical role from a researcher's or journal editor's point of view and boost the number of citations of the published paper (assuming that in this context, a preprint is only an intermediate stage). Results obtained by Fu and Hughey<sup>57</sup> suggest that releasing a preprint is associated with more attention and citations for the peer-reviewed article. Xu et al.<sup>58</sup> showed that the better the altmetrics and citations of preprints, the better performance when the preprints published in journals, while Fraser et al.<sup>59</sup> found that bioRxiv-deposited journal articles had sizably higher citation and altmetric counts compared to papers not deposited on this server before publication, as did Serghiou and Ioannidis.<sup>60</sup> Xie et al.<sup>61</sup> claimed that preprints correlate with more citations, but their study has been released only as a preprint and has not been peer-reviewed or otherwise validated. However, all these studies are still limited and do not allow for extrapolations or generalizations for all published papers that were previously released as preprints.

## Controversy around preprints

### Reliability of preprints

The most crucial concern raised is related to this exact feature of preprint which ushers their most prominent advantage: They are not peer reviewed. Thanks to this, they can be disseminated at once, but for exactly the same reason there is no guarantee of their scientific soundness. Some researchers expressed assurance that the academic community will self-regulate itself and detect faulty preprint publications; however, before this happens, inexperienced researchers or lay people may confuse a preprint with a legitimate, peer-reviewed scientific paper. Lack of peer reviews means that presented results and conclusions have to be closely scrutinized by readers (Bagdasarian et al.<sup>62</sup> discussed this issue in the context of the COVID-19 pandemic) because preprints may include a wide array of errors and/or dubious claims which will remain in circulation until a specialist

reads a given manuscript closely and alarms the public of its shortcomings. Moreover, lack of quality control may favor “salami-slicing” publishing – dividing one large paper into several shorter ones and releasing them as preprints independent of each other to obtain more publications.<sup>11,63</sup> Although the staff of preprint services verify manuscripts deposited on the most popular servers, this verification is brief and concerns mainly the scientific character of the paper; moreover, there are no studies in the literature examining the thoroughness and reliability of such verification.

## Faulty screening

Additionally, no method is currently available to screen preprint submissions for conflicts of interest<sup>13</sup> – Research Square requires authors to disclose such conflict. Still, it is unclear whether any verification in this regard occurs.<sup>33</sup> If such a paper is cited in other research papers or reposted on social media, confusion may spread, as in the case of the preprint concerning hydroxychloroquine use to treat COVID-19, summarized by Kang and Oh.<sup>3</sup> Moreover, there are no standards regarding data sharing and open data concerning preprinted manuscripts – Research Square “strongly encourages” data sharing but does not require it.<sup>33</sup> This issue has been outlined by Strcic et al.<sup>64</sup> in the context of papers on COVID-19, while McGuinness and Sheppard<sup>65</sup> conducted a descriptive analysis of the data availability statements accompanying medRxiv preprints and a comparison with their published counterparts.

Preprints allow the scientific community to learn about discoveries before they are published; however, their dissemination may lead – at least potentially – to scientific misconduct since investigators with ulterior motives may attempt to scoop other research team’s ideas and publish their results before the original team releases their paper in a peer-reviewed journal. On the one hand, the availability of predatory journals with very short turnaround time (because of only feigned peer review) theoretically makes such scoop possible; on the other hand, the probability of such occurrence seems very low in light of the current literature.<sup>55</sup> Nevertheless, such concern has been voiced<sup>3</sup> (mainly in the context of research representing a commercialization value), and they should be taken seriously. The risk of deliberate plagiarism is low because manuscripts deposited on most popular preprint servers are searchable for anti-plagiarism services (e.g., iThenticate) like published papers. The issue of scooping possibility in relation to preprints has been extensively discussed in a dedicated FAQ section on the ASAPbio server.<sup>66</sup>

## Duplicate publication

Even though the similarity (sometimes reaching 100%) between the preprint and the manuscript submitted to a scientific journal is not seen as self-plagiarism (since a preprint is not a publication), the surge in the number of papers

released as preprints prior to publication in a journal causes another significant problem: duplicate publications. The preprint servers do not monitor whether the deposited manuscripts end up published; therefore, it is the authors’ duty to complement the preprint following publication of the paper with a note about such publication and a DOI of the published version, with the latter (and not the preprint) considered the version of record (i.e., final version).<sup>67</sup> However, many authors neglect to fulfil this duty; they leave the preprint unchanged (this issue is discussed further on examples from our journal in the “Papers in *Adv Clin Exp Med* previously released as preprints in 2021–2024” section). Such neglect has a visible result: from our editors’ experience, it can be observed that often other researchers cite a preprint, unaware that when they submitted their manuscript, a published, in some instances, significantly revised version of the cited article has already been published. In our opinion, it would be sufficient when, before citing the preprint, the authors would search on the Internet for papers with the same title and authors – in most cases, such a simple procedure would allow for finding the peer-reviewed version of the record (provided that such version exists at all). However, some authors seem unaware that it is so easy to avoid confusion. Checking in this way the preprints included in the reference lists is a standard procedure in editing a manuscript accepted for publication. When it is revealed that a preprint instead of a peer-reviewed version has been cited (which results in “citation dilution” because citations of one paper are “diluted” between 2 DOIs treated by the databases as 2 separate entities), our editors inform the authors about this fact since the version of the record can be substantially updated. The authors may wish to revise the corresponding passages of their paper in light of such updates. Finally, each journal should employ a citation format that ensures discerning between published papers and preprints, as pointed out by Kang and Oh.<sup>3</sup>

In this regard, the ICMJE recommends that the authors should: 1) inform a journal if the work submitted has been posted on a preprint server; 2) provide a link to the preprint to indicate in the text of the manuscript that a preprint is available and how reviewers can access that preprint; 3) ensure that preprints are amended to point readers to subsequent versions of the work, including the published article. In addition, authors should not post the published article in the preprint archive, nor should interim versions produced during the peer-review process incorporate revisions based on journal feedback. Finally, when a preprint article has been subsequently published in a peer-reviewed journal, authors should cite the subsequently published article rather than the preprint article whenever appropriate.<sup>68</sup>

## Unequal status of preprints and their citability

It is also of utmost importance that all researchers in all fields of science and scholarly knowledge are fully aware

of the unequal status of preprints compared to peer-reviewed papers published in scientific journals. Although several funding entities – the Medical Research Council and Wellcome Trust – accept preprints in grant applications, such practice is far from uniform.<sup>69</sup> The same applies to citing preprints in other scientific publications – although most journals do not discourage it, a research paper with its reference list including many preprints may be treated as less reliable by peer reviewers.

Another concern also relates to citing preprints and their unequal status – and this is a two-edge sword. On the one hand, in a survey by Ni and Waltman<sup>14</sup> several respondents expressed doubts that their preprints would be cited at all because of low credibility of such dissemination form. Some researchers may be wary to release a manuscript as a preprint – since what is the point when one of the main expectations among all authors is to be cited? On the other hand, many scholars may also refrain from citing preprints – for 2 reasons: 1) disputable reliability of such sources may be frowned upon by peer reviewers if the reference list of a given manuscript comprises several such positions (even if certain topics are so far discussed only in preprints); and 2) not all citation standards include clear guidelines how to cite preprints in a way not would not be confused with papers already in press (from the experience of the authors of this editorial, it is clear that many less experienced authors confuse an in press paper – i.e., already accepted for publication but not yet published – with a manuscript only under review, which indeed can be cited only if it is concurrently available as a preprint).

## Possibility of confusion among laypeople

Some scholars have voiced concerns that lay public, especially journalists, who need to become more familiar with the tenets and reality of scientific publishing, may confuse preprints with peer-reviewed articles or even be unaware of the status difference between them. Consequently, dubious or unverified claims may be presented to the public by journalists in mainstream media or private persons in social media as verified scientific facts (while actually they are yet to be scrutinized). This can have dire consequences in medical sciences – possible harm to health may be a considerable danger in some instances. There is also a possibility that some authors may attempt to publicize claims of questionable scientific merit, using the media to attract attention as they are unlikely to win the approval of the scientific community – such practice is sometimes called ‘science by press conference’.<sup>70</sup> During the COVID-19 pandemic, Fraser et al.<sup>15</sup> noted that despite the warning messages provided by medRxiv and bioRxiv, COVID-19 preprints have received unprecedented coverage on online media platforms. Concerns were also raised that unverified claims in preprints can be used by politicians and physicians to advocate for specific treatments of disputable effectiveness or to support their political agenda.<sup>71</sup>

The most popular preprint servers place disclaimers on the 1<sup>st</sup> page of each deposited manuscript to minimize the danger of confusing it with a peer-reviewed journal paper – e.g., Research Square uses the formula “This is a preprint; it has not been peer-reviewed by a journal”,<sup>33</sup> while medRxiv states that “this article is a preprint and has not been peer-reviewed. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice”,<sup>12</sup> as seen in a preprint by Vazquez-Rodriguez et al.<sup>72</sup> Peiperl<sup>73</sup> proposed placing a digital watermark on all pages (“preprint, not peer-reviewed”) instead of a small disclaimer just on page 1 to deter the reporting of unverified data by the lay media.

Even the term ‘preprint’ is prone to mislead less experienced journalists and researchers because it says nothing about the peer review itself and can be confused with ‘Epub ahead of print’, which is a peer-reviewed paper published without pagination before it appears in a specific issue of a given journal, sometimes many months in advance (almost all papers published in *Adv Clin Exp Med* first appear as ahead of print versions). Therefore, Ravinetto et al.<sup>74</sup> proposed terms like ‘unrefereed manuscript’ or ‘manuscript awaiting peer review’ or ‘non-reviewed manuscript’ to avoid misunderstandings, while Mullins<sup>75</sup> pointed out that preprints that have not been subsequently published in a peer-reviewed journal and their authors do not intend to do so should be called “no-prints” to steer clear of suggesting that some form of publication occurred or is likely to happen.

## Information overload

Already, so many papers are published in an ever-multiplying number of scientific journals that it becomes impossible to keep track of them in one’s field of interest, which causes concerns about general information overload in the scientific community. It is said to be additionally amplified by the circulation of preprints, mainly due to them being an opportunity to disseminate low-quality research while circumventing the peer review, which serves as a gatekeeper in journals.<sup>63</sup> There are no studies aiming to cover all preprints released in a given field of science in a restricted period; therefore, it is so far impossible to assess whether this concern is legitimate.

## Retractions of preprints

Preprints are a part of one of most prominent problems concerning scientific publishing: Although there is a mechanism of retraction, which enables to remove seriously flawed papers from circulation while at the same time appropriately informing the readers about the reasons for such action (in a retraction note) and retaining the basic information about the paper (title, authors and journal of publication, etc.), there is no universal mechanism of relaying the fact of retraction to databases and



other entities where the paper, often in full-text version, is available. The same applies to preprints – if authors cite a preprint, but does not access the manuscript as it is available on the preprint server, relying only on the version in the database, they may be unaware that it has been retracted. However, several major preprint servers – including arXiv, medRxiv and Preprints.org, but excluding Research Square – are included into the Retraction Watch Database (<http://retractiondatabase.org/RetractionSearch.aspx>). Should a preprint deposited in a repository present in this database be retracted, it would be visible after a proper search – not only the fact of retraction, but also the reason for it. The Retraction Watch Database address also the issue of preprint versioning: If a retracted preprint has multiple versions with different DOIs, all of them are entered into this database and the term “Revision” is added to the revised versions of the original article in the description of the article type.<sup>76</sup>

## Lowering editorial standards

Last but not least, there is a controversy regarding the editorial aspect of preprints. As it has been pointed out above, such materials are neither typeset nor do they undergo any other editing, neither linguistic nor technical. They are deposited by authors as \*.doc/\*.docx files, and are available usually as \*.pdf files obtained by simple conversion of the source file. Such low technical standard of dissemination – from the experience of authors of the present editorial – may influence some researchers’ expectations concerning the editing process, particularly its speed and thoroughness. Many authors appear genuinely surprised when they learn that their paper will not be published immediately following final acceptance and that it will be edited and typeset. When provided with the galley proof with many remarks and corrections, they sometimes expect that the \*.pdf file may be at this stage simply “reverted” to the \*.doc/\*.docx form, which is impossible – not only at this stage, but at any stage after typesetting (a manuscript after typesetting cannot be converted into text and \*.pdf form back and forth at will).

## Examples of notable medical COVID-19 preprints

In this section, both examples of preprints that contained valuable scientific knowledge and of those which were debunked and removed from circulation will be briefly discussed. The presented cases do not prove anything in themselves, but they show that both praise and criticism of this dissemination form are warranted.

A preprinted manuscript by Pradhan et al.<sup>77</sup> titled “Uncanny similarity of unique inserts in the 2019-nCoV spike protein to HIV-1 gp120 and Gag” was published on bioRxiv on January 31, 2020, and quickly attracted attention

of the scientific community, with a flurry of comments both directly on the preprint server and on Twitter, where the authors posted an URL to the preprint. Commenters contended that the author’s methods seemed rushed, and the findings were at most a coincidence. Already on February 2, the manuscript was withdrawn and a following note appeared in its place: “This paper has been withdrawn by its authors. They intend to revise it in response to comments received from the research community on their technical approach and their interpretation of the results. If you have any questions, please contact the corresponding author.”<sup>77</sup> The title and information about authors are still in place and the older (i.e., full) version of the paper is available, albeit with a large watermark “Withdrawn” on each page. However, in several databases, this preprint is marked not as withdrawn, but retracted, which is an important difference. Preprints may be withdrawn also for reasons not related to their content (e.g., conflict among authors), just like papers submitted to a journal but not yet published; however, a published paper can only be retracted (withdrawals or removals are rare) and such move is in most instances connected to its scientific flaws or plagiarism.

Luckily, all of that happened before a single news outlet with any reach covered the paper. Already on February 8, 2020, Zhang et al.<sup>78</sup> released as a preprint (also on bioRxiv) a 1<sup>st</sup> version of a manuscript reanalyzing the data provided by Pradhan et al. and heavily criticizing the methodology employed in their paper. What is important, this manuscript was later published in a peer-reviewed version.<sup>79</sup> Later that year, claims of Pradhan et al. were invalidated in other peer-reviewed papers, among them in a study by Xiao et al.<sup>80</sup>

This example showcases that the scientific community is able to rapidly react to preprints of low quality. However, it should also be noted that such appropriate answer may be ascribed to the subject of the paper in light of the unfolding COVID-19 pandemic in its early stages, when all scientific materials concerning this issue were actively sought and received unprecedented attention. We cannot be sure that a faulty manuscript about a less timely topic would be debunked so swiftly and thoroughly.

An example of the positive role of preprints during the same time – early months of the COVID-19 pandemic – is a paper by Guan et al., released first as a preprint on medRxiv<sup>81</sup> on February 9, 2020, and just less than a month later (on February 28, 2020) in the *New England Journal of Medicine*.<sup>82</sup> Nineteen days seem not a long time; however, the crisis was spreading like a wildfire and such rapid dissemination truly made a substantial difference: The authors had shared the clinical symptoms, laboratory abnormalities and radiologic findings of over 1,000 patients with COVID-19 well before many American or European clinicians gained direct experience with SARS-CoV-2. The initial preprint provided an early window into one of the largest threat that COVID-19 would pose for patients

and the healthcare system – many experts became aware that the increasing number of patients with acute respiratory distress syndrome would shortly dwarf the number of available ventilators around the world. Awake prone positioning and shared ventilation, which were critical components of the global strategy to contend with the limited ventilator supply during the height of the pandemic, would not be known in many healthcare facilities around the world so quickly if the authors would wait for a peer-reviewed publication.<sup>83</sup> *New England Journal of Medicine* conducted the review process with a breathtaking speed, but the authors could not assume that when submitting the paper only a month before. Their decision about releasing the preprint and promoting it in social media was both warranted and expedient. Nevertheless, also in this case it should be borne in mind that in a less critical situation even a very important preprint may be overlooked – but this is a general consequence of a sheer number of scientific articles published every day; a peer-reviewed paper appearing in a journal other than top-ranking may also slip attention.

## Perspective of various stakeholders

Several studies have analyzed the approach to preprint among members of the scientific community, focusing, however, primarily on researchers. Soderberg et al.<sup>84</sup> provided an interdisciplinary survey of researchers regarding the credibility of preprints, while Chiarelli et al.<sup>8</sup> conducted a broad study combining a literature review and survey among different members of the scientific community concerning perception of and attitude to preprints. In 2 very recent (2024) studies, Ni and Waltman<sup>14</sup> separately surveyed researchers in different parts of the globe (China, then USA and Europe, and finally the rest of the world), while Biesenbender et al.<sup>85</sup> surveyed life sciences researchers who posted COVID-19-related preprints. In order to provide at least a partial insight into this issue, these 4 studies are discussed below.

Soderberg et al.<sup>84</sup> in 2020 asked 3,759 researchers across a wide range of disciplines about the credibility of individual preprints and preprint services. Among their respondents, 69.73% of the sample felt slightly to strongly favorable towards preprints, while only 15.16% felt opposed to preprints and 14.95% felt neutral. The average percentage of favorable responses among medical authors was lower but still high (51%). Usage of preprints was associated with preprint views/downloads more than by preprint submissions: 70.63% of all surveyed researchers had viewed/downloaded preprints either a few or many times, while only 29.85% had submitted a preprint a few or many times. Medicine had the lowest levels of viewing/downloading of any discipline (48.11%). Information about OS content and independent verification of author claims were rated as highly important

for judging preprint credibility, and peer views and author information were rated as less important.

Chiarelli et al.<sup>8</sup> conducted 38 semi-structured interviews of various stakeholders – mostly active researchers, but also research funders, administrators of research-performing organizations and preprint server providers – chiefly from the fields of biology, chemistry and psychology, between October 2018 and January 2019. The respondents expressed uncertainty and diverse views on both preprint definition and position in the scientific landscape. The main concerns were related to the lack of quality assurance and the Ingelfinger rule. Doubts and concerns were also recorded regarding the financial stability and business models of preprint servers, since some of them are owned and managed by non-governmental organizations (NGOs), some by universities and other research institutions, and others by private publishing companies. Although most of these institutions profess long-term preservation policy, respondents were not sure whether manuscripts disseminated only as preprints will be available indefinitely. The interviewees commented that if preprints were to play a more significant role in scholarly communication, major improvements to the preprints infrastructure would be needed – i.e., incorporation of preprints into scholarly and publisher workflows, provision for production of preprints in standards-based formats (e.g., \*.xml) and greater consideration of preservation services. The conclusions were that community norms are crucial and have not significantly changed in many cases, therefore constraining individuals' decisions. There was, nevertheless, some willingness to experiment, particularly amongst general OA supporters. There was some awareness of potential benefits becoming evident in practice but still at low levels; evidence of incomplete knowledge or misunderstandings amongst some researchers relating to preprints was also clearly visible.

Ni and Waltman<sup>14</sup> performed an online survey of corresponding authors of papers published in 2021 and early 2022 and indexed in the Web of Science database, asking them about familiarity with preprinting, ways of learning about it, experience with reading preprints, experience with posting them, willingness to post preprints in the future, as well as about attitudes toward preprinting (benefits of preprinting, concerns about it and ways to encourage it). Overall, 45% of the European survey participants reported to be “very familiar” or “extremely familiar” with preprinting, with 38% of participants from other continents answering in the same vein. Even more declared reading preprints (at least a few per year) – among medical researchers, approx. 70% regardless of the world part. Around 50% from the same group stated that they released at least 1 preprint during their career, and a similar percentage declared that they are willing to do so in the future (again or for the first time), while approx. 30% did not plan to engage in preprinting. The most emphasized benefits of preprints among medical investigators were: availability in OA (32–43% of respondents, depending on the continent, mentioned

this advantage), acceleration of scientific communication (31–38%), lack of publication charges (29–36%), establishing priority (24–34%), additional exposure (23–28%), early feedback (14–24%), and showing progress for grant/job applications (13–25%). More citations and sharing results that do not fit into journals were mentioned less often. Among the concerns raised most frequently were: low reliability and credibility (30–48%), sharing before peer review (25–41%), premature media coverage (23–53%), copyright/licensing uncertainty (16–27%), incompatibility with journal policies (17–19%), danger of getting scooped (13–35%), undermining peer-reviewed journals (9–24%), and lack of recognition for preprints (8–30%), with information overload and possibility of harmful comments on preprints appearing only seldom. Free-text responses revealed additional concerns: about quality of preprints, multiple versions of the same paper, citing preprints in peer-reviewed papers, and possible accusations of self-plagiarism. These authors also pointed out lower adoption of preprints in medical and health sciences when compared, e.g., to physics, astronomy, mathematics, and computer science. While reading preprints is more or less equally common in different countries, survey participants in the USA and Europe reported higher familiarity with preprinting and stronger commitment to posting preprints than those from other parts of the world.

Biesenbender et al.,<sup>85</sup> also very recently (2024), conducted a survey of life sciences researchers who have posted COVID-19-related preprints regarding their experiences and motivations. The most often cited motivations to release a preprint were: 1) to increase awareness of one's research; 2) to stake a claim on one's findings; 3) to receive early feedback; 4) to encourage increased citations of one's work; and 5) to promote possible research collaborations. The most often voiced concerns were that: 1) preprints lack quality assurance; 2) there is a risk of incorrect reporting by lay media; and 3) comments and feedback are generally not helpful. Many respondents also believed that in 5 years, preprinting will be a common practice in their research field. They then analyzed 8 popular preprint repositories regarding the number of posted preprints. Interestingly, survey and preprint server analysis have presented different, if not contradicting, results: While the majority of surveyed researchers were willing to continue posting preprints, the numbers of preprints published, especially on servers for the life sciences, have stagnated or declined. Also, while certain preprints garnered substantial citations during the COVID-19 pandemic, this has not resulted in a significant shift in researchers' publishing behavior, and the posting of preprints has not become a routine. The researchers concluded that the sustainability of preprint publishing practices is more strongly influenced by disciplinary norms and practices than by external shocks (as the COVID-19 pandemic).

The contents of the 4 above surveys can be summarized as follows: preprints are more and more accepted within

the scientific community – at least among researchers, who are aware of several of both potential benefits and possible problems associated with this form of dissemination. However, the lack of trust emphasized by Chiarelli et al.<sup>8</sup> persists – the authors do not trust other researchers (possibility of scooping, releasing low-quality research, harmful comments), journal editors (incompatibility with journal policies, accusations of self-plagiarism) and journalists (premature, sensational coverage in media).

An international, cross-sectional survey of preprinting attitudes among biomedical researchers was also conducted by Ng et al.,<sup>86</sup> but their methodology makes a comparison with the studies presented above an undertaking outside the scope of this paper.

## Policies of other journals

### General tendencies

Smart<sup>63</sup> divided the relationship between journals and preprints into 6 steps to acceptance: uneasy relationship (nostalgia for strict Ingelfinger Rule), acceptance, encouragement, participation (loose collaboration with preprint services), and sub-merger (a close alliance of preprint servers, journals and peer review services). In 2020, Klebel et al.<sup>87</sup> described the policy of most of the 171 major academic journals across disciplines they examined in this regard as “unclear”. During the last 4 years, the situation has probably improved, but the policies reviewed for the present study significantly differ in their specificity; however, they are clear enough to allow for comparisons. For example, in the same year, Massey et al.<sup>88</sup> published a cross-sectional study of preprint policies among the 100 clinical journals with the highest IF. They showed that 86% of journals allow for submitted articles to be previously posted as preprints. Policies of leading biomedical journals were also outlined in 2020 in an editorial by Flanagan et al.,<sup>71</sup> while Vlasschaert et al. presented the policies of scientific journals from the field of nephrology.<sup>89</sup>

Journals or publishers who do not accept papers previously released as preprint are only a fraction of all scientific medical periodicals.<sup>90</sup> Among them are all periodicals owned by the British Editorial Society of Bone & Joint Surgery, as well as *Journal of Orthopaedic Research* (owned by Wiley) and *Clinical Orthopaedics and Related Research* (owned by Wolters Kluwer).

Conversely, many journals do not stipulate anything particular apart from disclosing the existence of the preprint during submission and adding a note about the version of the record following publication; such policies will be called “unrestricted” in this section.

Examples of an unrestricted policy are the rules concerning preprints employed by Taylor & Francis,<sup>91</sup> Cambridge University Press<sup>92</sup> and the *Journal of Clinical Medicine Research*,<sup>93</sup> which do not include any further requirements.

Centers for Disease Control and Prevention (CDC) state that they will consider publication manuscripts posted on reputable, not-for-profit preprint servers on a case-by-case basis,<sup>94</sup> which is a slightly more cautious approach but still open to preprint practice.

## Specific attitudes

Narrowing the rules covering preprint only to non-commercial preprint services is standard, though not uniform; however, this lack of uniformity may be caused by the fact that all the most popular preprint servers listed above are free of charge. Some journals accept only disseminating preprints through non-commercial servers (e.g., arXiv, Open Science Framework, Zenodo) – such policy was adopted by, e.g., the American Association for Physics in Medicine.<sup>90</sup> It should be noted here that authors' or institutional websites (e.g., repositories offered by universities) are also considered non-commercial. Therefore, e.g., BioMed Central (BMC) explicitly accepts sharing preprints also on such servers.<sup>95</sup>

Wiley company gives the authors a choice regarding the abovementioned note: They can use such disclaimer or post the final published version of the article immediately after publication on the non-commercial preprint server instead of the previous preprint version,<sup>96</sup> which prevents the circulation of different versions of the same paper. Conversely, Elsevier stipulates that preprints should not be added to or enhanced to appear more like, or to substitute for, the final versions of articles.<sup>97</sup> American Society of Clinical Oncology (ASCO) journals somewhat mix the 2 above approaches and stipulate that, on the one hand, no revisions should be posted to the preprint server during the manuscript's peer review process, while on the other hand, revisions following publication must not deviate from the final version of the manuscript published by ASCO.<sup>98</sup>

Some differences in preprint policies concern licensing. Springer journals stipulate that the authors must disclose the DOI of the preprint and the licensing terms offered by the preprint server<sup>99</sup> because these terms affect how the preprint may be shared and reused.

Some journals and publishers state that the manuscript versions that have been altered due to the peer review process may not be deposited. This pertains, i.e., to journals published by the American Heart Association (AHA),<sup>100</sup> American Thoracic Society, European Respiratory Society, Cell Press journals (owned by Elsevier), and Japan Society for Cell Biology.<sup>90</sup> The American Association for Cancer Research (AACR) and *Science* journals use a slightly different formula: While a manuscript is considered, no versions revised in response to editorial input and peer review should be posted on a preprint server.<sup>101,102</sup> European Molecular Biology Organization Press states that no updated versions may be posted to preprint servers after initial submission to the journal – there is also a slight difference here because there is no mention that the update must be in any way related to the peer review process (the authors

can revise the preprint also for other reasons, but in this case it is forbidden as well).<sup>90</sup>

The American Psychiatric Association Publishing and the Journal of the American Medical Association (JAMA) Network stipulate that the submitted manuscript must add meaningful new information above that is already in the preprint. This narrows the number of preprinted papers that can be considered for peer reviews in these journals because many submitted papers previously disseminated as preprints are identical or almost identical to versions available on preprint servers.<sup>90</sup>

Specific preprint policies of different journals and publishers differ in minor details. *BMJ* declares that it “fully supports and encourages archiving of preprints” provided that: 1) they are deposited on non-profit servers; 2) the authors inform about the preprint during submission and include its DOI; 3) a given paper is not a case report (due to patient confidentiality concerns); 4) the authors add the following text to the preprint following the publication of a given paper in *BMJ*: “This article has been published in [insert full citation] following peer review and can also be viewed on the journal's website at [insert DOI].” *BMJ* does not restrict the license chosen when posting a preprint version of work, but authors must retain the copyright of their work when posting to a preprint server.<sup>103</sup> Policies of *Nature* portfolio journals are identical – the only difference is the lack of specific provisions regarding case reports.<sup>104</sup>

Several entities further connected the preprint dissemination with publishing articles in their journals. Authors submitting papers to *PLoS One* journals can choose to deposit them concurrently on medRxiv or bioRxiv; the preprints are checked for suitability according to the rules of the respective preprint server. Otherwise, the preprint policy of these journals can be defined as unrestricted.<sup>105</sup> BioMed Central has partnered with Research Square to provide In Review, a journal-integrated solution for preprint sharing.<sup>95</sup> Sage Publishing also launched its preprint server – Advance.<sup>106</sup>

## Summary

From the above, it can be inferred that the global trends are unequivocal: Preprints are more and more widely not only accepted but actively encouraged – some publishers and journals even themselves offer the authors the opportunity to release their manuscripts in this form as soon as a given article is submitted to their journal. Periodicals that consider preprints prior publication are only a tiny minority – since the advent of preprints, several journals changed their policies in favor of them, while in the literature, not a single case of a decision in the opposite direction is noted. As for now, the status of peer-reviewed papers compared to unrefereed preprints remains unchallenged. However, there are voices such as Neylon et al.,<sup>107</sup> which suggest that the role of preprints in specific fields of knowledge



becomes so paramount that the objective “state” of the article (work-in-progress, unpublished but completed, published, with other possibilities) can become divergent from the “standing” a given scientific community attaches to it.

## Adv Clin Exp Med preprint policy

Our journal endorses and encourages the practice of disseminating the pre-peer-reviewed versions of scientific papers through established non-profit preprint servers such as BioRxiv, medRxiv Research Square, or Authorea, as well as on authors’ or institutional websites, while not requiring it in any capacity. This policy does not interfere with the policies of funding institutions, employers or other entities, which may stipulate such release in their regulations concerning OA. Posting of preprints is not considered prior publication by the editorial office of *Adv Clin Exp Med* and a preprinted manuscript is treated as any other following submission.

Preprints are defined as an author’s version of a research manuscript before formal peer review at a journal, deposited on a public server. Preprints may be posted before or during the peer review process, but not after acceptance in the journal and certainly not following publication (we also do not encourage authors to update the preprint following publication in order to let it mirror the version of record – it could cause further confusion because it is not a popular practice).. Versions of a manuscript that have been altered as a result of the peer review process may not be deposited on the preprint server – the above means that the authors can disseminate a preprint following submission (due to the possible length of the peer review process), but its text has to be either the version initially submitted or any earlier version, but no changes related to the peer reviewers’ remarks can be implemented (changes unrelated to peer-review process are authors’ choice). The reason for this prohibition is that by definition and as stated above, a preprint is a version of a research manuscript before formal peer review at a journal and, therefore, cannot include any content incorporated in consequence of such review. A preprint that has been peer-reviewed in a journal is no longer a preprint but a postprint – a research journal article after it has been peer-reviewed and accepted for publication but before it has been typeset and formatted by the journal.<sup>8,108</sup>

*Adv Clin Exp Med* does not formulate any stipulations regarding the licensing terms stated by the preprint servers since it is a golden OA journal – articles published on the journal’s website (<https://advances.umw.edu.pl/en/home/>) are licensed under Creative Commons Licenses (CC), which means they can be freely distributed and shared so that other people can build their work based on them. Licenses offered by most popular preprint servers are either CC ones or at least do not create any legal conflict; therefore, we decided not to state any conditions

regarding preprint licenses because it could cause unnecessary confusion among authors.<sup>109</sup>

If the article is already accessible online as a registered preprint on any website or in any database and has been already assigned with a DOI, such information, together with a URL of the registered preprint, has to be provided during submission of the paper as well as appear in the cover letter. Once the preprint is published in *Adv Clin Exp Med*, it is the author’s responsibility to ensure that the preprint record is updated with a publication reference, including the DOI and a URL link to the published version of the article on the journal website. The editors of our journals check for the above annotation within the preprint periodically following publication to make sure that all authors comply with this policy.

*Adv Clin Exp Med* has not entered a partnership with any already established preprint server, owns no in-house preprint server, and has no intention to undertake any such initiatives.

## Reasons for Adv Clin Exp Med preprint policy

In general, the advantages of preprints outweigh the controversy surrounding them and their potential dangers. Disseminating preprints is a practice widespread enough both among authors and publishers that rejecting it would mean that many high-quality papers would be desk-rejected even before the peer-review stage simply because of high Similarity Index (SI).

## Supporting OS

We consider the opportunity to present the scientific developments to the global community of scholars as soon as they are available and foster discussion around them before the publication, as well as other most essential advantages of preprints the critical reasons for endorsing them in *Adv Clin Exp Med*. Our position is that rapid dissemination of research results in order to boost the development of knowledge does not necessarily contradict the need for peer review as the best-known method to secure professional assessment and verification of submitted manuscripts, provided that there is a clear distinction between refereed and unrefereed material. In our opinion, renowned preprint services like those that *Adv Clin Exp Med* authors choose most frequently (Research Square, bioRxiv, medRxiv, and Authorea) are a form of dissemination that assures such distinction thanks to their format and layout, which differ significantly from those of peer-reviewed journal. Nevertheless, the preprint servers should consider informing the readers even more clearly and unambiguously than they currently do that the manuscript they read has yet to be peer-reviewed and what it entails (the so-called caveat lector note).

## Rapid dissemination

An ideal situation would be a peer review process much more rapid than nowadays. Still, in the absence of working solutions to this long-known problem, we can at least not deter authors from using available and widely accepted tools to at least to some extent circumvent this obstacle. Establishing priority is also an essential reason in this context – a preprint available in OA mode in its entirety is much more helpful in claiming priority than any document from the editorial office confirming that a given manuscript is under peer review or even has been accepted for publication because such documents contain only the paper's title and the authors' names, not its whole contents.

As a medical journal, we aim to support and expedite the development of knowledge in this field, not obstruct it – we endorse the practice of discussing preprints on dedicated servers and in social media and improving manuscripts as a result of such feedback. Like many other journals, we may also be wary of publishing controversial or negative results – but such content should also be able to find its way to the scientific community. Rapid dissemination of results as an advantage of preprints became paramount during the recent COVID-19 pandemic when a massive, unprecedented surge in released preprints was observed; we consider it as evidence supporting our stance.<sup>110</sup> Watson<sup>111</sup> even stated that rapid data sharing during COVID-19 has changed science forever. Preprints enabled both rapid dissemination of discoveries and quick disproving of only ostensibly promising avenues of research, which in turn allowed for rapid adjustment of health policies in different countries.<sup>112</sup> Premature or insufficiently proven claims were quickly detected and debunked by the scientific community, which has shown (at least to some degree) that the global science system is indeed self-regulatory and low-quality or fraudulent preprint manuscripts will not circulate unchecked indefinitely. The quality of COVID-19-related research has also been analyzed by Fraser et al.,<sup>15</sup> Singh and Ravinetto,<sup>113</sup> Kodvanj et al.,<sup>114</sup> Majumder and Mandl,<sup>115</sup> Vlasschaert et al.,<sup>116</sup> Wang et al.,<sup>117</sup> and Gianola et al.<sup>118</sup>

## Authors in control

We also think that preprints empower authors with more control over the results of their work – they can (in a certain framework of preprint servers) inform others about their ideas and results on their own account. On the one hand, this reduces (to some degree) the dependence of researchers on the journals as the only channels of publishing science; on the other, it does not undermine the peer review verification system as a whole, since preprints are, in most fields of knowledge, only a complement, not a replacement of traditional peer-reviewed publishing.

The editors of *Adv Clin Exp Med* acknowledge that preprint dissemination may interfere with the anonymity

of the authors because the reviewers may find the preprint on the Internet and thus learn about the authors' identities. Moreover, should a discussion occur in social media or on other websites where the authors promoted their preprint, a peer reviewer may also inadvertently read such remarks and be influenced by them. Despite these potential problems, we believe the advantages of the abovementioned preprints outweigh the potential interference with the peer-review process.

## Papers in *Adv Clin Exp Med* previously released as preprints in 2021–2024

In 2022–2023, 9 papers were published in *Adv Clin Exp Med* that were previously disseminated as preprints; in 2024 (until July 10), 6 such papers were already published. Endorsement of preprints in our journal has been decided only in early 2021, so there are no data from the previous years that could allow for pointing out trends in the popularity of preprint release among our authors. In 2021, only 2 papers already available as preprints were published, but such a low number does not enable any meaningful comparisons – it is possible, e.g., that authors who wished to disseminate their work as preprint abstained from submitting their articles to *Adv Clin Exp Med* because they were not sure whether the editorial office followed the Ingelfinger Rule. The experience of editors shows that changes in editorial policy in this journal take a few months to be broadly recognized among prospective authors.

## Outline of preprinted papers published in *Adv Clin Exp Med*

Papers published in *Adv Clin Exp Med* since the implementation of the preprint endorsement policy, which were identified as made available using preprint servers, are summarized in Table 1.<sup>119–135</sup>

Overall, 2 such papers were published in our journal in 2021, 6 in 2022, 3 in 2023, and 6 in 2024 (until July 10). However, 3 from the last group are ahead of print articles which will appear in regular issues in 2025 (1/2025, 2/2025 and 4/2025) and 1 is an ahead of print publication from the 12/2024 issue; this makes 17 papers disseminated as preprints in total. We need to find an explanation for the surge in preprinted papers in 2022. Among the 17 papers, 11 came from China, 3 from Poland, 1 from India, 1 from the Czech Republic, and 1 from Mexico. These numbers roughly reflect the composition of the country of origin of papers submitted to *Adv Clin Exp Med* – from January 1, 2021, to July 10, 2024, 63% of papers were from China and 14% from Poland. There is no evidence that funding institutions or other institutional policies

**Table 1.** Papers published in *Advances in Clinical and Experimental Medicine (Adv Clin Exp Med)*, which were available as preprints at the time of submission

Article	Country	Title	Preprint server	SI	Additional information
Li et al., 2021 <sup>119</sup>	China	miR-874 ameliorates retinopathy in diabetic rats by NF-κB signaling pathway	Research Square	97%	Information about version of record being the paper published in <i>Adv Clin Exp Med</i> only in the *pdf version available on the preprint server.
Liu et al., 2021 <sup>120</sup>	China	Silencing of lncRNA SNHG12 inhibits proliferation and migration of vascular smooth muscle cells via targeting miR-766-5p/EIF5A axis	Research Square	82%	—
Guo et al., 2022 <sup>121</sup>	China	Metformin protects against abdominal aortic aneurysm by Atg7-induced autophagy	Research Square	69%	—
Li et al., 2022 <sup>122</sup>	China	Does a single dose of palonosetron have any role in preventing acute chemotherapy-induced nausea and vomiting in pediatric osteosarcoma patients without dexamethasone? A randomized clinical trial	Authorea	33%	iThenticate did not detect the preprint.
Putowski et al., 2022 <sup>123</sup>	Poland	High intraoperative pulse pressure is a risk factor for postoperative acute kidney injury in a cohort of abdominal surgery patients: An exploratory study	Research Square	69%	—
Ji et al., 2022 <sup>124</sup>	China	Hypoxia-inducible factor-2α promotes EMT in esophageal squamous cell carcinoma through the Notch pathway	Research Square	75%	Information about version of record being the paper published in <i>Adv Clin Exp Med</i> only in the *pdf version available on the preprint server.
Begum et al., 2022 <sup>125</sup>	India	Efficacy of different intensity of aquatic exercise in enhancing remyelination and neuronal plasticity using cuprizone model in male Wistar rats	Research Square	97%	—
Sun et al., 2022 <sup>126</sup>	China	Significance of detecting the levels of miR-29a, survivin and interferon gamma release assay in patients with lung cancer and tuberculosis	Research Square	77%	—
Sang et al., 2023 <sup>127</sup>	China	Bone marrow mesenchymal stem cell-derived exosomes attenuate the maturation of dendritic cells and reduce the rejection of allogeneic transplantation	Research Square	95%	—
Grotowska et al., 2023 <sup>128</sup>	Poland	Fluid resuscitation, but not inhaled nitric oxide, improves microcirculation in septic pigs	Research Square	67%	—
Ventruba et al., 2023 <sup>129</sup>	Czech Republic	The contribution of donated human embryos suitable for the production of embryonic stem cells to increase the quality of life: Selection and preparation of embryos in the Czech Republic	Research Square	91%	—
Yang et al., 2024 <sup>130</sup>	China	Correlation analysis of patients with diabetic foot ulcers treated with tibial cortex transverse transport surgery and platelet-to-lymphocyte ratio and monocyte-to-neutrophil ratio	Research Square	97%	Ahead of print (4/2025)
Li et al., 2024 <sup>131</sup>	China	Small RNA sequencing highlights a potential regulatory network mediated by Gecko miRNA affecting the prognosis of hepatocellular carcinoma	Research Square	68%	Ahead of print (2/2025); Editorial Note: The full text of this preprint has been withdrawn by the authors while they make corrections to the work. Therefore, the authors do not wish this work to be cited as a reference. Questions should be directed to the corresponding author.
Szczepanowski et al., 2024 <sup>132</sup>	Poland	Application of machine learning in predicting frailty syndrome in patients with heart failure	Research Square	88%	Information about version of record being the paper published in <i>Adv Clin Exp Med</i> only in the *pdf version available on the preprint server.
Zheng et al., 2024 <sup>133</sup>	China	Integrated analysis of a competing endogenous RNA network reveals a ferroptosis-related 6-lncRNA prognostic signature in clear cell renal cell carcinoma	Research Square	99%	Ahead of print (12/2024)
Yong et al., 2024 <sup>134</sup>	China	Differential expression of miRNA-769-5p and Smad2 in patients with or without oral cGVHD	Research Square	89%	Ahead of print (1/2025)
Vázquez-Rodríguez et al., 2024 <sup>135</sup>	Mexico	Fc-gamma receptor expression and cytokine responses to intravenous human immunoglobulin in whole blood from non-pregnant and pregnant women and newborns	medRxiv	43%	—

SI – Similarity Index

in China or Poland encourage or stipulate disseminating papers as results of funded research more strongly than such institutions in other countries. Among the preprint servers chosen by the authors, Research Square was clearly the preferred one, with 15 papers stored there; 1 article was deposited in Authorea and 1 in medRxiv. The reason for this is most probably the snowball effect – for years, this server has been unchallenged as the most popular among medical researchers, and many of them might not consider any other service when choosing a preprint server, even though policies of Research Square and medRxiv are similar.<sup>33,35</sup> There are no visible patterns regarding the topics of the preprinted papers compared to all papers published in *Adv Clin Exp Med* – as shown in Table 1, the thematic scope of this whole group of articles is vast and covers diverse areas of medical sciences. This is in concert with the journal's scope in general – it published papers that deal with all clinical and experimental medicine.

## Differences between preprints and published papers

Several studies discussed the scope of differences between preprint versions of medical papers and the final articles that appeared in peer-reviewed journals.<sup>13,41,51</sup> Although such an area of research is outside the scope of this paper, some insight might be provided by the results of the anti-plagiarism similarity check performed using the iThenticate service provided by Crossref (Lynnfield, USA). A study by Li et al.<sup>122</sup> was disseminated as a preprint using the Authorea service, which, for technical reasons, precluded it from being identified as a preprint during the verification above (the authors revealed the existence of the preprint in the cover letter). Among the remaining 16 papers, 8 (50%) remained very similar to the preprinted version, with the SI indicated by iThenticate varying between 88% and 99% (cf. Table 1). However, the reader should bear in mind that the percentage of changes does not necessarily reflect their significance; large parts of text can be rewritten for linguistic editing reasons, while changes small in terms of percentage may deeply modify the presented results (e.g., altered numerical values). Journals that accept preprinted papers do not require the most recent version deposited on the preprint server to be identical to the manuscript submitted to the editorial office – some only stipulate that it cannot be changed following submission, either as a result of peer-reviewers' remarks or at all; therefore, the SI in the range of 43–82% among the other 8 preprinted papers published in *Adv Clin Exp Med* is not a surprise. The authors may revise the paper substantially between posting it as a preprint and submitting it to a journal, and they do not have to post the exact submitted version on the preprint server – they may decide to leave the preprinted version unaltered. Such revisions may concern both the scientific content of the text and its structure and language.

## Impact on citations

As has been mentioned before, several authors<sup>57–61</sup> discussed the question whether preprints boost the number of citations of their published versions. Unfortunately, it is impossible to analyze this issue on the example of articles previously disseminated as preprint and subsequently published in *Adv Clin Exp Med*, since none of those papers was cited more than 1–2 times and none of them was among the above-average cited papers published in this journal (the current IF for *Adv Clin Exp Med* is 2.1). Therefore, it cannot be tracked whether this single citation or 2 citations are in any way related to the preprint deposition.

## Duplicate publication issues

An issue of particular importance is the persistence of preprints on dedicated servers even after the version of record (i.e., the published version) of the manuscript appears. This creates a paradoxical situation when both unrefereed and peer-reviewed versions of the same paper are in circulation. A paper can undergo many changes during the peer-review process, and the published version may differ substantially from the submitted one. Consequently, the preprint version may be misleading for the reader because it may include content that was put into question by the reviewers and altered as a result. Leading preprint services do not allow the removal of preprints (and published ones) from their servers entirely, considering them a part of the scientific record.<sup>9,33</sup> Therefore, the preprint reflecting the submitted version can still be available and citable, even though it presents only the imperfect, sometimes even flawed version of the manuscript.

An example of an unclear situation regarding a preprint is the paper by Li et al.<sup>131</sup> It has been withdrawn from Research Square with a withdrawal note placed (cf. Table 1), which provides the following reasons for withdrawal: "The full text of this preprint has been withdrawn by the authors while they make corrections to the work. Therefore, the authors do not wish this work to be cited as a reference. Questions should be directed to the corresponding author."<sup>136</sup> The note is dated August 30, 2023, while the submission to *Adv Clin Exp Med* took place 5 days later – on September 4, 2023. Whether the withdrawal occurred due to publication in *Adv Clin Exp Med* or for other reasons is unclear. It is possible that the authors attempted to avoid duplicate publication by withdrawing the preprint rather than supplementing it with a note about the version of record; in our opinion, such action intensifies the confusion instead of minimizing it (the authors did not react to contact attempts after the editors learned about the withdrawal note).

However, a note may appear at the beginning of the preprinted paper indicating that the version of the record is not the preprint but the published version, with a DOI



or a URL of the published article. Such note about the version of the record being the paper published in *Adv Clin Exp Med* appears in 3 papers (conf. Table 1), but only in the \*pdf versions available at the preprint server, not on the HTML subpages of the respective preprints.<sup>119,124,132</sup> This may lead to a situation when a researcher or a media outlet mistakenly cites the unrefereed preprint instead of the peer-reviewed article because when searched using the title in web browsers, preprint frequently appears directly or almost directly below the published version in PubMed and on the journal's website. There is also a possibility that the preprint is erroneously taken for a paper entirely different from the version of the record listed above in the browser (this can happen when the reader neglects to compare the title and author list of both releases). Therefore, the editorial office of *Adv Clin Exp Med* stipulated as follows in the instructions for authors<sup>109</sup>: "Once the preprint is published in *Adv Clin Exp Med*, it is the author's responsibility to ensure that the preprint record is updated with a publication reference, including the DOI and a URL of the published version of the article on the journal website."

## Rejected papers previously released as preprints in 2022–2024

The rejection rate in *Adv Clin Exp Med* is very stable and, since 2021, has oscillated around 80% each year. Therefore, many more manuscripts were submitted to our journal following a preprint release that did not make it to publication. Since the SI, which allows for (apart from unmasking plagiarism cases) the detection of a preprint (should the authors neglect to reveal its existence in the submission form), was consistently measured for all submitted manuscripts only from December 2021, we decided to sift the rejected papers for preprints releases only beginning from those submitted later than January 1, 2022.

Overall, from January 1, 2022, to July 15, 2024, 72 manuscripts previously released as preprints were submitted to *Adv Clin Exp Med*, of which 15 were published and 57 were rejected (there were no preprinted manuscripts among the withdrawn ones; manuscripts still under peer review were not considered since their fate is yet undecided). The total rejection rate for the given period is 19.62%. In comparison, for the previously preprinted papers, it is 20.83%, so the difference is negligible. It does not prove any difference in the quality between manuscripts released as a preprint and all papers published in our journal.

Nevertheless, it is interesting to investigate at which stages of the article assessment process the abovementioned 57 papers were rejected. Nineteen were rejected during the peer review stage because of negative reviews, while 15 were recommended for rejection by section editors resulting from a preliminary assessment before peer

review. The rest did not pass even the initial verification stage. Authors of 13 manuscripts disclosed that they released them beforehand as preprints in the submission form or after being asked by the editors when the SI check revealed the preprint existence in the SI report; however, they failed to implement during the initial verification the editor's remarks concerning other aspects of the paper (e.g., references formatting or the overall structure of the paper). Authors of 10 papers did not inform the editors in advance about the preprints. When the SI report uncovered this negligence, they did not address the (repeated and accompanied by a URL to the preprint) question about this issue. Our editors always assume the goodwill of the authors, so failing to disclose a preprint in the submission form is never a reason for rejection – provided that the authors confirm that they made a preprint release when asked about it; should they remain silent, the paper is rejected after 60 days. We cannot explain this lack of response (even though the authors were informed that *Adv Clin Exp Med* endorses preprint dissemination) nor make any informed supposition regarding the authors' motivation for breaking contact with the editors at so an early stage of manuscript assessment.

## Conclusions

### Should our preprint policy be changed?

The analysis of all preprinted papers submitted to *Adv Clin Exp Med* showed that their rejection rate is similar to the general rejection rate for all submitted manuscripts; consequently, it can be stated that the papers previously released as preprints do not differ in quality compared to all papers published in our journal. Therefore, the justification for endorsing preprints in *Adv Clin Exp Med* is not that they benefit this journal but that they serve the scientific community as a whole and science in general by facilitating rapid dissemination of results, fostering immediate assessment of those results by other investigators and debate around them, as well as by allowing to establish priority for researchers for whom this is important for any reasons. Though legitimate, concerns and controversies surrounding preprints are primarily rooted in potentialities and not established facts; thus, the policy of our journal will remain favorable to preprints unless their disadvantages are scientifically proven or at least many cases of harm caused by preprints emerge.

As stated at the end of the "Policies of other journals" section, the status of preprints in the scientific community is dynamic and the only things we can be sure of are more changes. We are unable to predict these changes and, in consequence, to act in advance. Arguments presented in the sections "Advantages of preprints" and "*Adv Clin Exp Med* preprint policy" clearly show that there is no way back and our stipulations regarding preprints may

become more detailed, encompassing more aspects of this issue, but we would contradict our dedication to advancing medical knowledge and promoting OS if we decided to stop considering preprinted papers for publication.

Therefore, we believe the most justified line of action in light of the knowledge amassed to date is educating authors – specifically, regarding 3 aspects of preprints. First, only a tiny fraction of papers submitted to *Adv Clin Exp Med* are released as preprints; the authors should be more aware of the advantages of preprinting for them and the scientific world. Second, some authors still seem to be unsure and wary whether disseminating the paper this way before publication could cause rejection by a journal; they should know that in most periodicals, it is not a problem nowadays, but at the same time, they should be aware that a preprint is not equal to a peer-reviewed publication, which can be crucial in the context of, e.g., scientific output assessment or grant application. Third, several authors neglected to amend their preprinted manuscripts with information about the published version of the record; however, we have no means to enforce our policy following publication. The authors should be educated on why it is essential from both ethical points of view and for practical reasons because preprint citations are not monitored. If 2 or more versions of a given paper (preprint(s) and published version of record) are circulating simultaneously, some researchers can erroneously cite the preprint because they are unaware that a published version exists, and the authors do not benefit as much as when their published paper is cited. Authors who neglect to link the preprint to the version of the record are presumable oblivious to this danger.

## Future directions for preprint policies and their potential evolution in the context of OS

During the last 15 years, the preprints have been rapidly evolving, concerning both their role in the scientific landscape and the growing number of services dedicated to their dissemination. It is not probable that preprints will be treated on par with papers – peer review remains the most reliable gatekeeping mechanism. However, based on the information and hypotheses presented in the cited literature on the subject, the following tendencies in this evolution can be pointed out.

The most important area of preprint development is the issue most often raised in their context – the fact that they are unrefereed manuscripts. Some initiatives have already been launched to provide at least some of the preprints with reviewing – at least those whose authors aim at ultimately publishing them in peer-reviewed journals. This issue was exhaustively discussed on a theoretical level in an important preprint by Avissar-Whiting et al.<sup>137</sup> They offered a definition of preprint review and outlined what sets it apart from other types of more informal feedback on preprints, presented the benefits

of preprint review, and called to action for stakeholders in the scholarly communication ecosystem to further promote preprint review.

Such action can take 3 directions. One is launching peer-review services independent of specific journals or publishers. Review Commons is an initiative recently launched by European Molecular Biology Organization (EMBO) and ASAPbio. It functions as a journal-independent peer review service to which authors submit preprints and obtain peer reviews that they can then present to journals to consider.<sup>138–140</sup> Another idea was recently implemented by the journal *eLife*, which since 2021 exclusively reviews papers already published as preprints.<sup>140</sup> The 3<sup>rd</sup> direction are overlay journals – OA academic journals that do not produce their own content, but select from texts that are already freely available online and contact the authors. Many overlay journals derive their content from preprint servers; therefore, in these periodicals, preprinting is also a prerequisite for submission.<sup>141,142</sup>

These initiatives show that the future of preprints is in closer ties with peer-reviewed journals – integrating preprinting in journal submission workflows and general closer cooperation between journals and preprint servers – rather than in becoming an alternative mode for dissemination. If such mechanisms become norm, it can also result in more preprints reaching the publication stage. Given the rising popularity of preprints, it is also possible that in the coming years, last journals who regard preprints as previous publication would abandon this interpretation of the Ingelfinger Rule and at least concede to reviewing such cases on an individual basis. A survey conducted by Fraser et al.<sup>143</sup> among authors of preprints deposited on bioRxiv showed that the core of the problem is shifting from journal policies to authors' perceptions – disproportionately many authors as recent as 2022 were convinced that still many scientific journals (much more than in reality) consider releasing a preprint a breach of the above rule; however, Fraser et al. pointed out that it may be due to still unclear policies of many journals.<sup>143</sup> This means that endorsement of preprints by editors must go hand in hand with policies' clarification.

The COVID-19 pandemic clearly showed that more thorough screening of manuscripts deposited on preprint servers in both possible (at least to some extent) and important. While peer-reviewing of all preprinted materials would diminish their primary advantage over peer-reviewed papers – the speed of dissemination – the leading preprint services seem to tighten both the requirements and the verification mechanisms, especially regarding scientific content, dubious claims, conflict of interest, and data sharing. This should include also mandatory cross-linking of preprints to their published peer-reviewed versions, stipulated by both preprint servers and journal editors, which should curb the issue of citation dilution. Licensing in regard to preprints should also become more uniform since now it is not always clear from authors' perspective

whether the terms offered by preprint servers will not cause problems later, when the paper is published.

An evolution of preprints policies among funders and not only journals can be observed. Some grant funders, such as the Bill and Melinda Gates Foundation,<sup>144</sup> NIH<sup>31,32</sup> and the European Research Council (ERC), oblige beneficiaries to make their papers available under green OA status, in which self-archiving by authors (including preprinting) is permitted. If all research funders required their grantees to post their manuscripts first on preprint servers, the widespread desire to provide immediate free access to the world's scientific output would be achieved with minimal effort and expense.<sup>55</sup>

During the COVID-19 pandemic, a marked change was observed in the use of preprints in policy documents; it is another proof that the status of preprints is improving in the view of organizational (public and private alike) and state bodies. It is not clear yet whether this tendency was specific only to the global health emergency situation or will persist – the latter is more probable in light of funders' moves towards OS. More accepting attitude to citing preprints in medical publications will be probably also visible in the near future.

Some members of the scientific community – like Ni and Waltman<sup>14</sup> – emphasize that research institutions and research funders should recognize and reward researchers for preprinting their work because in doing it they promote OS. This is especially important for early-career researchers. It can also be assumed that preprints will be more welcome in resumes and evaluation sheets of researchers, albeit not as a sole or primary mode of disseminating one's achievements. For example, the University of California Davis (UC Davis) and the New York University Grossman School of Medicine both allow preprints to be included as evidence for promotion. While this is encouraging, we suspect that such policies are rare, leaving it unclear for job applicants and faculty whether to list preprints on their curricula vitae.<sup>145</sup>

Policies of databases are also changing. Preprints are indexed in many of them, but searching, retrieval and accessibility of preprints is another issue, since currently there are no cross-platform searchable aggregators specific for preprints and the end-user is relied upon external content indexing by Google Scholar, SHARE, Microsoft Academic, Unpaywall, Crossref, Europe PMC, PubMed, Prepubmed, or SciLit search engines.<sup>10</sup> In the near future, preprints may become more integrated into the searching and aggregating tools available for researchers, which would in turn boost their citability.

In the long term, double-blind review may be impossible to maintain if authors have posted their article in a preprint server,<sup>63</sup> since the reviewers will be able to learn the authors' names by simply checking the title of the manuscript or a passage from it using an ordinary web browser. It may lead to abandonment of double-blind peer review in favor of open peer-review, like in the model adopted since 2021

by the journal *eLife*.<sup>140</sup> The scale of this process would depend on the ratio of manuscripts submitted to journals being released as preprint before submission or during the peer-review process.

## Suggestions for future research on preprints

Although the literature on preprints is abundant, several issues were only slightly touched or not referred to at all in scientific papers. Therefore, we want to offer our suggestions for future research concerning this topic.

The most important issue in the context of scientific publishing seems to be the long-term impact of preprints on citation rates. This area of research forks into 3 sub-issues: 1) What impact releasing preprints has on the citation rates of the same papers after they are published in a peer-reviewed journal? 2) Is citation dilution between preprint and peer-reviewed version of the same articles a real or only a perceived problem? 3) Are preprints themselves frequently cited? Attempts were made to answer the 1<sup>st</sup> question – this issue has been discussed, among others, by Fu and Hughey,<sup>57</sup> Xu et al.,<sup>58</sup> Fraser et al.,<sup>59</sup> Serghiou and Ioannidis,<sup>60</sup> and Xie et al.,<sup>61</sup> but this area of research is still in its infancy and no definite conclusions have been reached. Añazco et al.<sup>146</sup> showed that COVID-19-related preprints which were eventually published had a higher citation count as preprints when compared to unpublished preprints, and that published preprints had a significantly higher citation count after publication in a scholarly journal compared to as a preprint; however, their study had a limited scope and is a proof that broader studies would probably yield more reliable results.

Another key and yet only cursorily investigated problem is the perception of preprints among the general public. In our opinion, the most important specific question in this regard can be formulated as follows: Is the general public able to discern between preprinted and peer-reviewed papers? Experiences from the COVID-19 pandemic have shown that laypeople, lay media and politicians alike are in some cases unable to distinguish between a scientific publication, a preprint and a press release presenting some research results. This not a new problem: Penfold and Polka<sup>147</sup> described a case of bioRxiv preprint linking cell phone radiation to cancer in rats, which in 2016 was reported on without mentioning its preprint status; however, so far this issue has not been systematically analyzed. The results of such investigations would (and should) have considerable influence on appropriate marking of preprints as such on all most popular preprint servers (as for now, the policies are not uniform). Moreover, it would be an unprecedented opportunity to bridge the scientific and media communities to create a consensus on the reporting of preprints in order to at least partially avoid mistakes made during the pandemic in the future.<sup>15</sup> However, it should be borne in mind that laypeople (including many

journalists) may be simply unaware what does it mean that a manuscript has not been peer-reviewed since knowledge about tenets of scientific publishing is not widespread even among educated people (it is not part of the high school or even university curriculum in many countries if a given person does not attempt to launch a career in the scholarly milieu). What is obvious to researchers is certainly not self-evident among the general public. Therefore, educating broader audience should also take into account the abovementioned basic rules of disseminating knowledge in the scientific community.

A related issue is the true scope of reaction to preprints both on preprint servers and in social and lay media, also outside the context of the pandemic. An often raised (and discussed in this paper) advantage of the preprints is that they are to foster professional debate about their contents even before a paper is published (or even if it is not published); however, there are only single studies showing whether such debate actually occurs and how many people participate in it – both on preprint servers and in social media (X (formerly Twitter), Facebook, etc.), where the authors post links to the released but unrefereed manuscripts. For example, Rzayeva et al.<sup>148</sup> conducted a survey among authors of pandemic-related preprints deposited on arXiv, bioRxiv, medRxiv, and ChemRxiv in 2020, of whom 53% reported that they had received feedback on their preprints. However, only a quarter of the feedback received by respondents consisted of detailed comments. Respondents also reported that, compared to preprint feedback, journal peer review was more likely to lead to major changes to their work, suggesting that journal peer review provides significant added value compared to feedback received on preprints. This suggests that the possibility of valuable debate about a given preprint may be overrated so far; this matter must be investigated further.

Another issue requiring thorough investigation is at least an estimation of the real (not only perceived) possibility of scooping. Approximately 2% of respondents in bioRxiv's survey reported having suffered a loss in ability to claim priority or to publish in the journal of their choice as a result of having published a preprint.<sup>147</sup> It does not mean that these researchers were directly scooped (journal policies rejecting preprint could also be at play), but such voices show that such possibility is not only an unfounded, unjustified fear. If such act of scientific misconduct can actually happen, concerns voiced by authors in surveys discussed in this editorial are warranted and should be widely known – in order to let authors considering a preprint release make an informed decision.

Papers presenting surveys mentioned above focused on the perspective of researchers as authors – but not as peer reviewers. It would be very informative to have some insight how scientists serving as peer reviewers perceive the value of preprints and whether they are willing to engage in reviewing also preprints if such mechanism was to be wider established.

Sustainability of preprint services and servers is also an important but only scarcely discussed issue. While the preprint services most frequently chosen by the authors are owned and managed by respectable institutions, their model of financing and sustaining their functioning is not as stable as, e.g., dark archives like CLOCKSS or large databases like Scopus, Web of Science Core Collection, PubMed, PMC, Medline, or Ovid. A broad study describing, comparing and assessing the stability of these models would be paramount to the whole scientific community and could stimulate discussion about creating more sustainable mechanisms for preprint dissemination, especially if they are viewed as a form of OS.

Related to this field of research is the impact of preprints on changing hierarchies in global science, specifically concerning the country of origin of both authors and manuscripts. The question here is: Do preprint infrastructures and social mechanisms develop with issues of diversity, equity and de-colonialization of science taken into account?<sup>147</sup> Fry and MacGarvie<sup>149</sup> showed that COVID-19-related preprints from China received significantly less attention than those covering the same topic and originating from the USA, so certainly this is an issue worth attention. It is also an open problem why researchers outside Europe and USA are more cautious about preprints – this issue was clearly observed by Ni and Waltman,<sup>14</sup> who offered various hypotheses concerning the causes of this disparity; however, no clear explanation was yet offered. Biesenbender et al.<sup>150</sup> conducted a survey about experiences and attitudes towards posting and using preprints in the Global South as opposed to the Global North. It could be observed that a greater percentage of participants from the Global South expressed agreement with the proposed benefits of posting preprints than those from the Global North. This shows that there is an unexplored potential among researchers from developing countries regarding participation in OS, also in the form of preprints. Barriers blocking these scientists from broader participation in the preprint initiatives must be clearly identified and – if possible – overcome.

Last but not least, policies regarding preprint citation employed by different publishers and journals warrant a comparison in one source. The American Medical Association (AMA) reference standard required by *Adv Clin Exp Med* includes a specific preprint notation, but other reference models may allow for distinguishing preprints and papers accepted but not yet published (so-called in press articles) not clearly enough. Since we as editors sometimes observe authors themselves assuming that a paper still under review in a journal can be cited as paper “in press”, it is crucial to both show the authors how to cite preprints properly and to make them aware that a paper not accepted yet can be released as a preprint and cited as such while a paper already accepted but not yet published can be cited either as a preprint or as an in press article (having in mind that only the former mode allows




the reader for checking its contents immediately, without waiting for publication).

More interesting open questions regarding the future of preprints were proposed in a preprint manuscript by Puebla et al.<sup>151</sup>

The editorial staff of *Adv Clin Exp Med* remains vigilant regarding the evolving role of preprints in scientific publishing – our policy must never lag behind the development of OS.

## ORCID iDs

Marek Misiak  <https://orcid.org/0000-0003-2208-2193>

Donata Kurpas  <https://orcid.org/0000-0002-6996-8920>

## References

1. Relman AS. The Ingelfinger Rule. *N Engl J Med*. 1981;305(14):824–826. doi:10.1056/NEJM198110013051408
2. Angell M, Kassirer JP. The Ingelfinger Rule revisited. *N Engl J Med*. 1991;325(19):1371–1373. doi:10.1056/NEJM199111073251910
3. Kang H, Oh HC. Current concerns on journal article with preprint: *Anesthesia and Pain Medicine* perspectives. *Anesth Pain Med*. 2023; 18(2):97–103. doi:10.17085/apm.23036
4. Cobb M. The prehistory of biology preprints: A forgotten experiment from the 1960s. *PLoS Biol*. 2017;15(11):e2003995. doi:10.1371/journal.pbio.2003995
5. Committee on Publication Ethics (COPE). *COPE Discussion Document: Preprints*. Eastleigh, UK: Committee on Publication Ethics (COPE); 2018. doi:10.24318/R4WBao2
6. Kaiser J. The preprint dilemma. *Science*. 2017;357(6358):1344–1349. doi:10.1126/science.357.6358.1344
7. Berg JM, Bhalla N, Bourne PE, et al. Preprints for the life sciences. *Science*. 2016;352(6288):899–901. doi:10.1126/science.aaf9133
8. Chiarelli A, Johnson R, Pinfield S, Richens E. Preprints and scholarly communication: An exploratory qualitative study of adoption, practices, drivers and barriers. *F1000Res*. 2019;8:971. doi:10.12688/f1000research.19619.2
9. Blatch-Jones AJ, Recio Saucedo A, Giddins B. The use and acceptability of preprints in health and social care settings: A scoping review. *PLoS One*. 2023;18(9):e0291627. doi:10.1371/journal.pone.0291627
10. Chalepliglou A, Koulouris A. Preprint paper platforms in the academic scholarly communication environment. *Journal of Librarianship and Information Science*. 2023;55(1):43–56. doi:10.1177/09610006211058908
11. Alfonso F, Crea F. Preprints: A game changer in scientific publications? [published correction appeared in: *Eur Heart J*. 2023;44(10):870. doi:10.1093/eurheartj/ehad024]. *Eur Heart J*. 2023;44(3):171–173. doi:10.1093/eurheartj/ehac665
12. medRxiv. Frequently asked questions (FAQ). Laurel Hollow, USA: Cold Spring Harbor Laboratory; 2024. <https://www.medrxiv.org/about/FAQ#unrefereed>. Accessed August 21, 2024.
13. Elmore SA. Preprints: What role do these have in communicating scientific results? *Toxicol Pathol*. 2018;46(4):364–365. doi:10.1177/0192623318767322
14. Ni R, Waltman L. To preprint or not to preprint: A global researcher survey. *J Assoc Inf Sci Technol*. 2024;75(6):749–766. doi:10.1002/asi.24880
15. Fraser N, Brierley L, Dey G, et al. The evolving role of preprints in the dissemination of COVID-19 research and their impact on the science communication landscape. *PLoS Biol*. 2021;19(4):e3000959. doi:10.1371/journal.pbio.3000959
16. Wikipedia. List of preprint repositories. In: *Wikipedia*. San Francisco, USA: Wikimedia Foundation; 2024. [https://en.wikipedia.org/wiki/List\\_of\\_preprint\\_repositories](https://en.wikipedia.org/wiki/List_of_preprint_repositories). Accessed August 21, 2024.
17. Brock J. 10 tips for submitting a successful preprint. *Nature Index*. <https://www.nature.com/nature-index/news/tips-how-to-most-successful-preprint-research-science-submission-study>. Published May 26, 2020. Accessed August 21, 2024.
18. Bourne PE, Polka JK, Vale RD, Kiley R. Ten simple rules to consider regarding preprint submission. *PLoS Comput Biol*. 2017;13(5):e1005473. doi:10.1371/journal.pcbi.1005473
19. Ettinger CL, Sadanandappa MK, Görgülü K, Coghlan KL, Hallenbeck KK, Puebla I. A guide to preprinting for early-career researchers. *Biol Open*. 2022;11(7):bio059310. doi:10.1242/bio.059310
20. Sarabipour S, Debat HJ, Emmott E, Burgess SJ, Schwessinger B, Hensel Z. On the value of preprints: An early career researcher perspective. *PLoS Biol*. 2019;17(2):e3000151. doi:10.1371/journal.pbio.3000151
21. Columbia University Irving Medical Center. What is a preprint? Is it the right publishing choice for you? New York, USA: Columbia University; 2021. [https://library.cumc.columbia.edu/kb/what\\_is\\_preprint](https://library.cumc.columbia.edu/kb/what_is_preprint). Accessed August 21, 2024.
22. University of Oxford. Preprints. Oxford, UK: University of Oxford; 2024. <https://openaccess.ox.ac.uk/preprints>. Accessed August 21, 2024.
23. UK Research and Innovation. Preprints. Swindon, UK: UK Research and Innovation; 2024. <https://www.ukri.org/who-we-are/mrc/our-policies-and-standards/research/preprints/>. Accessed August 21, 2024.
24. National Institutes of Health (NIH). Reporting preprints and other interim research products. Bethesda, USA: National Institutes of Health (NIH); 2017. <https://grants.nih.gov/grants/guide/notice-files/NOT-OD-17-050.html>. Accessed August 21, 2024.
25. University of Surrey. Preprints. Guildford, UK: University of Surrey; 2024. <https://www.surrey.ac.uk/library/open-research/preprints>. Accessed August 21, 2024.
26. University of Melbourne. Preprints. Melbourne, Australia: University of Melbourne; 2024. <https://unimelb.libguides.com/openresearch/preprints>. Accessed August 21, 2024.
27. Eastern Michigan University. Preprints. Ypsilanti, USA: Eastern Michigan University; 2023. <https://guides.emich.edu/preprints>. Accessed August 21, 2024.
28. Harvard Countway Library. Open access publishing. Boston, USA: Harvard University; 2024. <https://guides.library.harvard.edu/c.php?g=1097539&p=8004417>. Accessed August 21, 2024.
29. University of Hong Kong Libraries. Preprint. Hong Kong, China: University of Hong Kong; 2023. <https://libguides.lib.hku.hk/preprint>. Accessed August 21, 2024.
30. Hettne K, Aardening R, Van Gorp D, et al. A practical guide to preprints: Accelerating scholarly communication. Preprint posted online October 10, 2021. *Zenodo*. doi:10.5281/ZENODO.5600535
31. National Institutes of Health (NIH). NIH Preprint Pilot. Bethesda, USA: National Institutes of Health (NIH); 2024. <https://www.ncbi.nlm.nih.gov/pmc/about/nihpreprints/>. Accessed August 21, 2024.
32. National Institutes of Health (NIH). NIH Preprint Pilot accelerates and expands discovery of research results. Bethesda, USA: National Institutes of Health (NIH); 2022. [https://www.nlm.nih.gov/news/NIH\\_Preprint\\_Pilot\\_Accelerates\\_Expands\\_Discovery\\_Research\\_Results.html](https://www.nlm.nih.gov/news/NIH_Preprint_Pilot_Accelerates_Expands_Discovery_Research_Results.html). Accessed August 21, 2024.
33. Research Square. Editorial policies. London UK: Springer Nature; 2024. <https://www.researchsquare.com/legal/editorial>. Accessed August 21, 2024.
34. medRxiv. Screening process. Laurel Hollow, USA: Cold Spring Harbor Laboratory; 2024. [https://connect.medrxiv.org/news/2022/06/13/screening\\_procedures](https://connect.medrxiv.org/news/2022/06/13/screening_procedures). Accessed August 21, 2024.
35. medRxiv. Submission guide. Laurel Hollow, USA: Cold Spring Harbor Laboratory; 2024. <https://www.medrxiv.org/submit-a-manuscript>. Accessed August 21, 2024.
36. Open Science Framework (OSF). Preprint: FAQs. Charlottesville, USA: Center for Open Science; 2023. <https://help.osf.io/article/230-preprint-faqs>. Accessed August 21, 2024.
37. Open Science Framework (OSF). Withdrawing a preprint. Charlottesville, USA: Center for Open Science; 2024. <https://help.osf.io/article/186-withdrawing-a-preprint>. Accessed August 21, 2024.
38. Kirkham JJ, Penfold NC, Murphy F, et al. Systematic examination of preprint platforms for use in the medical and biomedical sciences setting. *BMJ Open*. 2020;10(12):e041849. doi:10.1136/bmjopen-2020-041849
39. Malički M, Jeroncic A, Ter Riet G, et al. Preprint servers' policies, submission requirements, and transparency in reporting and research integrity recommendations. *JAMA*. 2020;324(18):1901. doi:10.1001/jama.2020.17195
40. Brainard J. No revolution: COVID-19 boosted open access, but preprints are only a fraction of pandemic papers. *Science*. 2021;373(6560):9058. doi:10.1126/science.acx9058

41. Janda G, Khetpal V, Shi X, Ross JS, Wallach JD. Comparison of clinical study results reported in medRxiv preprints vs peer-reviewed journal articles. *JAMA Netw Open*. 2022;5(12):e2245847. doi:10.1001/jamanetworkopen.2022.45847
42. Huisman J, Smits J. Duration and quality of the peer review process: The author's perspective. *Scientometrics*. 2017;113(1):633–650. doi:10.1007/s11192-017-2310-5
43. Andersen MZ, Fønnes S, Rosenberg J. Time from submission to publication varied widely for biomedical journals: A systematic review. *Curr Med Res Opin*. 2021;37(6):985–993. doi:10.1080/03007995.2021.1905622
44. Zimmer RL, Mancuso ACB, Matte U, Ashton-Prolla P. Analysis of the interval between submission and publication in genetics journals. *PLoS One*. 2023;18(5):e0284866. doi:10.1371/journal.pone.0284866
45. Harlanto NI, Harlanto ZN. Time from submission to publication in urology journals: A look at publication times before and during Covid-19. *Heliyon*. 2023;9(3):e14233. doi:10.1016/j.heliyon.2023.e14233
46. Sebo P, Fournier JP, Ragot C, Gorioux PH, Herrmann FR, Maisonneuve H. Factors associated with publication speed in general medical journals: A retrospective study of bibliometric data. *Scientometrics*. 2019;119(2):1037–1058. doi:10.1007/s11192-019-03061-8
47. Lee Y, Kim K, Lee Y. Publication delay of Korean medical journals. *J Korean Med Sci*. 2017;32(8):1235. doi:10.3346/jkms.2017.32.8.1235
48. Johansson MA, Reich NG, Meyers LA, Lipsitch M. Preprints: An underutilized mechanism to accelerate outbreak science. *PLoS Med*. 2018;15(4):e1002549. doi:10.1371/journal.pmed.1002549
49. Bero L, Lawrence R, Leslie L, et al. Cross-sectional study of preprints and final journal publications from COVID-19 studies: Discrepancies in results reporting and spin in interpretation. *BMJ Open*. 2021;11(7):e051821. doi:10.1136/bmjopen-2021-051821
50. Brierley L, Nanni F, Polka JK, et al. Tracking changes between preprint posting and journal publication during a pandemic. *PLoS Biol*. 2022;20(2):e3001285. doi:10.1371/journal.pbio.3001285
51. Carneiro CFD, Queiroz VGS, Moulin TC, et al. Comparing quality of reporting between preprints and peer-reviewed articles in the biomedical literature. *Res Integr Peer Rev*. 2020;5(1):16. doi:10.1186/s41073-020-00101-3
52. Nelson L, Ye H, Schwenn A, Lee S, Arabi S, Hutchins BI. Robustness of evidence reported in preprints during peer review. *Lancet Glob Health*. 2022;10(11):e1684–e1687. doi:10.1016/S2214-109X(22)00368-0
53. Akbaritabar A, Stephen D, Squazzoni F. A study of referencing changes in preprint-publication pairs across multiple fields. *J Infometrics*. 2022;16(2):101258. doi:10.1016/j.joi.2022.101258
54. Poremski D, Falissard B, Fegert J, et al. Moving from 'personal communication' to 'available online at': Preprint servers enhance the timeliness of scientific exchange. *Child Adolesc Psychiatry Ment Health*. 2019;13(1):42. doi:10.1186/s13034-019-0301-4
55. Sever R, Eisen M, Inglis J, Plan U. Universal access to scientific and medical research via funder preprint mandates. *PLoS Biol*. 2019;17(6):e3000273. doi:10.1371/journal.pbio.3000273
56. Clemens A. 5 disadvantages of preprints. Prague, Czech Republic: Researchers' Writing Academy; 2022. <https://annaclemens.com/blog/downsides-publishing-preprint/>. Accessed August 21, 2024.
57. Fu DY, Hughey JJ. Releasing a preprint is associated with more attention and citations for the peer-reviewed article. *eLife*. 2019;8:e52646. doi:10.7554/eLife.52646
58. Xu F, Ou G, Ma T, Wang X. The consistency of impact of preprints and their journal publications. *J Infometrics*. 2021;15(2):101153. doi:10.1016/j.joi.2021.101153
59. Fraser N, Momeni F, Mayr P, Peters I. The relationship between bioRxiv preprints, citations and altmetrics. *Quantitative Science Studies*. 2020;1(2):618–638. doi:10.1162/qss\_a\_00043
60. Serghiou S, Ioannidis JPA. Altmetric scores, citations, and publication of studies posted as preprints. *JAMA*. 2018;319(4):402. doi:10.1001/jama.2017.21168
61. Xie B, Shen Z, Wang K. Is preprint the future of science? A thirty year journey of online preprint services. Preprint posted online February 17, 2021. *arXiv*. doi:10.48550/ARXIV.2102.09066
62. Bagdasarian N, Cross GB, Fisher D. Rapid publications risk the integrity of science in the era of COVID-19. *BMC Med*. 2020;18(1):192. doi:10.1186/s12916-020-01650-6
63. Smart P. The evolution, benefits, and challenges of preprints and their interaction with journals. *Sci Ed*. 2022;9(1):79–84. doi:10.6087/kcse.269
64. Stric J, Civljak A, Gloznic T, Pacheco RL, Brkovic T, Puljak L. Open data and data sharing in articles about COVID-19 published in preprint servers medRxiv and bioRxiv. *Scientometrics*. 2022;127(5):2791–2802. doi:10.1007/s11192-022-04346-1
65. McGuinness LA, Sheppard AL. A descriptive analysis of the data availability statements accompanying medRxiv preprints and a comparison with their published counterparts. *PLoS One*. 2021;16(5):e0250887. doi:10.1371/journal.pone.0250887
66. ASAPbio. Scooping FAQ. San Francisco, USA: ASAPbio; 2020. <https://asapbio.org/preprint-info/preprint-faq#qae9-923>. Accessed August 21, 2024.
67. Moustafa K. Postprints-to-preprints linkage to enhance access to scientific literature. *Account Res*. 2023;30(7):542–546. doi:10.1080/08989621.2021.2019024
68. International Committee of Medical Journal Editors (ICMJE). International Committee of Medical Journal Editors Recommendations. Vancouver, Canada: International Committee of Medical Journal Editors (ICMJE); 2024. <https://www.icmje.org/recommendations/>. Accessed August 21, 2024.
69. ASAPbio. Funder policies. San Francisco, USA: ASAPbio; 2021. <https://asapbio.org/funder-policies>. Accessed August 21, 2024.
70. Moore A. Bad science in the headlines: Who takes responsibility when science is distorted in the mass media? *EMBO Rep*. 2006;7(12):1193–1196. doi:10.1038/sj.embor.7400862
71. Flanagan A, Fontanarosa PB, Bauchner H. Preprints involving medical research: Do the benefits outweigh the challenges? *JAMA*. 2020;324(18):1840. doi:10.1001/jama.2020.20674
72. Vazquez-Rodriguez S, Arriaga-Pizano LA, Mancilla-Herrera I, et al. Fc-gamma receptor expression and cytokine response to intravenous human immunoglobulin in mothers and neonates. Preprint posted online September 30, 2021. *medRxiv*. doi:10.1101/2021.09.28.21264275
73. Peiperl L; on behalf of the PLoS Medicine Editors. Preprints in medical research: Progress and principles. *PLoS Med*. 2018;15(4):e1002563. doi:10.1371/journal.pmed.1002563
74. Ravinotto R, Caillet C, Zaman MH, et al. Preprints in times of COVID19: The time is ripe for agreeing on terminology and good practices. *BMC Med Ethics*. 2021;22(1):106. doi:10.1186/s12910-021-00667-7
75. Mullins M. Opinion: The problem with preprints. *The Scientist*. <https://www.the-scientist.com/opinion-the-problem-with-preprints-69309>. Published November 1, 2021. Accessed August 15, 2024.
76. Retraction Watch. Retraction Watch Database User Guide. New York, USA: Center for Scientific Integrity (CFSI); 2024. <https://retraction-watch.com/retraction-watch-database-user-guide/>. Accessed September 3, 2024.
77. Pradhan P, Pandey AK, Mishra A, et al. RETRACTED: Uncanny similarity of unique inserts in the 2019-nCoV spike protein to HIV-1 gp120 and Gag. Preprint posted online February 2, 2020. *bioRxiv*. doi:10.1101/2020.01.30.927871
78. Zhang C, Zheng W, Huang X, Bell EW, Zhou X, Zhang Y. Protein structure and sequence re-analysis of 2019-nCoV genome does not indicate snakes as its intermediate host or the unique similarity between its spike protein insertions and HIV-1. Preprint posted online February 8, 2020. *bioRxiv*. doi:10.1101/2020.02.04.933135
79. Zhang C, Zheng W, Huang X, Bell EW, Zhou X, Zhang Y. Protein structure and sequence reanalysis of 2019-nCoV genome refutes snakes as its intermediate host and the unique similarity between its spike protein insertions and HIV-1. *J Proteome Res*. 2020;19(4):1351–1360. doi:10.1021/acs.jproteome.0c00129
80. Xiao C, Li X, Liu S, Sang Y, Gao SJ, Gao F. HIV-1 did not contribute to the 2019-nCoV genome. *Emerg Microbes Infect*. 2020;9(1):378–381. doi:10.1080/22221751.2020.1727299
81. Guan WJ, Ni ZY, Hu Y, et al. Clinical characteristics of 2019 novel coronavirus infection in China. Preprint posted online February 9, 2020. *medRxiv*. doi:10.1101/2020.02.06.20020974
82. Guan WJ, Ni ZY, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med*. 2020;382(18):1708–1720. doi:10.1056/NEJMoa2002032

83. Guterman EL, Braunstein LZ. Preprints during the COVID-19 pandemic: Public health emergencies and medical literature. *J Hosp Med*. 2020;15(10):634–636. doi:10.12788/jhm.3491
84. Soderberg CK, Errington TM, Nosek BA. Credibility of preprints: An interdisciplinary survey of researchers. *R Soc Open Sci*. 2020;7(10):201520. doi:10.1098/rsos.201520
85. Biesenbender K, Toepfer R, Peters I. Life scientists' experience with posting preprints during the COVID-19 pandemic [published online as ahead of print on April 5, 2024]. *Scientometrics*. 2024. doi:10.1007/s11192-024-04982-9
86. Ng JY, Chow V, Santoro LJ, et al. An international, cross-sectional survey of preprint attitudes among biomedical researchers. *F1000Res*. 2024;13:6. doi:10.12688/f1000research.143013.1
87. Klebel T, Reichmann S, Polka J, et al. Peer review and preprint policies are unclear at most major journals. *PLoS One*. 2020;15(10):e0239518. doi:10.1371/journal.pone.0239518
88. Massey DS, Opare MA, Wallach JD, Ross JS, Krumholz HM. Assessment of preprint policies of top-ranked clinical journals. *JAMA Netw Open*. 2020;3(7):e2011127. doi:10.1001/jamanetworkopen.2020.11127
89. Vlasschaert C, Giles C, Hiremath S, Lanktree MB. Preprint servers in kidney disease research: A rapid review. *Clin J Am Soc Nephrol*. 2021;16(3):479–486. doi:10.2215/CJN.03800320
90. Wikipedia. List of academic publishers by preprint policy. In: *Wikipedia*. San Francisco, USA: Wikimedia Foundation; 2024. [https://en.wikipedia.org/wiki/List\\_of\\_academic\\_publishers\\_by\\_preprint\\_policy](https://en.wikipedia.org/wiki/List_of_academic_publishers_by_preprint_policy). Accessed August 21, 2024.
91. Taylor & Francis. What are preprints and preprint servers? Abingdon-on-Thames, UK: Taylor & Francis; 2023. <https://authorservices.taylorandfrancis.com/publishing-your-research/making-your-submission/posting-to-preprint-server/>. Accessed August 21, 2024.
92. Cambridge University Press. Preprint policy. Cambridge, UK: Cambridge University Press; 2024. <https://www.cambridge.org/core/services/open-access-policies/open-access-journals/preprint-policy#>. Accessed August 21, 2024.
93. Journal of Clinical Medicine Research. Preprints policy. Richmond Hill, Canada: Journal of Clinical Medicine Research; 2023. <https://www.jocmr.org/index.php/JOCMR/about/editorialPolicies#custom-16>. Accessed August 21, 2024.
94. Emerging Infectious Diseases. Policy on preprint publication. Atlanta, USA: Centers for Disease Control and Prevention (CDC); 2024. <https://wwwnc.cdc.gov/eid/page/preprint-policy>. Accessed August 21, 2024.
95. BioMed Central. Preprint sharing and citation. London, UK: BioMed Central; 2023. <https://www.biomedcentral.com/getpublished/editorial-policies#preprint+sharing+and+citation>. Accessed August 21, 2024.
96. Wiley. Wiley's preprint policy. Hoboken, USA: Wiley; 2024. <https://authorservices.wiley.com/author-resources/Journal-Authors/open-access/preprints-policy.html>. Accessed August 21, 2024.
97. Elsevier. Article sharing. Amsterdam, the Netherlands: Elsevier; 2023. <https://www.elsevier.com/about/policies-and-standards/sharing>. Accessed August 21, 2024.
98. American Society of Clinical Oncology (ASCO) Publications. Preprint policy. Alexandria, USA: American Society of Clinical Oncology (ASCO); 2023. <https://ascopubs.org/authors/journal-policies#preprint-policy>. Accessed August 21, 2024.
99. Springer Nature. Preprint sharing. London UK: Springer Nature; 2023. <https://www.springer.com/gp/open-access/preprint-sharing/16718886>. Accessed August 21, 2024.
100. American Heart Association (AHA). Prior publication policy. Dallas, USA: American Heart Association (AHA); 2023. <https://www.aha-journals.org/prior-publication-policy>. Accessed August 21, 2024.
101. American Association for Cancer Research (AACR). Editorial policies. Philadelphia, USA: American Association for Cancer Research (AACR); 2024. <https://aacrjournals.org/pages/editorial-policies>. Accessed August 21, 2024.
102. Science. Prior publication and presentation at meetings. Washington D.C., USA: American Association for the Advancement of Science (AAAS); 2024. <https://www.science.org/content/page/science-journals-editorial-policies#prior-publication>. Accessed August 21, 2024.
103. BMJ Author Hub. Preprints. London, UK: BMJ Group; 2024. <https://authors.bmj.com/policies/preprints/>. Accessed August 21, 2024.
104. Nature. Preprints & conference proceedings. London, UK: Springer Nature; 2024. <https://www.nature.com/nature-portfolio/editorial-policies/preprints-and-conference-proceedings>. Accessed August 21, 2024.
105. PLoS One. Preprints. San Francisco, USA: Public Library of Science (PLoS); 2024. <https://journals.plos.org/plosone/s/preprints>. Accessed August 21, 2024.
106. Sage Publishing. Prior publication. Thousand Oaks, USA: Sage Publishing; 2024. <https://us.sagepub.com/en-us/nam/prior-publication>. Accessed August 21, 2024.
107. Neylon C, Pattinson D, Bilder G, Lin J. On the origin of nonequivalent states: How we can talk about preprints. *F1000Res*. 2017;6:608. doi:10.12688/f1000research.11408.1
108. Wikipedia. Postprint. In: *Wikipedia*. San Francisco, USA: Wikimedia Foundation; 2024. <https://en.wikipedia.org/wiki/Postprint>. Accessed August 21, 2024.
109. Advances in Clinical and Experimental Medicine. Instructions for authors. Wrocław, Poland: Wrocław Medical University Press; 2024. <https://advances.umw.edu.pl/en/instructions-for-authors/>. Accessed August 21, 2024.
110. Brierley L. Lessons from the influx of preprints during the early COVID-19 pandemic. *Lancet Planet Health*. 2021;5(3):e115–e117. doi:10.1016/S2542-5196(21)00011-5
111. Watson C. Rise of the preprint: How rapid data sharing during COVID-19 has changed science forever. *Nat Med*. 2022;28(1):2–5. doi:10.1038/s41591-021-01654-6
112. Besançon L, Peiffer-Smadja N, Segalas C, et al. Open science saves lives: Lessons from the COVID-19 pandemic. *BMC Med Res Methodol*. 2021;21(1):117. doi:10.1186/s12874-021-01304-y
113. Singh JA, Ravinetti R. COVID-19 therapeutics: How to sow confusion and break public trust during international public health emergencies. *J Pharm Policy Pract*. 2020;13(1):47. doi:10.1186/s40545-020-00244-0
114. Kodvanj I, Homolak J, Virag D, Trkulja V. Publishing of COVID-19 preprints in peer-reviewed journals, preprinting trends, public discussion and quality issues. *Scientometrics*. 2022;127(3):1339–1352. doi:10.1007/s11192-021-04249-7
115. Majumder MS, Mandl KD. Early in the epidemic: Impact of preprints on global discourse about COVID-19 transmissibility. *Lancet Glob Health*. 2020;8(5):e627–e630. doi:10.1016/S2214-109X(20)30113-3
116. Vlasschaert C, Topf JM, Hiremath S. Proliferation of papers and preprints during the coronavirus disease 2019 pandemic: Progress or problems with peer review? *Adv Chronic Kidney Dis*. 2020;27(5):418–426. doi:10.1053/j.ackd.2020.08.003
117. Wang Y, Cao Z, Zeng DD, Zhang Q, Luo T. The collective wisdom in the COVID-19 research: Comparison and synthesis of epidemiological parameter estimates in preprints and peer-reviewed articles. *Int J Infect Dis*. 2021;104:1–6. doi:10.1016/j.ijid.2020.12.040
118. Gianola S, Jesus TS, Barger S, Castellini G. Characteristics of academic publications, preprints, and registered clinical trials on the COVID-19 pandemic. *PLoS One*. 2020;15(10):e0240123. doi:10.1371/journal.pone.0240123
119. Li R, Yuan H, Zhao T, et al. miR-874 ameliorates retinopathy in diabetic rats by NF- $\kappa$ B signaling pathway. *Adv Clin Exp Med*. 2021;30(4):421–430. doi:10.17219/acem/130602
120. Liu W, Che J, Gu Y, Song L, Jiao Y, Yu S. Silencing of lncRNA SNHG12 inhibits proliferation and migration of vascular smooth muscle cells via targeting miR-766-5p/EIF5A axis. *Adv Clin Exp Med*. 2021;30(6):591–598. doi:10.17219/acem/133496
121. Guo J, Wang Z, Xue M, et al. Metformin protects against abdominal aortic aneurysm by Atg7-induced autophagy. *Adv Clin Exp Med*. 2021;31(1):59–69. doi:10.17219/acem/142026
122. Li Z, Li C, Li P, Li Y, Lai J, Rastogi S. Does a single dose of palonosetron have any role in preventing acute chemotherapy-induced nausea and vomiting in pediatric osteosarcoma patients without dexamethasone? A randomized clinical trial. *Adv Clin Exp Med*. 2022;31(3):223–230. doi:10.17219/acem/142332
123. Putowski Z, Krzych Ł, Czajka S. High intraoperative pulse pressure is a risk factor for postoperative acute kidney injury in a cohort of abdominal surgery patients: An exploratory study. *Adv Clin Exp Med*. 2022;31(5):511–517. doi:10.17219/acem/145946



124. Ji Z, Bao S, Li L, Wang D, Shi M, Liu X. Hypoxia-inducible factor-2 $\alpha$  promotes EMT in esophageal squamous cell carcinoma through the Notch pathway. *Adv Clin Exp Med*. 2022;31(7):795–805. doi:10.17219/acem/147270
125. Begum Z, Subramanian V, Raghunath G, Gurusamy K, Vijayaraghavan R, Sivanesan S. Efficacy of different intensity of aquatic exercise in enhancing remyelination and neuronal plasticity using cuprizone model in male Wistar rats. *Adv Clin Exp Med*. 2022;31(9):999–1009. doi:10.17219/acem/148112
126. Sun L, Li H, Fu Q, Hu S, Zhao W. Significance of detecting the levels of miR-29a, survivin and interferon gamma release assay in patients with lung cancer and tuberculosis. *Adv Clin Exp Med*. 2022;31(10):1073–1080. doi:10.17219/acem/150306
127. Sang H, Zhao R, Lai G, et al. Bone marrow mesenchymal stem cell-derived exosomes attenuate the maturation of dendritic cells and reduce the rejection of allogeneic transplantation. *Adv Clin Exp Med*. 2023;32(5):551–561. doi:10.17219/acem/156643
128. Grotowska M, Harbut P, Frostell C, Gozdzik W. Fluid resuscitation, but not inhaled nitric oxide, improves microcirculation in septic pigs. *Adv Clin Exp Med*. 2022;32(6):667–676. doi:10.17219/acem/156700
129. Ventruha T, Ventruha P, Jeřeta M, et al. The contribution of donated human embryos suitable for the production of embryonic stem cells to increase the quality of life: Selection and preparation of embryos in the Czech Republic. *Adv Clin Exp Med*. 2023;32(8):901–907. doi:10.17219/acem/158777
130. Yang S, Pan K, Hua Q, et al. Correlation analysis of patients with diabetic foot ulcers treated with tibial cortex transverse transport surgery and platelet-to-lymphocyte ratio and monocyte-to-neutrophil ratio [published online as ahead of print on June 27, 2024]. *Adv Clin Exp Med*. 2024. doi:10.17219/acem/187765
131. Li Z, Zhao J, Lu L, et al. Small RNA sequencing highlights a potential regulatory network mediated by Gecko miRNA affecting the prognosis of hepatocellular carcinoma [published online as ahead of print on April 29, 2024]. *Adv Clin Exp Med*. 2024. doi:10.17219/acem/185253
132. Szczepanowski R, Uchmanowicz I, Pasieczna AH, et al. Application of machine learning in predicting frailty syndrome in patients with heart failure. *Adv Clin Exp Med*. 2024;33(3):309–315. doi:10.17219/acem/184040
133. Zheng Q, Gong Z, Lin S, Ou D, Lin W, Shen P. Integrated analysis of a competing endogenous RNA network reveals a ferroptosis-related 6-lncRNA prognostic signature in clear cell renal cell carcinoma [published online as ahead of print on March 12, 2024]. *Adv Clin Exp Med*. 2024. doi:10.17219/acem/176050
134. Yong XZ, Zhou YX, Wu TT, et al. Differential expression of miRNA-769-5p and Smad2 in patients with or without oral cGVHD [published online as ahead of print on February 14, 2024]. *Adv Clin Exp Med*. 2024. doi:10.17219/acem/181147
135. Vázquez-Rodríguez S, Arriaga-Pizano LA, Mancilla-Herrera I, et al. Fc-gamma receptor expression and cytokine responses to intravenous human immunoglobulin in whole blood from non-pregnant and pregnant women and newborns [published online as ahead of print on January 5, 2024]. *Adv Clin Exp Med*. 2024. doi:10.17219/acem/174566
136. Li Z, Zhao J, Tong D, et al. WITHDRAWN: Investigating the miRNA of the Chinese herb Gecko on the cross-species regulation network of hepatocellular carcinoma. Preprint posted online August 30, 2023. *Research Square*. doi:10.21203/rs.3.rs-2204354/v2
137. Avissar-Whiting M, Belliard F, Bertozzi SM, et al. Advancing the culture of peer review with preprints. Preprint posted online April 3, 2023. *Research Square*. doi:10.31219/osf.io/cht8p
138. Lemberger T, Pulverer B. Review Commons: Pre-journal peer review. *EMBO Rep*. 2019;20(12):e49663. doi:10.15252/embr.201949663
139. Sever R, Carvalho T. What is the future of preprint peer review? *Acta Med Port*. 2023;36(4):225–226. doi:10.20344/amp.19675
140. Eisen MB, Akhmanova A, Behrens TE, et al. Peer review without gatekeeping. *eLife*. 2022;11:e83889. doi:10.7554/eLife.83889
141. Rousi AM, Laakso M. Overlay journals: A study of the current landscape. *Journal of Librarianship and Information Science*. 2024;56(1):15–28. doi:10.1177/09610006221125208
142. Ursić L, Gudelj D, Tomić V, Marušić M, Marušić A. Analysing overlay journals: The state-of-the-art in 2021 and possible perspectives. *Learned Publishing*. 2022;35(4):640–649. doi:10.1002/leap.1491
143. Fraser N, Mayr P, Peters I. Motivations, concerns and selection biases when posting preprints: A survey of bioRxiv authors. *PLoS One*. 2022;17(11):e0274441. doi:10.1371/journal.pone.0274441
144. Brainard J. In a bold bid to avoid open-access fees, Gates foundation says grantees must post preprints. *Science*. April 1, 2024. doi:10.1126/science.zqvd4bu
145. Maggio LA, Costello JA, Artino AR. Describing the landscape of medical education preprints on medRxiv: Current trends and future recommendations. *Acad Med*. 2024;99(9):981–986. doi:10.1097/ACM.0000000000005742
146. Añazco D, Nicolalde B, Espinosa I, et al. Publication rate and citation counts for preprints released during the COVID-19 pandemic: The good, the bad and the ugly. *PeerJ*. 2021;9:e10927. doi:10.7717/peerj.10927
147. Penfold NC, Polka JK. Technical and social issues influencing the adoption of preprints in the life sciences. *PLoS Genet*. 2020;16(4):e1008565. doi:10.1371/journal.pgen.1008565
148. Rzaeva N, Henriques SO, Pinfield S, Waltman L. The experiences of COVID-19 preprint authors: A survey of researchers about publishing and receiving feedback on their work during the pandemic. *PeerJ*. 2023;11:e15864. doi:10.7717/peerj.15864
149. Fry C, MacGarvie M. Author country of origin and attention on open science platforms: Evidence from COVID-19 preprints. *Management Science*. 2024;70(8):5426–5444. doi:10.1287/mnsc.2023.4936
150. Biesenbender K, Smirnova N, Mayr P, Peters I. The emergence of preprints: Comparing publishing behaviour in the Global South and the Global North [published online as ahead of print on January 15, 2024]. *Online Information Review*. 2024. doi:10.1108/OIR-04-2023-0181
151. Puebla I, Polka J, Rieger O. Preprints: Their evolving role in science communication. Preprint posted online February 18, 2021. *Open Science Framework (OSF)*. doi:10.31222/osf.io/ezfsk