COVID-19: emerging trends, healthcare practice, artificial intelligence–assisted decision support, and implications for service innovation

Harry HX Wang[1,2,3 #], PhD, **Yu-ting Li**[4 #], MPH, **Junjie Huang**[1,5], PhD, **Haifeng Zhang**[6], MD, **Wenyong Huang**[4], MD,
Martin CS Wong[5,7,8,9,10] *, MD, MPH

[1] *Editors, Hong Kong Medical Journal*
[2] *School of Public Health, Sun Yat-Sen University, Guangzhou, China*
[3] *Young Cadre Branch, Guangdong Primary Healthcare Association, Guangzhou, China*
[4] *State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-Sen University, Guangzhou, China*
[5] *Centre for Health Education and Health Promotion, The Jockey Club School of Public Health and Primary Care, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong SAR, China*
[6] *Department of Cardiology, Sun Yat-Sen Memorial Hospital, Sun Yat-Sen University, Guangzhou, China*
[7] *Editor-in-Chief, Hong Kong Medical Journal*
[8] *School of Public Health, Fudan University, Shanghai, China*
[9] *The Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China*
[10] *School of Public Health, Peking University, Beijing, China*

\# Equal contribution
* Corresponding author: wong_martin@cuhk.edu.hk

According to the World Health Organization (WHO) global statistics as of early January 2024, >774 million confirmed cases of coronavirus disease 2019 (COVID-19) and >7 million deaths have been reported worldwide during the COVID-19 pandemic.[1] At a global level, the COVID-19 pandemic has now evolved into a steady state of low-level transmission, with low numbers of reported COVID-19 cases and deaths. The trend has been maintained over the past 12 months, despite a slight increase in the number of reported cases during the most recent available 28-day period.[1] Since the declaration of the Public Health Emergency of International Concern by the WHO in January 2020, the global pandemic has caused widespread and devastating economic and social turmoil, along with extensive disruptions and backlogs affecting health services in overburdened healthcare systems. In the early months of the pandemic, global attention focused on COVID-19 emergency response and control efforts, such as case identification, contact tracing, rapid diagnostic tests, and acute treatment. As understanding has improved regarding the COVID-19 pandemic and its effects, including post-acute sequelae of COVID-19 (ie, long COVID), on all aspects of healthcare,[2,3] many countries have shifted their focus to the establishment of longer-term, dynamic, and sustained frameworks for health emergency preparedness, response, and resilience at national, regional, and global levels.

In the WHO Strategic Preparedness and Response Plan for 2023-2025,[4] a new strategy consisting of five core components—(a) emergency coordination; (b) collaborative surveillance; (c) community protection; (d) safe and scalable care; and (e) access to countermeasures—has been proposed with a strong emphasis on the mobilisation of multisectoral partnerships for coordination, planning, financing, monitoring, and evaluation. Considering the potential for surges of new variants with greater severity or transmissibility,[5] the updated WHO framework has been designed and positioned to maintain sufficient capacity, operational readiness, and system flexibility to scale up clinical care services and multidisciplinary team support. This approach builds on the response-driven pillars outlined between 2020 and 2022 to address the complex interactions of COVID-19 with an expanding range of emerging long-term conditions and circumstances.

Extensive research has been conducted regarding the effects of public health measures intended to reduce the risk of COVID-19 transmission.[6] The COVID-19–driven changes and innovations in health practice have also been captured in past issues of the *Hong Kong Medical Journal*.[7] In the Greater Bay Area, collaborative efforts between mainland medical staff and their Hospital Authority counterparts in a community treatment facility and large makeshift hospital to combat the fifth wave of the pandemic have highlighted the potential for cross-border connectivity and healthcare integration to benefit residents of Hong Kong and Macau.[7] In addition to government- and provider-level support for the expansion of community-oriented and patient-centred healthcare services, there have been dramatic increases in the use and application of digital health technologies during the COVID-19 pandemic. Such innovations

have also substantially impacted the manners in which clinical competencies are enhanced, patient education is delivered, performance parameters are evaluated, resilience-building environments are created, and health practices are strengthened. Studies have shown satisfactory perception and acceptance of telemedicine consultations among adults in Hong Kong; telemedicine users reported positive experiences regarding physician diagnosis, disease management, and resolution of barriers to healthcare delivery.[8,9] Transformative health practices empowered by digital technologies, including (but not limited to) computerised decision support tools and clinical management systems, may help to address clinical inertia and workload-related factors, thereby facilitating efforts to improve physician motivation and satisfaction in the post-pandemic era.

The digital technology innovations also contributed to the understanding of the dynamic associations between regions with low average number of daily COVID-19 cases and early public awareness of WHO-recommended multiple preventive measures. This has been shown in an infodemiology study based on Google Trends data.[10]

The use of publicly available and aggregated data retrieved from internet searches could offer valuable insights into population-level behaviours and their links to the spread of COVID-19 across different time periods; these insights may support risk communications, community engagement, and response coordination.[11] Post-pandemic cancer care delivery should be tailored to accommodate the diverse unmet needs of patient groups with different psychological phenotypes, as suggested by Hong Kong researchers who reported the use of psychometric analysis as a tool to identify patients with high risks of decline in physical, psychological, and dietary wellness.[12]

In parallel with the explosive spread of COVID-19 and the persistence of long COVID symptoms over the past 4 years, the development of artificial intelligence (AI) technology has advanced at an unprecedented pace worldwide. In preventive ophthalmology, there is evidence that community-based diabetic retinopathy screening via teleophthalmology, based on imaging examinations with low-cost devices and remote interpretation, can serve as an accurate and cost-effective alternative to conventional face-to-face examinations; it achieves similar clinical outcomes, broader population coverage, and timely referral to ophthalmologists, while maintaining high satisfaction rates.[13] This approach could substantially enhance workflow efficiency across clinical settings and support clinical decision-making by determining triage thresholds and tailoring interventions using predictive analytics.

The use of telemedicine and AI has also received increasing attention; in particular, the integration of clinical, biological, and genetic data with long-term health outcomes will help to elucidate the bi-directional relationship between COVID-19 and the cardiovascular system.[14] The 2023 updated position paper from the Italian Society of Cardiology and Working Group on Telecardiology and Informatics has highlighted the considerable potential of AI-assisted clinical prediction models in terms of enhancing cardiovascular illness screening, diagnosis, monitoring, and adverse event prevention.[15] In both ambulatory and inpatient settings, health practice innovations such as telemedical care, mobile health applications, and personalised wearable biosensors play key roles in efforts to improve clinical decision-making, avoid unnecessary hospital admission, reduce time to treatment during cardiac emergencies, rationalise healthcare services, and promote home care.[15]

The evolution of COVID-19 demands sustained global commitment to building a well-prepared, responsive, and resilient future. This evolution also highlights the urgent need for research that addresses the legal, regulatory, ethical, and reliability challenges involved in transforming 'big data' and AI into innovative services that can be implemented in clinical and real-world settings. Important and open questions concerning the management of COVID-19—particularly in relation to its complex pathophysiology, risk factors, and effective treatments, as well as long-term vaccine safety and efficacy (and related issues)—continue to require multi-channel collection of standardised data supported by diverse, coordinated, and collaborative efforts from biomedical and research communities to inform practice and policy in the new digital era.

Author contributions

All authors contributed to the editorial, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

The authors have declared no conflicts of interest.

References

1. World Health Organization. COVID-19 epidemiological update—19 January 2024. Available from: https://www.who.int/publications/m/item/covid-19-epidemiological-update---19-january-2024. Accessed 5 Feb 2024.
2. Arsenault C, Gage A, Kim MK, et al. COVID-19 and resilience of healthcare systems in ten countries. Nat Med 2022;28:1314-24.
3. The Lancet Respiratory Medicine. Long COVID: confronting a growing public health crisis. Lancet Respir Med 2023;11:663.
4. World Health Organization. From Emergency Response to Long-Term COVID-19 Disease Management: Sustaining Gains Made during the COVID-19 Pandemic. Geneva:

World Health Organization; 2023.

5. Jacobs JL, Haidar G, Mellors JW. COVID-19: challenges of viral variants. Annu Rev Med 2023;74:31-53.

6. Ayouni I, Maatoug J, Dhouib W, et al. Effective public health measures to mitigate the spread of COVID-19: a systematic review. BMC Public Health 2021;21:1015.

7. Pai PM, Fan JK, Wong WC, Deng XF, Xu XP, Lo CM. Promoting integrated healthcare for Hong Kong and Macau residents in the Greater Bay Area during the COVID-19 pandemic. Hong Kong Med J 2023;29:268-72.

8. Hung KK, Chan EY, Lo ES, Huang Z, Wu JC, Graham CA. User perceptions of COVID-19 telemedicine testing services, disease risk, and pandemic preparedness: findings from a private clinic in Hong Kong. Hong Kong Med J 2023;29:404-11.

9. Choi MC, Chu SH, Siu LL, et al. Telemedicine acceptance by older adults in Hong Kong during a hypothetical severe outbreak and after the COVID-19 pandemic: a cross-sectional cohort survey. Hong Kong Med J 2023;29:412-20.

10. Mok A, Mui OO, Tang KP, et al. Public awareness of preventive measures against COVID-19: an infodemiology study. Hong Kong Med J 2023;29:214-23.

11. Wang HH, Li YT, Wong MC. Leveraging the power of health communication: messaging matters not only in clinical practice but also in public health. Hong Kong Med J 2022;28:103-5.

12. Bao KK, Cheung KM, Chow JC, Leung CW, Wong KH. The real-world impact of the COVID-19 pandemic on patients with cancer: a multidisciplinary cross-sectional survey. Hong Kong Med J 2023;29:132-41.

13. Vujosevic S, Limoli C, Luzi L, Nucci P. Digital innovations for retinal care in diabetic retinopathy. Acta Diabetol 2022;59:1521-30.

14. Lo YS, Jok C, Tse HF. Cardiovascular complications of COVID-19. Hong Kong Med J 2022;28:249-56.

15. Brunetti ND, Curcio A, Nodari S, et al; Working Group on Telecardiology, Informatics of the Italian Society of Cardiology. The Italian Society of Cardiology and Working Group on Telecardiology and Informatics 2023 updated position paper on telemedicine and artificial intelligence in cardiovascular disease. J Cardiovasc Med (Hagerstown) 2023;24(Suppl 2):e168-77.