MEDICAL, SAFETY AND HEALTHCARE

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DIGITAL HEALTHCARE-THE ONLY SOLUTION OF BETTER HEALTHCARE DURING PANDEMICS

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ABSTRACT:
Digital technologies are being harnessed to support the public-health response to COVID-19 worldwide, including population surveillance, case identification, contact tracing and evaluation of interventions on the basis of mobility data and communication with the public. These rapid responses leverage billions of mobile phones, large online datasets, connected devices, relatively low-cost computing resources and advances in machine learning and natural language processing. This Review aims to capture the breadth of digital innovations for the public-health response to COVID-19 worldwide and their limitations, and barriers to their implementation, including legal, ethical and privacy barriers, as well as organizational and workforce barriers. The future of public health is likely to become increasingly digital, and we review the need for the alignment of international strategies for the regulation, evaluation and use of digital technologies to strengthen pandemic management, and future preparedness for COVID-19 and other infectious diseases.

INTRODUCTION:

COVID-19, a previously unknown respiratory illness caused by the coronavirus SARS-CoV-21'2, was declared a pandemic by the World Health Organization (WHO) on 11 March 2020, less than 3 months after cases were first detected. With now over 9.8 million confirmed cases and more than 495,000 deaths3 recorded worldwide, there are grave concerns about the global health, societal and economic effects of this virus, particularly on vulnerable and disadvantaged

populations, and in low- and middle-income countries with fragile health systems4,5. At the time of this writing, 7.1 billion people live in countries that have had substantial travel and social restrictions6.
As with the control of outbreaks and pandemics before it, controlling the COVID-19 pandemic rests on the detection and containment of clusters of infection and the interruption of community transmission to mitigate the impact on human health. During the plague outbreak that affected 14th-century Europe, isolation of affected communities and restriction of population movement were used to avoid further spread7. These public-health measures for outbreak response remain relevant today, including surveillance, rapid case identification, interruption of community transmission and strong public communication. Monitoring how these measures are implemented and their impact on incidence and mortality is essential.

DIGITAL EPIDEMILOGICAL SURVELIANCE:

A core public-health function of outbreak management is understanding infection transmission in time, place and person, and identifying risk factors for the disease to guide effective interventions. A range of digital data sources are being used to enhance and interpret key epidemiological data gathered by public-health authorities for COVID-19.

Online data sources for early disease detection

Established population-surveillance systems typically rely on health-related data from laboratories, notifications of cases diagnosed by clinicians and syndromic surveillance networks. Syndromic surveillance networks are based on reports of clinical symptoms, such as 'influenza-like illness', rather than a laboratory diagnosis, from hospital and selected sentinel primary and secondary healthcare facilities, which agree to provide regular surveillance data of all cases. These sources, however, ultimately miss cases in which healthcare is not sought. In the UK, for example, where until recently only hospitalized patients and healthcare workers were routinely tested for COVID-19, confirmed cases represent an estimated 4.7% of symptomatic COVID-19 cases[8]. Identifying undetected cases would help elucidate the magnitude and characteristics of the outbreak[9] and reduce onward transmission.

In the past two decades, data from online news sites, news-aggregation services, social networks, web searches and participatory longitudinal community cohorts have aimed to fill this gap. Data-aggregation systems, including ProMED-mail GPHIN, Health Mapand EIOS, which use natural language processing and machine learning to process and filter online data, have been developed to provide epidemiological insight. These data sources are increasingly being integrated into the formal surveillance landscape and have a role in COVID-19 surveillance. The WHO's platform EPI-BRAIN brings together diverse datasets for infectious-disease emergency preparedness and response, including environmental and meteorological data Several systems have claimed detection of early disease reports for COVID-19, through the use of crowdsourced data and news reports, before the WHO released a statement about the outbreak The UK's automatic syndromic surveillance system scans National Health Service digital records to pick up clusters of a respiratory syndrome that could signal COVID-19. There is also interest in using online data to estimate the true community spread of infectious diseases

INTERUPTING COMMUNITY TRANSMISSION:

After case identification and isolation, rapid tracing and quarantining of contacts is needed to prevent further transmission. In areas of high transmission, the implementation and monitoring of these interventions is needed at a scale that is becoming increasingly unfeasible or at least challenging by traditional means.

Rapid case identification: Early and rapid case identification is crucial during a pandemic for the isolation of cases and appropriate contacts in order to reduce onward spread and understand key risks and modes of transmission. Digital technologies can supplement clinical and laboratory notification, through the use of symptom-based case identification and widespread access to community testing and self testing, and with automation and acceleration of reporting to public-health databases.

Digital contact tracing: Digital contact tracing automates tracing on a scale and speed not easily replicable without digital tools. It

reduces reliance on human recall, particularly in densely populated areas with

mobile populations. In the COVID-19 pandemic, digital contact-tracing apps have been developed for use in several countries; these apps rely on approaches and technologies not previously tried on this scale and are controversial in terms of privacy. Evaluating their accuracy and effectiveness is essential.

Public communication: Informing populations and effective implementation of interventions during a pandemic relies on public education and cooperation, supported by an appropriate communications strategy that includes active community participation to ensure public trust. With 4.1 billion people accessing the internet and 5.2 billion unique mobile subscribers, targeted communication through digital platforms has the potential to rapidly reach billions and encourage community mobilization. Key challenges persist, including the rise of potentially harmful misinformation and digital inequalities. Online data and social media have had an ongoing, important role in public communication since the first reports of an unusual influenza-like illness resistant to conventional treatment methods emerged in China. Public-health organizations and technology companies are stepping up efforts to mitigate the spread of misinformation and to prioritize trusted news sites; for example, Google's SOS alert intervention prioritizes the WHO and other trusted sources at the top of search results. There are few reports about the impact of these interventions and difficulties in defining misinformation. A United Nations study found that 86% of member states had placed COVID-19 information on national websites by early April 2020, and many are using text messaging to reach populations who do not have access to the internet. Chat-bots are also providing information to reduce the burden on non-emergency health-advice call centers, and clinical practice is being transformed by the rapid adoption of remote health-service delivery, including telemedicine, especially in primary care.

Future directions: Digital technologies join a long line of public-health innovations that have been at the heart of disease-prevention-and-containment strategies for centuries. Public health has been

slower to take up digital innovations than have other sectors, with the first WHO guidelines on digital health interventions for health-system strengthening published in 2019. The unprecedented humanitarian and economic needs presented by COVID-19 are driving the development and adoption of new digital technologies at scale and speed. We have highlighted the potential of digital technologies to support epidemiological intelligence with online datasets, identify cases and clusters of infections, rapidly trace contacts, monitor travel patterns during lockdown and enable public-health messaging at scale. Barriers to the widespread use of digital solutions remain.

Implementation: Digital technologies cannot operate in isolation and need to be integrated into existing public healthcare systems. For example, South Korea and Singapore successfully introduced contact-tracing apps to support large teams of manual contact tracers as one of many measures, including strict isolation of cases and quarantine. Digital data sources, like any data source, need to be integrated and interoperable, such as with electronic patient records. Analysis and use of these data will depend on the digital infrastructure and readiness of public-health systems, spanning secondary, primary and social-care systems. The logistics of delivery to ensure population impact are often given too little attention and can lead to over-focus on the individual technology and not its effective operation in a system. The coordination of interventions is also a challenge, with multiple symptom-reporting sites in a single country, which risks fragmentation.

Data sharing and data quality: Big-data and artificial-intelligence approaches are only as good as the empirical datasets that are put into them, yet detailed public-health and private datasets are often inaccessible, due to privacy and security concerns, and often lack standardized formats or are incomplete. Researchers are calling for technology and telecom companies to share their data in a ‘proportionate, ethical and privacy-preserving manner, often citing a moral imperative for these companies to contribute where there is justification for data use. Some companies are making subsets of aggregated data available. These data are not consistent and are not provided within the same timeframe, and there is no standard format

or long-term commitment. Researcher-led international collaborations have aimed to aggregate multiple international data sources of voluntarily reported information. Equally, governments should provide much greater transparency in their datasets, including epidemiological data and risk factors for acquisition, with downloadable formats for researchers. Several governments have made available de-personalized individual-level datasets for research purposes, although this raises potential privacy concerns. Open-source data, code and scientific methods are being rapidly and widely shared online, including increased use of preprints, which speed up data availability but lack peer review.

Conclusion: The COVID-19 pandemic is ongoing, and it is too early to fully quantify the added value of digital technologies to the pandemic response. While digital technologies offer tools for supporting a pandemic response, they are not a silver bullet. The emerging consensus is that they have an important role in a comprehensive response to outbreaks and pandemics, complementing conventional public-health measures, and thereby contribute to reducing the human and economic impact of COVID-19. Cost-effectiveness and sustainability will require systems-level approaches to building digital online care pathways that link rapid and widespread testing with digital symptom checkers, contact tracing, epidemiological intelligence and long-term clinical follow up. The COVID-19 pandemic has confirmed not only the need for data sharing but also the need for rigorous evaluation and ethical frameworks with community participation to evolve alongside the emerging field of mobile and digital healthcare. Building public trust through strong communication strategies across all digital channels and demonstrating a commitment to proportionate privacy are imperative[10]. The future of public health is likely to be increasingly digital, and recognizing the importance of digital technology in this field and in pandemic preparedness planning has become urgent. Key stakeholders in the digital field, such as technology companies, should be long-term partners in preparedness rather than being partners only when emergencies are ongoing. Viruses know no borders and, increasingly, neither do digital technologies and data. There is an urgent need for alignment of international strategies for the regulation, evaluation and use of

digital technologies to strengthen pandemic management and future preparedness for COVID-19 and other infectious diseases.

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