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# Managing COVID-19-related knowledge: A smart cities perspective

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## Abstract

Effective management of coronavirus disease 2019 (COVID-19) and the urgent need to improve epidemic prevention require rapid response and immediate solutions, deploying appropriate knowledge management procedures and facilitating effective decision-making and managerial efforts. The increased adoption of smart cities (SC) technologies offers various technologies that can support knowledge capturing, acquisition, sharing, and transferring. However, knowledge management practitioners and decision-makers face various challenges to manage huge data generated from the various SC platforms. Managing COVID-19-related knowledge necessitates filtering, cleaning, keeping, and sharing only useful data. Therefore, the aim of this paper is to investigate managing knowledge related to COVID-19 from a SC perspective. The methodological approach for this study is a systematic literature review. The findings indicate that SC technologies, through the advanced deployment of information communications technology (ICT) applications, have a crucial role in knowledge capturing and sharing. Smart cities strategies enable knowledge extraction through facilitating data collection and analysis over various disparate databases, as well as facilitating quick and accurate handling and analysis of huge and unpredicted amount of data. Managing knowledge related to COVID-19 pandemic has the potential to improve the planning, treatment and controlling the pandemic, enhance decision-making, and enable disaster management. However, the managing of a huge amount of complex, unstructured data and information remains a big challenge for COVID-19 knowledge management (KM) initiatives. The paper proposes a conceptual model and illustrates the various components and links between SC strategies, KM and COVID-19, and how this can inform, facilitate, and enhance decision-making to take steps for the path of recovery.

## 1 | INTRODUCTION

The emergence of a new disease caused by novel coronavirus—2019 (SARS-CoV-2) or coronavirus disease 2019 (COVID-19) has caused major impacts both in human health and societal activities (Kummitha, 2020; Ehrenberg et al., 2021). Kakderi et al. (2021) noted that the COVID-19 pandemic brought significant disruptions in the foundations of economies, societies, countries, and cities all over the world. The first modern COVID-19 pandemic was reported in December 2019, in Wuhan, Hubei province, China. Since then, the

disease rapidly circled the globe and has eventually affected every continent (Chakraborty & Maity, 2020). Cities are home to most of the world population and are centers of economic growth and innovation. However, the high concentration of people and activities in cities makes them vulnerable to various stressors such as natural and man-made disasters (Sharifi & Khavarian-Garmsir, 2020). Likewise, Connolly et al. (2020) remarked that the massive expansion of the global urban fabric over the past few decades has increased exposure to infectious diseases and posed new challenges to the control of outbreaks. However, the interconnectedness, mobility, and flows produced by urbanization and globalization are both vectors of contagion across territories and the lifeblood of their economic frameworks (Wu, 2021). As of March 3, 2021, COVID-19 has been transmitted to over 114 million people along with more than 2.5 million verified deaths (WHO, 2021), seriously affecting economic and social development (Zhou et al., 2020). In particular, the economic impacts of various containment measures began to ripple across the world and initial hopes for a swift recovery were soon dampened (Ehrenberg et al., 2021).

COVID-19 has significantly affected the global society in various ways (Zhang et al., 2021). Chakraborty and Maity (2020) stated that, besides its upsetting effects on human life, the novel coronavirus disease (COVID-19) has the potential to significantly slowdown the global economy. As difficult as it is to assess the magnitude of the collateral damage of the COVID-19 pandemic, there is no doubt that it was—and will continue to be—considerable. The pandemic is putting a massive strain on, among others, healthcare personnel, law enforcement agencies, public administrations and information and communication professionals (Casado-Aranda et al., 2021). A global recession, perhaps of a magnitude not seen since the Second World War, is on the horizon. The pandemic has already caused multidimensional changes in education, jobs, supply management, manufacturing, interpersonal relationships, social isolation, mental health, financial distress and so forth (Hart & Halden, 2020; Kummitha, 2020). Similarly, countries are also facing societal, healthcare and financial challenges in this pandemic (Khowaja et al., 2021). After affecting the world in unexpected ways, COVID-19 has started mutating, which is evident with the insurgence of its new variants (Khowaja et al., 2021). Therefore, healthcare personnel, governments and the public in general need to show solidarity and fight shoulder to shoulder for prevention and containment of the pandemic (Chakraborty & Maity, 2020).

Although extensive urbanization, and the global travel attitudes associated with globalization are perceived as the main contributors to COVID-19's rapid spread, yet the literature indicates that our current cities are more resilient than ever before (Kummitha, 2020; Zhou et al., 2020). This is due to the utilization of geographic information system (GIS) and spatial big data technology, as well as the increased adoption of smart cities (SC) technologies such as the Internet of Things (IoT), big data, machine learning (ML), and Artificial Intelligence (AI). Sonn and Lee (2020) noted that humanity is facing a COVID-19 pandemic, which is especially linked to the management of SC.

Thus, SC strategies and technologies offer a high degree of scientific and technological display. These technologies can be utilized to provide important scientific and technical support to allow governments to judge the pandemic situation and formulate prevention and control measures (Abdalla et al., 2020; Kummitha, 2020; Zhou et al., 2020).

Developing a safe and effective vaccine is a potential solution for reducing COVID-19-related illnesses, hospitalizations, and deaths. It also plays a vital role in controlling the pandemic and in restoring the global economy (Khowaja et al., 2021; Mortazavi et al., 2021; Weintraub et al., 2021). However, Khowaja et al. (2021) stated that it might take months or years to eliminate COVID-19, provided that the vaccine either effectively handles the variants, or the virus stops mutating altogether. Similarly, Mortazavi et al. (2021) noted that the direct effects of the vaccination will not be observed at all because of the challenges regarding global distribution and lack of data availability (Khowaja et al., 2021; Mortazavi et al., 2021).

James et al. (2020) argued that the COVID-19 pandemic provides an unfortunate opportunity to understand and apply smart city technology in social welfare and crisis management. Kakderi et al. (2021) noted that SC technologies and applications (e.g., sensors, data analytics, AI, IoT) can improve efficiency, awareness, and flexibility of urban ecosystems through real-time adjustments and better decision-making. Smart cities offer various technologies that can support tackling the virus spread as well as helping in managing data and knowledge related to the pandemic. For example, AI is one such technology which can easily track the spread of the virus, identifies the high-risk patients, and is useful in controlling this infection in real time. It can also predict mortality risk by adequately analyzing the previous data of the patients. AI can help to fight the virus by population screening, medical help, notification and suggestions about the infection control (Hu et al., 2020; Vaishya et al., 2020). The ongoing real-time monitoring provided policy makers, both local and national, with insight into the changing social behavior of urban residents. James et al. (2020) highlighted the role of utilizing SC systems (e.g., IoT, ML), sensors and data resources to provide timely insight into policy decisions as they played out in real time. For example, Newcastle, the largest city in the North East of England, has established a comprehensive observation platform to capture and monitor complex overlapping interactions as a result of planned and unplanned interventions in the city. During the COVID-19 pandemic, Newcastle rapidly repurposed the existing data capture systems to provide real-time insights into the impacts of lockdown policy on urban governance.

In response to lessons learnt from the previous pandemics (e.g., $H_1N_1$, 2009, and SARS, 2003) management measures should be considered (Olaimat et al., 2020). Chan et al. (2020) observed that, during pandemics such as the COVID-19, it is likely that a lack of awareness and preparedness puts healthcare workers at risk. Therefore, delivering rapid, reliable information that addresses critical infection control issues is of key importance. Moreover, World Health Organization (WHO) has emphasized the need for solidarity, resource redistribution, and collective action (Bump et al., 2021; Kummitha, 2020). Consequently, Bump et al. (2021) stated that sharing knowledge and experience accelerates learning and facilitates more rapid progress. Moreover, agreeing on rules and standards supports comparability of information, helps establish good practices and underpins shared understanding and mutual trust.

James et al. (2020) noted that COVID-19 has demonstrated a genuine demand for real-time data and analytics in a city context. Petrović et al. (2021) mentioned that the COVID-19 outbreak in 2020 stimulated reflection on the lessons learnt from the use of smart technologies in urban planning and operations. Cities are a major driver of innovation and rely on technological solutions to solve urban problems. However, the pandemic's outbreak prompted the question of how well cities can respond to the challenges posed by COVID-19. Allam and Jones (2020) noted that SC host a rich array of technological products that can assist in early detection of outbreaks (e.g., through IoT and sensors), and early discussions could render efforts towards better management of similar situations in case of future potential outbreaks, and to improve the health fabric of cities generally. However, SC brings about a substantial rise in the amount of data gathered by the various devices in different sectors like transport, environment, entertainment, sport and health sectors, among others (Allam & Jones, 2020). Sheng et al. (2020) noted that advancements and proliferation of different technologies have culminated in unprecedented production of mobile, digital devices and a vast amount of structured and unstructured data to be mined by firms and governments for sound and timely decision-making. Xia et al. (2020) remarked that managing COVID-19-related knowledge can provide decision-makers with a scientific decision-making basis to develop knowledge through data mining and feature extraction. Therefore, managing and controlling the COVID-19 pandemic necessitates effective management of its knowledge resources. Hence, organizations need to develop a set of capabilities to enable filtering, cleaning, keeping and sharing only useful data, information, and knowledge to effectively manage the COVID-19 pandemic (Rialti et al., 2020).

Montani and Staglianò (2021) argued that innovation in the time of COVID-19 is critically necessary, not only in the medical and pharmaceutical fields, but also in all sectors of the economy. This often calls for the capture, creation, use, exploitation, and sharing of knowledge related to COVID-19. Hence, to take advantage of the opportunities of knowledge management (KM) procedures, decision-makers need to take initiative to adapt KM in managing and controlling COVID-19 pandemic. According to Davenport and Prusak (1998) KM not only involves the production of knowledge and information, but also the capture of data at the source, the transmission and analysis of this data, as well as the communication of information based on, or derived from, the data, to those who can act on it. Therefore, managing COVID-19-related knowledge and having better population-wide data could aid in reducing the economic damage and social burden placed on populations dealing with stay-at-home ordinances, furlough, and involuntary unemployment (Hart & Halden, 2020).

The current pandemic outbreak is pointing to more coordinated actions from governments and public organizations, requiring new levels of urban digital integration. However, review of current literature on COVID-19 shows a gap in studies focusing on the role of KM in managing and controlling a pandemic. Therefore, this study aims at discussing the theoretical background of knowledge management, SC, and COVID-19. Thereafter, follows a systematic review of literature methodology to identify the various works of the authors, and to investigate managing knowledge related to COVID-19 from a SC perspective. Finally, this paper presents findings, discussion, and a conclusion.

## 2 | THEORETICAL BACKGROUND

### 2.1 | Smart cities

By 2030, the world's urban population will grow by 65 million people a year, and by 2050, two-thirds of the world population will live in cities (Ahvenniemi et al., 2017; De Las Heras et al., 2020; United Nations, 2018). This global extensive urbanization gives rise to various challenges regarding air pollution, lack of natural resources, climate change, overcrowding in urban areas, congestion, enormous production of waste and pollution, and human health (Ahvenniemi et al., 2017; De Las Heras et al., 2020). Technological developments can help alleviate these effects by taking data and analyzing them to provide recommendations for improving sustainability parameters (De Las Heras et al., 2020). The digital transformation is helping cities to become smart spaces. Alomari et al. (2021) noted that SC and societies are driven by the need to provide highly competitive, productive, and smarter environments through the innovation and optimization of urban processes and life.

Many definitions have been proposed to define SC. For example, Kourtit and Nijkamp (2012, 2018) defined them as "the result of knowledge-intensive and creative strategies aiming at enhancing the socio-economic, ecological, logistic and competitive performance of cities." Laurini (2020) noted that the idea of SC is based on a promising mix of human capital, infrastructural capital, social capital, and entrepreneurial capital. The SC have been set up using advanced information communications technology (ICT) infrastructures such as Internet of Things, which has been considered one of the determinant pillars of ICTs, based on the ability to exchange information and integrate them with physical and virtual "things." IoT refers to the massive use of advanced sensors and wireless communication in all kinds of physical object (Deloitte, 2015).

IoT improves the efficiency, accuracy and effectiveness in operation and management of such innovation ecosystem aiming at guaranteeing high quality of life and stimulating innovation process of firms (Scuotto et al., 2016; Snow et al., 2016). Roblek and Meško (2020) noted that the concept of SC covers the broad fields of smart governance, smart economics, smart mobility: smart environment: smart education, and smart safety, security and health. Boulton et al. (2011) remarked that a smart city is seen as a center of knowledge, education, and creativity, comprising a concentrated diversity of people with different professional, cultural, and social backgrounds who are creative, skilled and work flexibly in organizations.

Costa and Peixoto (2020) noted that cities can be perceived as living organisms. The literature suggests that data are the key aspect that makes a city smart (Batty et al., 2012; Bettencourt, 2014; Boulton et al., 2011; Roblek & Meško, 2020; Scuotto et al., 2016). Combining various sources of data together allows a city to develop an accurate

understanding of societal challenges such as sustainability, mobility, health, and security. This understanding helps make better, smarter, and data-based choices. The capability of gathering data from a varied range of sensors, in public spaces, in transportation networks, in energy systems, in all kinds of consumer devices provides real-time insight in transportation flows, energy flows, pollution, and human behavior. To achieve effective implementation, it is important to use these data sources in integration with each other to generate platforms of smartness. A successful smart city emerges when data are combined from various sources that have usually not been used in combination (Deloitte, 2015). Moreover, the emergence of SC and big data, particularly with a focus on big data analytics, has opened up opportunities for urban planners. Big data analytics provides the potential to bring together large datasets on transport, land-use, buildings, and health, which can be used to support decision-making and long-term planning through better analysis of urban planning problems (Batty et al., 2012; Bettencourt, 2014).

## 2.2 | Knowledge management

Knowledge is a critical factor that affects creative thinking (Amabile, 1988). Knowledge is an important success factor for organizations; it influences performance and learning to uphold organizational competitiveness (Bessick & Naicker, 2013). Knowledge has been defined as a justified belief that is organized and established and seeks to improve an organization's performance through effective and efficient action (Ferraris et al., 2019; Nonaka, 1994). Organizational knowledge can also be defined as "what does the organization recognize as knowledge and how is it developed in the organization and its employees" (McAdam & McCreedy, 2000). Moreover, KM can be defined as the process of adapting existing knowledge in order to solve current business challenges and create new solutions by studying patterns in existing knowledge (McAdam & McCreedy, 2000). Organizational knowledge construction is a central feature to all aspects of knowledge management. Nonaka and Takeuchi (1995) call this construction "organizational knowledge creation," referring to the creation and development of knowledge within the organization. McAdam and McCreedy (2000) noted various models of KM (e.g., intellectual capital models and knowledge category models). The authors highlighted the importance of the wider perspective of knowledge, which is not only limited to the scientific inputs but also includes the social and learning processes within the organization.

Farnese et al. (2019) noted that knowledge generates value by supporting an organization's capability to produce innovation, learn and unlearn, and transfer best practices across boundaries. The main objective of KM is not to administer management of all the data gathered in the organization, but to focus on the knowledge that is most important for the organization and which provides its competitive advantage on the active market (Ramona & Alexandra, 2019). Modern organizations can develop an "absorptive capacity": the ability to use previously obtained information in order to identify and perceive the value of new information, understand it and utilize it in order to formulate new knowledge (Cohen & Levinthal, 1990; Gold et al., 2001). New knowledge is usually created by combining existing knowledge with new knowledge and exchanging information, both of which necessitate social capital. Here, social capital is the collection of existing and possible resources embedded in a given social unit's relationship networks (Gold et al., 2001; Rialti et al., 2020).

Bessick and Naicker (2013) noted that knowledge retention is important to protect the knowledge in organizations. Knowledge socialization, codification, knowledge construction, and knowledge retrieval are key processes for knowledge retention in organizations (Bessick & Naicker, 2013). Furthermore, knowledge retention is perceived as an action that makes knowledge available to contribute to organizational operations and allow these operations to be sustainable through efficiency and effectiveness. Nonaka's (1994) SECI (Socialization–Externalization–Combination–Internalization) model is one of the best-known conceptual frameworks for illustrating and understanding knowledge generation and transformation processes in organizations (Farnese et al., 2019; Ivona, 2009; Nonaka, 1994). According to the SECI model, the spiral starts with the Socialization mode, in which tacit knowledge is exchanged among individuals through observations, imitation, and shared experiences in day-by-day social interaction (Farnese et al., 2019; Ivona, 2009; Nonaka, 1994). Communities of practice, collective, or organizational memory are all phenomena that have been studied as best practice of the circulation of tacit knowledge (Ivona, 2009). Tacit knowledge is converted, through the Externalization mode, into new explicit knowledge in the form of concepts, images, and written documents. Here, individuals use dialogue, metaphors, and team confrontations as effective methods to make tacit knowledge codifiable. For this mode to succeed, it is necessary that knowledge is dis-embedded through a reflection-on-action process, inserting distance between the subject and the object (Farnese et al., 2019). Ivona (2009) noted that the emergence of organizational strategies is a phenomenon of the articulation of collective tacit knowledge into an explicit formulation embracing a plan, actions, and tactics.

However, Spraggon and Bodolica (2017) noted that many studies analyzed tacit knowledge at the individual level (Nonaka, 1994; Nonaka & Takeuchi, 1995; Polanyi, 1966), but scant attention has been paid to collective tacit knowledge (CTK) phenomena in organizations. CTK is embedded within the "social collectivity," created by members via shared undertakings and experiences at work and socially distributed among specialized employees interacting in complementary ways in coordinated social practices (Shamsie & Mannor, 2013; Spraggon and Bodolica (2017). Moreover, Spraggon and Bodolica (2017) noted that collective tacit knowledge (CTK) generation is facilitated by distributed cognitive systems in organizations where group participants overcome their individual incomplete perspectives of work-related tasks and span their knowledge boundaries by pooling together complementary knowledge via joint endeavors. High levels of interaction and coordination among individuals exert a critical role during this transcendental process, melting down individual knowledge barriers and paving the way for collective knowing and organizing.

According to Alavi and Leidner (2001), KM processes generally contain activities such as creation, transfer, storage and utilization, in which knowledge transfer refers to the bidirectional knowledge exchanges between acquirers and receivers (Sun et al., 2020). Knowledge transfer is "the knowledge exchange process between knowledge providers and knowledge recipients" (Kim et al., 2011). It can be realized through communications and dialogues so that knowledge seekers can learn and apply the knowledge from another person (Sun et al., 2020). According to Soda et al. (2019), in organizations, employees are both acquirers and providers of knowledge. Knowledge acquisition and knowledge provision are two different ways to boost knowledge transfer and flow (Soda et al., 2019).

Other studies stated that KM involves three processes: acquisition, conversion and application (Ferraris et al., 2019; Gold et al., 2001; Rialti et al., 2020). The acquisition is the method used to extrapolate new knowledge from existing data and information, conversion is the process of making the knowledge obtained beneficial to the company and knowledge application (tacit and explicit) is the use of this knowledge to accomplish a task. Marketing practitioners operate in this way, capturing structured and unstructured information about consumers' daily behavior in order to fully exploit this knowledge (O'Connor & Kelly, 2017). Therefore, KM is an organization's processes of obtaining and converting knowledge into an arrangement that is easily usable, accessible, and applicable to the organization. When information is not distributed within the organization via the appropriate knowledge channels, it is unlikely to reach the relevant employees within the organization through which it would be rendered useful (O'Connor & Kelly, 2017; Rialti et al., 2020).

Bratianu et al. (2020) highlighted the influences of different types of knowledge and their inherent dynamics on the effectiveness of the decision-making (DM) process. According to Bratianu et al. (2020) and Bratianu (2015) a possible way to understand the dynamics in DM is to consider the underlying process of knowledge dynamics (KD) and its multifield structure, integrating three types of knowledge—rational knowledge (RK), emotional knowledge (EK) and spiritual knowledge (SK) (Bratianu, 2015). Bratianu et al. (2020) noted that RK can be defined as the result of rational thinking and practically is represented by explicit knowledge, mainly founded on the capture, sharing, and transformation of data and information into knowledge. EK is part of the tacit knowledge. It is generated and can be expressed by emotions and feelings. EK is the simplest form in which the wordless knowledge emerges mentally. On the other hand, SK represents the values we believe in and the way we relate them to our existence. Even though rational knowledge exerts a noteworthy effect on DM, its influence is exceeded by the KD, which proves that integrating emotional and spiritual knowledge in the decisional equation may become a pivotal input to making good managerial decisions regardless of the level of regulation and standardization in the field (Bratianu et al., 2020, 2021).

Considering the influence of the different types of knowledge is particularly important during crises such as the time of the COVID-19 pandemic, where rapid responses are required and where managers and decision makers need to set and develop emergent managerial strategies. Bratianu and Bejinaru (2021) noted that while deliberate strategies incorporated rational knowledge and economic data, the emergent knowledge strategies open towards emotional and spiritual knowledge. In accordance, Bratianu et al. (2020) noted that when the pressure of time is overwhelming, and there is a significant shortage of information and knowledge about a given problem, and yet a decision must be made, managers search unconsciously in their experience to find similar situations or common configurations and make decisions based on pattern recognition. Therefore, organizations had to capitalize on the full spectrum of knowledge (i.e., rational, emotional, and spiritual) in order to develop their knowledge capital and the critical knowledge capabilities for dealing with the new challenges of the COVID-19 social and economic crises.

## 2.3 | Knowledge management perspectives during the COVID-19 pandemic

Knowledge has been and continues to be the key to success and competitive advantage for all organizations (Ramona & Alexandra, 2019). Knowledge management aims to create, share, use and manage knowledge and information (Cegarra-Navarro, Wensley, et al., 2021; Nonaka, 1994; Nonaka & Takeuchi, 1995). The dissemination of knowledge during times of international crisis is guided by the principles first set out in the WHO's 2016 statement on data-sharing during public health emergencies, which incorporated lessons from the Ebola and Zika outbreaks, and was undersigned by many notable foundations and journals (Modjarrad et al., 2016). Kazi et al. (2020) observed that these principles have been adopted for use in the current pandemic through a call to share "research data and findings relevant to the novel coronavirus (COVID-19) outbreak" in the same fashion.

Xia et al. (2020) noted that managing knowledge related to COVID-19 can provide decision-makers with a scientific decision-making basis to develop knowledge through data mining and feature extraction, thus it can increase the effectiveness of decision-making. The rapid availability of knowledge ensures that global communities adapt, and researchers can mobilize, limited resources into effective response strategies (Berens et al., 2016; Bratianu, 2020; Kazi et al., 2020). On the other hand, Shah et al. (2020) noted that the limited available knowledge to guide medical decision-making combined with rapid progression of the pandemic has resulted in an urgent need to better define features of the disease, predictors of disease progression, predominant modes of transmission and effective treatments.

Bratianu et al. (2021) noted that KM developed mostly in the knowledge-intensive organizations because of the dominance of intangible resources and knowledge capabilities. Mariano (2021) noted that knowledge-intensive organizations develop and use creative outputs to solve complex problems, which appears to be particularly relevant in a context such as the one shaped by the COVID-19 crisis that requires rapid solutions to multifaceted issues. Working from home (WFH) during COVID-19 pandemic may make interactions and knowledge exchange more difficult and make some workers feel "isolated" (Bolisani et al., 2020; Kirchner et al., 2021). Additionally,

WFH brings challenges for knowledge mangers and knowledge workers, and it may also change the processes of knowledge creation and knowledge sharing. Therefore, effectiveness and quality of work—especially for knowledge workers can be consequently affected (Bolisani et al., 2020).

It is essential for organizations to dispense data formats in a timely manner, whilst simultaneously allowing management to decodify and transform data in order to make decisions that enhance organizational performance (Rialti et al., 2020; Vera-Baquero et al., 2016). Y. Wang et al. (2018) noted that organizations need to ensure infrastructural flexibility to be not only capable of ensuring the analysis of data but should also be able to handle increasing volumes of data. Employees with the requisite skills can identify the right data, analyze this data, and maintain the integrity of the company's infrastructure (Wamba et al., 2017). Cegarra-Navarro, Wensley, et al. (2021) noted that learning and knowledge sharing social processes. Therefore, their effectiveness is influenced by individual and collective characteristics, attitudes, and behaviors. Thus, the generation and exploitation of knowledge as a resource for decision-making is not only a process of a single individual, but it must be framed in a complex network of interactions where individuals share elements of knowledge of various quality, learn from one another and are affected by the reactions of others.

Moreover, the quality of knowledge as a resource for decision-making can be affected by the presence of counter-knowledge (Cegarra-Navarro, Wensley, et al., 2021). Counter knowledge can be defined as the knowledge that comes from unverified sources of information such as gossip, hoaxes, rumors, partial truths, or deliberate lies, which can be in certain contexts mistaken for true facts (Bolisani et al., 2021). Bolisani et al. (2021) and Bratianu et al. (2020) noted that counter-knowledge is part of the complex system of a person's cognitive development, which is not only rational but involves emotions and spiritual needs. Therefore, it is essential to understand the influence of counter knowledge on employees and its impacts on the decision-making process.

## 2.4 | The role of smart cities technologies in managing COVID-19-related knowledge

Hantrais et al. (2021) noted that SC aim to apply digital technologies to advance the wellbeing of their citizens. The authors argued that, since cities depend on social connections, the agglomeration effects that drive the productivity advantage of cities became the main source of risk during the COVID-19 pandemic. As the pandemic swept through the world, cities were at the forefront due to their global connections, social interactions, and population density.

Social distancing and other lockdown measures had a direct effect on cities as services, transport, hospitality and leisure industries took the biggest hit in the economic downturn. Technologies have been consistently developing day-by-day but, during an unexpected circumstance such as of COVID-19 pandemic, the role of these technologies to support humanity in various means is substantial (Elavarasan & Pugazhendhi, 2020; Vaishya et al., 2020). Smart cities offer various technologies and strategies that promote the exposure to diverse sources of knowledge and, thus, accelerate the knowledge capture and transfer processes (Alavi & Leidner, 2001). ICT and smart technologies enable interoperability at device and application levels. Additionally, at infrastructure level, ICT could be organized for enabling devices communication and information exchange, while at data level it could be used for understanding and extracting knowledge data in real time for making decisions and controls (Younan et al., 2020).

Bolisani et al. (2021) noted that the pervasive and increasing use of the various social media platforms today, brings about new opportunities for knowledge development and diffusion. However, at the time of the current COVID-19 pandemic, it also added additional challenges as it contributed to the development, circulation and spread of unverified news and information (Bolisani et al., 2021). For example, the No-Vax movement in Italy has gained strength and has affected political decisions. A growing number of people are claiming their right to avoid vaccines, and despite pro-vax campaigns by doctors and authoritative physicians, gained consensus also thanks to the massive role of social media (Bolisani et al., 2021).

The conceptual model depicted in Figure 1 illustrates the various components and links between SC strategies, KM and COVID-19, and how this can inform, facilitate, and enhance decision-making to take steps for the path of recovery. During the current pandemic, most countries are responding to contain the COVID-19 pandemic by retarding infection spread using different strategies such as lockdown measures, contact tracing and self-isolation, reducing, or banning events involving mass gatherings (e.g., distance learning, work-from-home), and encouraging people to apply hygienic health measures, such as social distancing, wearing face masks and frequent hand washing (Olaimat et al., 2020). Such measures require high levels of knowledge about COVID-19 (e.g., symptoms, testing, and vaccination) fostering attitudes among people to recognize and practice these measures properly (see Figure 1).

Managing knowledge related to COVID-19 necessitates enabling data collecting, storing, retrieving, mining and sharing from various resources, that are usually unstructured, inconsistent and inaccurate (Younan et al., 2020). Thus, it requires a combined effort and collaboration from all social bodies such as the healthcare system, government and, more importantly, from the public (Elavarasan & Pugazhendhi, 2020).

The extensive utilization of potential technologies together with effective healthcare treatment and strong governance, as well as sharing information and knowledge effectively, will facilitate better decision-making and enhance tackling the virus spread. Sun et al. (2020) noted that the usage of social technologies such as social media, virtual communities, instant messaging and social bookmarking has an impact on creativity and innovation. Smart technologies can facilitate tracking and forecasting the nature of the virus from the available data, social media and media platforms, about the risks of the infection and its likely spread. Further, it can predict the number of positive cases and deaths in any region. AI can help identify the

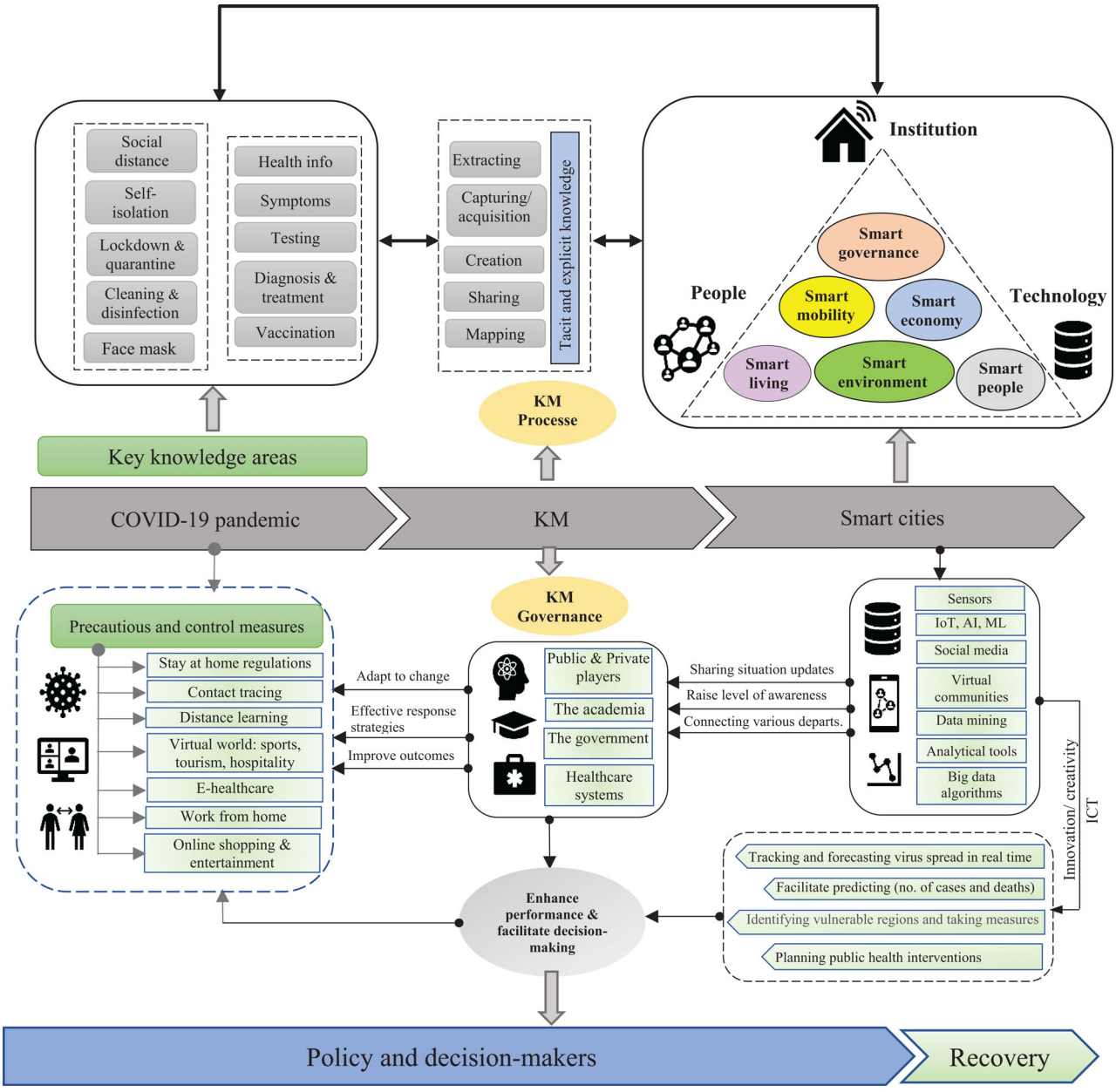


**FIGURE 1** The various components and links between SC strategies, KM and COVID-19 [Colour figure can be viewed at wileyonlinelibrary.com]

most vulnerable regions, people and, countries and take measures accordingly, as shown in Figure 1 (Vaishya et al., 2020).

However, SC platforms, sensors, and smartphones applications enable extracting and generating massive and huge data from multiple sources. Therefore, it is a challenge when accessing and aggregating this vast amount of information (Nguyen et al., 2020). Hence, answering real-time queries becomes a challenging task. Therefore, sensors should be able to filter and clean data in order to keep only interested data and share them with their base stations once a critical change occurs, e.g., tracing a COVID-19 patient (Younan et al., 2020). Costa and Peixoto (2020) argued that the integration of different sources of data can be one of the greatest transformations in our way of living in this century, along with the processing possibilities provided by data science and deep learning algorithms. As a result, this can not only pave the way for the anticipated digital society, but it can also be a source for prevention and mitigation of virus outbreaks, and, most importantly, for supporting and enhancing decision-making.

## 2.5 | Methodology

The study follows a systematic literature review (SLR), which can be defined as a tool to identify, evaluate and interpret available and relevant

studies regarding a particular research question (Kitchenham, 2004). This review analyzed and synthesized managing knowledge related to COVID-19 from a SC perspective following a systematic approach. Systematic reviews differ from ordinary literature surveys in being formally planned and methodically executed. They are intended to be independently replicable, and so have a different type of scientific value than ordinary literature surveys. In finding, evaluating, and summarizing all available evidence on a specific research question, a systematic review may provide a greater level of validity in its findings than might be possible in any one of the studies surveyed in the systematic review (Khan et al., 2011). The SLR steps adopted in this research are adapted from Tranfield et al. (2003) three-stage approach: planning the review, conducting the review, and reporting and disseminating the results (see Figure 2). Tranfield et al. (2003) stated that the search strategy should be reported in sufficient detail to ensure that it can be replicated. Therefore, the subsequent sections demonstrate the discreet activities in each stage to allow replication of findings.

A search systematization begins with the identification of search strings drawn from the scope of the study and discussions with the group involved with the review (Da Cunha Bezerra et al., 2020; Tranfield et al., 2003). Thus, the first stage is planning the review, which involves the core aspects of the systematic review protocol, developing a list of keywords, and criteria for the inclusion of articles, as well as defining the search string to be given in input to the data source. A university's library search engine, which gives access to various databases including: Science Direct, Scopus, TRID, Web of Science, and Wiley Online Library, was used to complete an online search. To this aim, we identified and, then, combined three keywords, namely "smart cities," "knowledge management," and "COVID-19." Thus, the resulting search string is ["COVID-19" OR "Coronavirus" AND "knowledge management" OR "KM"], and, to include the role of SC strategies or technologies, the term "smart cities" or "technolog*" has been added to the research string] to search the titles, abstracts and keywords of available articles.

Tranfield et al. (2003) argued that only studies meeting the specified inclusion criteria should be part of the sample. The authors highlighted the importance of documenting the numbers of included and excluded studies at each step of the review, providing reasons for the inclusion and exclusion. Included studies must satisfy all inclusion criteria including they must be peer-reviewed journal articles, written in English, published between December 2019 and February 2021 (to ensure relevance to COVID-19), and have relevance with respect to the research aim. These choices are justified by the fact that those inclusion criteria may assure the identification of the most relevant articles related to the topic under investigation (see Table 1 for the selected articles) (Natalicchio et al., 2017).

The second stage involved carrying out the review of relevant articles and selection procedure. The initial search resulted in a total of 677 records. These records were then screened and reduced to 331 by applying the inclusion criteria—i.e., subject area, English language and available online. The articles were then "eye-balled" to ensure they were consistent with the keyword search, the abstracts assessed against the research aim, and duplicates removed. The total number of articles was reduced to 58. The full text of the selected articles was read to determine the relevance with respect to the aim of the study and the results were reduced down to 28 articles. Finally, these 24 articles were reviewed, categorized, and analyzed (see Table 1). Finally, reporting and dissemination are considered in the third phase. This stage involved critically documenting and presenting the results from the selected articles analysis. A discussion of the role of SC strategies in managing knowledge related to COVID-19 is outlined in the next section. To conclude, the protocol used in this SLR process, which is based on Tranfield et al. (2003) guidelines, was rigorously applied and documented to objectively achieve the research aim.

Furthermore, to form a basis to triangulate the data, WHO situation reports, articles and news items that covered the past few months of the pandemic and focus on technologies and SC strategies have been refereed to (e.g., BBC News, CNN, The Guardian, New York Times, Economist, Reuters, and Financial Times) (Kummitha, 2020).

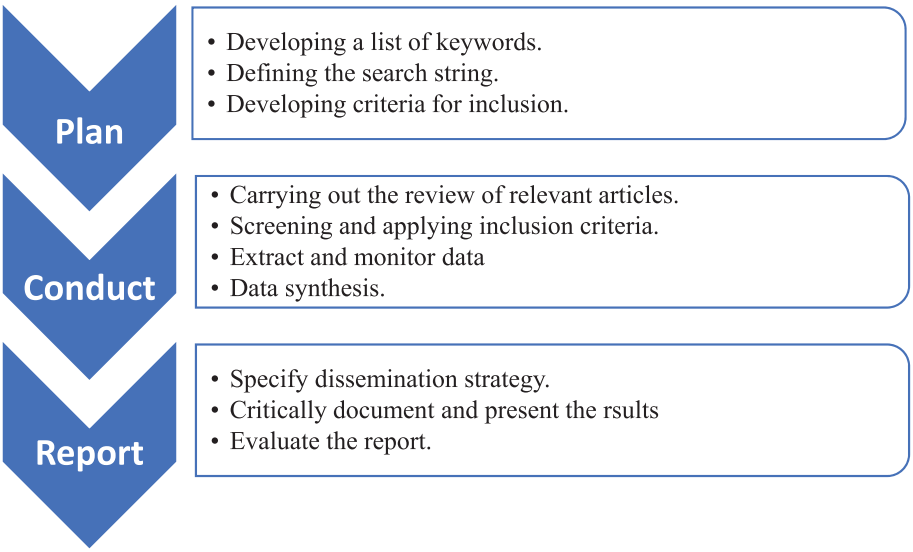


**FIGURE 2** Phases conducted in the systematic literature review [Colour figure can be viewed at wileyonlinelibrary.com]

**TABLE 1** The analysis highlights of the reviewed literature

| Reference | Title | Journal | Country/ territory | Methodology/type | Focus | Discussion |
|---|---|---|---|---|---|---|
| Abdulmajeed et al. (2020) | Forecasting of COVID-19 cases in Nigeria using limited data | Data in Brief | Nigeria | Ensemble forecasting models | SC & COVID-19 KM | SC strategies are potential tools to understand and predict the extent of the spread and effectiveness of containment strategies. Managing and sharing COVID-19 knowledge is crucial for modeling and forecasting COVID-19. |
| Bolisani et al. (2021) | Managing counter-knowledge in the context of a pandemic: challenges for scientific institutions and policymakers | Knowledge Management Research & Practice | Italy | Adopts KM models & concepts | ICT & COVID-19 KM | Highlighted that the quality of knowledge as a resource for decision-making can be affected by the presence of counter-knowledge. |
| Bragazzi et al. (2020) | How big data and artificial intelligence can help better manage the COVID-19 pandemic | International Journal of Environmental Research and Public Health | Canada | Literature review | SC & COVID-19 KM | Provides insights into the role of latest advancements in the field of ICT, AI and big data in handling the huge, unprecedented amount of data, real-time epidemic outbreaks monitoring, forecasting, regular situation briefing and updating. |
| Bratianu et al. (2020) | Untangling knowledge fields and knowledge dynamics within the decision-making process | Management Decision | Romania | A questionnaire-based survey | Knowledge sharing | Provide insights into the influences of different types of knowledge and their inherent dynamics on the effectiveness of the decision-making process. |
| Cai et al. (2020) | Demand analysis and management suggestion: sharing epidemiological data among medical institutions in megacities for epidemic prevention and control | Journal of Shanghai Jiaotong University | China | Opinion paper | Knowledge sharing | Importance of data gathering and information sharing through reliable approach. It is important to break the "data barriers" between various departments. |
| Cegarra-Navarro, Bolisani, and Cepeda-Carrión (2021) | Linking good counter-knowledge with bad counter knowledge: the impact of evasive knowledge hiding and defensive reasoning | Journal of Knowledge Management | Spain | Survey | ICT & COVID-19 KM | Suggests that good counter-knowledge can lead to bad counter-knowledge. Counter-knowledge can trigger evasive knowledge hiding foster defensive reasoning, and negatively affect decision-making. |
| Cegarra-Navarro, Wensley, et al. (2021) | Minimizing the effects of defensive routines on knowledge hiding though unlearning | Journal of Business Research | Spain | Survey | ICT & COVID-19 KM | Explored and analyzed how to overcome the presence of knowledge hiding generated by organizational defensive routines and to explore their effects on intentional unlearning in the context of measures adopted because of COVID-19. |
| Iandolo et al. (2020) | Combining Big Data and Artificial Intelligence for Managing Collective Knowledge in Unpredictable Environment—Insights from the Chinese Case in Facing COVID-19 | Journal of the Knowledge Economy | Italy | Conceptual paper | ICT & COVID-19 KM | Provided preliminary reflections about the ways through which KM processes can change thanks to the support provided by new technologies. |
| Katapally (2020) | A global digital citizen science policy to tackle pandemics like COVID-19 | Journal of Medical Internet Research | Canada | Literature review | Knowledge sharing | SC and mobile technology has immense potential for addressing the COVID-19 pandemic, as it gives access to big data in terms of volume, velocity, veracity, and variety. These data are particularly relevant to understand and mitigate the spread of pandemics such as COVID-19. |
| Kazi et al. (2020) | The delights and perils of publishing, knowledge-sharing and critique during a pandemic: Observations from COVID-19 coagulopathies | Thrombosis Research. | Canada | Literature review | Knowledge sharing | Sharing knowledge contributes a great deal to the goal of improving outcomes for those affected by the disease, as it ensures that global communities adapt, and that the limited resources can be mobilized into effective response strategies. |

(Continues)

**TABLE 1** (Continued)

| Reference | Title | Journal | Country/ territory | Methodology/type | Focus | Discussion |
|---|---|---|---|---|---|---|
| Kummitha (2020) | Smart technologies for fighting pandemics: The techno-and human-driven approaches in controlling the virus transmission | Government Information Quarterly | UK | Literature review | SC & COVID-19 KM | The techno-driven approach has proven effective to control the virus transmission. However, the enhanced use of technologies and data collection raises privacy concerns which are not addressed by the government authorities. Adopting a human-driven approach controlling the transmission of the pandemic is slower and time-consuming |
| Liao et al. (2020) | Public engagement and government responsiveness in the communications about COVID-19 during the early epidemic stage in China: Infodemiology study on social media data | Journal of Medical Internet Research | Hong Kong | Content analysis/ Weibo (the Chinese version of Twitter) | SC and ICT as for knowledge capture and sharing | ICT is an important source for knowledge capture during COVID-19, e.g., social media can facilitate the spread of awareness, attitudes towards control and preventive measures, and misinformation and rumors in the public through online interactivity. |
| M. Liu et al. (2020) | Modeling the evolution trajectory of COVID-19 in Wuhan, China: Experience and suggestions | Public Health | China | SEIR model/ National Health Commission of China | Big data, ICT and knowledge capture | Using mobile applications can help provide big data, which is important to implement strict control measures in the areas seeing large inflows of potentially infectious people to avoid further spread of COVID-19. |
| Pramanik et al. (2020) | Healthcare informatics and analytics in big data | Expert Systems with Application | Bangladesh | Literature Review | SC & COVID-19 KM | Provide insights on the four important segments such as the underlying technologies, system applications, system evaluations, and emerging research areas. HCI supports data collection, transformation, extraction and loading, and data analysis over disparate healthcare databases. |
| Nathavitharana et al. (2020). | Innovation and knowledge sharing can transform COVID-19 infection prevention response | Journal of hospital medicine | US | Opinion paper | Knowledge sharing | Infection prevention efforts can benefit from the unprecedented amount of data on COVID-19 that are being generated and shared. |
| Sun et al. (2020) | Enterprise social media affordances as enablers of knowledge transfer and creative performance: An empirical study | Telematics and Informatics | China | Questionnaire survey | Knowledge sharing and transfer | Generates insights into the effect of the enterprise social media (ESM) affordances on employee creative performance from the perspective of knowledge transfer. |
| Vaishya et al. (2020) | Artificial Intelligence (AI) applications for COVID-19 pandemic | Diabetes & Metabolic Syndrome: Clinical Research & Reviews | India | Literature review | AI & COVID-19 knowledge capturing | Smart technologies can facilitate tracking and forecasting the nature of the virus from the available data, social media, and media platforms, about the risks of the infection and its likely spread. Hence, help identify most vulnerable regions and take measures accordingly. |
| S. Wang and Wang (2020) | Big data for small and medium-sized enterprises (SME): a knowledge management model | Journal of Knowledge Management | Canada | A qualitative data analysis of the multiple cases | Big data & knowledge capturing | Generates insights into the relationship between big data and KM, analyses the challenges and IT solutions of big data for KM based on the collected real-world business cases. |
| Yan et al. (2020) | How hospitals in mainland China responded to the outbreak of COVID-19 using IT-enabled services: an analysis of hospital news webpages | Journal of the American Medical Informatics Association | China | Content analysis of hospitals websites | Collaboration and knowledge sharing | Giving insights on how hospitals can continue providing services in an effective manner under lockdown circumstances. The study investigated how (IT) helped hospitals better respond to the outbreak of the pandemic. |

**TABLE 1** (Continued)

| Reference | Title | Journal | Country/ territory | Methodology/type | Focus | Discussion |
|---|---|---|---|---|---|---|
| Yigitcanlar et al. (2020) | Contributions and risks of artificial intelligence (AI) in building smarter cities: Insights from a systematic review of the literature. | Energies | Australia | Systematic literature review | The role of ICT | Generate insights into forming a better understanding on how AI can contribute to the development of smarter cities using knowledge maps |
| Younan et al. (2020) | Challenges and recommended technologies for the industrial internet of things: A comprehensive review. | Measurement | Egypt | Comprehensive review | Benefits and challenges | Managing data that originate from heterogeneous resources (which is unstructured, inconsistent, and inaccurate) requires connectivity, storage, real-time analytics and benchmarking. Data analytics enables business decisions. Answering real-time queries becomes a challenging task. |
| Bricout et al. (2021) | Exploring the smart future of participation: community, inclusivity, and people with disabilities | International Journal of E-Planning Research (IJEPR) | USA | Critical review | The role of ICT | The role of technology use and how it influences the civic engagement potential of the smart city, in particular for people with disabilities, and how they can be involved in future smarter communities. |
| Zhang et al. (2021) | COVID-19 and transport: findings from a world-wide expert survey | Transport policy | Japan | Survey | Benefits and challenges | Provides insights into the impacts of COVID-19 on the transport sector and the corresponding policy measures. Improved sustainability and resilience are expected in the future, but should be supported by effective behavioral intervention measure. |
| X. Liu et al. (2021) | Examining public concerns and attitudes towards unfair events involving elderly travelers during the COVID-19 pandemic using weibo data | International Journal of Environmental Research and Public Health | China | Hybrid Weibo mining framework | Benefits and challenges | Examines the impact of the inadequate consideration of the elderly population in developing and implementing mobile applications during COVID-19. Explored the issues concerning elderly travellers without health codes. |
| Alomari et al. (2021) | COVID-19: Detecting government pandemic measures and public concerns from twitter arabic data using distributed machine learning | International Journal of Environmental Research and Public Health | KSA | Proposes a software tool comprising machine learning and other methods for the analysis of Twitter data | Knowledge capture | Suggests that social networking platforms, such as Twitter through its hundreds of millions of posts daily, can be treated as a useful medium for the dissemination of information about COVID-19. |
| Anttiroiko (2021) | Successful government responses to the pandemic: Contextualizing national and urban responses to the COVID-19 outbreak in east and west | International Journal of E-Planning Research (IJEPR) | Finland | multiple case study | SC & COVID-19 KM | Provides insights on how societal context, institutional arrangements, knowledge culture and technology deployment manifest in national responses to the pandemic. Discussion describes country cases from East and South East Asia, on the one hand, and from Europe and Asia-Pacific, on the other. The overall impression is that Asian cases reflect proactivity and diligence, while Western responses are reactive and more often than not slightly delayed. |
| Choi et al. (2021) | Smart Korea: Governance for smart justice during a global pandemic | Journal of Sustainable Tourism | USA | Literature Review | SC & COVID-19 KM | Provides insights into how South Korea, as a smart destination, rapidly "flattened the curve" during the global COVID-19 pandemic by implementing strong measures with the help of smart technologies and rapid innovations, and proactive information-sharing. |

(Continues)

TABLE 1 (Continued)

| Reference | Title | Journal | Country/territory | Methodology/type | Focus | Discussion |
|---|---|---|---|---|---|---|
| Garavaglia et al. (2021) | Italian mayors and the management of COVID-19: adaptive leadership for organizing local governance | Eurasian Geography and Economics | Belgium | Questionnaire survey | Knowledge sharing and transfer | Provides insights into the importance of building of knowledge on local governance and leadership models. Highlighting the role of technology as an enabler and medium for sharing information and crowdsourcing resources; and the importance of safe and trusted platforms for knowledge sharing among the various stakeholders. |

## 3 | FINDINGS AND DISCUSSION

### 3.1 | General observations

The first step in the analysis of the selected articles was to classify them by date of publication. Around two thirds of the articles included in this review are published in 2020 ($n = 18$, 65%), and around one third of the articles are published in 2021 ($n = 10$, 35%). Leading authors are affiliated with institutions in North America ($n = 7$), China ($n = 5$), Europe ($n = 7$), East Asia ($n = 3$) and Africa ($n = 2$), Australia ($n = 1$), the UK ($n = 1$), Hong Kong ($n = 1$), and the KSA ($n = 1$). Regarding the academic journals, the articles included in this review are published in various academic journals including: Journal of Business Research (1), International Journal of Environmental Research and Public Health (3), International Journal of E-Planning Research (IJEPR) (2), Journal of Medical Internet Research (2), Data in Brief (1), Diabetes & Metabolic Syndrome: Clinical Research & Reviews (1), Economy (1), Energies (1), Eurasian Geography and Economics (1), Expert Systems with Application (1), Government Information Quarterly (1), Journal of Hospital Medicine (1), Journal of Knowledge Management (2), Journal of Shanghai Jiaotong University (1), Journal of Sustainable Tourism (1), Journal of the American Medical Informatics Association (1), Journal of the Knowledge, Measurement (1), Knowledge Management Research & Practice (1), Management Decision (1), Public Health (1), Telematics and Informatics (1), Thrombosis Research (1), Transport Policy (1),

Articles were categorized under four groups based on the main KM procedures: (a) the key roles played by SC strategies and technologies in implementing these KM practices and knowledge; (b) knowledge capturing; (c) knowledge sharing; and (d) the benefits and challenges of using SC strategies in managing knowledge related to the COVID-19 pandemic. Around 40% of the articles ($n = 11$, 40%) were in the role of ICT in managing knowledge related to COVID-19, around one-fifth ($n = 6$, 20%) were in knowledge capturing, around one quarter of the reviewed articles ($n = 7$, 25%) were in knowledge sharing, and around 15% ($n = 4$) were in the benefits and challenges of using ICT in KM aspects (Table 2).

### 3.2 | The role of smart cities strategies in managing knowledge related to COVID-19

Research in this area focused predominately on technological innovation and the contribution of ICT and SC strategies that can be deployed for knowledge capturing, creation and sharing. This can be summarized (see Figure 3) as: (a) facilitating, tracking and forecasting the nature of the virus from the available data, social media and media platforms, that can provide insights about the risks of the infection and its likely spread; (b) facilitate predicting the number of positive cases and deaths in any region; (c) help identify the most vulnerable regions, people and countries and take measures accordingly; and (d) support and enhance decision-making by facilitating data mining, management and analyzing large volumes of

data from multiple sources. Table 1 presents the highlights of the reviewed literature.

Being smart is about capitalizing on all of our resources to build a better quality of life for all. Therefore, in SC, knowledge is perceived as the key to the future, and that the pivotal strategies in the development of "smart" knowledge areas, including technological innovation, collaborative networking and participative social interactions (Abdulmajeed et al., 2020; Dameri & Ricciardi, 2015). In general, SC can enable population-wide surveillance and counteract ageing by promoting active ageing, socialization, and healthy lifestyles, include disabled and marginalized people, and provide quick and effective responses to emergencies and disasters such as outbreaks (Rao & Vazquez, 2020). Choi et al. (2021) noted that ICTs have been studied with respect to public-private as well as consumer-related cooperation, collaboration and knowledge sharing, as well as emergency preparedness and management.

**TABLE 2** Categories revealed from reviewed literature

| Category | Reference |
|---|---|
| The role of SC in managing COVID-19 related knowledge | Abdulmajeed et al. (2020); Anttiroiko (2021); Bolisani et al. (2021); Bragazzi et al. (2020); Bricout et al. (2021); Cegarra-Navarro, Bolisani, and Cepeda-Carrión (2021); Cegarra-Navarro, Wensley, et al. (2021); Choi et al. (2021); Kummitha (2020); Pramanik et al. (2020); Yigitcanlar et al. (2020) |
| Knowledge capturing | Liao et al. (2020); M. Liu et al. (2020); Vaishya et al. (2020); S. Wang and Wang (2020); Alomari et al. (2021) |
| Knowledge sharing | Bratianu et al. (2020); Cai et al. (2020); Garavaglia et al. (2021); Katapally (2020); Kazi et al. (2020); Nathavitharana et al. (2020); Sun et al. (2020); Yan et al. (2020) |
| Benefits and challenges of SC strategies in managing COVID-19- related knowledge | Iandolo et al. (2020); Younan et al. (2020); X. Liu et al. (2021); Zhang et al. (2021) |

Choi et al. (2021) highlighted the role of ICTs to enable swift gathering and disseminating of data through public health communication on infections, address issues related to testing and contact tracing, and raise public awareness on necessary measures to prevent the spread of the coronavirus. Availability of reliable real-time data enabled reduction of infection risks. For example, local governments in South Korea have been sharing live updated information of confirmed cases in their area through mobile text messages. These data are available to residents not just from where they live, but also from the districts or provinces they visit, as their location data are collected in real time using global positioning system (GPS). This helps individuals to plan their movements based on reliable information, thereby reducing infection risks. In addition, the texts encourage the informed individuals to be proactively involved in contact tracing and testing.

Choi et al. (2021) noted the role of ICTs and technological platforms on which information and knowledge could be instantly exchanged among stakeholders to facilitate smart innovation. However, according to the authors, this cannot be achieved by only collecting data, but also by allocating resources and making decisions. With regard to managing COVID-19-related knowledge, SC strategies can be used to track the spread of the virus in real time, and plan and lift public health interventions accordingly, monitor their effectiveness and enhance the response of communities and territories to the ongoing pandemic (Bragazzi et al., 2019, 2020). Moreover, SC can play a key role in handling the huge, unprecedented amount of data, real-

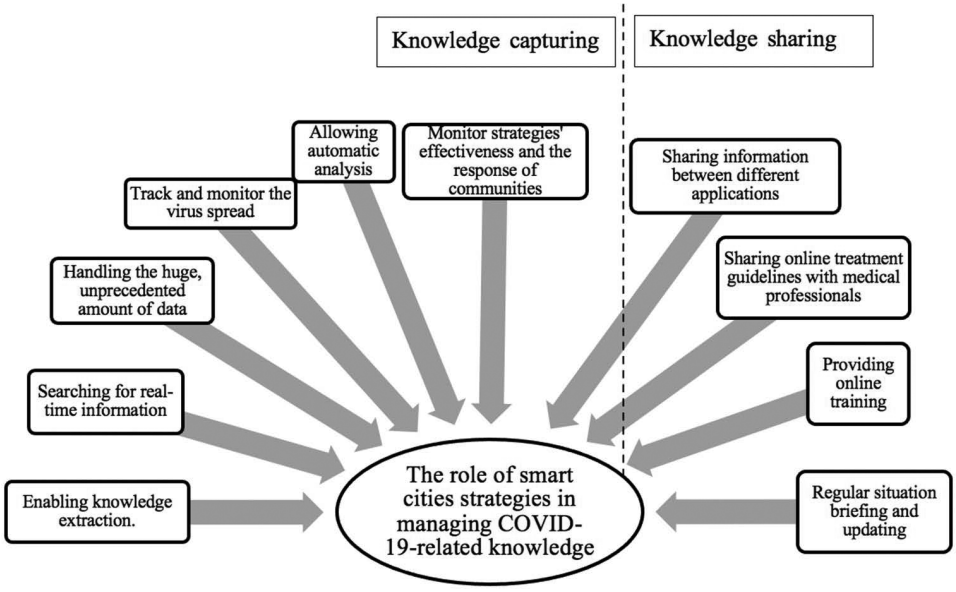


**FIGURE 3** The role of SC strategies in managing knowledge related to COVID-19 (summary of the findings)

time epidemic outbreaks monitoring, forecasting, regular situation briefing, and updating. Thus, they offer the opportunity for extracting useful data and information from large datasets and revealing valuable insights from different perspectives with the aim to define more efficient decision-making processes (Iandolo et al., 2020). For instance, the new phenomenon, called big data, represents a new era in data exploration and usage. Big data can be considered as an additional valuable knowledge asset, which can be used for enhancing performance and facilitating decision-making. Smart cities strategies promote advanced technologies necessary to big data analytics, which is important in analyzing large-scale heterogeneous datasets, big data mining, and statistical analysis which is specifically relevant in the case of COVID-19-related knowledge (Abdulmajeed et al., 2020; Pramanik et al., 2020; Yigitcanlar et al., 2020). Managing the COVID-19 outbreak and fighting the associated consequences necessitate combining employees' experiences and tacit knowledge, with the insights extracted from SC platforms analytics. It also helps overcoming the limitations related to reductionist approaches only based on experience and intuition (Iandolo et al., 2020; McAfee et al., 2012). It is important to highlight that counter-knowledge emerges during the processes of acquisition, distribution, and use of knowledge, as does scientific knowledge. This adds a new dimension to the problem when it takes place in the domain of healthcare. Particularly, when the public engages in an open debate of sensitive health-related issues potentially affecting each member of the community, counter-knowledge emerges naturally from the lack of understanding of the message being shared (Bolisani et al., 2021).

Additionally, through these advanced technologies, it is possible to build a computer system able to "change" thanks to experience (Iandolo et al., 2020). This approach offers the opportunity for identifying non-obvious and hidden patterns of information and building predictive models. The adoption of big data instruments in organizations' configurations determines the capacity to absorb untapped knowledge and combines it in innovative paths for improving organizations' performance (Iandolo et al., 2020). China focused on traditional public health outbreak response tactics—isolation, quarantine, social distancing, and community containment (Iandolo et al., 2020; Wu & McGoogan, 2020). More than this, other approaches based on sophisticated computational methods have been applied by the Chinese government. Data from hundreds of millions of smartphones have been collected and used for containing COVID-19 spread. Data from all smartphones with enabled GPS have been collected for tracking the user's itinerary and estimate the probability that an individual has exposure to COVID-19 by matching its position to the position of infected individuals or groups. Thanks to these data, authorities have increased efficiency in the use of limited medical resources directing—for example—tests for the virus to high-risk subjects identified by the artificial intelligence algorithm and controlling individuals who may have attempted to flee quarantine (Iandolo et al., 2020).

Smart phone applications have played vital roles in managing COVID-19-related knowledge in South Korea. According to Choi et al. (2021), location and health data collected through the app helped the government to efficiently assist and regulate quarantine. For example, in late March, local, provincial and national governments were informed through the app that a number of officially quarantined people who had arrived from other high-risk countries violated the quarantine rules. This led to imposing stricter penalties for quarantine violations. As a result, the country was able to keep borders open in the interest of international solidarity and collaboration. Rather than blocking travel within and across borders through lockdowns, it implemented a special immigration procedure whereby international travellers can enter if they agree to comply with the quarantine rules and self-report through the smart mobile apps. Moreover, Anttiroiko (2021) noted that South Korea has relied on open health informatics, including disclosure of real-time information on COVID-19 by the government via dedicated websites, mass media, phone messages, and mobile applications. In addition, with the help of open data, private sector actors have developed mobile apps to effectively disseminate disease information. As of March 19, 2020, there were approximately 85 drive-through testing stations, and nearly 20,000 people were tested every day, which was highest in the world at that time. It was also notable that people under compulsory self-quarantine were monitored through an app by government and police, and violators were punished. Moon (2020) noted that, among others, managing COVID-19-related knowledge through adopting a data-driven approach was critical to the success of South Korea's anti-contagion policy. However, the findings indicate that knowledge sharing among medical professionals was dominant in the early stages, while the number of online collaboration events increased gradually. This implies that medical professionals initially focused more on knowledge sharing and later more on knowledge application and discovery (Abdulmajeed et al., 2020; Kummitha, 2020).

### 3.3 | Knowledge capturing

The papers under the knowledge capturing category are those that provide insights into how SC strategies and technologies can contribute to and improve extracting and capturing knowledge related to COVID-19. Research in this area focused predominately on the availability of huge and various data sources about the virus spread, new infections, big data analytics algorithm, and data mining techniques.

Epidemiological data are essential for controlling the source of infection, cutting off the route of transmission, and protecting vulnerable populations (Liao et al., 2020; M. Liu et al., 2020). The COVID-19 pandemic has resulted in an unprecedented volume of data being generated and disseminated, with the potential to impact real-time responses in geographically disparate regions (Nathavitharana et al., 2020; S. Wang & Wang, 2020). The rapid development of ICT and the high penetration of internet use have made the internet an increasingly important health information source worldwide. For example, reading, commenting, sharing, and seeking health information from social media, particularly through a mobile device, has become an increasingly important pattern of health information consumption. During the COVID-19 pandemic, social media can facilitate the spread of awareness, attitudes towards control and preventive

**FIGURE 4** The role of SC technologies in sharing COVID-19-related knowledge (summary of findings)

- Government sharing important knowledge with other organisations.
- Using online collaboration tools (to work with colleagues in different locations, and to discuss the treatment plan for patients.
- Providing online training videos (for intra-organisational training, and for sharing with medical professionals in other hospitals).
- Sharing online treatment guidelines pertaining to COVID-19 with medical professionals.

measures, emotional responses and behaviors, as well as misinformation and rumors in the public through online interactivity (Liao et al., 2020; S. Wang & Wang, 2020).

Capturing and extracting knowledge related to COVID-19 requires unconventional and mature data storage, management, analysis, and visualization tools, and techniques (Pramanik et al., 2020). Additionally, it necessitates advanced capabilities to enable capturing knowledge from multiple and distributed data sources. Thus, smart technologies, apps, AI, ML, big data algorithms, and datamining play significant roles in managing COVID-19-related knowledge (Liao et al., 2020; Vaishya et al., 2020). COVID-19-related data and information are unstructured, wide ranging in complexity, length, and use of technical terminology, making knowledge discovery more challenging. Advanced analytical tools and applications facilitate a unique opportunity to extract and generate critical knowledge from textual data sources to develop well-informed decisions (Chen et al., 2005; M. Liu et al., 2020).

Deploying smart technologies and using mobile apps and online mapping helped to capture information about new infections and the virus spread and alert the public of their risk of exposure (e.g., contact tracing, mobile phone tracking) (Lee & Lee, 2020). Smart technologies can also find or cross-check other people with whom the patient had close contact, prior to quarantine. Through manual effort, these data can be used to identify potential future cases and target those people or areas for testing and precautionary self-quarantine (Liao et al., 2020; M. Liu et al., 2020; Sonn, 2020).

Online knowledge sources are typically classified into static and dynamic knowledge sources. Static knowledge sources are similar to communal sources, and knowledge seekers could learn and utilize knowledge displayed on the platform or websites and do not have interactions with providers. In contrast, dynamic knowledge sources represent connective sources, and knowledge seekers directly engage in the knowledge exchange process by posting their questions online and acquiring the knowledge or solution through the bidirectional online communications with other members who know the answers (Kim et al., 2011; Sun et al., 2020). Alomari et al. (2021) noted that social networking platforms such as Twitter stream hundreds of millions of posts daily. They can be treated as a useful medium for the dissemination of information about diseases. Moreover, social media analysis using ML has become a key method to provide the pulse for sensing and engaging with the environments and is expected to provide smarter solutions during and post the COVID-19 pandemic. However, it is important to notice that counter-knowledge affects both the citizens whose decision-making capability may be affected by counter-knowledge, and scientific and government institutions that need to deal with the negative impact of counter-knowledge on the credibility of the messages they need to convey. The strength of a counter-knowledge message is that it goes "straight to the core" of an issue and is "easier to get," as it can spread to a large audience and affect people's view of reality (Bolisani et al., 2021).

## 3.4 | Knowledge sharing

The role of knowledge sharing beyond the organizational boundaries is of crucial importance (Garavaglia et al., 2021). The COVID-19 pandemic is an extremely complex existential threat that requires cohesive societal effort to address health system inefficiencies and to overcome gaps in real-time data analytics (Katapally, 2020; Kazi et al., 2020). Sharing plans and guidelines pertaining to COVID-19 treatment is an important aspect in controlling the virus consequences. Also, medical training is extremely important to reduce the infection risk to healthcare workers. Training topics such as how to wear protective clothing appropriately, how to take care of confirmed or suspected COVID-19 patients, and how to provide professional counseling advice to anxious patients are thus critical (see Figure 4) (Sun et al., 2020).

Technology strategies can be adopted to assist government sharing important knowledge with other organizations and with the public (e.g., daily briefing web posting, and text alerting) (Lee & Lee, 2020). Additionally, the potential for repurposing smartphones is magnified in the current COVID-19 crises because smartphones have the reach to create equity by empowering disenfranchised citizens, and smartphone-based apps have the capacity to source big data to inform policies through the voice of the citizens (Katapally, 2020; Kazi et al., 2020; Klitmøller & Lauring, 2013). Moreover, social media can be used to inform decision-making (Liao et al., 2020). For example, the Chinese government agencies mainly used social media to "inform" the public about updates of the epidemic situation; knowledge of the coronavirus pneumonia; policies, guidelines, and government actions; and prevention tips, all being the key risk messages included in the official websites of health authorities for communicating about an epidemic (Ding & Zhang, 2010). This suggests that government agencies mainly adopt a top-down approach in risk communication and use the social media for one-way communication. However, analyzing social media data indicates that that the public have less interest in situation

updates, general knowledge, policies, and guidelines as the epidemic evolves. However, the public may feel more empathic with the affected people and angry with other individuals or the government who put people at risk, as an increasing number of people is affected by the disease and the control measures (Liao et al., 2020; Nathavitharana et al., 2020).

Moreover, the use of media for information sharing, and webinars for sharing knowledge and expertise have seen widespread adoption during the COVID-19 pandemic (Chick et al., 2020; Goniewicz et al., 2020; Megahed & Ghoneim, 2020). For example, Ruijin Hospital implemented an online collaboration platform for doctors to diagnose patients in a distributed mode. If the fever department had a patient that needed assistance from other departments, then doctors from other departments could stay in their own offices and join the consultation meeting via online collaboration tools. Another form of online collaboration was cross-hospital collaboration at the same hospital in Wuhan (Katapally, 2020; Yan et al., 2020).

Because of smart technologies, many hospitals have been able to record training videos and then share them online internally and externally. By doing so, the duration of onsite training was shorter, reducing the infection risk (Yan et al., 2020). The majority of online collaboration events took the form of cross-hospital online collaboration in distributed mode which involved medical professionals from multiple hospitals located in different locations. This type of online collaboration consolidated medical expertise from different areas in various hospitals. For instance, Hospital of Zhengzhou University collaborated with 11 hospitals to discuss and share treatment plans and experiences for COVID-19, through the distance healthcare platform constructed by the Henan provincial government (Katapally, 2020; Nathavitharana et al., 2020).

Sharing knowledge contributes a great deal to the goal of improving outcomes for those affected by the disease, as it ensures that global communities adapt, and that the limited resources can be mobilized into effective response strategies (Kazi et al., 2020; Nathavitharana et al., 2020). As a smart city which strengthens precise epidemic prevention and control, Shanghai has established a multi-department platform named "one-net management" on dynamic information monitoring. By sharing epidemiological data with medical institutions under a safe environment, it believes that the ability to prevent and control epidemics among medical institutions will be effectively and comprehensively improved (Cai et al., 2020; Katapally, 2020; Klitmøller & Lauring, 2013).

Above all, the prevention and control of epidemic is a complex health task for medical institutions with difficulty in identifying patients and verifying epidemiological information. A joint defense system with big data integration and information exchanging is needed to actually break down the barriers in health institutions, to eliminate hidden dangers or security threats of information, to reduce the repeated consumption of medical resources, and to truly implement the early detection, early treatment and early blocking of disease outbreaks like the COVID-19 epidemic (Cai et al., 2020; Kazi et al., 2020). Moreover, in Italy, the information provided by the individual municipalities, and the decrees and the ordinances were often confusing (Ren, 2020). This forced the mayors to engage in the difficult work of interpreting and communicating clear information to their disoriented citizens. The sharing of information about frequent problems and the related chosen solutions, and the comparison with the MOCs and with the mayors of other municipalities was a fundamental tool of learning. This suggests that the creation of a network grouping together several municipalities, which would then be able to work in a more structured way in the case of a new emergency, would be desirable in the future. More broadly, while the COVID-19 emergency confirms the vital importance of free flows of information, there is also the need for governments at any level to establish and manage trusted digital platforms for updating data, sharing lessons, and enhancing collaborative learning (Garavaglia et al., 2021).

Collaboration and sharing knowledge regarding critical patients are crucial in tackling the COVID-19 outbreak. Tackling the COVID-19 pandemic demonstrated the need for establishing common online collaboration platforms that enable connecting various departments together for knowledge sharing, discovery and application, especially to reduce close contact and, thus, mitigate the risk of infection (Kazi et al., 2020; Klitmøller & Lauring, 2013; Nathavitharana et al., 2020). Based on lessons learnt from the practice in preventing COVID-19, more effort and focus need to be directed towards supporting strategies such as epidemiological information sharing. Epidemiological data must be gathered through a steady and reliable approach, and a multi-department dynamic information sharing system established, which will effectively and comprehensively improve the ability of medical institutions in metropolises for epidemic prevention and control (Cai et al., 2020; Kazi et al., 2020; Sun et al., 2020).

### 3.5 | The key benefits and challenges associated with deploying smart cities strategies to manage knowledge related to COVID-19

Smart cities technologies provide various potential benefits in managing COVID-19-related knowledge (see Figure 5); for example, facilitating citizens' engagement and knowledge sharing (Katapally, 2020). Deploying SC technologies, such as artificial intelligence (AI), in analyzing data related to COVID-19 has the potential to improve the planning, treatment and controlling of the pandemic (Dameri & Ricciardi, 2015; Hu et al., 2020; Younan et al., 2020). AI can help capturing real-time data which can be analyzed to provide updated information which is helpful in the prevention of the disease. Managing knowledge related to COVID-19 is important to predict the probable sites of infection, the influx of the virus, need for beds and healthcare professionals. Policy makers have used these data to inform their decisions regarding travel bans, quarantines and economic stimulus (Younan et al., 2020; Zhang et al., 2021).

Data change the game in terms of how we respond to pandemics. Tracing the origins of new diseases through their growth into global pandemics, such as COVID-19, necessitates following the flow of relevant data. Global data on disease trajectories and the effectiveness and economic impact of different social distancing measures are

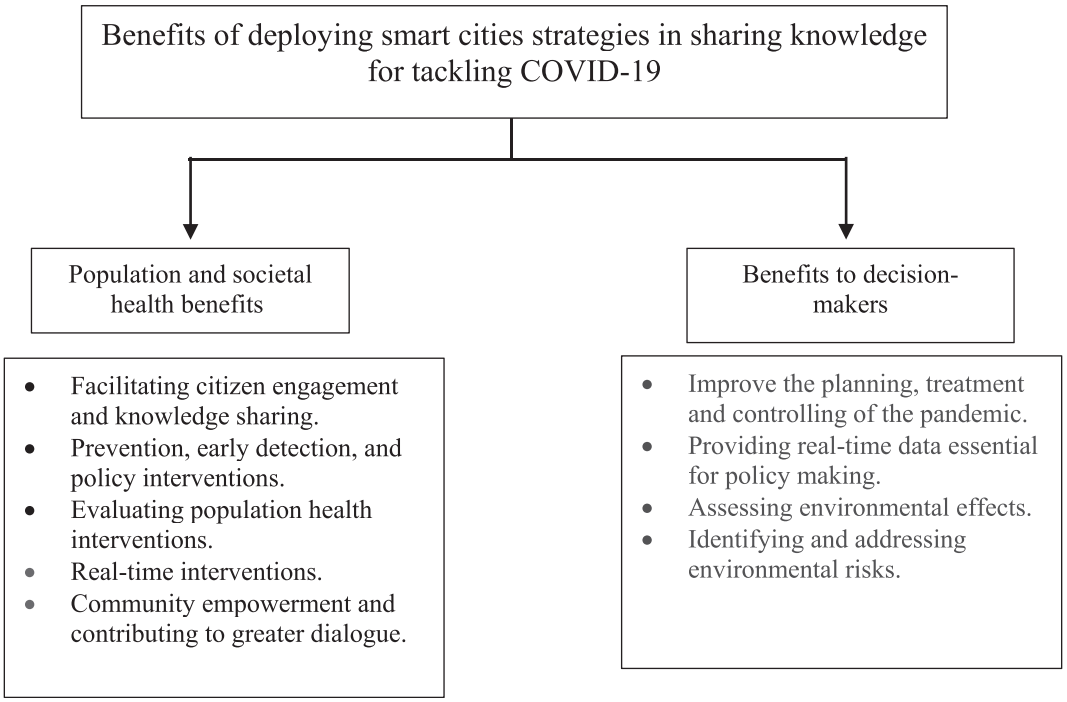


**FIGURE 5** Benefits of using SC strategies for managing COVID-19-related knowledge

essential to facilitate effective local responses to pandemics (Plasek et al., 2020).

Katapally (2020) noted that, with more than 3 billion devices currently in circulation worldwide, a smartphone is a ubiquitous tool that leverages the power of the internet like no other. The idea of smartphones being one of the primary solutions to this global problem might seem far-fetched until we unpack its potential. Smartphones provide the ability to directly reach and engage with a significant proportion of the world's population in near real time, which has immense potential for addressing COVID-19 outbreaks via rapid detection. Moreover, smartphones have the capacity to provide big data via sensors, such as global positioning systems (Kang et al., 2012; Younan et al., 2020). Empowering communities enhances decision-making processes by contributing to the greater dialogue around issues that are of the highest concern to society. Therefore, through facilitating citizen engagement in real time, it can help in predicting and addressing COVID-19 outbreaks in prevention, early detection, and policy interventions. Carrillo (2020) concluded that citizens' knowledge about the means of virus transmission has a great impact on society and is worrisome: because having accurate information on the mechanisms of virus transmission impacts the applied preventive measures (Dameri & Ricciardi, 2015; Younan et al., 2020).

However, effective management of knowledge related to COVID-19 necessitates considering the effect of counter-knowledge on an organization decision making at various levels (Bolisani et al., 2021). Counter knowledge negatively affects decision making and causes anxiety, stress, and despair (Bolisani et al., 2021). Adler and Shenhar (1990) highlighted five elements defining the knowledge base of an organization: skills, procedure, structure, strategy, and culture. Bolisani et al. (2021) noted that each of these could be directly affected by the emergence and spread of counter-knowledge. The authors argued that counter knowledge can hinder the mobilization of resources to address new business opportunities, it can have negative effect on shareholder value, and it can also hinder the ability to address opportunities and capture value from changing the way business is done, by incorporating new skills and procedures into core business practices (Bolisani et al., 2021; Cegarra-Navarro, Bolisani, & Cepeda-Carrión, 2021; Cegarra-Navarro, Wensley, et al., 2021).

Managing and analyzing COVID-19 data can enable monitoring of the disease outbreak in real time. With respect to previous epidemics and pandemics outbreaks, COVID-19 is unprecedented in that open-access datasets containing daily numbers of new infections broken down by country, and, in some cases, even cities, is widely available. Combined with the information we have about the movement of people, it represents the perfect dataset to combine mathematical modeling and AI (Dameri & Ricciardi, 2015; Younan et al., 2020).

However, Choi et al. (2021) noted that concerns have been raised about privacy violations relating to data being shared about location and places visited by infected travellers and residents. A number of infected people were subjected to anonymous criticisms, and the places they had visited suffered economic hardship due to the stigma associated with being discovered to be a COVID-19 infected area.

Additionally, the COVID-19 pandemic has led to the widespread implementation of social distancing measures and self and household isolation imperatives. Virtual work and working from home (WFH) strategies have been adopted by various organizations as a result (Elavarasan & Pugazhendhi, 2020; Olaimat et al., 2020; Vaishya et al., 2020). Bolisani et al. (2020) findings indicate that a fully positive

**TABLE 3** Implications for decision-makers and KM practitioners within public and private sector organizations

| Implications | Recommendations for decision-makers and KM practitioners |
|---|---|
| Knowledge capturing, extraction and creation | **Using social media & smartphones**<br>Smartphones show great promise for characterizing user behavior, while providing the ability to directly reach and engage with a significant proportion of the world's population in near real time. However, policy and decision-makers must consider which data are useful and would be included in the design, collection, analysis and interpretation from mobile phones and social media.<br>**Using big data analytical tools**<br>COVID-19-related data and information are unstructured, wide ranging in complexity, length, and use of technical terminology, making knowledge discovery more challenging. Harnessing the potential of big data analytics provides dependable and reliable information which is crucial for mitigating the impact of COVID-19. Therefore, organizations must adapt appropriate big data analytics capabilities to inform and provide insights to managers and policy makers to respond to COVID-19. |
| Knowledge sharing and transfer | Managing the COVID-19 pandemic requires innovation, collaboration, and knowledge sharing between governments, institutions, researchers, and organizations. Therefore, efforts need to be directed towards supporting sharing best practices and successful strategies. Digital platforms and multi-department dynamic information and knowledge sharing systems are needed which will effectively and comprehensively improve the ability for communication and content sharing. |
| Stakeholders' engagement and collaboration | For effective management of COVID-19, collaboration between various sectors and departments is necessary and is seen as a key to build and implement more efficient tackling and mitigation strategies. Therefore, there must be strategies to ensure engagement and collaboration at various levels, including public-private collaboration, cross-sector collaboration and international collaboration. Efforts need to be directed towards establishing cross-sector open platforms to facilitate various stakeholders' engagement and collaboration. |
| Users' privacy | Collecting and using potentially sensitive data requires a careful understanding of the legal and privacy concerns. Therefore, maintaining appropriate privacy data policies and regulations is necessary for effective adoption of mobile and social media data. |

or negative conclusion about working from home was not possible, nor a clear indication about the efficiency and effectiveness of this working modality. Other research suggests that it is more challenging to manage communication and knowledge sharing in virtual teams, which are based on individuals collaborating in geographically-dispersed work groups than in face-to-face co-located teams. This is due to lack of channel richness and to the delayed feedback inherent in some communication (Cai et al., 2020; Garavaglia et al., 2021; Kazi et al., 2020; Klitmøller & Lauring, 2013). Specifically, language and culture remain key barriers for knowledge sharing, specifically in virtual teams. Such challenges can be misinterpretations of messages due to absence of body language and tone of voice and slow or missing feedback. Accordingly, a number of researchers have argued that rich media communication (e.g., video conferences) is more suitable when sharing knowledge that is of a complex and equivocal nature, as it allows for back-channeling verbal and non-verbal signs of support or disagreement with a speaker's message (Andres, 2002; Klitmøller & Lauring, 2013). Moreover, it has been claimed that our increasingly digital world has arguably "left behind" those in older generations who are still offline (BritainThinks, 2015). As a result of being not online or not having smartphones, many senior citizens around the world are becoming further disadvantaged due to their inability to access and use information and communication technologies (ITCs) (e.g., obtaining the digital health codes that have become an essential tool during the COVID-19 pandemic) (X. Liu et al., 2021).

Nevertheless, the KM literature provides useful insights into this issue (Bolisani et al., 2020). For example, according to Bolisani et al. (2020), Dalkir (2008) used the distinction between tacit and explicit knowledge and Nonaka's (1994) model of knowledge conversions to explain that different information technologies can be more or less effective for interpersonal knowledge sharing, in relation to their capability to transfer tacit or explicit contents efficaciously. Moreover, Bratianu (2015) and Bratianu et al. (2021) introduced the metaphor of knowledge as energy which suggests that WFH can require that employees find a new dynamic balance between the different forms of knowledge (i.e., rational, emotional, and spiritual) which characterize actions and decisions of people (Bolisani et al., 2020). Bolisani et al. (2020) findings also show that a large part of employees can be able to keep sufficiently good and fruitful interactions while working from home. However, this is also associated to the kind of job, and to the availability of appropriate communication technologies. Indeed, the study confirms that technology is a key factor and, in general, there is no "one-fits-all" solution. This implies that many employees must struggle to use different communication systems, which can increase their stress (Bolisani et al., 2020).

Sharing COVID-19 data freely and globally boosts the data economy, enabling quicker dissemination and validation of pharmaceutical innovations, as well as improving knowledge of what prevention and mitigation measures work. Even if physical borders around the globe are closed, it is crucial that data related to COVID -19 continue to transparently flow across borders to enable a data economy to thrive, which will promote global public health through global cooperation and solidarity (Plasek et al., 2020). However, in societies with constrained data infrastructures, modeling and forecasting COVID-19 becomes an extremely difficult endeavor (Abdulmajeed et al., 2020).

## 4 | CONCLUSION

The effectiveness of managing COVID-19 necessitates an excellent understanding, managing and empowering of its knowledge assets (Bratianu, 2020; W. T. Wang & Wu, 2020). Knowledge management (KM) has the tools and approaches to help organizations cope with these challenges. KM provides the opportunities to make full use of the knowledge resources to make appropriate decisions (W. T. Wang & Wu, 2020). KM can be viewed as the process of identifying, capturing, storing, sharing, applying, and leveraging collective knowledge to improve performance. It can help organize and coordinate management actions, including quickly identifying knowledge owners and transferring the required knowledge to decision-makers, or to the right locations, when needed (W. T. Wang & Wu, 2020). The current COVID-19 pandemic and in other future pandemics, communication, collaboration, sharing knowledge and lessons learnt are needed at the highest levels in order to develop coherent and unified responses (Forman et al., 2020). At the same time, COVID-19 revealed the need to develop a (smart) knowledge base from which to tackle the upcoming challenges, identify and redress injustices, and contribute to destination resilience and societal wellbeing (Choi et al., 2021).

Smart cities technologies and strategies appear to have significant potential for the management of COVID-19, and their role is anticipated to increase in the future. Moreover, SC are considered to play a crucial role in enabling critical KM processes to support decision-making (Abdalla et al., 2020). KM is a mechanism that can add value to organizations via the application of ICT, through which the full potential of intellectual assets can be exerted (W. T. Wang & Wu, 2020). For example, data mining from official websites, the usage of social technologies such as social media, virtual communities, instant messaging, and social bookmarking as well as using mobile applications provide huge amount of data, in addition to their impact on creativity and innovation, which are important to arrange and implement necessary control measures to avoid further spread of the virus and tackle its impacts.

The paper concludes that employing SC technologies enables effective engagement of the public during the pandemic and facilitates two-way communication, which has a great impact on following the preventive measures. In turn, this not only influences the infection rate, but also it has a great impact on the pressure placed on the nation's healthcare infrastructure. However, it is still a great challenge for governments, public health agencies, and KM practitioners to capture and manage the huge and complex amount of knowledge and information needed to be communicated to the public.

The practical implication of this paper is that it informs policy and decision-makers on lessons learnt from effective management of knowledge related to the COVID-19 pandemic from a SC perspective. The paper reports the current implications of the deployed SC technologies and their impact on capturing and sharing knowledge related to COVID-19, in addition to the associated benefits and challenge. This research has made significant contributions to the role of the various SC strategies and how can they contribute to a more data-driven approach to provide solutions to adhere to lockdown and restriction measures and to enhance decision-making. Moreover, the paper provides decision-makers and emergency authorities with richer insights so that they could have more theoretical framing and knowledge of the role of SC strategies in managing the COVID-19 pandemic and other future outbreaks with a systemic and integrated view.

The study concluded that the ability to capture, use, manage and share of knowledge will be a crucial element, in both dealing with the current outbreak and also for effectively planning and preparing for the future. Therefore, it is vital to invest in KM as it is one of the key factors governing the impact of pandemics such as COVID-19. It is necessary to train doctors and healthcare practitioners to enable them to effectively manage real clinical challenges when dealing with highly infectious diseases. This requires providing them with as much updated knowledge as possible, which will enable them to effectively manage real clinical challenges when dealing with highly infectious diseases such as COVID-19. For example, in the UK, the National Health Service's ability to harness knowledge to help manage COVID-19 crisis follows on from a longstanding commitment to building KM capacity across the healthcare system. It is evident that managing knowledge is crucial for effective management of COVID-19. However, KM has also been found to be a difficult task that requires combined effort and collaboration among various social bodies sectors and departments, such as healthcare system, government and, more importantly, from the public. Therefore, systems that enable knowledge sharing and build a continuous communication channel among the various authorities are required. Thus, efforts need to be directed towards creating and establishing an open, multi-department dynamic knowledge sharing and monitoring platforms for a sufficient use of data. Table 3 presents the implications for decision-makers and KM practitioners within public and private sector organizations to rethink and act.

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