Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

CHAPTER 4

Actualizing Big Data Through Revised Data Protocols to Render More Accurate Infectious Disease Monitoring and Modeling

INTRODUCTION

The novel coronavirus epidemic (previously identified as the 2019-nCoV, the later officially named COVID-19) led to complete lockdown of entire cities globally, starting with the city of Wuhan in China. In areas of partial closure, the restrain on people's movement was effected by instituting stringent measures, and such measures, together with high levels of alertness, are seen to be adopted in high-risk countries. In perspective, in cities such as Wuhan, Hong Kong, Beijing, and Hubei Province among others, institutions such as schools, public markets, roads, and transport sectors have been shut down (Allam, 2020d) to ensure a reduction of human-to-human infection, which is the primary means through which the virus spread is minimized. Such steps have been tagged as being the most appropriate and timely to allow authorities to establish and gain concrete and accurate information on the virus (Buckley and May, 2020). On the global context, the spread and uncertainties prompted by this new virus captured the attention of the World Health Organization (WHO), which on January 30, 2019 declared the virus outbreak a "Global Public Health Emergency." However, the body was careful not to declare the outbreak a "Public Health Emergency of International Concern" (PHEIC) yet. This is understandable as PHEIC, in definition, is argued to be

> An extraordinary event which is said to have the potential to constitute a public health risk to other regions through the international spread of disease; hence, requiring a coordinated international response whose scope may be; serious, sudden, unusual or unexpected; carries implication for public health beyond the affected State's national border; may require immediate international action *(WHO, 2020b)*.

Following past experiences with some notable influenza pandemics, a Global Initiative on Sharing all Influenza Data (GISAID) platform (Wang et al., 2020) was instituted, and it became key in helping with the speedy sharing of information by Chinese scientists and officials about the emergence of the coronavirus. The platform became instrumental in helping other scientists drawn from different regions to access valuable data and information about the virus. For instance, scientists from Australian-based Virus Identification Laboratory were able to use the information from the platform to develop similar virus in their labs (Scott et al., 2020). Numerous other online tracking services also became very popular among the larger public, as shown in Fig. 4.1.

The COVID-19 virus not only serves as a live case study for pandemic preparedness and response but also provides an opportunity to address the thematic of urban health. In the case of a viral outbreak and spread, it has been observed how technological tools, equipment, and facilities (Allam, 2020a, 2020b) across the globe have been put to practice in a bid to come up with vaccines and cures. Such concerted and collaborative efforts can serve as pointers to smart cities professionals and stakeholders on how they can work together to actualize the public safety concept on such and similar scenarios. The advantage that smart city professionals have is the availability of invariable technological tools and products that they can be exploited in areas like early detection of outbreaks. On this, concerted discussions on all matters of potential

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FIG. 4.1 COVID-19 tracking platform.

outbreaks, coupled with the maximum utilization of products such as the Internet of things (IoT)—powered devices and sensors and use of artificial intelligence (AI) (Kamel Boulos et al., 2019), could help put a stop to outbreaks earlier before they spread. This would lead to creation of fool-proof health databases that could guarantee accuracy of data, efficiency, scalability, and real-time information on outbreaks and eventual dispersal of virus. With such, therefore, cities would be assured of unquestionable urban risk management decisions.

To achieve the aforementioned improvement in the healthcare realm, there is need for an urgent address of existing standards, frameworks, and protocols that guide smart city products to make them uniform and seamless (Boué et al., 2018). On this, open protocols for all IoT devices is required, placing emphasis on data integrity, privacy, and safety. Such would help overcome the problem of proprietary technology (Vermesan and Friess, 2014) that is synonymous with most smart city products. By ensuring that there is a standardization of protocols, urban managers would have unrestricted access to data and information on emerging trends; hence, they would manage to make concrete and informed decisions. It is with this background that this chapter, which is also inspired by the scenarios surrounding the COVID-19 virus, seeks to explore how urban resilience can be further improved, especially if communication between different smart cities can become possible by generating larger datasets.

THE RISING IMPORTANCE OF URBAN HEALTH DATA

The digital revolution, characterized by an increase of IoT devices, has resulted to an unprecedented increase in data from diverse sectors (Allam et al., 2019), and

FIG. 4.2 Data servers.

the end on this is not even nigh. On this, it is expressed by Stanford Medicine (2017) that by the end of 2020, those devices will have generated data amounting to over 2314 exabyte (EB) where IEB = 1 billion GB from the health sector alone, requiring immense data servers to store such, as shown in Fig. 4.2.

These medical data will not only be gathered from medical records alone, but also there is a general agreement that most of such will be generated from smart, health devices such as wearable devices that are increasing exponentially. This increasing in adoption, as noted by Grand View Research (2019), is being driven by the enlarging global healthcare market, which is expected to reach a value of more than USD 543.3 billion by 2025. Such lucrativeness is attracting numerous startups to invest in the healthcare sector. As more of these startups join the healthcare market, attention is being shifted to how data generated by those devices adhere to security and privacy concerns, data protection and sharing protocols, and others. Such concerns come to life, especially in the current scenario where the world is battling COVID-19, and any mishap on those protocols may be disastrous to steps already made globally. In particular, noting that the data on COVID-19 are cut across different cultural and geographical boundaries, where there are different unique laws and regulations concerning data access and management, it becomes critical to ensure that such devices adhere strictly to laid-down procedures, frameworks, and protocols. But, with so many and divergent views, laws, and regulations, it would still be impossible to have the devices that are strictly adherent; hence, the discourse to have uniform, standardized, and universally agreed and acceptable approaches and protocols that would guarantee open access of data.

The significance of having an open access dataset, as noted earlier, is to ensure that critical data, as that on COVID-19, are not managed only by a fragmented, small group of users, who have the potential to capitalize on it for financial or private gains. If that happens, some regions would be at a disadvantaged as most of the startups and corporations with potential to collect, store, manage and distribute such data are, unfortunately located in specific geographies (Allam, 2018; Allam, 2019a; Allam, 2020a; Allam, 2020c; Allam and Dhunny, 2019). And, from some past experiences, it is possible that such control could be used to settle some geopolitical tag-of wars that powerful economies have playing against each other. This argument, as it were, is not far-fetched, as just we have already witnessed the "push and pull" involving China and some powerful economies such as US economy concerning

the use of 5G Internet (Kharpal, 2018). Unfortunately, those geopolitical "battles" have denied the world the chance to have the 5G Internet finally rolled out, and such would go a long way in ensuring speedy sharing of data and other services. Likewise, if the COVID-19 data are to be subjected to similar geopolitical struggles, and national loyalty, instead looking at bigger picture that entails the welfare of humanity, it would be relatively hard to overcome the pandemic. Therefore, while the large corporations have the right to pursue their agendas, and safeguard their property rights, when it comes to issues touching on the welfare of human kind, they need to willingly allow for open access to big data such that efforts to come up with solutions can involve all and sundry (Allam, 2019b; Allam, 2020e; Allam, 2020f).

A BRIEF UNDERSTANDING OF THE CORONAVIRUS (COVID-19) OUTBREAK AND DATA

The fight against the COVID-19 pandemic is not only bound to be complicated by issues of nationalisms, but, as is evident from the time of the outbreak, also the challenge of movement of people into different parts of the globe has been a thorny one. With the ease, spread, and reduced costs of travel, it has been found that the spread of the virus has been extremely enhanced. To put this in perspective, since the first case was reported in Wuhan on December 31, 2019, China, in a matter of 3 weeks (by January 17, 2020), the case had increased to over 300. Ten days later, the reported cases had increased to 2,014, with 684 positively confirmed. Of those confirmed, 29 were reported outside China, and all these were exported via air travel. Following the seriousness of the disease, as of January 26, 2020, 56 individuals had succumbed (DW, 2020). As of March 31, 2020, the virus had spread to 136 countries, with 693,334 confirmed cases and, out of those, 33,106 deaths (WHO, 2020a). Among those regions that were first to have reported the outbreak outside China include Taiwan, South Korea, Japan, Thailand, France, the United States, Singapore, and Vietnam (Tierney et al., 2020). The complication in this case is based on the fact that health-related data on those found to be positive with the virus not only are based on local database but also would require access to data from other regions; thus, restriction on data access would make it had especially to establish whether the victim has had an existing health condition.

One common factor about COVID-19 is that symptoms are the same regardless of the geographical location. Nevertheless, while that is the case, and while it is also true that major cities are known to have some levels of preparedness against potential outbreaks, such are always divergent and different from each other. But, in the case of COVID-19, as highlighted by the WHO, the best approach to overcome it is to have international collaboration. In such a way, countries can benefit from the approaches taken by others, like China, which was the first to be affected, and which took drastic measures to address the outbreak. On this, during an emergency meeting held in Geneva by WHO health officials on January 22, 2020, China was lauded for its action on sharing the data, unlike in 2002 during the severe acute respiratory syndrome (SARS) outbreak where it was accused of withholding crucial information (WHO, 2020b). The delay in sharing information made the identification of the disease to drag (from November 2002 to April 2003) (Ren, 202). The same case was experienced in 2013 when Ebola virus outbreak occurred, and it took months to identify, thus causing death of over 11,000 people in West Africa. The Zika virus outbreak is also another classical case of how delayed sharing of information can impact the progress in finding medical solutions. It is reported that the virus was first reported in 2014 but was successfully identified only in 2015.

On COVID-19, following quick data sharing, it only took around 17 days (December 31, 2019—January 17, 2020) to identify the virus (Allam et al., 2020). With that information, and with availability of latest technological tools in cities, information about the virus spread has been shared in real time from different regions. This shows how the world has changed and moved away from the traditional epidemiological approaches that called for months for a successful identification and sharing of information (Grubaugh, 2020). While the information was shared in time, the impacts on cities and countries exposes how lack of international collaboration on such matters can have far reaching consequences. For instance, it has been observed that some cities and countries are overstretched in securing basic personal protective equipment, including for the health workers, thus exposing them to the virus. Wetsman (2020) posits that such are experienced since some vital information especially on issues such as how the virus was passed from person to another took time to establish; hence, cities took longer to come up with both soft and hard infrastructures. Therefore, when the information became clear, some of the countries were already overwhelmed. On this, it is the position of this chapter that such mishaps can be rectified, in the future, if there is transparency and speedy sharing of information, under the aegis of international collaboration.

URBAN ECONOMY AND HEALTH SAFETY

The outbreak of pandemics, or even diseases, either locally or internationally brings about numerous challenges, in different sectors. The economic sector is among those that are severely impacted. To put this in perspective, back in 2002 when SARS broke, the entire Asian region was observed to have shouldered a heavy burden in various sectors, with an overall impact estimated to have reached between USD 12 and 18 billion (Qiu et al., 2018). The Zika virus is estimated to have caused a loss of approximately USD 7−18 billion in the equator belt where it was experienced (UNDP, 2017). The Ebola virus that broke in 2014 in West Africa led to an economic loss of approximately USD 2.2 billion in three countries: Guinea, Liberia, and Sierra Leone in 2015 alone (Wojda et al., 2015).

Presently, although it is still early to quantify or project how much the global economy will suffer, the prelude on the economic frontier can serve as pointers as to what is coming. The expected losses will be unprecedented and immense as to what was experienced in the previous cases, as some actions taken globally were not instituted in those earlier cases. For instance, as of now, the travel industry, especially air travel and use of cruise ships, has been grounded in almost all countries of the world. Even before this happened, when COVID-19 broke in Wuhan, it was reported that more than 400 million people were expected to travel in or out of China for the Chinese New Year celebration (DW, 2020). The cancellation of travel spiraled to other industries such as the hotel industry, the hospitality industry, the art and entertainment industry, and others that rely on the opulence of the New Year celebration (BBC, 2020). Besides that, other sectors such as the manufacturing industry, the clearing and forwarding industries, the wholesale, and retail industries among others across the globe were also put on limbo by the lockdown in Chinese provinces.

This background information thus points to the fact that the impact of COVID-19 transcends the thinking that it is only an urban safety concern. It has now spilled over to all other realms within the urban and rural fabric, and each of these is experiencing unprecedented negative consequences. This means that things cannot be assumed to be normal anymore but demand that drastic and urgent decisions need to be made to ensure that the global economy does not sink to alarming levels. When this happens, the vulnerable societies and communities, especially within the global south, may find it rough to recover when the COVID-19 issues are finally behind us. On this end, therefore, the emphasis on the need for global measures that transcend nationalist agenda needs to be pursued. For instance, this would involve making the issue of data management and sharing open to all so that all those with potential to come up with solutions to the virus outbreak and spread can get fully involved. On this, Lawpoolsri et al. (2018) emphasizes that issues, such as transparency, timelessness of sharing, and access and quality of data, should be given maximum attention so that continuous monitoring and assessment can be achieved across the globe.

SHARING AND STANDARDIZATION OF DATA THROUGH URBAN NETWORKS

In the recent past, the availability of advanced technologies has made it possible to gather data from assorted sources. This has been enabled by the digitization of urban fabrics. In the same spirit, this digitization has made it possible for data on COVID-19 to be collected right from points of entries such as airports and seaports. This was enabled by the availability of numerous smart devices such as sensors installed in these establishments, such that everyone entering a region via these is screened and monitored in real time. A case in point here is the happening in the United States where it was observed that over 20 airports (Buckley and May, 2020) have had mandatory early screening and monitoring to ensure all verifiable positive cases are identified there and then. In Chinese cities, similar trends have been adopted in bus terminals, marketplaces, and subway stations in addition to health facilities.

Besides the physical monitoring and screening, it has been observed that other methods such as the use of terminal tracking systems are also being used, especially in smart cities. With such, as is highlighted by Li et al. (2020), it has become possible to distribute collected data in real time to the already installed digital infrastructures. With these infrastructures connected in a web to form a complex urban network, it becomes practically possible to provide real-time updates on different issues, thus warranting speedy reaction by the department or sector concerned. This interconnectedness is particularly important as it allows data from the ever-increasing health sensors such as wearables to be sent, stored, analyzed, and processed in record time, thus helping the health personnel within the system to derive valuable insights on the health condition of the people in the area. Such devices as expressed by Loncar-Turukalo et al. (2019) have been instrumental in the formation of Connected Health (CH) care, and this is paramount in monitoring the health status of specific areas. In addition, such approaches in the

health sector are said to allow for features such as spatiotemporal mapping, remote monitoring and management, and others, all focusing on bettering urban health management (Vashist et al., 2015).

In view of the previous information, although there is a general understanding that the basic sources of healthcare data are medical labs, clinics, hospitals, and general practitioners, it is without doubt that currently it is possible to secure such data from other sources. In particular, as is evident with the current epidemic, the urban arena is a rich source of medical data. As noted in the earlier sections, it has been established that different cities and countries have set up screening and monitoring tools in the point of entry, and these have yielded a massive amount of medical data that are sufficient to enrich existing health-related databases. As more and more people transit through those points of entry or exist, the amount of data is expected to continue growing, and this has been very instrumental in identifying those individuals who need extra medical attention. The emphasis in this chapter is to consider the urban areas as sources of data for COVID-19 case are also based on the fact that a majority of the isolation and mandatory quarantine centers are located there, and these too are contributing greatly in enriching the amount of COVID-19 data. Another valid reason that makes urban areas a valid source of data is the fact that most of the advanced technologies, especially those that facilitate the application of smart cities concept, are simulated here, and these include those that help in anonymizing of data, which is a critical consideration in the management of medical data. Those urban fabrics are already well connected to vital digital infrastructures (Fig. 4.3), and technologies like blockchain technologies (Naz et al., 2019) and quantum cryptography (Zhou et al., 2018) can help in anonymizing data.

While it is evident that the technologies will transform different sectors including the health sector significantly, there are some issues that need to be sought out to streamline data collection, storage, analysis, and distribution. One such issue is the communication factor where it is evident that barely any device sourced from different corporations integrates those freely (Van den Abeele et al., 2015). This is intentionally done by manufacturers who are always in competition for market shares, and by ensuring that their devices are unique and are incompatible with networks of their competitors, they are able to secure such competitions (Allam, 2020a, Allam, 2020b). The other aspect of communication is based on the geographical restriction, where most devices are unable to communicate with their likes installed in a different geographical location. Such strategies are adopted to allow for control, maintenance, and safety of the data collected. While both reasons noted here are valid, the risk is that such only helps to cement the aspects and difficult of data sharing and open access, which are critical if different urban challenges are to be won effectively. Therefore, as the pursuit to ensure that health data are sourced from urban areas, via the different technologies, it is also paramount to simultaneously pursue the need for standardization of protocols and network as is the clarion call in this chapter. This way, it will be possible to guarantee the volume, quality, accuracy, and complexity of the data that are collected. Such pursuits are not insurmountable, as it has already been done in the United States where it is reported that all the surveillance and monitoring of healthcare are combined into a singular network—dubbed National Healthcare Safety Network (NHSH) (Tokars et al., 2004).

Having a singular global network, especially for the present case of COVID-19, would be paramount as this would enhance the efforts undertaken to bring the situation into manageable levels. This global network would allow for the creation for a universal data sharing, including allowing for the adoption of volunteered geographic information (VGI), thus making the public feel part and parcel of this global fight. These strategies would not only serve in the current case but also guarantee that future outbreaks and pandemics would be handled effectively and in a timely manner to prevent their widespread (Allam and Jones, 2020). This would be facilitated by having an enriched database, and with the employment of modern technologies such as AI tools, the combat of outbreaks would be further enhanced, and by including early detection, this would allow for improved diagnosis methods and facilitate better and quality decision-making (Jiang et al., 2017). An example of how an elaborate data sharing and collaboration strategy can work is pointed by how it was done during the 2014 Ebola outbreak in West Africa. Bockarie (2019) expresses how different health professionals collaborated, by engaging in an open data sharing program, and this allowed them to contain the virus before it spread to more countries. By the time it was contained, it had only affected three countries. One takeaway from this collaboration is how the different stakeholders maintained high levels of trust and transparency and ensured speedy sharing of all that information generated and shared (Waithira et al., 2019).

The earlier case demonstrates that it is possible to overcome emergencies like the present one and others

FIG. 4.3 Digitally connected urban fabric.

that may be experienced in the future by ensuring sound, regulatory practices and international healthcare guidelines are formulated and strictly adhered to. This would be even very effective if they are complimented by relying on modern technologies. With such, it would be possible to not only address health risks but also ensure its consequences are reduced to the minimum as pointed by the WHO (2019). And, the emphasis is

to ensure that the application of smart devices and technologies is not overlooked, because these have potential to bring a tangible transformation.

CONCLUSION

As different urban managements and governments across the globe continue to pursue and heavily invest in the smart city concept, all geared toward achieving high levels of liveability, they should be conscious of the need to emphasis on the thematic of urban health. This is affirmed by the scenario that the present case of COVID-19 has plunged the world and even the smartest of cities around the globe, on a standstill. Therefore, this call for attention on the need for standardization of different issues appertaining to smart city technologies is topical. In particular, those in charge of cities should emphasize on having data platforms that have the capacity to communicate with each other; thus, in times of distress, like the current one, it would be practical to access the required data and information without going through the limitation of having to rely on solely specific and limited technology suppliers. Such emphasis should also be stressed in all other sectors, such that cities will be held together in a complex technological backbone that is well knit such that any uncertainty will be addressed without hitches and in record time.

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