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Research Brief

Ethical Implications of the Use of AI to Manage the COVID-19 Outbreak

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1. Pandemics and the COVID-19 Global Crisis

The World Health Organization (WHO) received the first report of a suspected outbreak of a novel coronavirus (COVID-19) in Wuhan, China on 31 December 2019 (Lai et al., 2020). Since that time, the outbreak has subsequently affected countries worldwide. As of April 6, 1.289.380 people have been diagnosed with Covid-19 and over 70.590 deaths, as well as 270.372 recovered patients, have been confirmed (Johns Hopkins CSSE, 2020-04-06).

COVID-19 presents similar symptoms to the Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS) (Wu and McGoogan, 2020), causing fever and cough and more severely leading to massive alveolar damage and progressive respiratory failure in some patients (Xu, Shi, Wang et al., 2020). Currently, studies have been demonstrating the human-to-human transmission of COVID-19 through droplets or direct contact (Lai et al., 2020). Because of the variation in type and severity of symptoms related to COVID-19, with some people experiencing no symptoms, there has been a high level of population exposure to the virus (Li et al., 2020). This characteristic, along with the unusually long incubation period of the virus (Lauer et al., 2020) and lack of any built up immunities in the populace, has led to nation wide calls to quarantine large populations to prevent person-to-person transmission, starting in China. Research and data collection continue on how this virus originated and spreads, as well as on potential medical treatments and tools for managing the spread.

Many countries around the world have adopted similar measures to China's initial strict response, such as curfews and closing schools and non-essential businesses, in order to try to slow the spread of the virus and help "buy time" for science to come up with medications and treatments that could save many lives (Wu and McGoogan, 2020).

The goal of slowing the spread is to ensure that health-care systems do not run over capacity and are able to deliver treatment of all the patients that might need hospitalization and admission to intensive care units (Lai et al., 2020).

In the process of managing this pandemic, many artificial intelligence (AI) -based tools have been used (or their potential has been discussed) in order to gather and analyze relevant data, develop treatments, make medical decisions, track infected populations and manage quarantines and information dissemination. In this Research Brief, we outline some of the current and potential uses for AI-based tools in managing pandemics and discuss the ethical implications of these efforts.

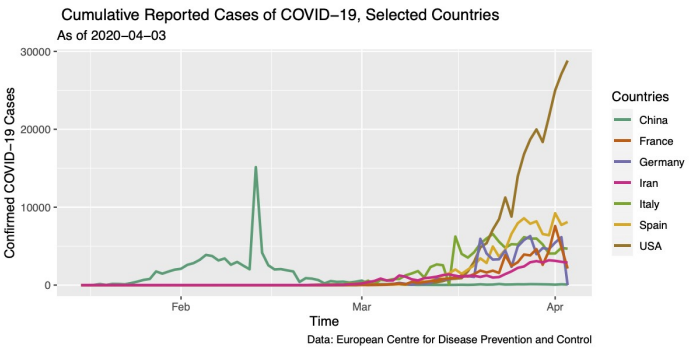

Fig. 1. Cumulative Reported Cases of COVID-19 in Selected Countries. Data from European Centre for Disease Control and Prevention (2020-04-03)

2. Current and Potential Roles for AI in Managing Pandemics

a) Data gathering and analysis

Machine learning (ML) methods are already being employed to model the outbreaks in different regions and predict cases, even asymptomatic cases, based largely on previous data and

case studies of infected areas. ML-based tools help scientists to speed up their predictions, and adapt models quickly to new information that emerges daily (See Bullock et al., 2020 for a good overview of the current case studies).

For example, warnings about the novel coronavirus spread were raised by AI systems about nine days before the official information on COVID-19 was released by international organizations (Berditchevskia and Peach, 2020; Kritikos, 2020). The health monitoring startup company called BlueDot, using natural-language processing (NLP) algorithms to monitor official news outlets and health-care reports around the world, warned of an unusual pattern of pneumonia cases in the city of Wuhan, China (Heaven, 2020). Researchers at Harvard similarly used social media post mining to find potential cases (Berditchevskia and Peach, 2020).

Unsupervised ML techniques could be also very helpful in identifying new patterns and making new predictions about the outbreak (Heaven, 2020), using collective phone data, for instance, to model spread and infection in real time (Berditchevskia and Peach, 2020). BlueDot was able to incorporate zipcodes into its virus pattern data, allowing for supplies and other resources to be minutely and dynamically targeted (Engler, 2020).

AI-based techniques have also helped to gather useful research as scientists race to learn more about the virus. The Allen Institute for AI, in partnership with others, has created a free resource of 45.000 scholarly articles about COVID-19 and the coronavirus family of viruses for use by the global research community (CORD-19, 2020). Similarly, the US Government launched a portal for research papers on COVID-19 that uses AI tools to scan and analyze the research for new insights into the pandemic (Romm et al., 2020).

b) AI to develop vaccines and treatments

AI has already been identified as a useful tool in the development of vaccines (Zhavoronkov, 2018). In early 2020, for instance, scientists discovered for the first time a new type of antibiotic using AI (BBC, 2020). Moreover, AI "invented" a drug to treat obsessive-compulsive disorder that moved to human trials in 12 months, instead of the typical 5 years (Wakefield, 2020).

AI could significantly impact the treatment of the virus by enabling rapid detection, optimization of the vaccine production, as well as enabling assistance with logistical issues arising during a global outbreak (Davies, 2020). ML applications can also help with improving the efficiency and effectiveness of randomized control trials, speeding up the testing phase for drugs (van der Schaar et al., 2020).

For instance, DeepMind, Google's AI division, is using its computing power to analyze the proteins that might be components of the virus in order to support researchers in developing treatments (Marr, 2020). The US government, IBM and others have recently granted researchers access to 16 super computers to speed the discovery of vaccines and other drugs related to COVID-19 (Castellanos, 2020). In China, tech companies such as Tencent, Huawei and DiDi are providing cloud-computing resources to researchers in order to exchange data and track the recent developments in possible cures or vaccines to deal with the virus (Marr, 2020).

c) AI to help doctors make decisions about care

In preliminary research, ML methods have shown immense potential for analyzing medical imaging (lung CT scans), speeding up the diagnostics of determining whether a patient has COVID-19 or another respiratory illness. ML approaches also have the potential to predict high-risk patients, allowing doctors and hospitals to better manage patient care and predict and allocate the necessary resources to reduce fatalities (See Bullock et al., 2020 for a complete overview of these studies). An effective use of ML tools could significantly impact early intervention by identifying patterns of risk for the disease and improving the coverage of testing and treatment where needed (Davies, 2020).

AI-based algorithmic models can help hospitals and doctors make decisions in light of limited time and resources.

Moreover, AI-based algorithmic models can help hospitals and doctors make decisions, based on diverse and changing data, in light of limited time and resources. ML-based analysis of the observational health data of patients can help predict the need

for testing or the risk of an infected patient experiencing adverse events. It can also be employed to develop individual treatment plans based on patient history and response to treatments during care. In the longer term, AI techniques can quickly analyze data to see which decisions/policies were more effective and model uncertainty in estimates gleaned from the training data (van der Schaar et al., 2020). The maximization of the data coverage during a global outbreak is essential in order to help doctors in choosing the right treatment, as well as quickening the decision-making process in general (Davies, 2020).

d) AI-based health and movement surveillance to manage quarantines

AI and ML-based tools have also been employed to determine (in less invasive and larger scale ways) potential carriers of the disease. This includes respiratory pattern monitoring for first order diagnostics (Wang et al., 2020).

More controversially, methods have also been developed to predict potential infection through embedded mobile data and personal surveys (See Oliver et al., 2020 for an overview). For instance, the Ministry of Interior and Safety of South Korea has developed an app that can monitor citizens on lockdown, in order to keep the spread of the virus under control. The app allows the citizens in quarantine to stay in contact with caseworkers to report their progress and uses GPS to track the location of the citizens on mandatory quarantine to make sure they are not in violation (Kim, 2020).

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Similarly, China has started a mass experiment in using real time data to monitor whether someone poses a contagion risk. The Chinese government is also requiring citizens to use the Alipay Health Code, which assigns citizens a color code – green, yellow or red – indicating their health status in order to determine whether they should be quarantined, or allowed to enter public spaces (Mozur, Zhong and Krolik, 2020). Israel approved emergency measures to track mobile-phone data to enforce the quarantine of those who may have come into contact with infected people (Tidy, 2020). Russia is considering enacting similar methods (Roth, 2020). Moreover, the U.S. Government is also currently in talks with major tech companies about the potential of mobile data for managing the pandemic and understanding policy impacts (such as required social distancing), albeit with anonymous data (Romm et al., 2020).

Facial recognition and AI-based drone techniques can also be potentially employed to track who is not wearing facemasks or violating quarantine, or to conduct thermal imaging to detect fever (Kritikos, 2020; Yang and Zhu, 2020).

e) AI and information dissemination in crises

AI-based tools can also be used to identify deep fakes, fake news and misinformation and model the spread of disinformation on social platforms (Bullock, 2020; Kritikos, 2020).

The WHO has warned that the global distribution through online platforms of information regarding COVID-19 might lead to the facilitated spread of misinformation. Therefore, along with the efforts to manage the emergence of an epidemic, there is the need to deal with the *infodemic,* a phenomenon in which populations are overwhelmed with information prevalently from non-reliable sources (Bullock, 2020).

The WHO, for instance, has been facing the infodemic by using its platform, the Information Network for Epidemic (EPI-WIN), in order to share information with key stakeholders. Furthermore, they have been working with major social media platforms, such as Facebook and Twitter, in order to ensure that when the users search for information about COVID-19 on social media, they are redirected to a reliable source (Zarocostas, 2020).

3. Ethical Considerations in the Use of AI to Manage Pandemics

Ethical considerations in the use of AI have become an increasingly popular topic in recent years. AI is a powerful tool that can be employed in various contexts and has the ability to amplify current positive efforts, but also entrench and increase

harms and discrimination if not used responsibly. Of ethical importance are the questions of by whom, how and when the impacts of AI technology will be felt? Floridi et al. (2018) outline these issues and propose five principles to guide AI ethics: *beneficence, non-maleficence, autonomy, justice and explicability.*[1]

The case of employing AI-based technologies in managing pandemics, with the noteworthy example of the COVID-19 crisis, is a prime example of how these guidelines may come into conflict. Do we value "public health" and "beneficence" over "individual privacy" and "autonomy"? How does AI enable decision-making for questions of who receives limited resources for healthcare reconcile with the need for justice and non-maleficence? In the case of a rush to create tools and put them into action, where does explicability rank in the order of importance? These are all questions that must be considered alongside the increasing development of AI tools to be used in healthcare crises. We have outlined some of these issues as they related to the uses of AI described above in terms of (1) governance and rights and (2) medical care.

5 principles to guide AI ethics: beneficence, non-malefincence, autonomy, justice & explicability

a) AI ethics and governance and rights

i. Mechanisms for data governance/data access In times of crisis

What the COVID-19 crisis has made clear to many in the field of data science and governance is the need for a coordinated, dedicated data infrastructure and ecosystem for tackling dynamic societal and environmental threats. A Call for Action, presented in March 2020 by a coalition of experts on data governance, argues that there has been a failure to re-use data between public and private sectors (data collaboratives) on how to deal with threats (The GovLab, 2020). Much needed data is not made available to those that need it, and the data that is released cannot be used in a systematic way. Since the AI and ML-based techniques that have the potential to help manage health crises rely on having data to train systems and make decisions, *this loss of opportunity to advance policy decisions and research through shared data represents an ethical challenge related to AI in itself.*

However, good governance mechanisms are needed to ensure trusted sharing of useful data in times of crisis.

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This needs to take into account current legal systems and legislation, privacy and transparency issues and create clear pathways of responsibility (The GovLab, 2020). Questions of privacy and data protection are related to ethical concerns, as data-sharing technology is, or is not, employed and must be considered alongside the potential benefits of data sharing (discussed further below). Governments around the world have taken considerably different actions in this regard, based on current legislation, and varying public opinions on the topic (Oliver et al., 2020).

ii. Ethics, privacy and relaxing of regulatory requirements in times of crisis

Related to structural ability to share data between actors in a trusted way are regulatory concerns about using data. Privacy is often the first thing to go in a crisis. Matters of security and public safety can end up taking precedence over individual rights. As Al Gidari, Director of Privacy at Stanford Law School, states, the "balance between privacy and pandemic policy is a delicate one" (Romm et al., 2020). In the face of a health related crisis, where the societal response could benefit from big data, regulators have to consider trade-offs between privacy and public health, *essentially placing societal beneficence in conflict with the other principles related to AI ethics.*[2]

[1]Four of the five criteria come from Bioethics. Beneficence can be described as promoting well-being, preserving dignity, and sustaining the planet, or "do only good". Non-maleficence implies "do no harm". Autonomy encompasses the idea that individuals have the right to make decisions for themselves. Justice deals with shared benefit and shared prosperity and relates to the distribution of resources and eliminating discrimination. Explicability is a added concept that focuses on enabling the other principles through making explicit the need to understand and hold to account the AI decision making processes (Floridi et al, 2018).

[2]Standards for using health related big data that can enable ML-based technologies to generate information and decisions looks similar to those related to AI more generally. At the WHO Big Data and Artificial Intelligence for Achieving Universal Health Coverage Meeting in 2017, several standard were mentioned including *autonomy and consent; privacy and confidentiality; ownership, custodianship and benefit sharing; justice; and sustainability* (WHO, 2018).

The question is how far should this be taken and how can we ensure that it is not the new normal.

A major question is the *precedent* this would set and the feasibility of *rolling back* emergency measures and technology once the crisis has subsided. The use of this data must go hand-in-hand with a human rights approach[3] to healthcare and promote trust and good governance (WHO, 2018). Professor Hu Yong from Peking University's School of Journalism and Communication recommends several guidelines. First, privacy intrusions must be entrenched in human rights law. Second, policy makers need to define basic civil rights that hold even in the case of weakened privacy (public interest can only go so far as an excuse). Third, there should be strict restrictions on where data generated during the crisis can be used (i.e. not outside uses for public health) (Hao, 2020). As stated by an EU Parliament brief, "least liberty-infringing alternatives" should be used to balance the requirements of conflicting ethical principles related to AI as best as possible (Kritikos, 2020).

Particularly in crises, where security might be prioritized over other aspects, these concerns need to be clear in AI developers, users and policymakers minds and *"mission creep" of surveillance measures need to be clearly avoided and addressed at governmental and global levels.*

b) AI Ethics and Public Health and Medical Care

i. Ethics of the use of AI in decision making related to prevention, treatment and care

Allocating of scarce resources during a health crisis is an ethical issue whether AI is involved or not. Principles of utility and equity need to be considered in the process, and balanced to maximize benefit while preserving justice (WHO, 2016). *There are always trade-offs, but these trade-offs need to be transparent.* Therefore, the principle of *explicability becomes particularly important* as we bring AI into the medical decision making process. It will be particularly important for AI-based decisions about treatment and allocation of resources to have some form of explicability in order to create trust in the tools and ensure utility and equity are balanced.

Other ethical considerations in health-related resource allocation to be considered by AI systems are defining "success" in outcomes, needs of vulnerable populations and those who face higher burdens (healthcare workers), support for those that are unable to receive resources, consistent application of the decision-making process, dispute mechanisms, avoiding corruption and separate responsibility for decision-making (WHO, 2016). In several of these points, AI-based decision-making may actually have an advantage, as it separates decision-making from healthcare works, who carry their own biases for patients and types of care, and can distribute uniform and uncorrupted decisions that separate decision-making from implementation. This, however, assumes fairness and inclusion in the training of AI-based systems, discussed more below.

The principle of explicability becomes particularly important as we bring AI into the medical decision making process.

Related to defining success, using AI-based tools to predict badly defined problems can exacerbate issues rather than help solve them. Thus, having multi-disciplinary expertise involved in designing these systems is necessary to increase the likelihood that the right questions are being asked and the right factors are being included (Engler, 2020).

ii. Fairness, inclusion and crowding out in AI tools used in pandemic response

Since they can examine a multitude of factors at once, ML-based techniques do have *the potential to identify vulnerable populations based on more intersectional inequalities* (a combination of income, race, sexuality, etc.) that could advance more inclusive treatment policies (Davis, 2019). However, because health data that *ML-based systems train on could be biased against certain/specific populations,* it could also risk vilifying or underrepresenting certain populations in pandemic management.

Moreover, on a cross-country level, low and middle-income countries may face fairness and inclusion issues in several ways. First, they have a lower capacity to implement some of the technologies being developed, thus not benefiting from what others have learned about successful quarantine and

[3] See Kriebitz and Lütge, 2020 for a detailed look at human rights considerations in the context of AI.

treatment options. Secondly, under-capacity health systems do not have the ability to collect the data needed to train ML-based systems, and, thus, the *outcomes will not reflect local dynamics and needs that would account for fairness and equity in AI decision-making.*

As Davies (2019) notes, however, the presence of AI as a tool in managing pandemics should not serve to lower the attention paid to strengthening health systems and global healthcare governance, nor should it undermine the need to look for gaps in the data and outlier/venerable cases. *Thus, decision-making and response needs to be AI-enabled, but this should not crowd out traditional efforts and support for health management.*

4. Final Thoughts

AI-based tools can help increase social and personal welfare and provide much needed guidance under time and resource-scarce conditions. However, AI needs ethical guidelines to work effectively and with regard for intrinsic human rights. Hopefully in the future, AI-based systems can be used early on to manage health-related crises, in particular to prevent pandemics at early stages.

In addition to preventing the health-related costs of such outbreaks, early detection and management would help to significantly reduce the long-term societal, psychological and economic consequences of a widespread crisis.

Practitioners must be able to trust in AI systems in order to use them effectively. This requires inclusive and transparent processes and well-understood governance.

However, one must always be on guard against misuse and the potential for spillover into non-emergency related sectors of invasive AI-based tools, and employ some skepticism about fully automated AI solutions. This, again, is where explicit and well-defined ethical guidelines can play an important role. Practitioners must be able to trust in AI systems in order to use them effectively. This requires inclusive and transparent processes and well-understood governance. To build this trust, expertise from the practitioner perspective is also vital in the development and training phase of AI-based technologies. AI should enable and prioritize the efforts of decision-makers rather than automate without expert opinion in mind.

Defining ethical guidelines, regulatory limits, and metrics for success requires international and multi-cultural exchange.

The various uses of AI to manage pandemics, as well as the ethical challenges related to them, are interrelated and require multi-disciplinary and multi-stakeholder engagement to tackle. For example, in order to improve the accuracy and efficacy of AI-based tools related to medical detection and treatment and quarantine surveillance, they must have training and test data readily available. This again requires an improved governance of rapid data sharing.

Moreover, in addition to multi-disciplinary approaches, we need to invest in worldwide collaboration on developing AI governance. Much of these technologies are transboundary in nature and their efficacy relies on having diverse data and perspectives. Thus, defining ethical guidelines, regulatory limits, and metrics for success requires international and multi-cultural exchange.

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