Chapter 12
Long-Term Pandemic Management and the Need to Invest in Digital Transformation:
A Resilience Theory Perspective

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ABSTRACT

Assessing the preparedness of Ghana's health sector is a crucial task that requires a comprehensive and multi-faceted approach. Ghana's health sector faces many challenges, including limited resources, inadequate infrastructure, and workforce shortages, which can impede the delivery of quality healthcare services to the population. Thus, building a strong health resilience system is essential to cope with catastrophic events, and the capacity to prepare and effectively respond to pandemics. The COVID-19 pandemic has highlighted the critical role of digital technologies in managing public health emergencies. In the context of long-term pandemic management, digital transformation can provide numerous benefits, such as improving the speed and efficiency of response, enhancing communication and collaboration, and enabling remote access to essential services. Empirically, our study found that individual and systemic resilience are significant predictors of long-term pandemic management. Conversely, community resilience in times of crisis is not a significant predictor.

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INTRODUCTION

The COVID-19 pandemic has significantly impacted global health, presenting unprecedented challenges to healthcare systems worldwide. As the pandemic evolves, there is an increasing emphasis on developing long-term pandemic management strategies. These strategies are crucial for effectively addressing the ongoing health and social consequences of the pandemic. In Ghana, like in many countries, managing long-term COVID-19 patients has become a critical aspect of the pandemic response. Several studies have highlighted various challenges and proposed approaches to address these issues. For instance, Comber (2024) has proposed a framework for primary care physicians to manage COVID-19 patients over the long term. They stress the importance of continuous monitoring and follow-up care for patients who have recovered from COVID-19. This approach is essential to manage potential post-COVID complications and ensure optimal recovery. Persistent symptoms and complications post-COVID, often referred to as "long COVID" or "post-acute COVID-19 syndrome," can include a range of symptoms like fatigue, breathlessness, and cognitive impairment, necessitating ongoing medical support and care.

Montani et al. (2021) underscores the importance of a multidisciplinary approach in managing long-term COVID-19 patients, especially those with chronic conditions or those requiring rehabilitation. A multidisciplinary team, including primary care physicians, specialists, nurses, physical therapists, and mental health professionals, can provide comprehensive care tailored to the diverse needs of long-term COVID-19 patients. This approach integrates medical, physical, and psychological support, addressing the multifaceted impact of COVID-19 on patients' health. Furthermore, the application of technology in managing long-term COVID-19 patients is increasingly being recognized. Telemedicine (Chauhan et al., 2024), digital health tools (Arif et al., 2024; Miranda, 2024; Tomé et al., 2024), and remote monitoring technologies (Tariq, 2024a) can play a vital role in providing continuous care, especially in settings where healthcare resources are limited or where patients may face challenges in accessing in-person healthcare services.

Significant research gaps persist in understanding the best practices for long-term pandemic management, especially in the context of countries like Ghana. Key areas that require further exploration include the specific healthcare needs of long-term COVID-19 patients, assessing the effectiveness of various management strategies, and determining the impact of these strategies on patient outcomes. Moreover, there is a crucial need for research focusing on the socio-economic impacts of long-term COVID-19 and evaluating the effectiveness of public health policies in mitigating these impacts. Current studies have concentrated on clinical management strategies for long-term COVID-19 patients, yet there is an urgent need to expand research into the realms of digital transformation, psychosocial effects, and economic consequences of the pandemic. Di Toro et al. (2021) emphasize the importance of research into the economic burden of long-term COVID-19 care and the potential role of digital health technologies in effective pandemic management. Alawi (2021) has also highlighted the necessity for more research on the efficacy of pandemic management strategies in long-term care settings.

Another critical research gap is the lack of understanding regarding the long-term impacts of the pandemic on vulnerable populations (Fung et al., 2022; Tan et al., 2023), as well as identifying which technologies could support future pandemics (Weaver et al., 2022). The COVID-19 pandemic has disproportionately impacted marginalized communities, intensifying existing health disparities. In-depth research is needed to unravel the long-term health and social consequences of the pandemic on these vulnerable groups, including low-income communities, racial and ethnic minorities, and individuals with

pre-existing health conditions. Embracing digital transformation could shed light on these disparities, bridging the gap between the privileged and underprivileged, and fostering meaningful living in Ghana and similar environments. Overall, the COVID-19 pandemic has brought about significant challenges for long-term pandemic management, and there is a growing need for research to address these challenges (Garcia & Revano, 2022; Kuhlmann & Franzke, 2022). While several studies have proposed management strategies for long-term COVID-19 patients, there is a need for more research on the accelerated development and use of digital technology solutions in healthcare and the effectiveness of pandemic management strategies in vulnerable populations. By addressing these research gaps, we can develop more effective long-term pandemic management strategies and mitigate the ongoing impacts of the pandemic on global health and society.

MAIN FOCUS OF THE CHAPTER

This chapter aims to present a comprehensive overview of the existing knowledge on long-term pandemic management in Ghana. It aims to identify critical research gaps in this area and to discuss potential directions for future research. This study is significant as it addresses the pressing need to understand and manage the prolonged impacts of the COVID-19 pandemic, particularly in a context like Ghana where the healthcare system faces unique challenges. The implications of this research are far-reaching, offering insights that could inform public health strategies, shape policy decisions, and guide healthcare practices in Ghana and similar settings. By highlighting research gaps and suggesting future research directions, this chapter contributes to the global effort to combat the long-term effects of the pandemic. By doing so, the chapter contributes to the improvement of health outcomes and the mitigation of socio-economic impacts of global crises like pandemics.

BACKGROUND OF THE STUDY

Understanding Resilience Theory

Resilience Theory provides a framework for understanding how systems, communities, and individuals adapt, survive, and grow in the face of adversity and challenges. This theory is particularly relevant in the context of long-term pandemic management. It offers insights into how healthcare systems, like Ghana's, can withstand, adapt to, and recover from the shocks and stresses of prolonged health crises such as COVID-19. By examining resilience mechanisms, we gain a comprehensive understanding of the capabilities and strategies required to maintain and improve healthcare services during and after a pandemic. Applying Resilience Theory to pandemic management allows for an analysis of the capacity of healthcare systems to enhance their resilience, including the role of digital transformation in this process. This perspective is crucial in guiding effective and sustainable responses to global health emergencies. It highlights the importance of adaptability and growth in the face of unprecedented health challenges, demonstrating why investing in digital infrastructure and capabilities is essential for building resilient healthcare systems.

The Ghanaian Context

The COVID-19 pandemic began in December 2019 when a new virus named SARS-CoV-2 was discovered in Wuhan, China. It quickly spread around the world and was declared a pandemic by the World Health Organization (WHO) on March 11, 2020 (Cucinotta & Vanelli, 2020). Ghana reported its first two cases of COVID-19 on March 12, 2020. Symptoms of COVID-19 include fever, cough, fatigue, shortness of breath, and loss of smell and taste (Astuti & Ysrafil, 2020). According to the Ministry of Health - Ghana, between the 12th of March and 31st of December 2020, Ghana confirmed 55,168 cases of COVID-19 from a total of 672,364 tests performed, giving a positivity rate of 8.2%. Among these cases were 705 recorded among international arrivals at the Kotoka International Airport. Ghana recorded 335 deaths among the confirmed cases of COVID giving a case fatality rate of 0.61% (Ghana Health Service, 2020). The first major wave of COVID-19 cases in Ghana was recorded between June and August 2020, with the 2nd of July 2020 recording the highest number of cases in a day (774).

Ghana's response to the COVID-19 pandemic was primarily health sector-driven and included a range of activities such as infrastructure, equipment, logistics, human resource capacity development and enhancement, public education and sensitization, and public and stakeholder engagements (Kwame et al., 2023; McCarthy et al., 2023; Sarkodie & Owusu, 2021). The preparations included training healthcare workers on the disease, surveillance using developed case definitions, infection prevention and control, and appropriate use of Personal Protective Equipment (PPE). Furthermore, it is important to note that the COVID-19 pandemic has had a significant impact on Ghana's economy and society. According to another source (Khoo, 2020), Ghana's developing economy with a fragile public health system has faced challenges compounded by the country's political, economic, and socio-cultural realities (Dzando et al., 2021). The pandemic has exacerbated poverty, disparities, and social conditions in Ghana, disproportionately impacting the poor and vulnerable. The World Bank (2021) further states that Ghana's GDP growth is expected to have slowed to 1.1 percent in 2020, after averaging 7 percent per year from 2017 to 2019, and the labor market has also been hard hit by the pandemic.

Initiatives Taken by the Government of Ghana to Curb Pandemics

The government of Ghana and governments around the world have taken various initiatives to curb pandemics, including the COVID-19 pandemic. Some of the key initiatives taken by governments are:

- **Public Health Measures**: The government of Ghana implemented public health measures such as social distancing, quarantine, and lockdowns to slow the spread of the virus. Other initiatives include testing and contact tracing and vaccination programs to immunize the population against the virus. To strengthen the health systems, the government purchased essential medical supplies, hired more health workers, and increased the hospital capacity (Frenk, 2010).
- **Information Dissemination**: Governments have provided timely and accurate information about the pandemic to the public, including guidelines for prevention, symptoms, and treatment. The Ghana government likewise provided timely and accurate information about the pandemic to the public, including guidelines for prevention, symptoms, and treatment. They also launched a mobile app to provide real-time information and updates about the pandemic (Sarkodie et al., 2021).
- **Economic Relief Measures**: The Ghana government provided economic relief measures to mitigate the impact of the pandemic on individuals and businesses, including financial assistance,

tax relief, and stimulus packages. These include tax relief, stimulus packages, and a COVID-19 Alleviation Program to provide financial support to small and medium-sized enterprises.

- **International Collaboration**: Governments have collaborated with international organizations and other countries to share information, resources, and best practices in pandemic response.
- **Research and Development**: Governments have invested in research and development to develop new therapies, vaccines, and other medical technologies to combat the pandemic. For instance, the government of Ghana on 18th April 2023 cut sod for a vaccine manufacturing plant with the purpose to help the nation realize the dream of becoming self-sufficient in the production and manufacturing of vaccines.

In terms of monitoring, governments have established surveillance and monitoring systems to track the spread of the virus and detect any outbreaks or new variants. While these initiatives have been crucial in curbing the spread of pandemics in Ghana, there are challenges and limitations to their implementation (Abor & Abor, 2020; B. Owusu et al., 2023), including vaccine hesitancy, limited healthcare infrastructure, political and societal factors, inadequate funding, and insufficient coordination among different sectors. Ongoing research and evaluation of these initiatives are necessary to inform evidence-based policies and strategies for pandemic preparedness and response in the future.

Assessing the Preparedness of Ghana's Health Sector

Assessing the preparedness of Ghana's health sector is a crucial task that requires a comprehensive and multi-faceted approach. Ghana's health sector faces many challenges, including limited resources, inadequate infrastructure, and workforce shortages, which can impede the delivery of quality healthcare services to the population (Dwomoh et al., 2023; Mensah, 2022). Thus, building a strong health resilience system is essential to cope with catastrophic events, and the capacity to prepare and effectively respond to pandemics (Grimm & Wyss, 2022). Ghana has adopted several strategies, policies, and action plans to build a health resilience system in preparedness and management to fight pandemics. Among them include Ghana's 2009-2013 Integrated Strategic Response Plan for Pandemic Influenza, Ghana's COVID-19 Emergency Preparedness and Response Plan, the National Action Plan for Health Security (NAPHS), the Public Health Emergency Response Plan (PHERP) for Kotoka International to help check to reduce the spread of infectious diseases through air transport, and Emergency Preparedness and Response Plan (EPRP) (Asiedu-Berkoe et al., 2022; Norman et al., 2013; Sarkodie & Owusu, 2021). The Government of Ghana sanctioned these action plans, through the Ministry of Health and Ghana Health Service in collaboration with other agencies, to provide directions towards the fight against pandemics (Dzando et al., 2022).

Several assessments have been conducted to evaluate the effectiveness and preparedness of Ghana's programs or policies in building health resilience to fight pandemics (I. Owusu et al., 2023). Norman et al. (2013) assessed the preparedness of Ghana's 2009-2013 integrated strategic response plan for pandemic influenza and reported that the health emergency preparedness is in disarray and the plan is different from Ghana's public health emergency preparedness. Throughout the COVID-19 pandemic, various measures were implemented to curb the disease's spread. These included training healthcare workers about the disease using available knowledge, conducting COVID-19 surveillance, enforcing disease prevention strategies, promoting social distancing, implementing lockdowns, and advocating the use of appropriate PPE. These measures were essential in managing the pandemic and limiting the

transmission of the virus. Despite all these measures, there was a shortage of PPEs, delays in receipt of COVID-19 test results, and a lack of staff to manage treatment centers as most health workers were afraid due to the infection rate among them and lack of PPEs (Sarkodie & Owusu, 2021). Though there are several policies and actions in the fight against pandemics, the preparedness of Ghana's health system in the fight against pandemics in the past and present has been weak. There is a substantial human resource, availability of strategic plans, and operational guidelines at all levels but there is weak coordination of emergency programs at the local level, weak linkages, and collaboration between other sectors, and more dependent on resource mobilization on donors' partners (Asiedu-Berkoe et al., 2022). To build a strong resilient health system, there is a need for a well-coordinated action plan from the national to the local level, less reliance on donor partners financing Ghana's health system preparedness, and involvement of technology to coordinate some of the activities between and within the various sectors.

THE NEED TO INVEST IN DIGITAL TRANSFORMATION

Chasing Robotics for Digital Transformation

The gradual adoption of robots in healthcare to improve efficiency has been a slow process due to concerns over job elimination and costs (Clipper, 2020). However, the COVID-19 pandemic has accelerated the adoption of robots in healthcare by freeing up caregivers to focus on important activities that require human interaction, critical thinking, and empathy. In Ghana, during the COVID-19 surge, *Assuah Robotics*, which is based in Tarkoradi in the Western Region, manufactured an electronic hand sanitizer that was mounted in offices, roadsides, and other public spaces to help fight the novel coronavirus. The electronic hand sanitizer is programmed to allow the substance to flow automatically into the hands of users. This device has been listed among the top five devices invented by Ghanaians to fight COVID-19. Other humanoid-looking robots were also introduced into COVID units to assist physicians and nurses (Andtfolk et al., 2022; Clipper, 2020; Shen et al., 2021). These robots performed specific roles such as communicating with patients, taking temperatures, and making beds. They were successful in assisting with patient care and decreasing human exposure to the virus. It is highly likely that because these robots have been successfully deployed in COVID units, they will be integrated into workflows with much less objection than usual. Additionally, the pandemic saw an increase in the use of room cleaning and UV light robots, which have been around for 10 years and have been proven to destroy COVID-19 and other pathogens (Clipper, 2020). These robots are extremely helpful to disinfect hospital rooms and are safer for their human counterparts, the environmental services staff.

In the field of supply chain systems, drones, and other robots (Sarker et al., 2021) are increasingly being used to improve efficiency and speed up delivery times in Ghana. Drones were used to deliver packages (i.e. vaccines, medicines, and PPE) in remote or hard-to-reach areas, such as rural communities or disaster zones, where traditional modes of transportation may be limited or impossible (Flemons et al., 2022). Thus, Zipline's drones have been deployed in Ghana to tackle the COVID-19 pandemic, and they have helped the country respond timely to the crisis. The drones have a range of 22,500 square kilometers and can travel at a speed of 100 km per hour. In Zipline's seven-year history, their drones have made over 115,000 commercial deliveries, including medical supplies and blood, to underserved communities. Robotics are becoming a more common mainstay in the environmental services and infection prevention ecosystem and are also being used in grocery stores and schools. The growth in the

utilization of robots for this purpose is projected to continue as we adjust to living with COVID-19 and the need to invest in digital transformation in Africa.

Digital Technologies for Public Health Emergencies

The COVID-19 pandemic has highlighted the critical role of digital technologies in managing public health emergencies (Baudier et al., 2023; Bhaskar et al., 2020; Panja, 2024). Digital transformation refers to the adoption and integration of digital technologies into all aspects of an organization or society, including healthcare, education, business, and government services (Darda & Matta, 2024; Ofosu-Ampong, 2021). In the context of pandemics, digital transformation can provide numerous benefits, such as improving the speed and efficiency of response, enhancing communication and collaboration, and enabling remote access to essential services. One of the key advantages of digital transformation during pandemics is the ability to facilitate remote healthcare services. Telemedicine, which involves the use of digital technologies to provide remote medical consultations and treatment, has become a vital tool in the fight against COVID-19 (Cucinotta & Vanelli, 2020). It allows healthcare professionals to evaluate and treat patients without exposing them to the virus, reduces the burden on healthcare facilities, and increases access to care, especially in rural or remote areas.

Digital transformation can also enable effective communication and collaboration between different sectors and stakeholders involved in the pandemic response (Arayata et al., 2022; Cortez et al., 2022; Garcia, Revano Jr, et al., 2022; Parel et al., 2022). For example, digital platforms can facilitate real-time sharing of information, data, and best practices, and enable coordinated responses among healthcare providers, public health agencies, and government officials. This can improve the speed and accuracy of response and reduce the risk of confusion or miscommunication. Moreover, digital transformation can provide new opportunities for businesses to adapt to the challenges posed by pandemics. For example, e-commerce platforms and digital payment systems can enable businesses to continue operating and serving customers remotely, even during lockdowns or other restrictions on physical interactions. However, there are also challenges and limitations to digital transformation during pandemics. These include issues related to data privacy and security, unequal access to technology and digital literacy, and the need for adequate infrastructure and resources to support digital transformation (Erisen & Uludag, 2024; Garcia, Garcia, et al., 2024; Tariq, 2024b). Therefore, it is essential to invest in digital transformation during pandemics, to ensure that the benefits of digital technologies are harnessed, and the challenges are addressed. This requires collaboration between different sectors and stakeholders, including government, private sector, civil society, and international organizations, to develop and implement digital solutions that are equitable, accessible, and sustainable.

Many digital transformation initiatives have been implemented in various sectors during the pandemic. Here are a few examples:

- **Remote Working**: Remote working involves the use of digital technologies to enable employees to work from home or other remote locations (Garcia, Alcober, et al., 2022). During the pandemic, many organizations have implemented remote working policies to reduce the risk of infection and to maintain business continuity (Bawole & Langnel, 2023; Ofosu-Ampong & Acheampong, 2022).
- **Digital Payment Systems**: Digital payment systems enable contactless transactions between businesses and customers. During the pandemic, digital payment systems have become essential for businesses that need to continue operating while minimizing physical interactions.

- **E-Commerce Platforms**: E-commerce platforms enable businesses to sell products and services online. During the pandemic, e-commerce has become a crucial tool for businesses that have had to close physical stores or limit in-person interactions.
- **Digital Marketing and Advertising**: Digital marketing and advertising involve the use of digital technologies to promote products and services online. During the pandemic, many businesses have shifted their marketing and advertising budgets from traditional media to digital channels to reach consumers who are spending more time online (Damenshie-Brown & Ofosu-Ampong, 2023).

Artificial Intelligence (AI) tools have been on the rise in recent times and are also an important digital transformation initiative that has been adopted during the pandemic (Garcia, Arif, et al., 2024; Patibandla et al., 2024; Swayamsiddha et al., 2021). AI involves the use of algorithms and machine learning to analyze and interpret data, make predictions, and automate decision-making (Kazi, 2024; Ofosu-Ampong, 2023). Here are some examples of how AI tools have been used during the pandemic:

- **Diagnosis and Treatment**: AI tools have been used to help healthcare providers diagnose and treat patients with COVID-19. For example, AI algorithms can analyze medical images to identify signs of pneumonia or other respiratory diseases, which can be associated with COVID-19.
- **Predictive Modeling**: AI tools have been used to develop predictive models that can forecast the spread of the virus, estimate the demand for medical supplies, and identify high-risk populations. These models can help governments and healthcare providers plan and allocate resources more effectively (Kuvvetli et al., 2021; Xu et al., 2022).
- **Contact Tracing**: AI tools have been used to improve contact tracing efforts by analyzing data from various sources, such as mobile phones, credit card transactions, and social media. This can help identify potential contacts of infected individuals more quickly and accurately (Shahroz et al., 2021).
- **Chatbots and Virtual Assistants**: AI-powered chatbots and virtual assistants have been used to provide information and support to people affected by the pandemic. For example, chatbots can answer questions about COVID-19 symptoms and guide how to seek medical care (Garcia, 2023a, 2023b; Mbunge et al., 2022).
- **Drug Discovery**: AI tools have been used to accelerate drug discovery efforts by analyzing large datasets and identifying potential drug candidates. This can help researchers develop new treatments for COVID-19 more quickly and efficiently.
- **Robot-Assisted Care**: AI-powered robots have been used in hospitals and care facilities to assist with tasks such as patient monitoring, cleaning, and delivery of medication. This can help reduce the risk of infection for healthcare workers and improve the quality of care for patients (Duan et al., 2021).

AI tools have been used to improve supply chain management by predicting demand for medical supplies, optimizing inventory levels, and identifying potential disruptions in the supply chain. This can help ensure that essential supplies are available when and where they are needed i.e. the case of drones in Ghana Health Systems. As initially stated, public health surveillance is key to the growth of pandemic management. As such, AI tools have been used to monitor and analyze data from various sources, such as social media and news reports, to identify potential outbreaks and track the spread of the virus. This can help public health officials respond more quickly and effectively to emerging threats. Concerning mental health support, AI-powered chatbots and virtual assistants have been used to provide mental health support to people affected by the pandemic. For example, chatbots can provide coping strategies

for stress and anxiety related to COVID-19. Virtual clinical trial tools have also been used to facilitate virtual clinical trials, which allow participants to take part from home using digital technologies. This can help accelerate the development of new treatments and vaccines for COVID-19. Overall, AI tools have been a critical component of the digital transformation initiatives during and after the pandemic, helping to improve the speed and accuracy of decision-making, diagnosis, and treatment. As the pandemic continues to evolve, we will see many more innovative applications of AI and other digital technologies (Ramos, 2024; Toit & Goosen, 2024).

Long-Term Pandemic Management in Health Care

Based on the review of literature on long-term pandemic management, we surveyed to investigate how resilience can influence adoption in healthcare. In this regard, we employed the resilience theory. The theory focuses on the individual, community, and systemic capacity to adapt and recover from situations and disruptions in uncertain periods. Resilience is the capacity to maintain health systems' competent functioning despite high-risk status or during pandemics (Kaplan et al., 1996). Thus, the theory proposes a building block of resilience at different levels, such as individual, community, and systemic levels. The resilience theory provides health institutions strategies to enhance their system capabilities and support health systems to recover from long-term pandemic impacts. Individual resilience comprises adaptability (adjusting to changing circumstances) (Paterson & Durrheim, 2013), positive coping strategies (effective ways of dealing with a pandemic), and social support (availability and quality assistance) while community resilience comprises social capital (resource availability via social networks), community cohesion (connectedness within a community) and resource access (availability of resources during a crisis). Furthermore, systemic resilience consists of adaptive governance (the ability of health institutions to adapt and respond to difficulties), diversity and adaptive behavior (the ability to change behavior to respond to the context) and learning and innovation (the capacity to learn from experiences and innovate to suit context). Consequently, 50 health personnel (mostly nurses and health administrators) were asked to answer these questions. The questions were basic on the levels of resilience (independent variables) and how it influences long-term pandemic management in healthcare (dependent variable) for long-term pandemic management.

Resilience Factors as Predictors of Long-Term Pandemic Management in Healthcare

A regression analysis was conducted to determine whether individual, community, and systemic resilience is a significant predictor of long-term pandemic management in healthcare in Ghana. The result of this analysis is shown in Table 1.

From the analysis, the significant predictors of individual resilience in the face of long-term pandemic management are adaptability, positive coping strategies, and social support. Conversely, two main factors in community resilience are not predictors of long-term pandemic management. Thus, only resource access under community resilience is a predictor. Based on the results of this research we can state that individual resilience during a crisis is more important than community resilience in managing long-term pandemics. Thus, it is essential to focus on the individual adaptive capabilities rather than the community at large. Hence, individual survival will result in community continuity. Furthermore, all the factors (adaptive governance, diversity, adaptive behavior, and learning and innovation) under

Table 1. Resilience factors of long-term pandemic management

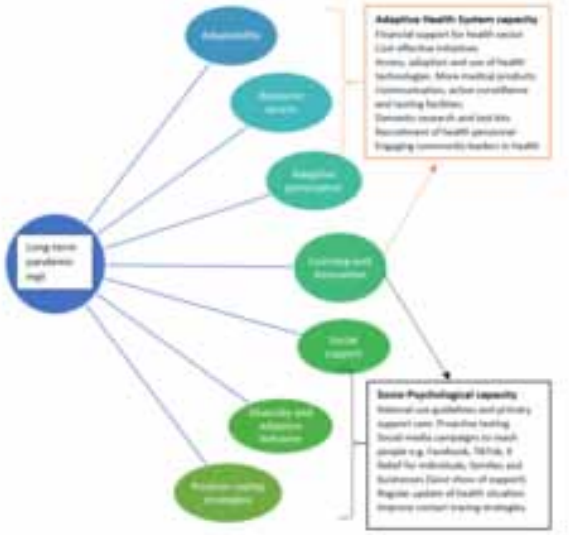
Dependent variables	Significance	Outcome
Adaptability	<0.001	Highly significant
Positive Coping Strategies	<0.001	Highly significant
Social Support	<0.001	Highly significant
Social Capital	0.503	Non-significant
Community Cohesion	0.402	Non-significant
Resource Access	<0.001	Highly significant
Adaptive Governance	<0.001	Highly significant
Diversity and Adaptive Behavior	<0.001	Highly significant
Learning and Innovation	<0.001	Highly significant

systemic resilience were significant predictors of long-term pandemic management ($p < 0.001$). Based on the findings, we conclude that individual and systemic resilience are the key determinants in managing crises or pandemics. Surprisingly, there is limited research into how various resilience can influence technology adoption during a crisis. However, our research has established that resilience is a significant predictor in health systems management.

Long-Term Pandemic Management Framework for Resilience

Based on the results of the regression analysis for determining resilience factors for long-term pandemic management, we propose the following framework as shown in Figure 1. The determining factors can be grouped into two main resilience capabilities.

Figure 1. Long-Term pandemic management framework for resilience



The first resilience capability is the Adaptive health system capacity. This capacity includes adaptability, resource access, and adaptive governance. Under this capacity, we expect financial support for health personnel and sector (including recruitment), and a more cost-effective initiative to reduce the burden on the state and families. Also is the access, adoption, and use of health technologies to reduce vulnerability. Communication at this stage is crucial for resilience. Furthermore, there is a need to engage the community leaders (gatekeepers) in planning health services for digital technologies' acceptability.

The second capability is the socio-psychological capacity. Predictors of this capacity include social support, diversity and adaptive behavior, and positive coping strategies. This capacity has the potential to improve individual and family resilience strategies since it relies mostly on social support and coping strategies. At this stage, we expect rational guidelines, proactive testing, and heavy reliance on primary support health care. With the increasing use of social media in developing countries, managing the pandemic is premised on social media campaigns to create awareness and provide health solutions. It is no surprise that recent research is focusing on social media and healthcare solutions during the pandemic. Finally, the determining factor common to both the adaptive health system and socio-psychological capacity is learning and innovation. The interesting thing about learning and innovation is that the initiative can originate from an individual facing a pandemic, a business venture that is for profit, or a government seeking to protect life and property.

CONCLUSION

Though there are several policies and actions in the fight against pandemics, the preparedness of Ghana's health system in the fight against pandemics in the past and present has been weak. The COVID-19 pandemic has highlighted the challenges associated with predicting and managing public health emergencies. Predicting virus trends and the future of the pandemic has become even more challenging three years on from the start of the pandemic. Meanwhile, infectious disease experts, epidemiologists, and public health officials have been looking ahead to the future of the pandemic and considering what needs to be done to prepare for future pandemics. Effective pandemic management requires collaboration and coordination among multiple disciplines, sectors, and government apparatus. This includes public health agencies, healthcare providers, emergency responders, policymakers, and the public. Pandemic management also involves a range of strategies, including surveillance, containment, mitigation, and treatment. Preparing for future pandemics and long-term pandemic management requires a multi-faceted approach towards digital transformation as espoused in this paper. By taking these transformational actions, we can improve our ability to predict, prevent, and manage future pandemics.

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KEY TERMS AND DEFINITIONS

Digital Transformation: This refers to the integration of digital technology into all areas of a business or organization, resulting in fundamental changes to how businesses operate and how they deliver value to customers. In the context of healthcare, it involves using digital tools and technologies to improve healthcare delivery, patient engagement, data management, and overall healthcare processes.

Health System Resilience: This is the ability of a health system to prepare for, manage, and recover from various challenges and stresses, including epidemics, natural disasters, economic pressures, or political instability. A resilient health system can maintain core functions and deliver high-quality care even in the face of adversity.

Healthcare Preparedness: This term refers to the readiness of healthcare systems to manage and respond to health emergencies, such as pandemics, natural disasters, or bioterrorism events. It involves having the necessary plans, resources, workforce, and infrastructure to effectively respond to and recover from such emergencies.

Long COVID: Also known as post-acute sequelae of SARS-CoV-2 infection (PASC), Long COVID describes the long-term effects that some people experience after they have recovered from the acute phase of the COVID-19 infection. Symptoms can include fatigue, shortness of breath, cognitive impairments, and other health problems that persist for weeks or months after the initial illness.

Pandemic Management: This refers to the strategies and actions taken to control and mitigate the effects of a pandemic. It involves a coordinated response that includes public health measures (like vaccination, social distancing, and testing), healthcare delivery, resource allocation, and communication strategies to manage the spread of the disease and minimize its impact on society.

Resilience Theory: In the broadest sense, resilience theory is a framework for understanding how individuals, communities, systems, and organizations withstand and adapt to challenges, stresses, and shocks. In the context of health systems, it looks at how these systems can absorb, adapt, and transform in response to health-related crises or changes in their environment.