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The Next Normal of Healthy Cities

Building a Resilient City: Implementing technologies that help predict, prevent and respond to health risks

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The COVID-19 pandemic has fuelled the adoption of data and digital technologies to improve the resilience of cities, regions and countries. These tools have been leveraged across each component of the sense-predict-respond model that underpins public health preparedness and risk management strategies. The lessons that cities learned from the pandemic on the applications of data and technologies to innovate public health can be extended to non-communicable diseases and can be leveraged to shape broader population health management strategies. This article highlights how cities, and their ecosystem partners, can enhance their resilience by leveraging data and digital technologies to predict, prevent and respond to health risks.

Key Points

- COVID-19 demonstrated more than ever the value of data and digital technologies to make cities more resilient to health emergencies.
- The feasibility and success of the digital solutions utilised during the COVID-19 pandemic depended on the availability and intelligent use of high-quality data, the interoperability of systems, and the workforce's digital skills.
- The pandemic has also amplified the challenges that already limited the ability of cities, and their ecosystem partners, to deliver digital public health initiatives.
- Going forward, cities will need to proactively manage challenges related to citizen's data privacy and trust, technical and organisational interoperability across the healthcare ecosystem and overcoming budgeting procurement and implementation bottlenecks that limit investment in data and technological innovation.
- If these challenges are overcome, cities and their ecosystem partners will be able to successfully collaborate to deliver a data-driven and value-based integrated service model.

The Next Normal of Healthy Cities

COVID-19 has demonstrated more than ever the value of data and technology to make cities more resilient to health emergencies. Data and technology have been at the forefront of the pandemic response, from early detection and contact tracing, to proactively coordinating services, organising resources, such as hospital beds, triage systems and long-term care centres, to optimising operations, such as directing ambulances to the hospitals with available and appropriate resources to ensure citizens' access to essential care. Actionable insights from data have helped city leaders coordinate with national health authorities, public and private healthcare providers, national and international health institutions and communicate with citizens to **prevent what is preventable and prepare for what is imminent.** The feasibility and success of these solutions have depended on the availability and intelligent use of high-quality data, the interoperability of systems and digital capabilities and skills.

- **Sense and enable** includes ongoing activities such as public health surveillance and disease monitoring, developing effective strategies and building resilient systems and infrastructure for emergency preparedness.
- **Predict and prevent** involves putting in place systems for effective disease management, prevention and control, and strengthening capabilities to produce proactive insights for early identification of diseases, epidemiological modelling and demand forecasting.
- **Respond and protect** entails emergency response management, real-time monitoring and surveillance, risk communication and community engagement, health promotion and public awareness raising and implementing integrated care service models.

Lessons that cities learned from the pandemic on the applications of data and technologies to innovate public health can be extended more broadly to diseases management and control.... or to manage everyday accidents and emergencies more efficiently

The lessons that cities learned from the pandemic on the applications of data and technologies to innovate public health can be extended more broadly to diseases management and control, including to non-communicable diseases such as diabetes, cardiovascular diseases and cancer, or to manage everyday accidents and emergencies more efficiently. This can lay the foundation for the 'next normal' of healthy cities. More effectively and systematically utilising data and technology can help improve health operations and drive better and more inclusive health and social outcomes for citizens, thus empowering cities to achieve Sustainable Development Goals (SDGs), such as SDG #3 (Good Health and Wellbeing), and SDG #11 (Sustainable Cities and Communities) (United Nations 2021).

The Integrated Service Model Leading to Healthy Cities

City leaders that want to improve the health resilience of their communities must integrate competencies and capabilities across the continuum of the sense-predict-respond model that underpins public health preparedness and risk management strategies (Allocato et al. 2020).

Data has been used to **sense** the causes of disease outbreaks and track its spread since the 19th century, when John Snow mapped cholera outbreaks in London in 1854, by tracking down the source of the infection to a water pump on Broad Street (Rogers 2013). Since those early days, the availability of health-relevant data has risen exponentially, providing information on patient health status, socioeconomic characteristics, clusters of diseases, patients' location and resource availability and other variables. This explosion of data has been fuelled by technological advancements and new data sources such as Mobile Positioning Data (MPD), online public health reports, wearable biosensors, and big data from social media. Combining multi-sourced data with advanced analytic capabilities such as Artificial Intelligence (AI) can provide valuable insights to help detect and track diseases in near real-time, swiftly spot the outbreaks of epidemic-prone threats such as the current coronavirus and inform and **enable** emergency preparedness systems. For example, the European Centre for Disease Prevention and Control (ECDC) has developed the Epitweetr social media monitoring tool that helps users monitor trends by time, topic, and location to capture early signals, such as an unusual increase in the number of tweets, to support early detection of public health risks ECDC (2020).

Data is essential to **predict and prevent** public health

risks, for example, to anticipate the transmission and spread patterns of infectious diseases or to model the progression and future burden of non-communicable diseases for specific population groups. Predicting which neighbourhoods are more likely to be vulnerable to the spread of viruses or identifying population segments with elevated health risks, such as ageing communities with long-term conditions and comorbidities, can help cities respond to the needs of those communities, and plan effective population health management and public health strategies. For instance, the German government is using big data, including anonymised county-level MPD as well as data on social, economic and environmental indicators, as part of a prototype project to identify successful counties with relatively low infection rates (positive deviants) and analyse their strategies and citizen mobility patterns during the pandemic (GIZ Data Lab and Teralytics 2021). The insights gained can help in the design of more effective strategies to prevent transmission.

City leaders that want to improve the health resilience of their communities must integrate competencies and capabilities across the continuum of sense-predict-respond model that underpins public health preparedness and risk management strategies

Respond and protect systems can be significantly improved by the intelligent use of data and digital technologies. Data and the capacity to learn from data, synthesise the information and embed insights into decisions can drive effective, efficient and sustainable response strategies. In turn, these strategies can be implemented by leveraging an array of tech-enabled tools for response and protection such as contact tracing applications and platforms to effectively manage the distribution of available resources. For example, the city of Cascais set up an operational COVID-19 control room and digital platform to efficiently manage its resource availability and have a real-time view of the situation and disease's spread (Claps and Dignan 2021). The city was able to manage the crisis in an integrated manner through real-time data visualisation and integrating information from the civil protection, firefighters, and other actors of the health system. The operational control room was also used to optimise COVID-19 test scheduling and result management and to monitor resources, as well as their capacity (total and available), and is currently being used to optimise vaccine distribution.

The emergence of the COVID-19 pandemic was also a pivotal moment for accelerating the use of digital technology for delivering health services. During lockdowns, telehealth and remote care became a crucial way of providing essential services to manage both COVID and non-COVID patients to preserve care continuity while containing infection spread. The pandemic accelerated the uptake and acceptance of digitally enabled services, leveraging telehealth and virtual care platforms and an array of technologies including mobile apps, Internet of Things (IoT) and AI-based chatbots and intelligent health assistants. It is expected that these digitally-enabled services will play an increasingly important role in healthcare systems going forward, including in the aftermath of COVID-19.

Cities across Europe have also used various digital tools, including web-based resources, mobile apps and AI-enabled chatbots, to communicate risks, engage with the public and deliver close to real-time information on the evolving crisis to raise awareness and protect city residents and visitors. For instance, the Valencia Smart City Office deployed a municipal website coronavirus.valencia.es that brings together data on the evolution of the health crisis including positive cases detected, fatalities, number of people hospitalised and discharged (from the regional health board), as well as critical updates regarding other services, such as mobility, urban waste management, pollution and water consumption (Smart City Valencia 2021).

The COVID-19 Pandemic and the 'Next Normal'

The 'next normal' of healthcare will become increasingly digital. In the new normal, building healthy and resilient cities will rely on multi-stakeholder collaborative digital ecosystems to support proactive, integrated and value-based care models and services. Several national and local governments have already started advancing efforts and developing partnerships to achieve this vision and COVID-19 is accelerating this paradigm shift. For example, since 2018, the National Health Service (NHS) in the U.K. has been working to strengthen its relationships with local councils, communities, and other key stakeholders to provide place-based coordinated healthcare and social services and develop integrated care

systems (ICSs) (NHS 2021). Data and technology, including data exchanges between partners, are at the core of these reforms and have been put in place to facilitate services that improve the population's health and create a more equitable and accessible healthcare system, including keeping people healthy and out of hospitals and close to their homes, families and communities.

Tackling the Open Challenges of Healthy Cities

The pandemic has accelerated the use of data and technology to improve the resilience of cities, regions and countries. However, it also highlighted the gaps and amplified the challenges that already limited the ability of cities and their ecosystem partners to deliver digital public health initiatives. Going forward, cities will need to proactively manage these challenges, including:

- **Data privacy and ethics –** citizen's data privacy came to the fore, particularly related to track and trace applications, as cities and countries across the world experimented with different uses of mobile positioning to track the movement of their citizens. Cities must develop ethical principles related to the use of citizen location data and around the fair and non-discriminatory nature of predictions, the accuracy of insights, and the understandability of algorithms (Cities for Digital Rights 2021).
- **Ecosystem collaboration and interoperability** – the pandemic highlighted the complexity and dynamic nature of the city health ecosystem, with siloed programs and technologies among health and social care agencies, between levels of government and across the private and public sector, making it difficult to align incentives to share data for the public good. Cities must establish governance mechanisms that bridge those gaps, like Aberdeen did with their Autism Strategy that brought together the local council, the NHS and community organisations (Aberdeen City Council et al. 2019).
- **Data quality and digital capabilities** - the feasibility and success of many of the solutions and services highlighted in this article depended on the availability of high-quality data, data integration and analytics capabilities and the workforce's digital skills. Cities should focus efforts and investments on enhancing these capabilities and consolidating and improving the quality and interoperability of the data they collect or procure.
- **Agile operations -** the pandemic also highlighted the need to speed up budgeting, procurement and implementation cycles to increase the ability of public health authorities to invest in data and technology innovation. In particular, the emergency resulted in national and international institutions issuing guidance on how to make procurement faster, while maintaining transparency (OECD 2021).

In the new normal, building healthy and resilient cities will rely on multi-stakeholder collaborative digital ecosystems to support proactive, integrated and value-based care models and services

Conflict of Interest

None. ■

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