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Call for better systems and data to support artificial intelligence for pandemic response

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The COVID-19 pandemic has been a major disruption for the world, and countries have struggled to manage the spread of the virus and its many consequences with variable success. To control a novel infectious agent with unknown behaviour and effects, it is essential to be able to access and analyse large quantities of data in near real time. Some nations have done better than others, and how a country or region responds can significantly affect the human consequences of the pandemic (see online supplemental appendix for a description of the five curves of a pandemic). For example, China and Italy, early epicentres of the pandemic, deployed artificial intelligence (AI) based software to rapidly identify patients with COVID-19 using lung images,[1 2] and Iceland sequenced cases early on to understand spread.[3]

AI holds potential early in pandemic response where there is great uncertainty; this is an optimal time to leverage AI for pattern recognition and prediction to inform public health decisions, clinical triage and care. But early in pandemics, less data are available to learn useful information. Thus, AI techniques such as unsupervised learning, few-shot learning, meta-learning and transfer learning may offer greater help than techniques that require huge quantities of labelled data. COVID-19 has highlighted constraints to the use of AI for pandemic response, particularly timely access to high-quality data needed for decision making.[4] With public health data, there were challenges posed by old infrastructures, lags in data collection and privacy concerns. Furthermore, available data were generally incomplete, which may have led to uncertain or biased estimates. Early on, it was estimated that there were approximately 10 COVID-19 infections for each reported case, with only severe cases counted due to limited testing with strict criteria.[5] To date, perhaps the most comprehensive estimates of asymptomatic infections have come from major league baseball teams.[6]

RECOMMENDATIONS FOR FUTURE PANDEMICS

Given the realities of globalisation, it is certain that more pandemics lie ahead. Three key steps in managing pandemics are prepare, respond and recover. Many governments did all these poorly for COVID-19. To be poised to leverage AI in the next pandemic, countries must prepare by creating and maintaining high-quality public health datasets, which can be shared securely and efficiently, when needed for global health emergencies. Despite numerous attempts, many AI applications were not fit for clinical use. Access to high-quality datasets may help to ensure that more AI applications will be used clinically in the next pandemic. In most developed countries, electronic health records are now widely used, and it will be essential to develop and maintain surveillance technologies for timely reporting of cases to public health agencies. Frameworks for sharing data across stakeholders, including governments, health systems, industry and academics, are critical. These datasets should include infectious disease data and a wide array of information to support management of the health equity, mental health and chronic disease consequences. With appropriate infrastructure and governance, ongoing surveillance could enable prompt response to emerging infectious disease threats to 'flatten the curves' or even eliminate novel pathogens through suppression.

To support effective AI response for future pandemics, strategies for international sharing of robust, high-quality data are needed.[7] Examples of collaboratives from this pandemic include the COVID-19 Decision Support Dashboard from the COVID-19 Healthcare Coalition of over 900 healthcare organisations, technology companies and non-profit

organisations; the Radiological Society of North America COVID-19 Data Imaging Repository; the IBM Functional Genomics Platform; and the European Imaging COVID-19 AI initiative supported by the European Society of Medical Imaging Informatics.

It is never too early to start preparing. Looking forward, nations need to determine how many resources to allocate, which will involve maintaining support for modelling teams in between pandemics. Finally, recovery is extremely challenging—determining how rapidly to reopen requires balancing the economic and health risks of restrictions with those of reopening too quickly and causing another wave of contagion. The key to better outcomes is being able to predict what will happen and the impact of specific actions. AI can be invaluable in pandemic response if robust data, public health infrastructure, collaborative networks and appropriate policies are in place. While AI played a relatively minor role for COVID-19, it can be positioned to play a central role in the next pandemic.

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REFERENCES

1 Simonite T. Chinese hospitals Deploy AI to help diagnose Covid-19. WIRED. Available: https://www.wired.com/story/chinese-hospitals-deploy-ai-help-diagnose-covid-19/ [Accessed 7 Dec 2021].
2 Infervision Europe. Infervision's AI is in Italy Helping to Battle COVID-19. NEWSWIRE. Available: https://www.newswire.com/news/infervisions-ai-is-in-italy-helping-to-battle-covid-19-21115608 [Accessed 7 Dec 2021].
3 Gudbjartsson DF, Helgason A, Jonsson H, *et al*. Spread of SARS-CoV-2 in the Icelandic population. *N Engl J Med* 2020;382:2302–15.
4 Naudé W. Artificial intelligence vs COVID-19: limitations, constraints and pitfalls. *AI Soc* 2020;35:761–5.
5 Park A. CDC head estimates U.S. coronavirus cases might be 10 times higher than data show. TIME. Available: https://time.com/5859790/cdc-coronavirus-estimates/ [Accessed 20 Oct 2021].
6 MLB announces Weekly COVID testing results. MLB. Available: https://www.mlb.com/news/weekly-mlb-covid-testing-results-for-june-25 [Accessed 20 Oct 2021].
7 Peiffer-Smadja N, Maatoug R, Lescure F-X, *et al*. Machine learning for COVID-19 needs global collaboration and data-sharing. *Nat Mach Intell* 2020;2:293–4.