

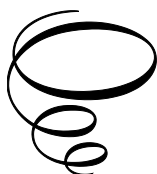
The Psychosocial Impact of the COVID-19 Pandemic and its Consequences

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Edited by

Emmanuel Janagan Johnson

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Give thanks to the LORD, for He is good; His
loving devotion endures forever.

—1 Chronicles 16:34

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PREFACE

Health professionals faced challenges due to the recent impact of the 'coronavirus,' which spread across the entire world, and infected 229 countries and more than 7.5 million people were affected. (CDC, 2020). COVID-19 has impacted everyone's life and livelihood in one way or another. Individual responses to measures taken to control the rapid spread of this disease depend on their knowledge and perceptions. The general population's compliance with preventive measures and legislation is mainly influenced by their knowledge level, attitude, and practices. This pandemic has affected public health, with thousands of individuals and families experiencing both physical illness and the less-discussed stigma. This book highlights the knowledge, attitude, and practices of public health after the coronavirus pandemic and the challenges that people are facing today globally. The hope is that the material presented in this book deepens the reader's understanding of all the aspects of maintaining healthy conditions. This book covers a wide range of fields to narrow the gap between health professionals and paraprofessionals. The contributors to this book are from various fields such as medicine, social work, psychology, sociology, criminology, international relations, nursing, and mediation. The contributing authors represent the USA, India, the United Kingdom, and Trinidad and Tobago.

INTRODUCTION: HEALTH AND SOCIAL WORK.

Health professionals and the public, all face challenges due to the recent impact of the SARS-Cov-2 virus, which spread rapidly across the entire world, infecting more than two hundred countries and affecting more than 50 million people in early 2020 (CDC, 2020). The disease it caused, COVID-19, has impacted on everyone's life and livelihood in one way or the other. Individuals' response to take measures to control the rapid spread of this disease depends on their knowledge and perceptions. The general population's compliance with preventive measures and legislation is mainly influenced by their knowledge, attitude, and practices regarding the virus, the disease it causes, and its spread. The pandemic affected public health across all societies and social groups, with thousands of individuals and families experiencing both physical illness and the less-discussed stigma associated with it. This book describes the impact on the health professionals, paraprofessionals such as social workers and nurses, schools and highlights the knowledge, attitude, and practices of the public towards COVID-19 and its preventive measures. The hope is that the material presented in this book deepens the reader's understanding of all the aspects of healthcare and COVID-19. These chapters in this book cover a wide range of fields: contributors come from Medicine, Allied Health, Social Work, Psychology, Sociology, Anthropology, Criminology, International Relations, Nursing and Mediation. They represent geographically diverse countries including the USA, India, United Kingdom, and Trinidad and Tobago.

In Chapter One, **Dr. S.M. Vanmathi, and Dr. M. Mayilvaganan** explain the background of the COVID-19 pandemic and describe the public health response, using India as a case study. The Government of India instigated a nationwide lockdown on March 24, 2020, due to an increasing number of COVID-19 infections. Subsequently, restrictions were relaxed in three phases beginning in June 2020. This chapter examines the public health response to COVID-19 in India, beginning from April 27, 2020, when national guidelines required all symptomatic patients and families to be transferred to healthcare facilities and isolated away from their homes, with entire neighborhoods declared containment zones. There was an initial rush

to build new COVID-19 hospitals and to secure ventilators. Whilst containment measures were essential to protect the population, this strategy aimed at distancing those who were infected from society but overwhelmed the healthcare system in India's most populous cities, including Mumbai and Delhi, and precluded access to non-COVID care. In addition, the resultant fear and stigmatization (further explored in Chapter 3) resulted in delays in seeking timely care, violations of privacy and considerable social distress.

In Chapter Two, **Dr. Divya Verma and Dr. Bhawna** explain the impact of the COVID-19 pandemic on sociological, psychological, and economic aspects of human life and analyze changing human sentiments during lockdowns, using Google Trends. They discuss emerging solidarities to manage the impact of COVID-19 in India and the impact of COVID-19 impact on three broad indicators: psychological indicators, sociological indicators, and economic indicators. They conclude that human sentiments during lockdowns were different compared to pre-lockdowns and post-lockdowns periods. They highlight opportunities the crisis has presented, such as more sophisticated use of technology, and a revived appreciation of family, relationships, community, and health. Increased solidarities between Government, cultural communities, social institutions, scientific community, actors at the grassroots levels, policymakers and civil society will be crucial to handle the pandemic and post-pandemic recovery of society and the economy.

In Chapter Three, **Dr. J. S. Santhosh, and Dr. F. X. Lovelina Little Flower** focus on social stigma in the context of health. Social stigma is the negative association between a person or group of people who share certain characteristics and a specific disease. In an outbreak, this can lead to people being labeled, stereotyped, discriminated against, treated separately, and/or experiencing loss of status because of a perceived link with the disease. Social stigma has an adverse effect not only on those with the disease but also on their caregivers. To reduce stigma, it becomes imperative to separate a person from an identity defined by COVID-19. Evidence shows that stigma and fear around communicable diseases hamper the response, and a better environment is created when the impact of the disease is openly discussed in an effective manner, which helps in addressing this important Social Determinant of Health. The main objective of this chapter is to explore COVID-19 stigma in different sociocultural contexts, including across borders, to understand the psychological impact of stigma on health professionals, individual and communities, and to recognize solutions and strategies employed in combating stigma through cross-learning experiences.

In Chapter Four, **Dr. S. Esther Rani, and Dr. S. John Wesley** focus on the impact of school closures on education, and how this threatens to widen the learning gaps between the children from poorer socioeconomic backgrounds and their more affluent peers. The worst effects will be felt in rural/hilly areas with no internet facilities or slow internet speeds, exacerbated by parents' inability to monitor and support the children's use of digital technology for learning. They explore how education through online classes can cause physical difficulties and increase psychosocial problems in schoolchildren. The authors highlight the key functions of social work during pandemic lockdowns including: i) Ensuring that the most vulnerable communities are included in planning and response; ii) Organizing communities to ensure that essentials such as food and clean water are available; iii) Advocating within social services and in policy environments that services adapt, remain open and pro-active in supporting communities and vulnerable populations; iv) Facilitating physical distancing and social solidarity; v) As a profession, advocating for the advancement and strengthening of health and social services as an essential protection against the virus, inequality, and the consequent social and economic challenges.

In Chapter Five, **Dr. Francis Powell** highlights the disparities in healthcare access within African American communities. African American communities have been disproportionately affected by COVID-19, with higher rates of hospitalization and death compared to other racial and ethnic groups in the United States. This is due, in part, to a lack of access to healthcare and other socioeconomic factors. COVID-19 does not discriminate but disparities that have long been part of the medical system in America are leading to what is being called a "crisis within a crisis." African American communities across the country are being hit hard by COVID-19, in greater numbers than their white countrymen, and with fewer resources to save them. Compounding the issue is the higher rates of diabetes in African American communities compared to other racial and ethnic groups. This is due to a variety of factors, including genetics, lack of access to healthy food options, and socioeconomic status. Dr Powell shows how food deserts, which are more often found in low-income and minority communities, contribute to this problem by making it difficult for residents to access healthy food options.

In Chapter Six, **Ms. Jessica E. Emmanuel Janagan**, presents a meta-analysis of recently published articles in referred journals on mental health issues in high schools have grown to become one of the most dramatic features of global mental health, with long-term consequences. It has

become a public health challenge globally. This study is a meta data analysis of recently published articles in the refereed journals. Fifteen articles were purposively selected based on the criteria of mental health among the high school students and were analyzed to find the recent changing trends of mental health status in schools. The analysis of studies demonstrates that school-aged children in the United States have a high prevalence of mental health issues particularly trauma. The findings provide evidence for prevention and intervention strategies to reduce mental health issues. The finding shows that there is a need for more greater awareness of the issues of mental health in high schools and the author recommends the ways and means to improve the mental health status of high school students in the United States. It is recommended that more selfcare and balancing the schoolwork and lifestyle during high school age is a must for teenagers to avoid mental health issues.

In Chapter Seven, **Mr. Anto and Dr. Esther Rani** present their study on conserving children's wellbeing during stressful times such as the pandemic, which needs greater consideration in all sectors. Children's health is one of the most important issues in the Sustainable Development Goals and science has shown that genetic predispositions are modified by environmental influences, such as those experienced during a pandemic. This affects learning capacities, adaptive behaviors, physical and mental health, and adult productivity. The closure of schools is, of course, harmful to children's education but schools are not just a place for learning – they are places where children socialize, develop emotionally and, for some, they provide a refuge from troubled family life. Children are not always at the forefront of pandemic discussions but they risk being among their biggest victims, as their lives are being changed in profound ways. Thus, this chapter focuses on the conditions and problems faced by children during the COVID-19 pandemic.

In Chapter Eight, **Dr. Esther Shirley Daniel, Dr. Gloria Ramdeen-Mootoo, and Dr. Gavaskar Ramnanansingh** discuss the mental health of nursing students during COVID-19 pandemic, as they cared for patients. The aim of this study was to assess the mental health of undergraduate nursing students during the pandemic, particularly in relation to depression, anxiety, and stress in a nursing school in Trinidad and Tobago. The study was a descriptive, quantitative, cross-sectional web-based study in which participants (n=65) were selected via random sampling. The DASS-21 item self-administered questionnaire, consisting of questions that assessed the desired variables, was applied. Multivariable statistical methods were

applied to identify independent predictors for depression, anxiety, and stress among the participants.

In Chapter Nine, **Dr. Jennifer Cole** highlights the need to provide healthy environments to maintain human health, including psychological health, into the future. ‘Lockdowns’ measures, first put in place to control the spread of the COVID-19 pandemic in early 2020, limited the spread of pathogens but also reduced social contact and movement, separating and isolating people. Such measures present a challenge to mental health at the very time when reassurance and support is needed. Those at risk need to be simultaneously distanced from the disease (to avoid exposure) and able to discuss with, and learn about the situation from others, to understand the risks and how to avoid or manage them, as well as to remain socially connected. Online discussion forums offered places in which people could be physically isolated but socially connected, creating safe space where communities could gather to provide agency, support health literacy, and improve resilience, both for psychosocial wellbeing and for managing infection exposure. During the pandemic, online forums became places where safe pandemic encounters could take place. Through a case study of *r/COVID-19_support*, an online forum set up on the popular platform Reddit, the different characteristics of such spaces are explored and critiqued.

In Chapter Ten, **Dr. Emmanuel J Johnson** presents his study on suicide in Guyana as a serious social problem: Guyana is ranked first in suicides per capita worldwide and the mental health impacts of the pandemic may see an increase in the stresses that led young people to consider suicide. Qualitative data was collected from key members of the Essequibo community in Guyana. One focus group was held to collect data, where experiences were explored and strategies for self-care were exchanged. The focus group consisted of key players in the community with first-hand experiences of interacting with adolescents who have attempted suicide and survived. Findings revealed that domestic issues, rumors of relationships, verbal abuse by parents, and low self-esteem are some of the causes of attempted suicide. Self-care strategies and suggestions were discussed to prevent suicide attempts. The study gives insights into some of the causes of suicide as well as strategies for self-care among those involved in providing support for people who have attempted suicide and their families.

In Chapter Eleven, **Dr. Emmanuel J Johnson, and Ms. Aleisha Udit** further investigate the experiences of practitioners who engage with adolescent suicide attempt clients in Guyana. The aim of this study was to

explore the practitioners' experience in dealing with adolescents who had made a non-fatal attempt to commit suicide. Qualitative data were collected from thirteen female practitioners aged 23 – 51 years who were purposively selected, and who were working with the suicide call center run by the welfare office of the Police Department, Guyana. The findings indicate that there is a need for more systematic counseling and support services to reduce suicide attempt cases. Research reiterates that domestic issues, rumors of relationships, verbal abuse by parents, and low self-esteem are some of the causes that drive people to attempt suicide: all issues that may have become more acute during pandemic lockdowns and restrictions. Self-care strategies and suggestions were discussed to prevent future suicide attempts. The psychosocial stress reported by suicidal adolescent callers in this study is convergent with earlier findings and highly topical considering the increased stress levels reported during COVID-19 in earlier chapters by school children, college age students, student nurses, healthcare professionals and the public at large.

CHAPTER ONE

MANAGING THE COVID-19 PANDEMIC: INDIA'S PUBLIC HEALTH RESPONSES AND STRATEGIES

S.M. VANMATHI AND M. MAYILVAGANAN

Abstract

India is home to a sixth of the world's population. The public health response to COVID-19 was highly centralized, resulting in a homogenous strategy applied across the entire country. The Indian Government instigated a nationwide lockdown on March 24, 2020, when numbers of COVID-19 infections were increasing rapidly. Subsequently restrictions were relaxed in three phases, starting from June 2020. This chapter examines the public health response to COVID-19 in India beginning from April 27, 2020, when national guidelines required all symptomatic patients and families be transferred to healthcare facilities and isolated away from their homes, with entire neighborhoods being declared containment zones. There was an initial rush to build new COVID-19 hospitals and to secure ventilators. This strategy, while essential, aimed at distancing those who were infected from society overall, overwhelmed the healthcare system in India's most populous cities, including Mumbai and Delhi, and impeded access to non-COVID care. In addition, the resultant fear and stigmatization resulted in delays in seeking timely care for a variety of conditions, and violations of privacy.

Most people with COVID-19 can be cared for at home: there was no justification for institutionalizing those with mild or no symptoms. Where isolation was essential but impossible, dignified quarantine facilities could have been constructed in the community, as was done in the densely populated slums of Dharavi in Mumbai; mandatory use of facial coverings would also have played a substantial mitigating role. The attention placed on potential new drugs and vaccine development was significant but

distracted from the importance of testing, contact tracing, and safe work environments across India. For months, physicians were barred from testing asymptomatic patients. Although India's daily test count later grew exponentially, it remained low, at around 0.35 per 1000 people as of August 2020, when the global pandemic was at its peak. Publicly shared data were not disaggregated enough to shed light on local incidence, or on the demographic determinants that might have explained the country's low reported infection fatality rate. Thus, the main aim of this chapter is to assess India's public health emergency response to COVID-19 as a case study of the pandemic and, in the process, understand what would need to be improved to attain a virus free society more quickly in future such emergencies.

Keywords: Public health, COVID-19, India, healthcare system, emergency response

Introduction

In recent decades, several new diseases have emerged in different geographical regions, caused by pathogens such as Ebola virus, Zika virus and Nipah virus, and coronaviruses (CoVs), including severe acute respiratory syndrome (SARS-CoV) and Middle East Respiratory Syndrome (MERS-CoV). The emergence and spread of the novel coronavirus (SARS-CoV-2) that emerged late in 2019 has threatened global public health. Coronavirus disease 2019 (COVID-19) is the novel respiratory disease caused by SARS-CoV-2. On January 30, 2020, the World Health Organization (WHO) declared COVID-19 a Public Health Emergency of International Concern and, on February 28, 2020, it raised the global risk of COVID-19 to the highest level. On March 11, 2020, a global pandemic was declared. Given the rapid global spread of SARS-CoV-2, there was an urgent need for large-scale data analysis and clinical research of cases worldwide. This was needed to improve understanding of the epidemiology and clinical characteristics of SARS-CoV-2 and to reveal pathogenic mechanisms and potential risk factors. Many studies and case reports have begun to answer these questions.

COVID-19 – spread by transmission of SARS-CoV-2 to and between humans – was reported first in Wuhan, Hubei Province, China in December 2019. Gradually, COVID-19 rapidly spread worldwide, creating a pandemic. By 9 December 2020, nearly a year later, there had been 68,568,678 cases reported globally and 1,563,132 reported deaths, affecting 220 countries and territories around the world. Europe, North America, and Asia were the

most affected continents. Despite rapid development of knowledge, precautionary measures, and clinical trials, researchers, regulatory bodies, and government administrations faced a great challenge globally in preventing the COVID-19 pandemic. Pandemics have occurred throughout history, and have had a severe impact on human lives, economy, and the affairs of state. The global battle against SARS-CoV-2 was complicated by multiple mutant variants of virus that were first recorded in the UK, South Africa, Brazil, and other regions. In short, the emergence and large-scale outbreaks of SARS-CoV, MERS-CoV and now SARS-CoV-2 indicate that infectious diseases caused by coronaviruses are a serious threat to global health and economy. With changes in global climate and ecological environments, and increased opportunities for human-animal contact, it is probable that novel viruses will continue to appear in the future, with harmful consequences to human health (Dhama K et. al, 2020). Hence, more effective, and constant public health responses and strategies must be put in place to contain emerging global health threats.

COVID-19 and its impact

The novel disease COVID-19, caused by a new strain of coronavirus, was first recorded in Wuhan, a city in the Hubei Province of China at the end of 2019 and soon spread to different parts of the world. The virus was mostly spread through person-to-person contact, when people with COVID-19 expelled tiny droplets containing the virus while breathing out or coughing. These droplets then entered the mouth, nose, or eyes of someone who was in proximity, causing an infection to occur. Once infected, common symptoms of COVID-19 are fever, breathlessness, cough, sore throat, headache, muscle pains, chills, and loss of taste or smell, which may occur 2–14 days after exposure to the virus. Many infected people are asymptomatic, however. Nearly all countries where COVID-19 was recorded had high fatality rates compared with seasonal influenza or other respiratory diseases and hence went into some form of lockdowns, with subsequent gradual relaxation.

Vulnerable populations

As an emerging infectious disease to which people had no prior natural immunity or, initially, vaccination protection, the entire global population was vulnerable to COVID-19. However, most patients who were seriously affected were above the age of 30 (of 44,672 cases analyzed in an early study, 77.8%, were between 30 and 69 years of age) with a median age of

42–59 years (Guan, W., et al. 2020; Huang, C., et al. 2020; Ki, M., 2020; Li, Q., et al., 2020). Most patients were 50 years of age or older (Chen, N., et al., 2020; Yang, Y., et al., 2020) and less than 1% of patients were under 10 years of age (Lanzhou University, 2020). Although these studies showed higher incidence in men than in women, the difference was not statistically significant. However, based on a meta-analysis of 77,932 patients, it was confirmed that the morbidity (OR = 1.12; 95% CI = 1.01–1.25), severity (OR = 1.63; 95% CI = 1.28–2.06), and mortality (OR = 1.71; 95% CI = 1.51–1.93) of males was significantly higher than those of females (Wei, X, et al., 2020).

Elderly people with hypertension, asthma, diabetes, and other underlying diseases had a significantly increased risk of infection. Studies showed that 36.8% of patients with visible SARS-CoV-2 infection had underlying diseases, with the most common being hypertension (18.6%), cardiovascular disease (14.4%), and diabetes (11.9%) (Rodriguez-Morales, et al., 2020). Older patients (>60 years of age) with underlying diseases, such as cardiovascular disease was particularly vulnerable to severe illness (Wu, Z., and McGoogan, J. M., 2020). Infections on *The Diamond Princess* cruise ship, important in the early stages of the pandemic as a microcosm of community infection, confirmed that all races could be infected. However, studies showed that people with blood group A had a significantly higher risk for SARS-CoV-2 infection compared with non-A blood groups, and that ‘O’ blood group had a significantly lower susceptibility for the infection compared with non-O blood groups (Zhao, J., et al. 2020). In summary, although the general population was vulnerable to SARS-CoV-2, several studies showed that the population most at risk from SARS-CoV-2 infection was characterized by older men and people with underlying health conditions. Children and infants could be infected but tended to have much less severe outcomes (Liu, W., et al., 2020). People with lower immunity were more vulnerable to SARS-CoV-2.

Clinical characteristics

The typical clinical symptoms of COVID-19 are fever, fatigue, and dry cough. Other, less common clinical symptoms include wet cough (including with blood), headache, nausea, vomiting, and diarrhea. Chemosensory dysfunction, such as loss of smell and taste, is also closely associated with COVID-19 infection but is usually recovered within 2 to 4 weeks after infection (Yan, Y., et al., 2013). Some confirmed patients are asymptomatic (Chang, D., et al., 2020) or have low fever, mild fatigue, or other symptoms

without presenting with pneumonia, and most recover without medical intervention after one week (Wenxiao Tu, et al., 2020). A meta-analysis of several research studies identified the following abnormalities in blood indicators: decreased albumin (75.8%), increased C-reactive protein (58.3%), increased lactate dehydrogenase (LDH) (57.0%), decreased lymphocytes (43.1%), and increased erythrocyte sedimentation rate (ESR) (41.8%). In addition, chest X-ray examination revealed that serious cases of novel coronavirus pneumonia presented with bilateral lung injury (72.9%) which was primarily characterized by ground-glass opacities (68.5%) (Rodriguez-Morales, et al., 2020). The CT imaging analysis of 130 COVID-19 patients in China showed that their distribution centered in the subpleural and lobular zones, with the two possibly merged into a sheet or progressing into biolab diffuse opacities, in severe cases. During the recovery period, the margins of consolidation opacities contract, the bronchi expand, and subpleural linear or fibrous opacities are the primary features (Wu, J., et al., 2020). Lung lesions in recovered coronavirus pneumonia patients disappear completely on CT, and there are no symptoms of fibrosis, which differs from SARS.

The clinical classification of COVID-19 is primarily divided into mild, normal, severe, and critical, based on clinical symptoms, clinical indicators, and imaging (Kenneson, A., and Cannon, M. J., 2007). An early analysis of the clinical typing of 1,099 confirmed patients found that the proportion of severe patients was 15.7% (Guan, W., et al., 2020a). For instance, classification of the 8,866 patients in China found that the proportions of severe, normal, and mild cases were 25.5, 69.9, and 4.5%, respectively. The study reported 18.5% critically ill patients among 72,314 patients (Yang, Y., et al., 2020).

In summary, most early COVID-19 patients – before vaccination or specialist treatments were available – were of the normal and mild types. Analysis of clinical characteristics showed that critically ill patients were presented with moderate to low fever (or even no obvious fever, in some cases), with dyspnea – shortness of breath – presenting after the first week. In severe cases, they progressed rapidly to acute respiratory distress syndrome (ARDS), septic shock, metabolic acidosis, which was difficult to correct, and coagulopathy (Wenxiao Tu, et al., 2020), as well as injury to the kidney, heart, and other organs, and even multiple organ failure (Wang, D., et al., 2020). These clinical symptoms suggested that SARS-CoV-2 infection, in addition to affecting the lungs, also had clinical presentations that involve invasion of other organs such as liver, kidney, heart, esophagus, bladder, ileum, and pancreas (Liu, F., et al., 2020).

Later reports suggested that human liver ductal organoids are permissive to SARS-CoV-2 infection and support robust replication, which impaired the barrier and bile acid transporting functions of cholangiocytes, indicating a potential cause of liver damage by viral infection (Zhao, J., et al., 2020b). However, liver damage in patients with SARS-CoV-2 infection may not be directly caused by viral infection, but by the systemic inflammatory response caused by therapeutic drugs or pneumonia (Chai, X., et al., 2020). In addition, studies have confirmed that renal insufficiency is already common as an underlying health issue in patients with COVID-19, which may be one of the main causes of COVID-19 eventually leading to multiple organ failure and even death in such patients (Li, Z., et al., 2020). However, the same study reported that, among sixty-two patients with SARS-CoV-2 infection in Zhejiang, China, kidney damage was rare (Xu, X. W., et al., 2020). This may be due to factors such as the timely admission of diagnosed patients, small sample size, or the virulence of the virus which may decrease with increasing passage number.

The results of different analyses of the clinical characteristics of COVID-19 by different researchers in early studies were inconsistent and were likely affected by factors such as the region from which samples originated, sample size, methods of analysis, and the level of expertise in the local medical center. By comparing the sex-related hormones between 81 women of childbearing age and 100 men infected with novel coronavirus, it was found that serum luteinizing hormone (LH) increased significantly, but the ratio of testosterone (T) to LH and the ratio of male follicle stimulating hormone (FSH) to LH decreased significantly (Ma, L., 2020), which may account for gender differences in recorded cases and disease progression.

Disease complication

Acute Respiratory Distress Syndrome (ARDS) is one of the major complications of SARS-CoV-2 infection. An early study involving 138 patients in Wuhan, China showed that 19.6% of the patients developed ARDS. Other common complications identified in this study included shock (8.7%), arrhythmia (16.7%), and acute cardiac injury (7.2%) (Guan WJ, et al., 2020). Patients who were admitted and received care in the ICU were more likely to develop these complications than non-ICU patients (Wang D, et al., 2020). Another study including 191 patients in Wuhan, China showed that the most common complication was sepsis (59%) followed by respiratory failure (54%), ARDS (31%), heart failure (23%), and septic shock (20%). Other less frequent complications included coagulopathy

(19%), defined as 5-s extension of activated partial thromboplastin time or 3-s extension of prothrombin time, and acute cardiac injury (17%) defined as elevated high sensitivity cardiac troponin I to above the 99th percentile of the upper reference limit or new EKG and/or echocardiogram findings. Non-survivors suffered more of these complications compared to survivors. Cardiac events such as new or worsening congestive heart failure, myocardial infarctions, arrhythmias, and cardiac arrest occurred more frequently in patients with associated pneumonia (Zhou F, et al., 2020).

In severe COVID-19 disease, hypercoagulability can be stimulated by endothelial cell dysfunction, increased blood viscosity from hypoxia, or hypoxia-induced transcription factor-dependent signaling pathway (Gupta N, et al., 2019). Acute venous thromboembolism (VTE) has been reported in patients with SARS-CoV-2 infection. A Dutch study involving 184 ICU with proven COVID-19 found a 31% incidence of thrombotic complications, of which 27% comprised of radiographically confirmed VTE. Pulmonary embolism (PE) was the most frequent of these thrombotic complications (Klok FA, et al., 2020). Another study in Wuhan, China showed that sixty-six out of the 143 hospitalized patients with COVID-19 included in the study developed a lower extremity deep vein thrombosis (DVT). Their analysis suggested multifactorial causes of DVT in these patients including older age, more severe illness, more chronic illness, stasis, and high thrombotic and inflammatory abnormalities (Zhang L, et al., 2020). Further, a case report by Danzi et al. described the case of a 75-year-old COVID-19 positive hospitalized female radiographically diagnosed with a pulmonary embolism who had no other predisposing factors other than the acute infection with COVID-19 (Danzi GB, et al., 2020).

Risk factors are associated with the severity of the disease.

Many of the early studies described above showed that severe illness and death was more likely to occur in patients with certain risk factors including older age and underlying medical comorbidities. A study by Wu et al. showed that among 44,672 cases of COVID-19 in Wuhan, China, most patients were 30 to 79 years of age (87%) followed by those aged 80 years and older (3%) while only 1% were aged 9 years and younger (Wu Z, McGoogan JM., 2020). Older age was quickly identified as one of the risk factors associated with poor prognosis and death (Zhou F, et al. 2020). Similarly, a study by Guan et al. showed that those with severe diseases were older by a means of 7 years compared to those with mild disease (Guan WJ, et al. 2020). A retrospective case series carried out in New York showed

that among 393 patients with confirmed COVID-19, 60.6% were males. Also, males were more likely to receive mechanical ventilation (Goyal P, et al. 2020). However, this correlation does not imply causation since this study did not adjust for other medical comorbidities. The study by Guan et al. showed that patients with severe disease were more likely to have an underlying coexisting illness compared to those with non-severe disease (38.7 vs. 21%) (Guan WJ, et al., 2020). Another study, in Wuhan, China, showed that among 191 patients with COVID-19, hypertension (30%) was the most reported comorbidity followed by diabetes (19%), coronary heart disease (8%), and chronic obstructive lung disease (3%) (Zhou F, et al. 2020).

According to data from the United States CDC, among 7,162 patients with reported medical problems, diabetes mellitus (10.9%), chronic lung disease (9.2%), and cardiovascular disease (9.0%) were the most reported comorbidities. Immunocompromising conditions (3.7%) and chronic kidney diseases (3%) were also reported (Chow N, et al., 2020). In a case series study in New York including 5,700 patients with COVID-19 infection, the most common comorbidities in hospitalized patients were hypertension (56.6%), obesity (41.7%), and diabetes (33.8%) (Richardson S, et al., 2020). Obesity was found to be a risk factor for intubation in a retrospective cohort study of 124 patients with SARS-CoV-2 infection. Of the patients who were intubated, 47.6% had a body mass index (BMI) > 30 kg/m² and 28.2% had a BMI > 35 kg/m² (Simonnet A, et al., 2020).

Socioeconomic impacts of the COVID-19 outbreak

COVID-19 affected everyday life and hindered the worldwide economy. The pandemic impacted social life for people all over the world. Many countries locked down facilities, amenities, educational institutions, industrial sectors, and marketplaces to prevent the spread of infection. Nearly all trade and business sectors were severely influenced by the pandemic. Some of the most significant impacts and concerns on the healthcare services, economy and social life are outlined below.

Human services (healthcare) impacts

- Difficulties in the identification, isolation, and treatment of suspected or infected patients
- Overburdening of medical and clinical professionals
- Patients suffering or diagnosed with other diseases were affected due to healthcare resources shortages.

- An overload of cases decreased medication availability and depleted resources in medical shops.
- High assurance was needed to keep patients confident.

Monetary (economy) impacts

- The availability of basic products was reduced.
- Disruptions were experienced in the supply of a broad range of essential goods and services.
- Loss of national and global trade
- Reduced income in many global markets.

Social impacts

- Distancing from family, friends, and relatives was widely imposed.
- Cafeterias, restaurants, shops, recreations centres, and gyms were locked down.
- Service sectors struggled to provide adequate support.
- Local, national, and international sporting activities stopped.
- Tourism was severely affected.
- Festivals and religious observances were cancelled or curtailed.

COVID-19 impacted the worldwide economy. The Indian economy faced a major downturn: the COVID-19 lockdowns resulted in an 8% output loss; gross domestic production decreased by 0.4% and 0.1% at end of 2020 and in March 2021, respectively. The unorganized workforce was adversely impacted, as were the banking and corporate sectors: the impact was felt across all sectors and social groups.

India's public response and strategies

According to the Global Health Security Index 2019, India ranked 57th among 100 countries on a scale to gauge preparedness for an outbreak of serious infectious diseases (GHS Index 2019). Densely populated cities, low public awareness, and unhygienic conditions were able to turn any outbreak into an epidemic in a matter of days. Shortage of health facilities such as hospital beds, rapid testing facilities, healthcare equipment, and quarantine facilities laid an immense burden on an already over-stretched healthcare system. India, with a population of more than 1.38 billion, was dependent on having robust and evidence-based healthcare management and action plans in place, along with extraordinary monitoring, supervision, and continuous assessment to control the pandemic. While maintaining an

effective screening system was a priority, it will be important in future to ramp up preparedness to meet any major outbreak when it occurs. At the beginning of the COVID-19 pandemic, India had neither the infrastructure nor sufficient preparedness to face the challenges, though containment facilities were quickly established, and human resources were trained in handling patients to minimize chances of virus spread (Tabish SA., 2009).

India had two major challenges: the size of population and limited resources. Rapid diagnosis was a critical aspect in the collective response to COVID-19. Some states in India experimented with containment zones. They considered employing the Cluster Containment Strategy, which included containment of the pandemic within a defined region with a high rate of infection, and thus preventing its spread to new areas. Another approach, the Bhilwara model, included a complete citywide curfew, extensive follow-up and testing of its residents, and travel bans. This approach proved to be more flexible and efficient. After implementation of this approach, an intensive risk communication campaign was employed to encourage the citizens to stay in their homes for an initial period of 28 days, which was later extended after subsequent risk assessments. The Government of India decided to divide the entire country into three regions: red, orange, and green, based on the severity of the infection rates. Then, the restrictions were lifted in a staggered manner. This initially proved to be an effective strategy for containing the virus.

Strategies

In a comprehensive strategy to prevent the spread of virus, India adopted four basic strategies: early detection and isolation; surveillance of clusters and designation of containment zones; strengthening health infrastructure such as intensive care and securing medical equipment including ventilators and ECMO; and, finally, containment measures such as lockdowns. However, health professionals had insufficient PPE and there was a shortage of ventilators and PPE across the country. Passengers arriving from foreign countries were tested at airports, and subsequently those who were in contact with them, if the passengers tested positive. India lagged on testing initially however, with on average only 10,000 tests conducted a day, which was too small for a huge population of 1.38 billion. The contact tracing was also weak early in 2020.

For infected people, a three-tier arrangement was made. First, those who had mild and very mild symptoms were allowed to be treated at home (an initial policy of isolating them in temporary COVID Care Centers was soon

relaxed), whereas patients with moderate symptoms were kept in hospital, and patients with severe symptoms were kept in dedicated, isolated wards of COVID Health Centers within existing hospitals that had all the necessary facilities. The Government of India launched a mobile application called *Arogya Setu* on April 2, 2020, as a way of informing the population about their potential risk of infection, contact tracing and medical advisories. Meanwhile, the Indian government ordered a nationwide lockdown on March 24, 2020. The immediate imposition of the lockdowns affected migrant workers, daily wage earners, manual laborers, and informal workers, most of whom were left to fend for themselves. Hundreds of thousands of migrants had to walk over long distances to reach their homes in rural areas of states such as Bihar and Odisha, as they had no job or source of income in locked down metropolitan cities.

Management: Contact tracking applications

Speed and ease of communication is at the heart of controlling the spread of any infectious disease as it helps to build extensive surveillance, shares epidemiological data, and enables patient monitoring. Mobile phones, and especially smart phones with the help of various mobile apps (software applications) aided speedy connectivity, remote access to data and information, electronic reporting, epidemiological data basing, collection of real-time geospatial information, and digitized the process of contact tracing, helped to create more complete and shareable records, and enhanced coordination among regional, national, and global health agencies (Nayak, S., et al., 2017). Further, smart phones embedded point-of-care testing and self-reporting facilities which helped to reduce the risk of contracting COVID-19 by helping actual and suspected patients with mild symptoms under self-quarantine to report remotely without going to crowded hospital or healthcare centers. The World Health Organization (WHO) also launched a mobile app to accurately track and trace COVID-19 cases. There are several more social contact tracing apps available for the citizens of many countries to help inform people of their own health and to help governments to maintain strategic control, for instance, ‘Arogya Setu’ in India, ‘Covid Watch’ in the US, ‘NHS COVID-19’ in UK, and ‘Alipay Health Code’ in China.

Second wave

As seen in multiple previous pandemics, including the influenza pandemic of 1918-20, the first wave is often followed several months later by a second

wave of infections that could potentially be even worse than the first. A second wave of disease can be caused by a region being re-exposed to infection by an influx of infected people from another region, by a new mutation of the disease re-infecting people who have immunity only to the original virus, or because immunity from a previous infection has waned. The degree of severity of the resulting new outbreak will depend on the level of immunity from the initial wave. In India, the second wave of COVID-19 was influenced by multiple factors including waning immunity in the population and exposure to the virus of people who were not immune (i.e., who had not caught it in the first wave). During the first wave of COVID-19 in Indian, mitigation strategies did prove effective at controlling the pandemic in several regions. A study by Aleta et al. showed that removing these restrictions could have led to the second wave of COVID-19 infections and that while this could have overwhelmed the health care system (Aleta A, et al., 2020), combining it with enhanced testing and contact tracing reduced transmission and allowed the reopening of economic activities (Sohrabi C, 2020).

The sharp spike in COVID-19 cases in India in March 2021 was termed a second wave by the media. As per a *Hindu* news report, cases in India increased from 11,107 on February 15, 2021, to 37,223 by March 21, 2021, in just 35 days (Vignesh Radhakrishnan, et al., 2021). As per the Indian government's Ministry of Health and Family Welfare data, more than 80% of new COVID-19 cases were from six states alone: Maharashtra, Punjab, Gujarat, Chhattisgarh, Karnataka, and Kerala – though the spike was also attributed to the higher testing levels in some states/provinces in India, not necessarily higher incidence of disease. According to K Srinath Reddy, President of the Public Health Foundation of India, and adjunct professor of epidemiology at Harvard TH Chan School of Public Health, the second wave was caused by laxity: abandoning COVID-19 precautions such as wearing masks, reopening crowded places, allowing celebrations, and having public meetings, including many elections that were held at local and assembly levels (Govindraj Ethiraj, 2021). A State Bank of India (SBI) research report titled *the second wave of infections: The beginning of the end* pointed out that vaccination – which by this stage was becoming more widely available – would be more effective than lockdowns in beating the second wave (Rahul Shrivastava, 2021).

Vaccination: Opportunities and Challenges

Generally, the clinical development of a new vaccine requires many years of effort and clinical trials. However, the milestone experience of the rapid development of a successful vaccine for severe human foot and mouth disease (HFMD) caused by EV71 virus in the early years of the 21st Century, has shown that it is possible to develop vaccines against an emerging virus quickly (Deng, M. P, et al., 2012). Moreover, previous efforts related to SARS CoV and MERS vaccine research were available, meaning that the first steps in responding to the threat of the new virus by developing an effective vaccine had already been taken. For vaccine developers, attention was focused on the safety evaluation of a new candidate vaccine against SARS-CoV-2 in humans. As the immune response to the virus plays a major role in the pathogenesis of SARS-2 infection, it was important to ensure that vaccine should not induce immunopathological injury of host cells. In this regard, the foremost issue considered was the type of vaccines available and the immunogens selected. Another scientific challenge was having effective strategies of vaccine delivery. Evidence of respiratory tract infection and findings of SARS-CoV2 in stool samples (Amanat, F., Krammer, F. 2020) suggested that mucosal delivery routes by oral or aerosol administration of vaccines were possible modes of SARS-CoV-2 immunization.

By 2021, epidemiological studies had shown that the disease caused by SARS-CoV-2 was significantly associated with a higher age, with individuals above 50 years of age often exhibiting more severe pathology following infection and more likelihood of dying from infection. In many viral infections, immunologically naive younger individuals experience milder manifestations of the disease. Because the health of older people was affected more strongly, vaccination as a public health measure was prioritized to protecting this vulnerable population (Sambhara, S., McElhaney, J. E., 2009). It is precisely in this population that vaccines are the least efficacious because of immune senescence – the graduation deterioration of the immune system with age (Pang, J., 2020) – meaning that second doses and boosters were needed in swift succession to provide lasting immunity.

Several successful SARS-Cov-2 vaccines were developed and became available throughout 2021, including ones developed by Oxford University/AstraZenaca, Pfizer and Moderna, and marketed as Covishield™, (the Oxford/AstraZenaca vaccine manufactured by the Serum Institute of India) and Covaxin™, manufactured by the Bharat Biotech in collaboration with the Indian Council for Medical Research. Responsible access to these

vaccines was part of global efforts. India and China displayed considerable ‘vaccine diplomacy’ – supplying their COVID-19 vaccines to other countries and making them available to everyone in the world in an affordable way, despite the challenges inherent in this. Nonetheless, regardless of the availability of the vaccine, social, clinical, and economic hurdles faced the vaccine rollout and vaccination programmes including, for example, hesitancy among some sections of the public to get a vaccination or booster due to concerns over possible adverse reactions (which were often significantly overstated in the media) and potential variations in the efficiency of different vaccines (Sen-Crowe, B., McKenney, M., Elkbuli, A., 2020).

Way forward and lessons learned

The pandemic took many lives. As it develops and as it recedes into the past, there are innumerable lessons to be learned for future pandemics. First, it is essential to ensure that not only do all countries of the world take notice of the early monitoring systems for potential global health emergencies but also that they take appropriate action once potential threats are detected. For all the accusations of lack of transparency levelled at China, barely a few weeks passed between the first cases of an unusual influenza-like illness being detected and China’s notification to WHO, after which nearly three months passed between WHO’s notification to its member states and the instigation of lockdowns in most of those countries: appropriate actions need to be taken more quickly. In future, once high-risk areas are identified, precautions including travel restrictions and quarantines should be implemented as soon as a possible health threat is identified – and much sooner than they were in the early days of the COVID-19 pandemic. It crucial to implement population-based interventions including social distancing, quarantine, and isolation actions promptly. Secondly, it is imperative for healthcare systems, along with local, regional, and global forces to work together to ensure better preparedness for future pandemics in all aspects including staffing, supplies, the number of hospital beds, testing capacity, research and development, and policy. A high price was paid for these difficult lessons to be learned, so it is now everyone’s responsibility to dedicate the appropriate funding and effort to prevent this level of catastrophe from repeating itself (Lu, S., 2014). On a more positive note, clinicians and scientists across the globe displayed admirable transparency in sharing important information as soon as it was detected, on the sequenced genome of the virus, on the emergence of new variants, on potential treatments and on vaccine development, manufacture, and