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Emerging trends in healthcare driven by the COVID-19 pandemic: A review from Health Informatics Perspective.

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Abstract

The COVID-19 pandemic is the first of its kind to hit the world in the modern information age. People working in healthcare across the globe have harnessed technological advances and modern digital tools in innovative new ways. This has brought specific, more recent trends in healthcare delivery to the forefront. In this review, we present a collection of articles that highlight some of the emerging trends in healthcare driven by the COVID-19 pandemic and that have the potential to transform healthcare in the coming decades. We provide a brief commentary on the opportunities and challenges for each trend.

Keywords

Healthcare trends, digital health, future health, COVID-19, healthcare delivery

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Conflict of Interest Statement

None

REVIEW

Emerging Trends in Healthcare Driven by the COVID-19 Pandemic: A Review from Health Informatics Perspective

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Abstract

The COVID-19 pandemic is the first of its kind to hit the world in the modern information age. People working in healthcare across the globe have harnessed technological advances and modern digital tools in innovative new ways. This has brought specific, more recent trends in healthcare delivery to the forefront. In this review, we present a collection of articles that highlight some of the emerging trends in healthcare driven by the COVID-19 pandemic and that have the potential to transform healthcare in the coming decades. We provide a brief commentary on the opportunities and challenges for each trend.

Keywords: Healthcare trends, Digital health, Future health, COVID-19, Healthcare delivery

Since March of 2020, when the first wave of the COVID-19 pandemic hit a more significant portion of the globe, we have seen people, organizations, and nations respond to this pandemic in various ways. Given the rapid spread of the pandemic, the strain on resources, and the time challenge, they had to be innovative or even disruptive at times to achieve the goals of providing healthcare services throughout the pandemic. This pandemic is the first to hit the world in the modern information age. People working in healthcare across the globe have harnessed technological advances and modern digital tools in innovative new ways. This has brought specific, more recent trends in healthcare delivery to the forefront. In this journal club review, we present a collection of articles that highlight some of the emerging trends in healthcare driven by the COVID-19 pandemic and that have the potential to transform healthcare in the coming decades. With each trend, we present an illustrative article with its summary and a commentary on the opportunities and the challenges which will need to be overcome for widespread adoption of these newer trends in healthcare delivery.

1. Telemedicine/telehealth

Article: Trial by Fire: Impact of Rapid Expansion of Telemedicine in a.¹

Summary: In this article, Smith et al. have shared their experience with a community-based health system in the rapid and widespread adoption of telemedicine during the first few weeks of the COVID-19 pandemic. During the pre-pandemic times, the health system averaged fewer than 10 video visits a month, and fewer than 20 providers had performed a direct-to-patient video visit. Due to the COVID-19 pandemic and the consequent restrictions, the health system had to rapidly adapt and implement widespread use of telehealth to maintain patient care.

The article discusses the challenges and the constraints under which the team operated, including the lack of standardized reimbursement models, the need for significant capital investments, technology acquisition and implementation, end-user buy-in, and training. Despite these challenges, the team implemented a system-wide telehealth framework leading to the massive adoption of telehealth

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services. In three months, from February 2020 to April 2020, they went from sporadic use of telehealth visits to over 30% of all telehealth visits. By the end of a year, they had 522 providers who had conducted 100 or more video visits. They also reported that patient satisfaction was high during this period, and quality of care was preserved. Implementation of telemedicine also had a positive impact on the patients receiving behavioral health therapy; telemedicine allowed for a 'safe space' for the behavioral health professionals and patients to interact despite the challenges of the pandemic. The article makes a case for telemedicine as an opportunity in healthcare to reach people we may be unable to reach, whether due to pandemics or any other access-related challenges.

Commentary: Telemedicine is the most salient trend in healthcare that the COVID-19 pandemic has catalyzed. As illustrated above in the article, numerous hospitals and healthcare facilities were forced by the COVID-19 pandemic to implement telemedicine services for their patients rapidly. Telemedicine brings many possible benefits to patient care and care-providing organizations, individuals, and the wider society. These benefits include reductions in hospital admissions, readmission rates, and length of stays for inpatient encounters, contributing to overall reductions in healthcare costs.² For patients using telemedicine, psychological benefits, including higher satisfaction rates and better medication adherence, have also been suggested.³ The footprint of telemedicine continues to expand across specialties like cardiovascular medicine, pulmonology, neurology, palliative care, mental health, physical therapy services, and diseases, including successful implementations for chronic diseases like COPD, Heart failure, hypertension, and diabetes.^{2,3} While telemedicine plays a vital role in improving access to healthcare, it may also contribute to slowing down climate change by reducing the carbon footprint of delivering healthcare services.⁴ But some of the significant challenges continue to hamper its expansion, including difficulties with technology standardization, acquisition costs, lack of standardized reimbursement models, need for workforce education and training, and need for patient education and engagement, to name a few. With the COVID-19 pandemic, some of these issues move forward faster than usual. The Centers provided the most significant impetus for Medicare & Medicaid Services (CMS), making favorable changes to telemedicine reimbursements.⁵ The COVID-19 pandemic has favorably affected the patients' and caregivers' perception of modern technology and its use in

healthcare. What we do over the next several years following this pandemic in terms of supportive healthcare policy development, innovation, and resource allocation will decide the pace and the breadth of the expansion of telemedicine across the healthcare landscape.

2. Hospital at home programs

Article: Insights from rapid deployment of a "virtual hospital" as standard care during the COVID-19 pandemic.⁶

Summary: This article by Sitamagari et al. is another example of innovative care delivery models driven by the unique challenges brought on by the COVID-19 pandemic. They describe the development and rapid deployment of a virtual hospital at home program to care for COVID-19 patients within Atrium Health, a large health care system in the southern United States.

As a part of this model, they provided proactive home monitoring and hospital-level acute care to eligible COVID-19 patients through a virtual observation unit (VOU) and a virtual acute care unit (VACU). This program was developed to extend the hospital medicine division's existing transition services program. They created a robust virtual care platform with a dedicated team of virtual hospital medicine providers and nurses who provided frequent virtual in-home visits with proactive escalation and de-escalation of care intensity, 24/7 coverage, monitoring, and other linked specialty services as needed through virtual consultations. They describe the broad collaboration across the hospital and organization required to implement the model. They had a robust screening program set up to identify eligible patients. Every patient admitted to the V.A. CU was then provided with a home monitoring kit, written instructions on using each device, and a phone number to call for help. This kit was delivered to patients during the first in-home mobile clinician visit. The mobile clinicians included paramedics and registered nurses (RNs). A telemedicine mobile app interface allowed patients to escalate their concerns to the VACU team 24 h a day. A structured workflow with follow-up check-ins by the VACU team and integrated algorithms to handle disease progression were implemented. When deemed required, the covering physician could make a secure virtual visit using Vidyo videoconferencing software. Specific at-home procedures and interventions were also offered as a part of this model, including performing electrocardiography, obtaining blood samples for laboratory tests, and administering intravenous fluids,

medications, and respiratory therapies. Patients were either escalated to in-hospital care or deescalated to VOU care when deemed appropriate. The VOU included ongoing mobile app-driven symptom monitoring and telephonic nurse follow-ups. This model was integrated into the HER by creating a virtual facility location and allowed a seamless interface and flow of patient-related data across encounters irrespective of location and level of care. Interestingly, they also used GPS-enabled web-based fleet management software to efficiently distribute the mobile clinician's team.

They reported that between March and May of 2020, they had 1477(64%) of their COVID-19 positive patients receiving care through this model, of which 1293 received VOU level of care while 184 received hospital-level care under the VACU. Of the one to 93 patients admitted to the VOU, about 40 required escalations of care to inpatient hospitalization. Of the 184 patients cared for under the VACU, 24 required escalations to inpatient hospitalization. By implementing this model, they could keep patients out of emergency departments, minimize exposure to healthcare staff, and may have positively impacted freeing up inpatient hospital capacity. The authors add that such a virtual care model has potential long-term benefits, including reduced healthcare costs, readmission rates, and improved health outcomes for non-COVID-19 diagnoses.

Commentary: The Hospital at Home (HaH) is a newer care-delivery model emerging from the COVID-19 pandemic. While these kinds of programs were piloted in some health systems before the pandemic, the above article shows how the COVID-19 pandemic accelerated the implementation of this model. The growth in the HaH acute care delivery model is also driven by improvements in the health technology space with the availability of remote monitoring equipment and the ability to provide mobile acute care services at home. This model, just like telemedicine, also promises to reduce healthcare costs and improve patient outcomes, although this evidence is just starting to accumulate.⁷ In addition, in the case of surgical conditions, HaH provides an opportunity to reduce hospital-acquired adverse events (like those arising out of mistaken identity, nosocomial exposures, etc.), improve patient and caregiver satisfaction, and reduce costs.⁷ The limited evidence has shown comparable mortality and morbidity between the HaH model and the traditional inpatient model. In the wake of the pandemic, CMS also made some regulatory strides with approvals for several hospitals to provide the HaH model of care to receive Diagnosis-Related Group (DRG) reimbursements

for patients in the HaH model. Despite this, challenges remain. The most significant of these challenges is the need for developing guidelines and standardized workflows for this care delivery model. There also needs to be a substantial investment in technology acquisition, training, and infrastructure development. Given that HaH is just being implemented, there needs to be a significant investment in research to identify appropriate and specific use cases and answer questions related to various aspects of the HaH model of care. In this regard, providers, payers, and regulatory agencies need to work together to ensure the growth and sustainability of this new care-delivery model.

3. Remote patient monitoring

Article: The promise of remote patient monitoring: Lessons learned during the COVID-19 surge in New York city.⁸

Summary: This article by Casale et al. describes the lessons learned by the authors through the development and implementation of a COVID-19 hypoxia monitoring program at the New York-Presbyterian (NYP) health system in the Greater New York area. During the first wave of the COVID-19 pandemic, the team at NYP rapidly expanded their remote-monitoring care-delivery models for heart failure and hypertension to start the COVID-19 hypoxia monitoring program. This enabled care teams to discharge a large subset of COVID-19 patients home with the ability to remotely monitor and assess their health status, resulting in maximizing inpatient capacity. The program involved identifying appropriate patients and equipping them with new tools in their homes while providing infrastructure to care teams to evaluate and respond to the information being gathered. The challenges they had to overcome largely revolved around optimizing device standardization, developing standardized escalation protocols, and coordinated escalation infrastructure. They identify standardization and leadership buy-in as the main factors in making the program efficient and scalable. The second half of the article chronicles further details on the lessons learned from this experience. One important lesson is that these remote monitoring programs are embedded and well-integrated within the care models. This is necessary because while RPMs generate data at home or outside the hospital setting, this data needs to be presented to the care teams in a meaningful way through standardized workflow settings for timely interventions. The authors also note that building in coordination across

providers at different levels of care teams improved the value of the services and reduced care fragmentation. Developing centralized and standardized device management and support infrastructure for an RPM program is also critical to its success. The authors also talk about the equity-centered approach that will be required to be considered in designing RPM programs to avoid excluding access for certain groups of patients resulting from barriers like language, literacy, and access to technology. The authors conclude by enlisting system-level challenges, including reliable reimbursement models and supportive regulatory policy, which will determine these RPM programs' future growth and sustainability.

Commentary: With growing technological progress, healthcare monitoring is tethered free from the hospital to affordable, portable, and inexpensive personal devices. This has fueled the growth of RPM programs like the one detailed in the article above. The need for the COVID-19 pandemic to keep patients isolated and outside the resource-constrained hospitals but still be well-monitored for escalation of care accelerated the rapid expansion of innovation in this area. RPM programs will eventually be a significant contributory factor to the implementation and success of other emerging healthcare trends like telemedicine and HaH mentioned above. It also offers the opportunity to keep patients outside the hospitals, enabling more efficient use of in-hospital resources (reduced use of PPE, isolation rooms, etc.). The main challenges are to develop standards related to technology and equipment, establish new workflows and guidelines, create mechanisms for vendors, providers, and payors to communicate, educate and train new clinical teams and structures, create resources for patient education, and most importantly making sure that the digital divide does not create new inequities in the delivery of care. To ensure this, there needs to be a dialogue regarding the ethics of all these more recent technology-driven healthcare delivery trends. It will also be necessary for people of different ages, abilities, and socioeconomic backgrounds to be offered a seat at the table in the design and implementation of these newer care-delivery models. Another big challenge for implementing the RPM programs would be big data. RPM programs will generate large amounts of data which will need to be shared, stored securely, and analyzed. Developing the standards for interoperability and the infrastructure to handle this big data will be a crucial requirement for the success of these programs.

4. Data and interoperability

Article: Building capacity of community health centers to overcome data challenges with the development of an agile COVID-19 public health registry: a multistate quality improvement effort.⁹

Summary: In this article by Romero et al., the authors argue for the need for a national infrastructure to support the sharing of patient-level health center data for public health evaluation and ad-hoc analytics across the United States. They provide an overview of the current state of data interoperability in the U.S. public health system and describe in detail the development of a multistate reusable public health data analytics system for data aggregation that enables the reuse of clinical data to evaluate the health burden, inequities, disparities, and impact of COVID-19 on populations served by health centers.

This undertaking was a collaboration between the Centers for Disease Control and Prevention (CDC) and the National Association of Community Health Centers (NACHC) in association with the Health Resources and Services Administration (HRSA). As a part of this Multistate Data Strategy project, six regional and state Health Center-Controlled Networks (HCCNs) and Primary Care Associations (PCAs) serving over 900,000 patients were selected to reach diverse geographic regions and populations. The six states included Alaska, California, Louisiana, Florida, Ohio, and New York. A NACHC informatics team utilized a human-centered design framework to assess the health center data challenges by engaging project partners. The team then summarized each project partner's assessment data. These assessments became the basis of the registry's design and proposed measures to improve data aggregation. The team developed a cloud-based data infrastructure instance to allow the intake and processing of raw data in various formats from various sources asynchronously. This data was then processed, and the streamlined data was published into a data warehouse through an Automated Extract, Transform and Load (ETL) process. This data warehouse, in turn, fed downstream information systems. The team also developed a comprehensive data dictionary containing data elements and concepts related to COVID-19, which were expected to be available in various EHRs and electronic systems. These data elements were categorized into 12 domains to harmonize data requirements with existing health center databases maintained across the nation by various health agencies. For quality improvement purposes, all the project partners provided feedback on the

dictionary and performed chart reviews to ensure quality and identify opportunities to close data gaps and improve mapping. The NACHC entered into a separate data use agreement with each project partner to allow extraction and sharing of de-identified data for public health purposes. The NACHC informatics team developed dashboards from sample data that were then shared with project partners for validation before being offered and updated routinely on the data warehouse. Through the implementation of the project, the authors chronicle several challenges related to data extraction. These included lack of access to data types other than demographics and clinic-provided medical data, a high proportion of missing data related to social determinants of health (SDOH) and utilization data, and challenges with inconsistencies in data collection driven mainly by lack of standardization. This was further compounded by the fact that EHR vendors provided limited or no direct support for the mapping of medical terminology.

Despite all the above challenges, between August 2020 and March 2021, the team moved from the initial data feasibility and aggregation phase to the extraction and reporting phase. They continue to work on quality improvement efforts. Based on their experiences, they conclude by reporting that although federal interoperability data standards have been in place for nearly a decade, data from health centers lack standardization and completeness. They highlight the need for better health I.T. systems that support on-demand data extraction, ensure high-quality data capture, and data-driven quality improvement in patient care. They call on federal, state, and local health organizations and agencies to assess and guide the development of public health informatics infrastructure.

Commentary: The COVID-19 pandemic, the first of its kind in the age of information, has shown us how to use our modern technological capabilities to respond to such public health events. Public health agencies have used these capabilities across the continuum of public health services, including surveillance and risk assessments, testing and diagnosis, vaccination, research, and communication. Being able to gather accurate data, analyze it and share the insight across communities, nations, and the globe is very vital to the response to a public health crisis like this. While the pandemic created clear use cases and scenarios for this, it also exposed the lack of standardization and national framework in this regard. A newer public health framework around data collection, interoperability, and data dissemination is called for. Such a framework will enable public health agencies to be nimble in their

response to pandemics and help them identify and address disparities in healthcare outcomes across marginalized sections of the community, even in other non-pandemic situations. Such a framework could also be geared to function across well-defined geographic units like cities, counties, states, nations, and globally based on how the pandemic evolves. Recognizing this, organizations like the CDC, CMS, and Office of National Coordinator for Health Information Technology (ONC) have started developing a public health informatics agenda focusing on data interoperability. As it is clear from the article above, there is a need for standardization of data across EHRs and for EHR vendors to collaborate and innovate ways to harness clinical data for public health purposes. Given our ability to share data, there needs to be an ongoing debate around the ethics of sharing data between organizations with all the stakeholders, including people from the community being at the table. We strongly believe that we are in for good times in this space. Depending on how we move forward, we will be seeing groundbreaking changes in our ability to respond to pandemics and public health emergencies and our ability to manage healthcare at a population level.

5. Artificial intelligence

Article: DeepCOVID-XR: an artificial intelligence algorithm to detect COVID-19 on chest radiographs trained and tested on a large U.S. clinical data set.¹⁰

Summary: The article discusses the use of Artificial Intelligence(A.I.) to detect COVID-19 on chest X-rays. The A.I. was trained on images from Northwestern Memorial Health Care System. The algorithm was trained on 14,788 images, of which 4253 were confirmed to have COVID-19. The performance of the A.I. was then tested on 2214 images, of which 1192 were confirmed COVID-19 via PCR. A comparison was performed with five experienced thoracic radiologists on 300 random test images using the McNemar test for sensitivity and specificity and the Delong test for the area under the operating characteristic curve. DeepCOVID-XR was found to have higher sensitivity and specificity when compared to one and two radiologists, respectively.

Commentary: As artificial intelligence gains further traction in the health industry, the importance of a data-driven decision support model is clear. Although current regulations prohibit A.I. systems from signing off on radiographic reports, one can see a general use case in the model in its current state with optimizing read workflows

through the use of A. I. to flag images with high pretest probabilities for expedited radiologist review.

6. Precision medicine

Article: Machine learning as a precision-medicine approach to prescribing COVID-19 pharmacotherapy with remdesivir or corticosteroids.¹¹

Summary: In this study, a machine learning algorithm (MLA) was utilized on retrospective admissions data to identify patients with COVID-19 who would benefit from either a corticosteroid or remdesivir. MLAs were trained using adult (age >18) EHR data between December 18, 2019, and October 18, 2020, with COVID-19 in 10 U.S. Hospitals. Two thousand three hundred sixty-four patients' EHR data were included; 893 patients were treated with remdesivir, while 1471 were treated with a corticosteroid. Although, after adjusting for confounding, neither corticosteroid nor remdesivir use was associated with increased survival times, in the population of patients identified by the algorithm, both corticosteroids and remdesivir were significantly associated with an increased survival rate.

Commentary: The role of informatics in precision medicine has never been so crucial. There is significant value in bridging informatics and medicine with the invention of high-level computing and machine learning algorithms. The model facilitates care delivery and empowers research to be completed in record time. In fact, various vaccines are tested and developed using machine learning models, an advantage that has changed how quickly novel vaccines and therapies are created. Another great example of machine learning models in use today is in tumor genomics. IBM's Watson supercomputer not only facilitates faster genomic sequencing of certain tumors but can also help identify treatment plans in just a few minutes.

7. Social determinants of health

Article: Reducing health disparities in radiology through social determinants of health: lessons from the COVID-19 pandemic.¹²

Summary: The first documented case of COVID-19 in the U.S. was on January 21, 2020. In March 2020, the U.S. regrettably tallied the highest number of cases worldwide. New York City demonstrated staggering differences in hospitalizations and deaths among its five boroughs. Dates of hospitalizations were highest in the Bronx, which houses the most considerable portion of ethnic minorities and

has the highest rate of poverty and lowest rate of educational achievement. Meanwhile, lower rates of hospitalization and death were found in Manhattan, the most affluent borough. Neighborhoods predominantly Black or Hispanic accounted for 8 out of 10 ZIP Codes with the highest mortalities. In initial studies in the Mission district in San Francisco, 89% of individuals who tested positive for COVID had an annual income of less than \$50,000. The vast majority of these people (90%) could not work from home and were more likely to live in close quarters, such as apartment complexes which undermine social distancing efforts.

Interventions to advance health equity must begin the daunting task of dismantling these systems. Whereas black-and-white radiologic images appear to be agnostic to race and socioeconomic status, social determinants of health still impact radiology. Contributing factors include limited access to imaging services for geographic and financial/insurance reasons, low patient awareness surrounding screening, patient fear and distrust of the healthcare system, and race-based differences in provider ordering and follow-up practices. In emergency departments across the United States, the likelihood that any imaging exam will be ordered varies significantly by race and ethnicity. Non-white patients undergo significantly less imaging when compared to white patients. A study by Ross et al. showed that white patients receive medical imaging at 49% of visits and non-white patients at 41% of the visits ($p < 0.001$).¹³ In breast cancer, Black and Latinx women consistently demonstrated lower utilization of screening mammography and often receive screening mammography at facilities with less access to high-quality mammography. Many of these women are diagnosed in an emergency department of a safety net hospital and experience significant delays. Currently constructed national guidelines for breast cancer screening do not reflect a specific pattern based on race, which can further harm minority populations. Similarly, racial inequities are likely to persist in lung cancer screening recommendations.

Disparities in screening exams have been exacerbated by the COVID-19 pandemic, which initially caused a dramatic drop in the volume of elective and screening procedures. Simultaneously, there was a dramatic shift in nonelective imaging practices that illustrated the extent of the disparate impact of COVID-19 infection. Social determinants of health lead to the differential provision of minimally invasive, image-guided procedures. Examples are low thrombectomy rates in stroke for Black patients and a four times higher likelihood of Black

patients undergoing amputation over percutaneous revascularization for peripheral arterial disease.

Opportunities to reduce racial and socioeconomic disparities within radiology include incorporating more diversity in the radiology workforce to increase the likelihood of generating more sensitive policies that mitigate rather than create delays in initial and follow-up care. Algorithm-based imaging protocols, and greater communication between radiologists, ordering clinicians, and patients may ensure more equitable imaging practices.

Commentary: During the COVID-19 pandemic, the disproportionate toll experienced by racial minorities, patients of lower socioeconomic status, and patients lacking health insurance reflects the need for targeted institutional and national interventions. The COVID-19 pandemic has uncovered disparities in healthcare provision and outcomes even further in a much shorter time. Although these disparities were present before, in addition to uncovering them further, the COVID-19 pandemic has increased such disparities even further in regard to COVID-19 vaccination status, elective screening services, and other preventive services. Interventions are needed to mitigate such differences in healthcare access. Such interventions may include training for healthcare providers, recruiting bilingual/multilingual healthcare staff, and information technology (I.T.) solutions to track incidental findings and communicate to primary care providers. The inclusion of underrepresented segments of the population can enhance equitable policymaking and resource allocation to avoid healthcare disparities, as well as advocate for the affected groups of the population.

8. Digital public health

Article: Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing.¹⁴

Summary: COVID-19 is a rapidly spreading infectious disease that caused a global pandemic leading to a large number of hospitalizations and fatalities. At the time of this article, there was no vaccination available. The only approaches to stop the epidemic were case isolation, contact tracing and quarantine, physical distancing, and hygiene measures. Researchers in the study developed a mathematical model for contact tracing while considering several aspects of disease spread. They considered different transmission routes that could be implicated for prevention, including symptomatic transmission, presymptomatic transmission, asymptomatic transmission, and environmental

transmission without an attributable contact source. Other parameters considered were basic reproduction number which is the typical number of infections caused by an individual in the absence of widespread immunity, the growth rate of epidemic and corresponding doubling time, incubation period, and generation time which is defined as the time between the infection of the source and the infection of the recipient. Mathematical formulas were devised while considering the variabilities of infectiousness, heterogeneity between individuals, and average ages over those individuals who infect few others and those who infect many.

The study group proposed a mobile app to make contact tracing and notification instantaneous upon case confirmation. By keeping a temporary record of proximity events between individuals, it can immediately alert recent close contacts of diagnosed cases and prompt them to self-isolate. Similar apps were deployed in China at the beginning of the pandemic. The app allowed the central database to collect data on user movement and coronavirus diagnosis and displays a green, amber, or red code to relax or enforce restrictions on movement.

In addition to contact tracing, researchers modeled the combined impact of two interventions, isolating asymptomatic individuals and tracing contacts of symptomatic cases and quarantining them. Researchers also calculated the effect of such measures in containing the pandemic. The results implied the need for highly rapid contact tracing and interventions to stop the spread of infection. Authors also recognize the ethical implications of such a mobile application as it relies on well-founded public trust and confidence.

Commentary: The most challenging part of the COVID-19 pandemic is its rapid progression and the large number of cases making it very difficult to contain the infection and prevent the spread in a population. In the current digital age, with smart devices, we can leverage technology to help with contact tracing and detecting areas with high prevalence. This can help devise interventions to prevent the spread of the infection and enable targeted allocation of healthcare resources. Using such mathematical models through applications and mobile devices can help automate the process of contact tracing and detection of infections. However, such interventions require public trust and confidence. This applies to the use of applications as well as data gathering. Implementation of such technology requires transparent algorithms and policies regarding the use of data, agreements for access to public data, and guarantees of equity in accessing treatment. In the current era of social

media and public awareness of personal data sharing, it is even more prudent to create policies in such a way that enables the use of data judiciously and also maintains public trust. This, however, can be very challenging, especially in the United States, where sharing of healthcare data still requires aligning the consenting process in different states. As modeled by the researchers and this article, early intervention of isolation and contact quarantine is extremely important to prevent the rapid spread of infection. Such technology can tremendously help with that.

Conflict of interest

None.

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