REVIEW ARTICLE

Community Engagement and Public Health Strategies in Mitigating the COVID-19 Pandemic: Lessons for Future Preparedness

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ABSTRACT

Community-government engagement was vital in mitigating the global spread of COVID-19. A well-informed community that supported governments' initiatives help reduce transmission and improve public health outcomes. This review examined academic and grey literature retrieved from PubMed, Scopus, Google Scholar, and Google searches, covering the pandemic period, alongside pre- and post-pandemic sources to provide comprehensive insights. Keywords were refined to capture government-community engagements in pandemic response. Four key domains emerged: (1) the role of community health workers and community-based support systems; (2) government-led interventions, including enforcement of SOPs, movement control orders, quarantine, and vaccination roll-outs; (3) adoption of digital technologies such as contact tracing apps and telemedicine; and (4) socioeconomic support to mitigate the pandemic's impact. Examples from Malaysia and global contexts highlighted practical applications and lessons learned. Effective pandemic management requires sustained, coordinated government-community engagements, integration of digital tools, and targeted interventions to strengthen preparedness for future public health emergencies.
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INTRODUCTION

The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of Coronavirus Disease 2019 (COVID-19), shocked the whole world with its rapid spread since the end of 2019. On 30 January 2020, the World Health Organization (WHO) Emergency Committee raised concerns over the rising number of COVID-19 cases reported daily, prompting governments all over the world to impose lockdown measures to curb the spread of the disease [1].

Coronavirus was first identified in 1965 when Tyrrell and Bynoe successfully passaged a virus from the respiratory tract of a patient with common cold [2]. Due to its morphology resembling a solar corona with spherical virions, a core shell, and surface projections, the virus was termed a coronavirus [1]. Since the early discovery and that of SARS-COV-2, scientists have identified other variants of the virus. On the 3 August 2021, the CDC lists Variants of Concern (VOC), including: (1) Alpha (B.1.1.7), first detected in the United Kingdom (UK) in December 2020, (2) Beta (B.1.351), first identified in South Africa in October 2020, (3) Delta (B.1.617.2), a lineage of B.1.617 from India in October 2020, and (4) Gamma (P.1) initially detected in Japan in January 2021 [3]. These variants demonstrated increased transmissibility, higher risks of severe disease, hospitalization or death, and decreased efficacy of treatments, vaccines or diagnostic detection [4-7].

Individuals infected with the virus experienced mild to moderate respiratory symptoms unless they had comorbidities such as cardiovascular disease, diabetes,

or chronic respiratory illnesses. Older adults were also among those at highest risk of developing severe complications [8]. COVID-19 is primarily spread through respiratory droplets and aerosols, which can remain suspended in the air, especially in poorly ventilated indoor spaces [9-11]. Forceful exhalations such as sneezing, coughing, shouting, or singing, releasing larger particles and quantities of airborne particles [12,13]. Aerosolized droplets can travel up to four meters, remain viable on surfaces like plastic and stainless-steel for up to three days, and may even persist on the soles of shoes [14,15]. Indirect transmission may also occur via contact with contaminated surfaces. These multiple modes of transmission necessitated strict public health measures, including travel restrictions, quarantine, social distancing, and lockdowns. These, in turn, created challenges in executing face-to-face awareness campaigns, health education programs, and community outreach in both urban and rural settings [9-11].

By 24 October 2021, the global tally of confirmed COVID-19 cases had exceeded 243 million, with more than 4.9 million recorded fatalities since the pandemic began [16]. The United States recorded the highest number of deaths of more than 700,000 during that same period [17]. The first confirmed COVID-19 case reported in Malaysia was on 25 January 2020 [18]. By October 2021, Malaysia had reported over 2.3 million confirmed cases and nearly 28,000 deaths [19]. The country experienced multiple waves of infection, prompting various levels of Movement Control Orders (MCOs). These measures restricted mobility and public gatherings, significantly impacting community-level efforts in health promotion and risk communication [20].

In most countries, large gatherings and physical contact were restricted during the pandemic, making it even more difficult to reach communities through health awareness campaigns and outreach programs [21,22]. Fortunately, COVID-19 vaccines were developed and rolled-out at unprecedented speed to mitigate the spread of the disease. Distribution was accelerated globally via the COVAX initiative, a partnership involving WHO and other key organizations, to ensure equitable and timely vaccine access for all countries, regardless of income level [23].

Rural areas faced heightened risk of COVID-19 transmission, prompting governments to adopt systematic and inclusive strategies, rather than focusing only on urban populations [24]. Studies showed that rural communities had higher proportion of individuals with pre-existing health conditions compared to their urban and suburban counterparts, making them more susceptible to severe COVID-19 outcomes [25]. Additional barriers, including limited financial resources, shortage of healthcare personnel, and inadequate infrastructure, further complicated diagnostic testing access and enrollment in clinical trials among rural populations [25,26].

This narrative review explores the critical role of community health engagement, alongside government-led initiatives, digital technology integration, and inclusive public health strategies, in managing the COVID-19 pandemic and draws lessons to strengthen preparedness, response, and resilience for future global health crises.

METHODS

This review was developed through a comprehensive and structured literature search across several major databases, including PubMed, Scopus, Google Scholar, and Google search engine. These platforms were selected for their wide coverage of peer-reviewed biomedical literature and grey literature relevant to COVID-19 response strategies. The keywords used for literature search included: "COVID-19", "COVID-19 pandemic", "COVID-19 lockdown", "COVID-19 community health workers role", "COVID-19 contact tracing", "COVID-19 government response" and "COVID-19 interventions". These keywords were developed following an initial scoping review of titles and abstracts from related publications in PubMed and Google Scholar to identify frequently used terms in the literature. A pilot search was first conducted using broader terms (e.g., "COVID-19" and "community health") to evaluate the scope, relevance, and volume of search results. Based on the keyword frequency and thematic alignment, the final search terms were refined to ensure a balance between comprehensiveness and specificity, thereby capturing the core concepts relevant to government-community engagement during the COVID-19 pandemic.

The primary focus was on articles published between March 2020 and January 2022, in line with the timeline of the COVID-19 pandemic. However, earlier and post-pandemic publications were also considered when they provide important background or historical information, contextual insights, emerging perspectives, post-pandemic analysis and novel information.

The review focused on extracting qualitative themes and descriptive summaries relevant to public health practices and community-based responses. Topics of interest included roles and mobilization of community health workers (CHWs) and community-based support systems, government-led community health engagement or interventions (e.g., safety SOPs, contact tracing, digital tools, vaccination), socioeconomic support mechanisms to reduce pandemic-related economic hardship and strengthen community resilience, and key outcomes or lessons learned for building preparedness against future public health crisis. Both peer-reviewed and grey literature were included. This comprises empirical

study designs (e.g., case studies, observational reports) and reputable grey literature sources (e.g., official government reports, documents from international organizations such as WHO and CDC, established news outlets).

Articles were included if they met the following criteria: (1) addressed any form of community engagement or public health communication during the COVID-19 pandemic; (2) described implemented programs, tools, or strategies in response to the pandemic; and (3) were accessible in English and Malay Language. Articles were excluded if they focused solely on clinical treatment, diagnostics, or vaccine development without addressing community or public health engagement. Duplicates, opinion pieces without empirical or descriptive value, and non-English or Malay Language sources were also excluded.

In total, this narrative review includes 104 relevant sources, with 91 published within the pandemic period, covering diverse geographic regions, focusing on government-community-based COVID-19 pandemic responses. Key insights and findings from the included references have been synthesized and integrated into the review to support contextual discussion and recommendations.

RESULTS

The literature reviewed in this study highlights a wide range of government and community interventions that were implemented across different regions in response to the COVID-19 pandemic. These interventions span multiple domains, including public health measures, digital tools, vaccination strategies, socioeconomic support, and community-driven initiatives. To provide a structured overview, the key characteristics of major publications examined in this review, focusing on global, government and community interventions implemented during the COVID-19 are summarized in Table I.

1.0 Mobilizing Community Health Workers (CHWs) During the Pandemic

The devastating impact of the COVID-19 pandemic stemmed from its rapid and widespread transmission, resulting in high mortality rates around the globe, directly placing enormous burden on the global healthcare system [27]. In response, CHWs emerged as vital contributors to pandemic response efforts, particularly in low-resource and undeserved settings. Due to their essential roles, Haines et al. emphasized the need for proper and adequate training and education for CHWs as part of a large-scale emergency response programs, particularly focusing on pandemic-response aid [28].

In the United Kingdom, pandemic response strategies prioritized supporting the most vulnerable individuals within their homes, with the objective of establishing a sustainable, long-term community-based care model. This approach was inspired by the successful implementation of large-scale, community-based healthcare delivery workforce in Brazil, Pakistan, and Ethiopia, where coordinated efforts significantly improved health and social well-being [29-31].

CHWs are frontline public health professionals trained with proper knowledge and practice to monitor, educate, and support healthcare needs in the community, which became crucial during the pandemic [32]. A well-structured CHW response during the surge of infection should be systematically implemented to achieve the following goals: (1) protect healthcare workers, (2) disrupt chains of virus transmission, (3) sustain and enhance essential access to healthcare services, and (4) provide support for socioeconomically vulnerable groups. However, to fulfill these roles effectively, CHWs must be well-equipped and prepared to play a pivotal role in a pandemic response, especially in low-income nations with underdeveloped healthcare systems [33]. At the global level, this initiative is supported by the Community Health Impact Coalition (CHIC), a large network of healthcare practitioners from over 30 countries. The coalition is committed to implementing high quality, impactful community health systems through accredited CHW programs with sustainable financial support [34,35].

2.0 Contact Tracing Innovations

The spread of COVID-19 within the community could be halted through rapid and continuous testing, contact tracing, isolation and quarantine measures, spearheaded by professional frontliners and with the support of CHWs. In Italy, medical experts proposed that an epidemic (or pandemic on a global scale) requires a shift away from hospital-centered treatment towards a more community-based approach [36].

During the early phases of the COVID-19 pandemic, contact tracing was largely performed manual, placing the local public health authorities at a disadvantage, undermining the process of tracing where and with whom COVID-19 positive individuals may have interacted [37,38]. To address this, new digital solutions utilizing smartphone applications were developed to enhance the contract tracing process, and public acceptance was key to the success of these tools. Altmann et al., reported strong public support for app-based contact tracing in countries such as France, Germany, Italy, the United Kingdom, and the United States [39].

In Malaysia, contact tracing served as a fundamental strategy for managing the spread of COVID-19. The Malaysian Ministry of Health (MOH) spearheaded the adoption of digital tools such as the MySejahtera and MyTrace smartphone applications, designed to track infected individuals and identify those who had been in close contact with confirmed cases [40]. The

Table I: Community and Government Interventions Implemented During the COVID-19 Pandemic

Theme	Country / Organization	Intervention Type	Outcomes	References
Community Health Workers (CHWs)	Global (CHIC, CHW Central)	CHW programs with accreditation and financing.	Strengthened global health systems.	[34,35]
	United Kingdom	Community-based care model for vulnerable groups.	Established sustainable long-term care system.	[28]
	Italy	Proposal to shift from hospital-centered to community-based pandemic care.	Increased resilience of health services.	[36]
Public Health Measures	WHO, CDC, Multinational	Infection control guidelines: distancing (1–2m), PPE, isolation / quarantine practices, hygiene, sanitization, travel avoidance.	Standardized infection prevention and control in healthcare settings, reduced community spread, enabled early detection.	[13,57,63]
	WHO (Global)	Lockdowns as critical strategy.	Curbed community transmission.	[49]
	Malaysia	Movement Control Orders (MCOs) restricting mobility and gatherings.	Flattened transmission curve; reinforced health promotion and communication.	[20,40]
	China, Thailand	Nationwide lockdowns.	Significant drop in transmission growth rates.	[69,70]
	China	Construction of quarantine facilities (Huoshenshan, Leishenshan and Fangcang hospitals).	Expanded treatment capacity, though delayed action worsened global spread.	[66-68]
Digital Tools	Multinational	Wide adoption of national contact tracing apps.	Strong public support, enhanced tracing effectiveness, surveillance and case detection.	[39,43]
	Malaysia	Digital communication platforms: Ministry of Health website, Crisis Preparedness and Response Centre (CPRC) portal, Telegram.	Improved transparency, countered misinformation.	[42,79]
	Nigeria	Mobile positioning data for contact tracing.	Strengthened real-time monitoring and response.	[44]
Vaccination	Multinational (WHO, COVAX)	Vaccination roll-outs, with equitable access for low- and middle-income countries.	Accelerated access globally, indirect protection for vulnerable through herd immunity, decline in cases and healthcare burden.	[19,23,46]
	Multinational (Governments, CHWs)	Mass vaccination guidelines (rapid delivery, cultural adaptation, misinformation management).	Improved uptake and confidence.	[50]
	Multinational	Prioritization of healthcare personnel for early vaccination.	Protected frontline workers, reduced nosocomial risks.	[50]
	USA, Malaysia	Mobile vaccination units to reach remote populations.	Expanded coverage, improved equity.	[47,48]
Socioeconomic Policies	USA	Unemployment insurance (UI) up to 26 weeks.	Mitigated economic stress for unemployed.	[96]
	Canada	Expanded Employment Insurance (EI) covering childcare and family caregiving.	Supported households during closures.	[97]
	Malaysia	Economic stimulus packages such as PRIHATIN (PRIHATIN Rakyat Economic Stimulus Package) and PENJANA (National Economic Term Recovery Plan).	Wage subsidies, loan moratoriums, business and household support.	[98,99]
Community Solidarity	Netherlands	Volunteer grocery delivery for homebound residents.	Strengthened local resilience.	[100]
	Malaysia	Ramadhan crowdfunding for food distribution to low-income households.	Alleviated food insecurity during crisis.	[101]

* CHIC: Community Health Impact Coalition; WHO: World Health Organization; PPE: Personal Protective Equipment; CDC: Centers for Disease Control and Prevention; COVAX: COVID-19 Vaccines Global Access.

MySejahtera app has since been enhanced with many features including COVID-19 hotspot areas, self-health assessments, COVID-19 self-test integration, global update, registration and notification of vaccination status, and helpdesk functions, all aimed at improving public awareness and countering misinformation [40,41]. These tools facilitated real-time exposure alerts and centralized health data management.

Beyond mobile apps, the Malaysian government utilized multiple digital platforms, namely the MOH website, the Crisis Preparedness and Response Centre (CPRC) portal, and the CPRC Telegram channel, to effectively convey awareness and disseminate accurate COVID-19 updates to the public in a timely manner. Daily public briefings, recorded conference sessions, and frequent press release on COVID-19 situations further strengthened government transparency and countered misinformation [42].

Globally, numerous contract tracing apps were developed, including China's Health Code on Alipay, Hongkong's StayHomeSafe, the UK's NHS CV19, Singapore's TraceTogether, Australia's COVIDsafe, Israel's Hamagen, Vietnam's BlueZone and Stopp Corona used by Austria, among many others [43]. While highly effective in enhancing surveillance, their success depends on user adoption and digital literacy.

In some regions, particularly among rural and elderly populations, limited access to digital devices or stable internet connectivity hindered the effectiveness [39]. Nonetheless, countries like Nigeria have leveraged mobile positioning data to greatly improve surveillance and contact tracing capabilities [44].

3.0 Vaccination Roll-Outs

The WHO authorized several novel vaccines for emergency use in response to COVID-19 emergency health crisis. These included vaccines developed by Pfizer/BioNTech, AstraZeneca/Oxford, Janssen (Johnson & Johnson), Moderna, and Sinopharm/Sinovac [45].

The development and global distribution of COVID-19 vaccines were paramount to achieve herd immunity, reduce disease prevalence and ultimately break the chain of transmission. Herd immunity provides indirect protection to vulnerable groups, especially those who cannot be vaccinated due to medical conditions such as allergic reactions [46]. To expedite population coverage and move toward herd immunity, mobile vaccination units were deployed in countries such as the United States and Malaysia to reach undeserved communities and remote areas [47,48]. The proportion of the population that needs to be immunized to achieve herd immunity varies depending on the infectiousness of the disease. For instance, measles requires the vaccination of approximately 95% population coverage, whereas for polio, the threshold is around 80%. Unfortunately for COVID-19, it was difficult to determine the herd immunity threshold due to several factors, such as emerging variants, the variability of vaccine efficacy, the accuracy of diagnostic tests and differing immunization timeliness across regions [49].

Healthcare personnel were prioritized as the first group to benefit from the COVID-19 vaccination, given their frontline exposure. Subsequently, it was vital for governments to ensure rapid, large-scale vaccination roll-outs as vaccines became available. This effort was made possible and supported through collaborative initiatives involving government task forces, community-based organizations, and CHWs. DeRoo et al., proposed essential guidelines which ensured successful vaccination programs as follows: (1) rapid delivery and distribution of vaccines to the high-risk groups immediately upon approval, (2) a proactive COVID-19, culturally sensitive mass vaccination campaigns and programs, (3) promotion of vaccination information and debunking misinformation via public health officials, social media, and influential figures, and (4) promotion of real-life experiences from frontline healthcare workers on COVID-19 vaccination experiences to increase public confidence [50].

In Malaysia, national vaccination efforts showed positive outcomes. As of 17 October 2021, the country showed a decline in all epidemiological and healthcare burden indicators, coinciding with the vaccination status, where 93.8% of the adult population and 25.6% of adolescents had been vaccinated with the second dose of the COVID-19 vaccine [19].

4.0 Comorbidities and Vulnerable Populations

Comorbidities significantly increased the risk of severe illnesses and adverse outcomes from COVID-19 [51]. Individuals with pre-existing conditions such as hypertension and diabetes tend to experience worse prognosis, regardless of age, and are more likely to require hospitalization or intensive care support. Diabetes has been consistently associated with an increased rates of morbidity, mortality, hospitalizations, and intensive care unit (ICU) admissions among COVID-19 patients [52]. According to Zhao et al., patients with chronic obstructive pulmonary disease (COPD) and other respiratory illnesses are nearly four-times more likely to contract COVID-19 compared to those without these conditions [53].

A meta-analysis study revealed that male individuals, advanced age and presence of comorbidities have been strongly linked to greater disease severity and poorer prognosis of COVID-19 [51]. Another meta-analysis involving 1786 COVID-19 patients reported hypertension, cardiovascular and cerebrovascular disorders, and diabetes as the most common underlying comorbidities, while HIV and hepatitis B co-infection, malignancy, respiratory syndromes, renal diseases, and immunodeficiencies also contributed to increased susceptibility and poor outcomes, although less reported [52]. These findings strongly support the prioritization of vulnerable groups in public health interventions and national vaccination programs.

5.0 Public Health and Safety Measures for Containment

5.1 SOPs: Masking, Distancing, Hygiene and Sanitization

The most concerning aspect of the COVID-19 pandemic is its ability to spread via asymptomatic individuals. Throughout the pandemic, the basic reproduction number (R0) of COVID-19 fluctuated widely. A meta-analysis reported values ranging from 1.4 to 6.49, with a mean of 3.28, and a median of 2.79, which were higher than those reported for SARS outbreak caused by the original SARS-CoV [54]. For COVID-19, it was estimated that by 11.7 days after infection, 95% of the individuals began to exhibit symptoms [55]. Transmission in closed environments was shown to be significantly higher, with a 29.8-fold increased risk compared to open-air conditions [56].

In healthcare settings, suspected COVID-19 patients should be isolated in well-ventilated rooms. Healthcare providers (HCPs) should familiarize themselves with up-to-date infection prevention and control (ICP) guidelines. These may vary by region, with WHO recommending

the physical distance between individuals of 1 meter, Australia 1.5 meters and the CDC advising 2 meters [13]. In China, family-support caregivers were advised to adopt contact-droplet precautions, whereas the European Centre for Disease Prevention and Control (ECDC) advocated for the utilization of full personal protective equipment (PPE) when providing care in healthcare settings [13].

Due to the rapid COVID-19 transmission, WHO released recommendations and precautionary guidelines for the public to prevent its spread [57]. The highlighted precaution measures include avoiding travel to high-risk areas, social distancing, avoiding close contact with symptomatic individuals, and refraining from consuming meat from outbreak regions. The importance of basic hygiene practices such as frequent handwashing and face mask usage in public were also emphasized [57]. WHO also published a guideline annex on implementing adaptive public health and social measures in the workplace in response to COVID-19 [58].

The transmission of the COVID-19 in professional and home settings can be reduced with surface sanitization, ultraviolet-based disinfection, ventilation improvement, and High-Efficiency Particulate Air (HEPA) filtration [59]. Importantly, the key element to avoid the spread of COVID-19 virus transmission is through proper and enhanced ventilation systems by increasing the outdoor air change, constant supply of fresh air and elimination of air recirculation, and proper maintenance and instalment of air purifiers [60]. For better and more comprehensive prevention of COVID-19 outbreaks at the workplace, effective PPE usage, proper staff zoning, isolation of potential cases, and rapid identification of contact tracing must also be performed [61].

5.2 Quarantine and Lockdown Policies

The CDC and WHO have classified individuals as close contacts if/when they are within six feet of an infected person for 15 minutes or more, providing care, have direct physical contact (sharing meals or utensils) or exposed with respiratory droplets through coughing or sneezing of COVID-19 infected individuals [62]. During the pandemic, preventive recommendations to be observed upon positive diagnosis and close contacts included 14-day self-quarantine, paired with monitoring of symptoms such as fever, loss of taste or smell, and respiratory issues [63]. Presently, isolation guidelines for individuals who test positive for COVID-19 have evolved significantly with much reduced self-isolation period [64]. However, with the emergence of COVID-19 variants of concern such as Alpha, Delta, Omicron, extended self-isolation periods were recommended for senior citizens and vulnerable individuals due to their elevated risk of severe disease outcomes [65].

Despite the first reports of COVID-19 cases made on 31 December 2019, the Wuhan, China local authorities only began the quarantine measures on 23 January 2020, upon realizing the state of emergency and severity of the epidemic [66]. Close monitoring and isolation of suspected cases for diagnostic-treatment care were immediately implemented. The subsequent rise of confirmed COVID-19 cases prompts the construction of new facilities, Huoshenshan, Leishenshan, and Fangcang emergency hospitals. Eventually, the delay of this emergency announcement and public health interventions impacted the global economy and placed a major burden towards the healthcare system, making COVID-19 a deadly pandemic [67,68].

Globally, lockdown measures resulted in a significant drop of COVID-19 growth rate as observed in countries like China [69] and Thailand [70]. The movement control order (MCO) implemented in Malaysia successfully flatten the curve of COVID-19 new cases especially during the first wave of the pandemic from 18 March to 28 April 2020 [40]. The WHO emphasized the importance of timely lockdowns, reduced physical interactions and restricted movements in halting the community transmission of COVID-19 [49].

5.3 Surge of Cases due to Non-Compliance with SOPs

Malaysia in particular, experienced three major waves of COVID-19 cases; the initial wave reported 22 cases (January-February 2020), followed by the second wave with 5,945 cases (February-April 2020) [40]. A massive religious gathering in Kuala Lumpur contributed to a rapid surge in March 2020 during the second wave. Eventually, the cluster which ended in June 2020 resulted in 34 deaths [20]. The country initially was able to control the number of cases subsequently after; however, it experienced the third wave from September 2020, with 8,082 cases linked to the Sabah state election [71]. By 17 October 2021, Malaysia had reported 2,390,687 confirmed cases despite a population of only 32.7 million [19].

Similar surges of COVID-19 cases due to large gatherings occurred globally. In India, after the first wave in September 2020 [72], public non-compliance and mass gatherings, including national elections, and religious festivities and activities such as the Ganges River dip led to the second wave [73]. In a report on 3 May 2021, India became the first country to record over 400,000 new cases within 24-hours [74]. Other COVID-19 outbreaks were linked to a film festival held in the EL Gouna city, Egypt [75], EURO football championship 2020 in Europe [76], and religious gathering at Shincheonji Church in South Korea [77].

Public awareness and risk communication were pivotal in promoting SOP adherence and avoid surge of COVID 19 cases [78]. In Malaysia, the government through the CPRC and National Security Council (NSC) conducted daily press briefings and provided updates through mainstream channels, and social media platforms such

as Telegram [79]. Meanwhile, misinformation remains a critical threat to public health efforts, hence, should be countered by reliable, culturally tailored content delivered through trusted official channels [80].

6.0 Telemedicine and Remote Healthcare Solutions

The implementation of social distancing and self-isolation measures across the globe during the COVID-19 pandemic posed a major challenge to healthcare delivery. One of the most pressing concerns was to ensure that all people obtain accurate and updated information about the pandemic, as well as receiving appropriate healthcare services. Due to face-to-face restrictions, patients experienced difficulties accessing regular health assessments and consultations with healthcare providers [44].

The fast-changing world of technology, enhanced portability and accessibility of digital devices such as smartphones, has made these tools indispensable in daily lives including during the pandemic [81]. As portable electronics became more affordable and widely available, most households were reported to have at least one digital device. In recent years, telemedicine, also described as "healing at a distance" has gained traction in providing medical care in rural areas where access to healthcare facilities is often an issue [82,83].

The pandemic significantly accelerated this transition. Social distancing, quarantine policies and lockdowns implemented during the pandemic disrupted traditional healthcare services, prompting a global shift toward telemedicine. Telemedicine was able to minimize physical contact between healthcare workers and patients, thereby reducing the risk of COVID-19 transmission [81]. Remote live consultations via video calls, mobile apps, emails and chat platforms became the new norm and allows for management of routine check-ups, monitoring of patients, and even initial COVID-19 diagnoses [81].

In Malaysia, the MySejahtera app, initially launched for contact tracing, expanded into a more comprehensive public health platform. Its features include vaccine registration, health self-assessments, and hotspot tracking [41], makes it a telemedicine model for integrated digital public health systems. The application of these digital means of communication and resources in telemedicine are the new frontiers in the healthcare delivery systems and should be implemented widely, particularly during times of crisis.

However, the shift toward technology-based public health solutions came with both benefits and costs. On the positive side, telemedicine reduces healthcare facility congestion and minimizes infection risks, offers cost savings, as well as improves access and continuity during health emergencies. The pandemic has catalyzed its mainstream acceptance and underlined its potential for future healthcare delivery models. Nevertheless , it must be noted that the initial implementation required substantial investments. For instance, Malaysia's MySejahtera development and maintenance involved public-private partnerships with government funding [84]. In return, economic savings were achieved via reduced hospital visits, early detection, and more efficient outbreak containment. On the public side, many digital solutions were made free, but some communities, especially the elderly or rural populations, may face difficulties due to limited digital access, indirectly widening health disparities [85,86]. These concerns highlight the need for inclusive digital health strategies and better support systems for digital access. The pandemic has made it clear that telemedicine is no longer a complementary tool, but a central pillar of modern healthcare systems moving forward.

7.0 Mitigating Socioeconomic Impacts

The COVID-19 pandemic triggered a severe global economic downturn, disrupting livelihoods, supply chains, and labour markets worldwide. In 2020, the global economy contracted by 3.1% [87], marking the deepest recession since the Second World War, with over 114 million jobs lost, predominantly in low- and middle-income countries [88,89]. The crisis disproportionately affected vulnerable populations, exacerbating income inequality and pushing an estimated 97 million people into poverty [90]. Lockdowns and mobility restrictions also disrupted education for over 1.5 billion learners, with long-term implications for human capital development [91].

As the COVID-19 pandemic struck globally, job losses became a common reality, exacerbating financial insecurity and affecting mental health, especially for those unable to provide basic necessities for themselves and their families [92-95]. In response, many governments have laid out policies to mitigate the economic impact. For example, the United States government provided up to 26 weeks of unemployment insurance (UI) benefits, with incentives for job-seeking activities during the pandemic [96]. In Canada, the Employment Insurance (EI) program, funded jointly by employees and employers through payroll tax, covered a wide range of situations. This included individuals caring for children at home due to school and daycare closures, as well as those caring for sick family members with COVID-19 [97]. The Malaysian government introduced the Prihatin Rakyat Economic Stimulus Package (PRIHATIN), a MYR250 billion stimulus package that included aid for individuals and businesses, alongside wage subsidies and loan moratoriums to preserve jobs and support household consumption [98]. After the initial economic stimulus, Malaysia rolled out several additional support packages: the Prihatin Package for SMEs (Additional Measures) on 6 April 2020, the National Economic Recovery Plan (PENJANA) on 5 June 2020, and the Prihatin Supplementary Initiative Package

(KITA PRIHATIN) on 23 September 2020 [99].

Beyond formal policy measures, community solidarity played a crucial role in resilience. In the Netherlands, community movement volunteered to help homebound individuals with organized grocery deliveries [100]. In Malaysia, the communities including individuals and business owners mobilized during the holy month of Ramadhan to crowdfund and distribute meals to low-income households [101]. These impacts underline the interconnectedness of public health and economic resilience, highlighting the urgent need for integrated policies that safeguard the communities' livelihoods.

Community-based efforts, combined with targeted government support, highlighted the value of both institutional and community-driven strategies in mitigating the socioeconomic toll of a prolonged public health crisis. Such collective efforts underline the importance of community engagement and resilience, where mutual aid, grassroots initiatives, and government support work in tandem to help the most vulnerable. Strengthening these support systems not only provides immediate relief but also ensures that societies can withstand and recover from the prolonged social and economic disruptions caused by a global health crisis.

DISCUSSION

This review underscores the indispensable role of government-community engagement, digital health technologies, and coordinated public health responses in mitigating the effects of the COVID-19 pandemic. Across diverse countries, interventions that prioritized localized action through trained CHWs, integrated health communication, and early implementation of digital tools such as mobile applications for contact tracing contributed significantly to slowing transmission rates and protecting vulnerable populations [28,29,50].

CHWs in particular, served as a vital bridge between public health authorities and hard-to-reach communities, especially in rural and underserved areas. In certain countries, the deployment of CHWs proved essential in delivering accurate health information, conducting surveillance, and facilitating equitable access to testing and care [28]. This community-led model of engagement aligns with the goals of the CHIC which advocates for professionalizing and expanding the global CHW workforce as a cornerstone of pandemic response and preparedness [34,35].

Digital health platforms and telemedicine also emerged as transformative tools in managing healthcare services while maintaining physical distancing. In Malaysia and other countries, platforms like MySejahtera enabled not only contact tracing but also provided access to self-health assessments, vaccination registration, and real-time pandemic updates, thus facilitating both top-down coordination and bottom-up participation [20]. These systems contributed to public compliance and trust, both of which are vital in emergency response scenarios [39]. Hence, investments in digital infrastructure are highly essential, but should aim to reduce disparities in access and promote technological inclusivity. It is vital that policy frameworks support, protect the digital rights of users, and promote collaborative governance that includes civil society, healthcare professionals, and technology partners.

Nevertheless, the COVID-19 pandemic has highlighted the increasing likelihood of future pandemics due to zoonotic spillovers, globalization, environmental disruptions, and climate change [102-104]. Large-scale outbreaks of novel infectious diseases are becoming more frequent over the past century, with the likelihood of another pandemic occurring is substantially high [104]. Hence, a sustainable preparedness strategy is no longer optional, rather it must be systematically embedded within national and international public health frameworks.

The findings from this review based on the collective experience of COVID-19, has offered valuable insights and critical lessons for future pandemic preparedness and how it can be strengthened. Governments must not only maintain robust surveillance and rapid response systems but also build public trust through continuous engagement and empowerment of local communities, including the institutionalization of CHW programs. Clear, transparent and culturally relevant public health messaging and communication delivered through trusted local platforms, can bolster public trust and resilience against misinformation, which was a major barrier during the COVID-19 crisis [80].

Inter-agency collaboration has also emerged as a critical factor in enabling effective pandemic response. Coordination between government institutions ensured consistency in public health messaging and enforcement of SOPs, while partnerships with private institutions and non-governmental organizations facilitated wider dissemination of health information, mobilization of resources, and implementation of innovative solutions such as telemedicine platforms and digital contact tracing applications. These collaborations highlighted the importance of cross-sector and community-wide approaches to enhance community engagement and trust in mitigating a public health crisis.

Limitations and Future Recommendations

In reflecting on the methodological strengths of this review, it provides a broad and integrative perspective by including peer-reviewed articles, governments' official reports, international agency documents, as well as authorized news outlets and websites. The inclusion of grey literature allows the capture of real-time emergency situations, policy responses and

interventions that may not yet have appeared in indexed journals. However, reliance on grey literature also presents limitations, particularly regarding variability in methodological rigor, potential bias, and the evolving nature of information reported during the pandemic. To mitigate this, such sources were interpreted with caution and corroborated where possible.

Moreover, as this is a narrative review, it lacks formal quality assessment of the included studies and does not use systematic review frameworks like PRISMA or PICO. Future work should consider systematic methodologies with clear inclusion criteria, study appraisal tools, and meta-analyses where applicable. Further research is also needed to explore the broader economic impacts of pandemic responses, evaluation of the cost-effectiveness and long-term outcomes of digital health interventions, particularly in low- and middle-income countries, and challenges communities faced in adapting to remote health services.

CONCLUSION

The COVID-19 pandemic has severely disrupted and strained the healthcare systems worldwide. To prevent the spread of COVID-19, it is paramount to not only improve public awareness, knowledge, and preventive practices, but also addressing misinformation and misconceptions. Transparent reporting of COVID-19 cases, coupled with effective community engagement, is essential to ensure that all governments' initiatives are well supported.

The ongoing emergence of new variants underscores the urgency for vaccination programs to be accelerated to achieve broad population immunity and protect vulnerable groups. Beyond strict compliance and continuous enhancement of safety SOPs, both the governments and the communities should leverage digital technologies and further embark on telemedicine services as integral components of an effective, accessible, resilient, and sustainable healthcare delivery system, during pandemics and in routine healthcare alike.

Ultimately, the lessons learned from the COVID-19 pandemic highlighted the critical importance of integrating community engagement with robust public health strategies to strengthen preparedness for future global health emergencies.

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