

Evidence check

8 March 2021

Rapid evidence checks are based on a simplified review method and may not be entirely exhaustive, but aim to provide a balanced assessment of what is already known about a specific problem or issue. This brief has not been peer-reviewed and should not be a substitute for individual clinical judgement, nor is it an endorsed position of NSW Health.

COVID-19 pre-peer review articles

Evidence check question

What impact has the COVID-19 pandemic had on the publication of pre-peer review articles and subsequently, the quality of research evidence?

In brief

- Since the outbreak, there have been reports of a surge of pre-peer review articles on COVID-19.(1)
- Though challenges remain with regards to the speedy and widespread distribution of knowledge prior to 'thorough vetting', pre-peer review articles have been useful in highlighting and disseminating preliminary findings on rapidly evolving topics such as [vaccines](#) and viral [variants](#).(2)
- For papers published on pre-reviewed platforms and subsequently in the peer-reviewed literature, there is no system in place to direct readers to the most up-to-date (peer-reviewed) version. This means that pre-peer review articles continue to be cited and 'double referencing' occurs, potentially drawing on superseded information.(3)
- The use of pre-peer review articles is a dynamic situation – snapshot analyses at various time points found:
 - By the end of April 2020, more than 16,000 COVID-19 scientific articles had been published; among these, 6,753, were manuscripts hosted on a range of printing servers, including BioRxiv and MedRxiv (2,527 articles).(4)
 - By June 2020, it was estimated that around one in four of the scientific articles relating to COVID-19 were pre-peer review articles.(5)
 - By December 2020, it was estimated that more than 30,000 of the COVID-19 articles published in 2020 were pre-peer review articles, between 17% and 30% of total COVID-19 research papers depending on database searched.(6) In MedRxiv, the medical science pre-peer review article publishing platform, '[m]ore than two-thirds of the preprints [...] were related to COVID-19'.
- Characteristic of pre-peer review articles:
 - Two studies reported that pre-peer review articles predominantly presented original results (89.8%), including from randomised controlled trials and systematic reviews.(7, 8) Case reports (6% academic versus 0.9% pre-peer review articles; $p < 0.001$) and

- letters (17.4% academic versus 0.5% pre-peer review articles; $p < 0.001$) accounted for a greater share of peer-reviewed compared to pre-peer review articles.(7)
- In the first three months of the pandemic, COVID-19 articles including pre-peer review articles mostly covered the epidemiology of COVID-19 (35.7%), clinical aspects of infection (21.0%), preventative measures (12.8%), treatment options (12.5%), diagnostics (12.2%), mathematical modelling of disease transmission and mitigation (9.6%), and molecular biology and pathogenesis of SARS-CoV-2 (8.7%).(8)
 - A large proportion of COVID-19 pre-peer review articles were written by authors affiliated in China (51%)(7, 8). Or the articles were funded by sources in China (46%).(7) A high number of contributions was also seen from the United States, the United Kingdom, and Italy.
- Impact of preprints:
 - *Science* journal described that the surge in pre-peer review articles during COVID-19 has created an 'information revolution' in how research is communicated.(9) It has been reported that such articles have been widely adopted for the dissemination and communication of COVID-19 research, and in turn, the pandemic has greatly impacted the science publishing landscape.(4)
 - A pre-peer reviewed study found that COVID-19 pre-peer review articles received a significant amount of attention from scientists, news organisations, the general public and policy-making bodies, representing a departure for how pre-peer review articles are normally shared.(4, 10) In July 2019, there were 6,800 article downloads and 25,300 abstract views in MedRxiv, whereas there were 2,356,900 and 5,853,600 in June 2020, respectively.(11)
 - Because of the speed of their release, it is surmised that pre-peer review articles, in comparison to peer-reviewed literature in the same topic area, may be driving discourse related to the ongoing COVID-19 outbreak.(10)
 - Quality:
 - There are concerns around the speed and rigour arising from the surge in COVID-19 pre-peer review articles, especially in the difficulty of ensuring quality and trustworthiness of such articles amidst expedited publishing.(4, 9, 12)
 - One study found that of 61% of COVID-19 publications had been reported in pre-peer review articles: 20% of these had an associated journal article, with median time to publication being 76 days.(3) Twenty seven percent had more than one pre-peer review version. For studies with both a pre-peer review and peer-reviewed version, a median of 29% of total citations were attributed to the pre-peer review version instead of the article.(3)
 - The same study found that a total of 139 studies was reported in multiple evidence sources or versions of the same source and for 63 (45%), there was a change in at least one evidence component between or within sources.(3) A different study found that only 18 (0.002%) pre-peer review articles were withdrawn after posting on MedRxiv, including 13 that were pandemic related.
 - In a cross-sectional survey of medical specialists, the opinion on pre-peer review article archiving was divided, and only one-third believed such articles were useful.(13)

Background

A huge volume of scientific and medical evidence has been produced in response to the COVID-19 pandemic.(1, 2) The need for swift clinical and policy response to COVID-19 has transformed research publishing, including a recent ‘torrent’ of pre-peer review articles or ‘pre-prints’.(6)

Limitations

The evidence on pre-peer review articles is still emerging. Much of the available evidence was editorials and perspectives on the trend of COVID-19 pre-peer review articles, which have been included separately in Appendix 2.

Methods (Appendix 1)

PubMed and referential search were conducted on 20 January 2021.

Results

Table 1 Trends, characteristics, and impact of COVID-19 pre-peer review articles (‘preprints’)

Note: The text in the table is largely unedited from the original source.

Source	Aim
Peer reviewed sources	
Will the pandemic permanently alter scientific publishing? Callaway 2020 (5) [Nature news item] 3 June 2020	<ul style="list-style-type: none"> • A <i>Nature</i> news feature discussing the preprint rush: the growth in bioRxiv was driven by more than 3,700 COVID-19 papers it hosts. Many also appear at medRxiv. • ‘Around one-quarter of the scientific articles that relate to COVID-19 are preprints, by one estimate.’
How a torrent of COVID science changed research publishing - in seven charts Else 2020 (6) [Nature news item] 16 December 2020	<ul style="list-style-type: none"> • A <i>Nature</i> news feature discussing ‘a torrent of COVID science’, including a preprint rush: ‘More than 30,000 of the COVID-19 articles published in 2020 were preprints — between 17% and 30% of total COVID-19 research papers (depending on database searched). And, according to Dimensions, one-tenth of all preprints this year were about COVID-19.’ • ‘More than two-thirds of the preprints at medRxiv were related to COVID-19.’

Source	Aim
Peer reviewed sources	
<p>Research methodology and characteristics of journal articles with original data, preprint articles and registered clinical trial protocols about COVID-19</p> <p>Fidahic, et al. 2020 (7)</p>	<ul style="list-style-type: none"> • Analysis of the characteristics of journal articles and preprints about COVID-19 and SARS-CoV-2 to assess their characteristics. • Assessed articles published on preprint servers medRxiv and bioRxiv by 3 April 2020. • Among 1,088 analysed preprint articles, the majority came from authors affiliated in China (51%) and were funded by sources in China (46%). Less than half reported study design; the majority were modelling studies (62%), and analysed transmission/risk/prevalence (43%).
<p>Preprinting the COVID-19 pandemic</p> <p>Fraser, et al. 2020 (4) [Preprint]</p>	<ul style="list-style-type: none"> • An investigation of the attributes of COVID-19 preprints, their access and usage rates and characteristics of sharing across online platforms, with a focus on bioRxiv and medrxiv, between 1 January and 30 April 2020. • COVID-19 preprints were posted early in the pandemic: <ul style="list-style-type: none"> ○ 2,527 COVID-19 related preprints were posted to bioRxiv and medRxiv in the first four months of the outbreak alone ○ By the end of April more than 16,000 COVID-19 scientific articles had been published. A large proportion of these articles (6,753) were manuscripts hosted on a range of preprint servers. • These results show that preprints have been widely adopted for the dissemination and communication of COVID-19 research, and in turn, the pandemic has greatly impacted the preprint and science publishing landscape. • Attention to preprints: <ul style="list-style-type: none"> ○ The data reveals that COVID-19 preprints received a significant amount of attention from scientists, news organisations, the general public and policy making bodies, representing a departure for how preprints are normally shared (considering observed patterns for non-COVID-19 preprints). • There is a need to better understand the general quality and trustworthiness of preprints compared to peer-review articles. The authors found comparative levels of preprints had been published within a short timeframe and that acceptance rates at several journals was only slightly reduced for COVID-19 research compared to non-COVID-19 articles suggesting that, generally, preprints were relatively of good quality.
<p>Characteristics of academic publications, preprints, and registered clinical trials on the COVID-19 pandemic</p> <p>Gianola, et al. 2020 (1)</p>	<ul style="list-style-type: none"> • A cross-sectional study comparing the amount and reporting characteristics of COVID-19-related academic articles and preprints and the number of ongoing clinical trials and systematic reviews. (Up to 20 May 2020) • A total of 3,635 academic publications and 3,805 preprints were retrieved. • Only 8.6% (n = 329) of the preprints were already published in indexed journals.

Source	Aim
Peer reviewed sources	
	<ul style="list-style-type: none"> • The number of academic and preprint publications increased significantly over time ($p < 0.001$). • Case reports (6% academic versus 0.9% preprints; $p < 0.001$) and letters (17.4% academic versus 0.5% preprints; $p < 0.001$) accounted for a greater share of academic compared to preprint publications. • Randomised controlled trials (0.22% versus 0.63%; $p < 0.001$) and systematic reviews (0.08% versus 5%) made up a greater share of the preprints. • Preprints were slightly more prevalent than academic articles, but both were increasing in number.
<p>Scholarly publishing and journal targeting in the time of the Coronavirus Disease 2019 (COVID-19) pandemic: a cross-sectional survey of rheumatologists and other specialists</p> <p>Gupta, et al. 2020 (13)</p>	<ul style="list-style-type: none"> • An anonymised and validated e-survey featuring 30 questions was circulated among rheumatologists and other specialists ($n = 108$) over social media to understand preferences while choosing target journals, publishing standards, commercial editing services, preprint archiving, social media and alternative publication activities. • The opinion on preprint archiving was disputed; only one in three believed preprints were useful. High-quality peer review (56%), full and immediate open access (46%) and post-publication social media promotion (32%) were identified as key anticipated features of scholarly publishing in the foreseeable future.
<p>Submissions and Downloads of Preprints in the First Year of medRxiv</p> <p>Krumholz, et al. 2020 (11)</p>	<ul style="list-style-type: none"> • The authors report medRxiv’s submissions, posts, revisions, downloads and withdrawals, using data from the medRxiv website, internal data, and Altmetric.com from launch on 11 June 2019 until 30 June 2020. • Submissions and posts: <ul style="list-style-type: none"> ○ In its first complete month (July 2019), medRxiv had 176 submissions, of which 116 (66%) passed screening and were posted. ○ During June 2020, there were 1,866 submissions and 1,615 (87%) were posted. ○ As of 30 June 2020, medRxiv had 11,052 submissions and 7,695 (77%) were posted from 57,096 unique authors in 124 countries. ○ Thus far, 22% of submissions have been revised at least once. ○ In the pre–COVID-19 period, the median number of submissions per day was 6 (interquartile range, 4-8), in contrast to 51 (interquartile range, 23-83) in the post-COVID-19 period. COVID-19 submissions comprised 73% of the total posted in February-June 2020. Overall, 31% of COVID-19 submissions were not posted because they did not meet the screening criteria. • Downloads:

Source	Aim
Peer reviewed sources	
	<ul style="list-style-type: none"> ○ In July 2019, there were 6,800 article downloads and 25,300 abstract views, whereas there were 2,356,900 and 5,853,600 in June 2020, respectively. ○ Among preprints posted through June 30, 2020, there were 28 with Altmetric scores of 3,000 or greater and 90 with scores of 1,000 or greater. The 20 highest Altmetric scores ranged from 3,727 to 20,607. ● Peer-reviewed publication: <ul style="list-style-type: none"> ○ Overall, to date, 14% of the preprints posted through 30 June 2020, have been published in 532 peer-reviewed journals. ○ The median interval between posting and journal publication was 141 days for non-COVID-19 articles and 46 days for COVID-19 articles. ● Withdrawal: <ul style="list-style-type: none"> ○ A total of 18 (0.002%) preprints were withdrawn after posting on medRxiv, including 13 that were pandemic related.
<p>How swamped preprint servers are blocking bad coronavirus research</p> <p>Kwon 2020 (12) [Nature news item] 7 May 2020</p>	<ul style="list-style-type: none"> ● <i>Nature</i> news feature discussing the surge of COVID-19 preprints being published on servers such as bioRxiv and medrxiv (nearly 3,000 on the topic of COVID-19), and potential harms of publishing non peer-reviewed studies. ● Data as of 7 May 2020 showed that 2,355 publications at medRxiv, 801 at arXiv, 587 at bioRxiv, and 346 at ChemRxiv were related to the coronavirus since the outbreak began.
<p>Preprints bring 'firehose' of outbreak data</p> <p>Kupferschmidt 2020 (9)</p>	<ul style="list-style-type: none"> ● A <i>Science</i> magazine blog post discussing the tension between speed and rigour arising from the surge in COVID-19 preprints. The article discusses that this has created an 'information revolution' in how research is communicated. ● Scientists are sharing more information using preprints than they did during any previous outbreaks, with the number of published papers exploding as well.
<p>Early in the epidemic: impact of preprints on global discourse about COVID-19 transmissibility</p> <p>Majumder, et al. 2020 (10)</p>	<ul style="list-style-type: none"> ● Investigators used both preprint and peer-reviewed studies that estimated the transmissibility potential (that is, basic reproduction number [R0]) of SARS-CoV-2 on or before 1 February 2020 to investigate the role that preprints have had in information dissemination during the ongoing outbreak. ● Average R0 estimates across the preprint group were 3.61 (95% CI 2.77-4.45) and 2.54 (2.17-2.91) across the peer-reviewed group—showing overlap in 95% CIs. Exclusion of two outlier estimates yielded an average R0 estimate of 3.02 (95% CI 2.65-3.39) for the preprint group.

Source	Aim
Peer reviewed sources	
	<ul style="list-style-type: none"> In the selected time frame, search interest peaked on 27 January 2020 after a sharp increase between 23 and 25 January immediately after the publication of five early preprint studies – all of which estimated R0 – in bioRxiv, medRxiv, and SSRN. Meanwhile, news media interest peaked on 28 January, coinciding with a sixth preprint study published in arXiv. Because of the speed of their release, preprints – rather than peer-reviewed literature in the same topic area – might be driving discourse related to the ongoing COVID-19 outbreak.
<p>When science goes viral: The research response during three months of the COVID-19 outbreak</p> <p>Nowakowska, et al. 2020 (8)</p>	<ul style="list-style-type: none"> A bibliometric survey of peer-reviewed and preprint papers published in the English language on issues related to COVID-19 within the first three months since 31 December 2019. Number of publications: <ul style="list-style-type: none"> Up to 31 March 2020, a total of 2,062 papers published in 578 peer-reviewed journals and 1,425 preprints posted mostly on medRxiv (55.4%), were identified. The mean number of published journal papers and preprints per day in the considered period was 27 and 12, respectively, and reached a maximum of 51 and 46 a day in March, respectively. Topic: <ul style="list-style-type: none"> The identified articles, journal papers and preprints, mostly covered the epidemiology of COVID-19 (35.7%), clinical aspects of infection (21.0%), preventative measures (12.8%), treatment options (12.5%), diagnostics (12.2%), mathematical modelling of disease transmission and mitigation (9.6%), and molecular biology and pathogenesis of SARS-CoV-2 (8.7%). Publication type: <ul style="list-style-type: none"> The majority of the journal papers were commentaries (38.5%), reviews (33.6%) and original research (21.3%), while preprints predominantly presented original results (89.8 %). Origin: <ul style="list-style-type: none"> Chinese scientists contributed the highest share of original research and were responsible for 32.9% of journal papers and 43.9% preprints published in the considered period. A high number of contributions was also seen from the United States, the United Kingdom, and Italy.
<p>Changes in evidence for studies assessing interventions for COVID-19 reported in preprints: meta-research study</p>	<ul style="list-style-type: none"> A meta-research study to describe the proportion of evidence on the effect of interventions for COVID-19 from preprints and journal articles and map changes in evidence between and within different sources reporting on the same study. Of 556 identified studies, in total, 338 (61%) had been reported in a preprint, 66 (20%) of these had an associated journal article

Source	Aim
Peer reviewed sources	
Oikonomidi, et al. 2020 (3)	<p>(median time to publication 76 days [interquartile range 55-106] and 91 (27%) had less than one preprint version.</p> <ul style="list-style-type: none"> A total of 139 studies (25% of the overall sample) were reported in multiple evidence sources or versions of the same source. For 63 (45%), there was a change in at least one evidence component between or within sources and 42 (30%) had a change in study results and in 29 (21%) the change was classified as important. As well, 33 [24%] had a change in the abstract conclusion. For studies with both a preprint and an article, a median of 29% (interquartile range 14-50) of total citations were attributed to the preprint instead of the article.

Appendix 1 Search Strategy

PubMed search terms

((COVID-19) AND ((((((("pre-print*" [Title/Abstract]) OR ("peer-review*" [Title/Abstract])) OR ("MedRxiv" [Title/Abstract])) OR ("bioRxiv" [Title/Abstract])) OR (preprint* [Title/Abstract]))) AND ((publications [MeSH Terms]) OR (publishing [MeSH Terms])))

= 92 hits

Inclusion and exclusion criteria

Inclusion	Exclusion
<ul style="list-style-type: none"> Discussion on pre-peer review articles Articles presenting empirical data on pre-peer review articles – trends, characteristics, or impact Pre-peer review articles (publication type) were included 	<ul style="list-style-type: none"> Not about the publication of pre-peer review articles <ul style="list-style-type: none"> e.g. expedited publications (e.g. fast-tracking peer review) e.g. retraction or correction of poor quality or erroneous evidence e.g. rapid reviews Articles about impact of COVID-19 broadly on the process and method of conducting scientific research without discussion of publication Anecdotal evidence or recommendations about the publication or use of pre-peer review articles without presenting empirical data 'Mission statements' and editorial letters from Journals about their publishing process

Appendix 2 List of editorials and opinion pieces on COVID-19 pre-peer review articles

- No author. All that's fit to preprint. *Nat Biotechnol.* 2020;38(5):507.
- Armstrong S. Research on covid-19 is suffering imperfect incentives at every stage. *BMJ.* 2020;369:m2045.
- Avissar-Whiting M. How the world is adapting to preprints. *Nature Research.* 2021.
- 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.
- Flanagan A, Fontanarosa PB, Bauchner H. Preprints involving medical research – do the benefits outweigh the challenges? *JAMA.* 2020;324(18):1840-1843.
- Freckelton I. Perils of precipitate publication: fraudulent and substandard COVID-19 research. *J Law Med.* 2020;27(4):779-789.
- Guterman EL, Braunstein LZ. Preprints during the COVID-19 pandemic: public health emergencies and medical literature. *J Hosp Med.* 2020;15(10):634-636.
- King A. Fast news or fake news?: The advantages and the pitfalls of rapid publication through pre-print servers during a pandemic. *EMBO Rep.* 2020;21(6):e50817.
- Lakens D. Pandemic researchers – recruit your own best critics. *Nature.* 2020;581(7807):121.
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SHPN: (ACI) 210170 | ISBN: 978-1-76081-646-9 | TRIM: ACI/D21/695-10