Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Clinical Microbiology and Infection xxx (xxxx) xxx

Contents lists available at ScienceDirect

Clinical Microbiology and Infection

journal homepage: www.clinicalmicrobiologyandinfection.com

Letter to the Editor

Surging publications on the COVID-19 pandemic

Guanqiao Li [1, 2, †], Yangzhong Zhou [3, †], Junyi Ji [4], Xiaozhen Liu [1, 2], Qiao Jin [4], Linqi Zhang [2, *]

[1)] *Tsinghua Clinical Research Institute, School of Medicine, Tsinghua University, Beijing, China*
[2)] *School of Medicine and Vanke School of Public Health, Tsinghua University, Beijing, China*
[3)] *Peking Union Medical College Hospital, Beijing, China*
[4)] *School of Medicine, Tsinghua University, Beijing, China*

ARTICLE INFO

Article history:
Received 27 July 2020
Received in revised form
2 September 2020
Accepted 6 September 2020
Available online xxx

Editor: L. Leibovici

To the Editor

Few infectious diseases have posed such tremendous challenges as coronavirus disease 2019 (COVID-19), which had swept across 216 countries or territories by 29 August 2020. In response, an unprecedented upsurge of research has been witnessed [1]. To assess the pattern and scale of COVID-19 research, we searched for 'nCov', 'COVID-19' or 'SARS-CoV-2' in Embase, MEDLINE and Cochrane CENTRAL databases through 31 March 2020 (see Supplementary material, Appendix S1). A total of 1431 out of 3780 publications were included and further manually divided into eight mutually exclusive categories with regards to research topics (Fig. 1a; Supplementary material, Table S1).

Clinical observational studies appeared at the fastest speed. As of 31 March 2020, the number was 625 (44%). Of note, 70 publications analysed radiographic manifestations and emphasized their diagnostic roles supplementary to nucleic acid testing. These findings translated into guidelines of the appropriate application of imaging in managing patients [2]. Epidemiological studies ranked second with 210 (15%) publications, describing transmission routes, incubation period and reproduction number. The number of basic research publications grew steadily to 116 (8%). Viral genomic evolution and the structural basis of spike–receptor interaction were identified. Interestingly, studies on diagnostic assays, and therapeutic and preventive medications initially followed the pace of basic research, but preceded it since late February, reflecting the high demand of these agents in a pandemic context. Urgent need drove the research into treatment and prevention remedies, including repurposed molecules, investigational drugs and vaccines [3]. Policy-related analyses reached 95 (7%), covering containment strategies, medical resource allocation and economic impact. Furthermore, patients with pre-existing conditions need special attention during the outbreak, which was addressed in 171 (12%) publications.

Given the rapid spread of COVID-19, many countries joined the global action of research. Generally, research activities correlated with the epidemic from national perspectives (Supplementary material, Fig. S4). As the first affected country, China's aggressive public interventions provided evidence for evaluating epidemic responses [4].

We also compared the trend of COVID-19 research with that of severe acute respiratory syndrome (SARS) in 2003 (see Supplementary material, Appendix S1 and Fig. S2). The patterns of COVID-19 research subjects were generally comparable with those in SARS (Fig. 1a,b). The temporal trends in both diseases generally agreed with the way we gain knowledge on novel diseases, and also reflected accessibility of resources to researchers in different disciplines.

However, the volume of COVID-19-related publications increased at a significantly greater speed than that of SARS in all aspects (Fig. 1a,b), associated with the extent of pandemic severity and diversification of research tools. As of 29 August 2020, there were more than 60 000 publications on journal or preprint servers [5]. Studies on therapeutics accumulated dramatically, and results of clinical trial results were published 6 months earlier than those in the SARS epidemic (Fig. 1a,b). The initial reaction from China was represented by two remdesivir trials in early February, and quickly expanded to 5000 trials testing antiviral, anti-inflammatory and immunoglobulin therapies on a global scale [6]. As of 28 August 2020, at least 45 randomized controlled trials and 19 prospective non-randomized trials have been published [6], and quickly

* Corresponding author: L. Zhang.
E-mail address: zhanglinqi@tsinghua.edu.cn (L. Zhang).
† G. Li and Y. Zhou contributed equally to the work.

https://doi.org/10.1016/j.cmi.2020.09.010

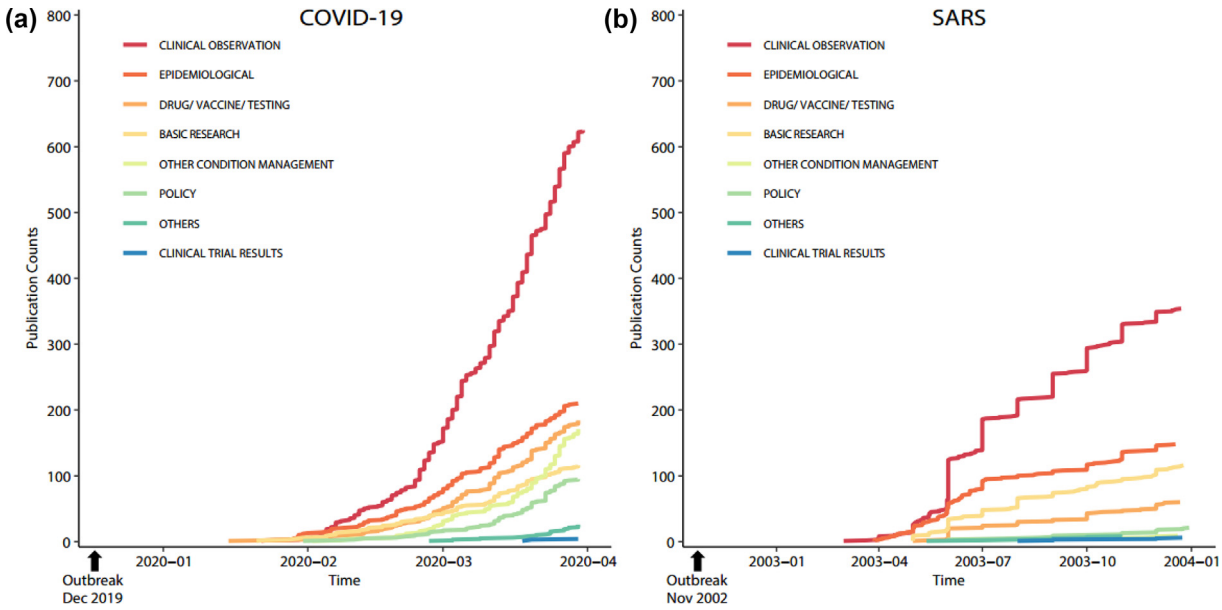

Fig. 1. Analysis of research activities for coronavirus disease 2019 (COVID-19) and severe acute respiratory syndrome (SARS). Research publications were classified into eight categories for COVID-19 (a, 1 December 2019 to 31 March 2020) and SARS (b, 1 November 2002 to 31 December 2003), respectively. Detailed study selection process, classification criteria are provided in the Supplementary material (Appendix S1 and Table S1).

translated into consensus of clinical practice. Notably, based on the results from the international trial of remdesivir from the NIH [7], the US Food and Drug Administration issued authorization for its emergency use in severe COVID-19. Moreover, 95 policy-related publications for COVID-19 were found, compared to 29 for SARS (Fig. 1a,b), which underscored evidence-based public health policy in the modern era. The global spread of COVID-19 brought substantial challenges to other health metrics, especially the management of other medical conditions (Fig. 1a,b). In the settings of severe COVID-19 epidemics, health-care services of non-urgent ailments have been disrupted [8]. The containment strategies, such as social distancing, might negatively influence metabolic health [9].

We also identified 1085 COVID-19 papers in preprint platforms (bioRxiv, medRxiv, ChemRxiv and ChinaXiv) using the same search strategies (see Supplementary material, Appendix S1 and Fig. S3). Despite similarities in most topics, there were 2.2-fold more policy-related studies in preprints than in peer-reviewed counterparts as of late March (see Supplementary material, Fig. 5), which may be explained by the motivations brought by rapid dissemination in preprints and pre-emption obtained by preprint publication for policy research based on open-source data [10]. Clinical observational studies were more prominent in peer-reviewed publications, reflecting the accelerated process of peer review in response to COVID-19 [11]. However, worries have been proposed about the quality and reliability of these studies [12], as exemplified by the retraction of a registry analysis for hydroxycholoroquine due to concerns on veracity 13 days after publication [13].

The outlook of the COVID-19 pandemic is still unclear, and its influence is far-reaching. Continuous research achievements will help to fill the knowledge gap. However, we are left behind in some aspects. For example, funds to support the development of therapeutics and vaccines for SARS coronavirus were reduced when SARS ended [14], leaving us underprepared to cope with COVID-19. Hopefully, reasonable research efforts will persist even after the threat subsides, allowing for better preparedness for the next unexpected yet historically recurring crises.

Authors' contributions

LZ took responsibility for the integrity of the data and the accuracy of the data analysis. GL and YZ designed the study. GL, YZ, JJ and XL collected the data and independently reviewed the data. QJ cleaned and processed the data. GL and YZ contributed to the statistical analysis. GL, YZ, and JJ drafted the manuscript. All authors contributed to data interpretation, revised the manuscript and approved the final version.

Funding

The authors received no funding for this work.

Transparency declaration

We declare no competing interests.

Acknowledgements

We thank Dr Xiaole Xie and Zhenghao Fan for their great supports in data processing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cmi.2020.09.010.

References

[1] Callaway E, Cyranoski D, Mallapaty S, Stoye E, Tollefson J. The coronavirus pandemic in five powerful charts. Nature 2020;579:482–3.
[2] China National Health Commission. Chinese clinical guidance for COVID-19 pneumonia diagnosis and treatment. 7th ed. Beijing: China National Health

Commission; 2020. http://kjfy.meetingchina.org/msite/news/show/cn/3337.html.
[3] Forbes. Pricing of COVID-19 treatments and coronavirus vaccines. 2020. Available from: https://www.forbes.com/sites/joshuacohen/2020/05/11/pricing-of-covid-19-treatments-and-coronavirus-vaccines/#1d591eb72865. [Accessed 13 May 2020].
[4] Pan A, Liu L, Wang C, Guo H, Hao X, Wang Q, et al. Association of public health interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. JAMA 2020. epub ahead of print.
[5] COVID-19 Open Access Project. Living evidence on COVID-19. 2020. Available from: https://ispmbern.github.io/covid-19/living-review/. [Accessed 30 August 2020].
[6] COVID-Network meta-analysis (NMA). Living mapping and living systematic review of Covid-19 studies. Available from: https://covid-nma.com/. [Accessed 30 August 2020].
[7] Beigel JH, Tomashek KM, Dodd LE, Mehta AK, Zingman BS, Kalil AC, et al. Remdesivir for the treatment of Covid-19—preliminary report. N Engl J Med 2020. epub ahead of print.
[8] Li G, Yin C, Zhou Y, Wang T, Chen J, Liu Y, et al. Digitalized adaptation of oncology trials during and after COVID-19. Cancer Cell 2020. epub ahead of print.
[9] Clemmensen C, Petersen MB, Sorensen TIA. Will the COVID-19 pandemic worsen the obesity epidemic? Nat Rev Endocrinol 2020;16:469–70.
[10] Fraser N, Brierley L, Dey G, Polka JK, Pálfy M, Coates JA. Preprinting a pandemic: the role of preprints in the COVID-19 pandemic. bioRxiv 2020. epub ahead of print.
[11] Palayew A, Norgaard O, Safreed-Harmon K, Andersen TH, Rasmussen LN, Lazarus JV. Pandemic publishing poses a new COVID-19 challenge. Nat Hum Behav 2020;4:666–9.
[12] Glasziou PP, Sanders S, Hoffmann T. Waste in COVID-19 research. BMJ 2020;369:m1847.
[13] Mehra MR, Ruschitzka F. Patel AN> Retraction—hydroxychloroquine or chloroquine with or without a macrolide for treatment of COVID-19: a multinational registry analysis. Lancet 2020. epub ahead of print.
[14] Jiang S, Lu L, Du L. Development of SARS vaccines and therapeutics is still needed. Future Virol 2013;8:1–2.

Please cite this article as: Li G et al., Surging publications on the COVID-19 pandemic, Clinical Microbiology and Infection, https://doi.org/10.1016/j.cmi.2020.09.010