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Review

Home Isolation and Online Support Strategies during Mild COVID-19 Pandemic Waves in Thailand: A Scoping Review

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Abstract: Objectives: In 2021, Thailand experienced its fourth and fifth waves of COVID-19, overwhelming the nation's public health system. The significant gap between health resources and the demand for services from patients was one of the primary challenges in responding to the catastrophic COVID-19 pandemic. Hospitals were inundated with a surge in new patients, leading to a growing backlog of individuals suffering delayed care or even rejection from the healthcare system. To tackle this issue, strategies such as "outpatient self-isolation" (SI), "home-based isolation" (HI), and "community-based isolation" (CI) were implemented to stabilize COVID-19 cases with mild to moderate symptoms. This review aimed to explore the experiences in the management of COVID-19 care in patients with mild to moderate symptoms and identify challenges after the initial response of the Thailand health system to the pandemic. Methods: This study was conducted during the Delta pandemic (June–November 2021) and the Omicron pandemic (December 2021–15 March 2022). We present the lessons learned from the management of the HI system based on experiences gained at a university hospital, which provided remote professional-to-patient support during the pandemic. The study involved retrospective data from electronic medical records and qualitative analysis of responses provided during the pandemic using the HI system. Results: Data from a total of 2704 and 1912 participants were included in the analysis. The vast majority of patients were assigned to HI immediately after being diagnosed with COVID-19. This system facilitated remote consultations, provision of necessary medications, and delivery of survival kits to patients' homes. Qualitative reviews indicated several key factors that could contribute to successful COVID-19 management under the HI system: (1) effective management and vaccine status, (2) establishment of home isolation using the find-test-trace-isolate-support system, and (3) adherence to home isolation guidelines and system support. Challenges included the digitalization of tools for securing isolation, team preparedness and adequate support system during HI, as well as hospital policies for psychological support for healthcare workers and measures to alleviate their workload. Conclusions: Our investigation suggests that the HI teleconsultation system was an effective approach to managing COVID-19. It allowed for a prompt response to patients' needs and provided timely access to medical support, particularly for individuals with mild to moderate symptoms.

Keywords: COVID-19; home isolation; online consultation; mild symptomatic COVID-19

1. Introduction

On 13 January 2020, the Ministry of Public Health of Thailand announced its first case of coronavirus disease 2019 (COVID-19), brought in by a traveler from Wuhan, China [1]. In response, the country implemented various disease-control and public health policies, including public and land border closures, to contain the pandemic [2,3]. The COVID-19 outbreak eased over time. The collaborative effort of Thai citizens and healthcare personnel resulted in successfully containing the pandemic throughout most of 2020 [3]. Although the number of locally transmitted cases dropped to zero in May 2020, a third wave emerged in April 2021, driven by clusters in entertainment and gambling venues along with dense living conditions of migrant workers and inadequate social distancing [4]. This wave was exacerbated by the emergence of the Alpha (B.1.1.7) and Beta (B.1.351) variants, although the Delta variant (B.1.617.2) eventually became dominant as the most worrisome strain of the coronavirus circulating globally. B.1.617.2 demonstrated a higher replication efficacy than B.1.1.7 in the human respiratory tract [5]. Furthermore, it was able to escape immunity conferred by past infections or vaccinations, resulting in numerous pandemic waves worldwide [6].

A further variant, B.1.1.529, was first detected in Botswana and South Africa. On November 26, 2021, the World Health Organization (WHO) declared the Omicron variant a variant of concern due to its rapid spread in Botswana and South Africa in late 2021, and it quickly became the dominant strain worldwide [7]. Omicron has since continued to evolve genetically and antigenically with an expanding range of sublineages, such as BA.1, BA.2, BA.5, BA.4, BQ.1 and XBB [2,8], with different spike protein sequences, leading to diverse infectivity, evasion of current population immunity, and greater severity. In January 2022, there was a dramatic surge in BA.2-related infections globally [9]. SARS-CoV-2 has proven to be a highly capable human pathogen, but also a generalist virus capable of using a variety of mammalian membrane proteins for cell entry, enabling infection of a wide range of mammals [10]. Since February 2022, the Omicron viruses have been responsible for more than 98% of the publicly available sequences, and they are the genetic foundation from which new SARS-CoV-2 variants are likely to arise [11]. With the continued decrease of severe COVID-19 cases and death rate and increased vaccination coverage, in October 2022, the Ministry of Public Health of Thailand downgraded COVID-19 to a "disease under surveillance" [2].

The recent discovery of the XBB.1.5 variant, known as the Kraken, which is more transmissible than all current strains, is concerning [12]. XBB.1.5 has a mutation that enables it to bind to cells while continuing to evade immunity, making it spread more easily [12,13]. In January 2023, a new subvariant of Omicron, XBB.1.16, was discovered in India and has since been added to the WHO list of variants of interest for monitoring [11]. The XBB.1.16 variant has three additional mutations in the SARS-CoV-2 spike protein (E180V, F486P and

K478R) and was detected in Thailand after the Songkran Festival, causing an increase in the spread of COVID-19 that can spread faster than the XBB.1.5 strain that was the main transmitter of the epidemic in Thailand. So far, 27 cases of the XBB.1.16 strain had been found in Thailand as of 17 April 2023 [2].

Severe illnesses and deaths in Thailand have been significantly reduced by rising COVID-19 vaccination rates and natural immunity. Nevertheless, serious concerns have been drawn due to two issues. One is the increased transmissibility of Omicron [14]. The other is its potential to have reduced sensitivity to neutralizing antibodies due to mutations in its viral spike glycoprotein [15], the primary target for the neutralizing antibodies of current vaccines [16]. These two attributes are grounds for serious concern. They give the Omicron variant an increased propensity to infect people who have received their full vaccinations but whose antigens are specific to the original S sequence [17]. Our "home isolation" (HI) strategy and in vitro and in vivo studies demonstrated that the Omicron variant replicated well in the upper respiratory tract but was poorly involved in the lower respiratory tract [18], leading to higher transmissibility than the Delta variant. A body of evidence shows that breakthrough infections have still occurred since the Delta variant wave, increasing total daily confirmed cases, and that primary immunization with the current available approved vaccines provides limited protection against symptomatic disease due to the Omicron variant, so that a booster shot is indispensable [19,20]. Still, vaccination and prior infection have been documented to reduce COVID-19 transmission during an Omicron-predominant period, and additional doses of updated vaccination (bivalent vaccines) led to greater reductions in infectiousness, thereby providing additional protection against symptomatic new SARS-CoV-2 variant infection [21,22].

The main contribution of this article is to provide a comprehensive overview of the COVID-19 situation in Thailand, a developing country, including the initial response to the pandemic, the emergence and impact of different variants such as Delta and Omicron, and concerns regarding transmissibility and reduced sensitivity to neutralizing antibodies of the Omicron variant. The article also highlights the importance of vaccination and prior infection in reducing transmission and emphasizes the need for booster shots and updated vaccinations to provide additional protection against new SARS-CoV-2 variants.

2. Materials and Methods

This scoping review study was performed during the Delta pandemic (June–November 2021) and the Omicron pandemic (December 2021–15 March 2022) using consenting COVID-19 patients who consulted the health care team on an online platform. The Ethics Committee of the Siriraj Institutional Review Board approved the study's protocol and its access to fully anonymized data housed in the Siriraj HI management system (approval number Si 732/2021).

2.1. Study Population and Selection

The home isolation program was initiated on 8 July 2021 for the provision of health care for patients with confirmed COVID-19 with mild to moderate symptoms at first presentation. Figure 1 summarizes the functions and procedural flows of the Siriraj HI management system. During the Delta and Omicron waves in Thailand, 2704 and 1912 COVID-19 cases, respectively, were assigned to HI by the hospital. Someone who met inclusion criteria would be considered to have mild symptoms or be asymptomatic and would be referred to the Siriraj-Home system (SI-Home), where medicine would be delivered by health personnel within 24 h, rather than being relegated to a field hospital or other potentially unpleasant arrangement. The initial criteria and criteria for referral were detailed in our prior publication [20].

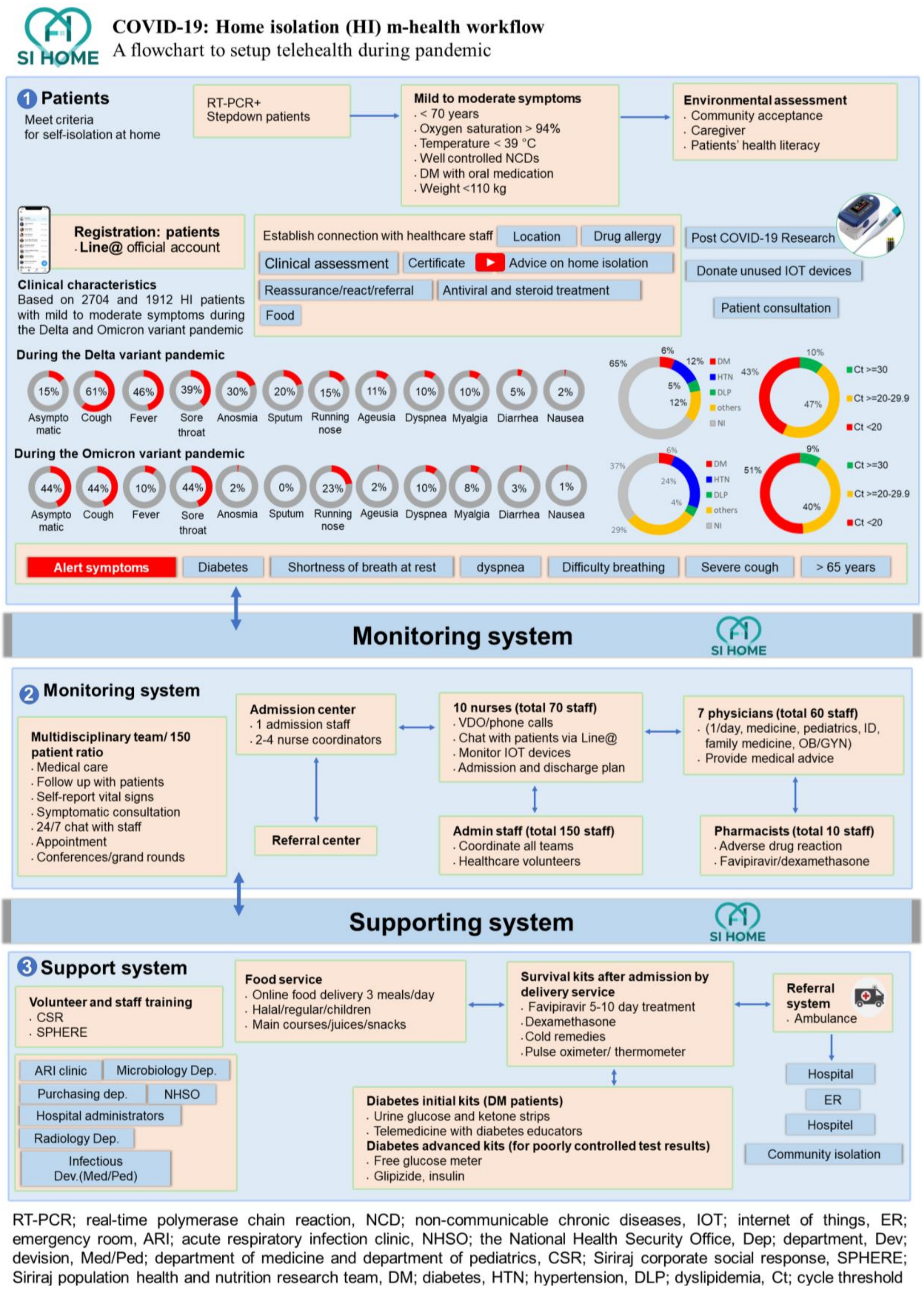

Figure 1. This graphic illustrates a strategy for patient self-isolation outside healthcare facilities with limited resources during a COVID-19 outbreak. The depicted workflow was used at the Siriraj Hospital (a university-based hospital in Bangkok, Thailand) from July to October 2021 and from December 2021 to March 2022.

2.2. Data Collection

Secondary data was obtained anonymously from electronic medical records and the information provided by patients to the teleconsultation service. All patients in this study were admitted to the HI system. During home isolation, patients had their temperatures and respiratory symptoms checked at least twice a day, either by telemedicine with nurses or by using self-monitoring equipment and reporting via an electronic diary. Online communication with medical staff, available 24/7, was a standard management approach to monitor the progression of COVID-19 for medical purposes. Customized sets of medication such as antipyretics, antitussives, and cetirizine were provided for each patient for symptomatic treatment. These medications were prescribed by medical staff through the online platform. The online medical staff consisted of infectious disease physicians, infectious disease pediatricians, ambulatory physicians, psychiatrists, family physicians, obstetricians, registered nurses, volunteers, pharmacists (who monitored adverse drug reactions), dietitians, and the referral center staff. Breathing exercises performed in a prone position were recommended for patients with dyspnea and reduced oxygen saturation.

2.3. Data Analysis

The characteristics of the patients at baseline were reported as counts and percentages. Categorical variables were presented as absolute numbers and their relative frequencies. Continuous variables were summarized as mean and standard deviation. To assess HI management, we identified key success factors, including management and vaccine situation, establishment of the find-test-trace-isolate-support system, and adherence to home isolation. All analyses were conducted using STATA version 17 (Stata Corp., LP, College Station, TX, USA).

3. Results

The 2704 (Delta) and 1912 (Omicron) COVID-19 cases assigned to HI by the hospital during the Delta and Omicron waves were recruited for the study. Cough and sore throat were the predominant early symptoms after post COVID-19 infection (Figure 1). During the Delta and Omicron waves, a large majority of the patients had a cycle threshold between 20–30 and below 20, respectively. All detailed analysis was described in the previous publication [23]. From the analysis, we identified several key factors that could play a role in successful management of COVID-19 under the HI system: (1) effective management and vaccine status, (2) establishment of home isolation using the find-test-trace-isolate-support system, and (3) adherence to home isolation guidelines with system support.

3.1. Effective Management and Vaccine Status

Vaccination is still the main hope for controlling the COVID-19 pandemic and conferring high levels of protection against severe disease caused by all SARS-CoV-2 variants of concern, including Omicron. Hybrid immunity provided by a combination of vaccination and infection, as well as breakthrough infection, including asymptomatic infection, may confer effective protection against death [23]. Studies have reported that vaccinated individuals have a much lower mortality rate than unvaccinated individuals. For the best protection against severe COVID-19, it is suggested that all persons should stay up to date with required COVID-19 vaccination, including receipt of a bivalent booster by eligible persons [24]. Thailand had previously aimed to reach herd immunity by the fourth quarter of 2021 by vaccinating most people. However, due to the shortage of vaccines worldwide, Thailand launched its COVID-19 vaccine rollout on 28 February 2021, later than desired. Initially, only 200,000 doses of an inactivated vaccine (CoronaVac supply, Sinovac Life Sciences, Beijing, China) were available. They were provided to front-line professionals, volunteers, and high-risk populations. Several months later, a viral vector vaccine from Siam Bioscience (AstraZeneca [Thailand] Co., Ltd., Nonthaburi, Thailand) [25], became available. In June 2021, the Delta variant became the dominant variant in the country (accounting for two thirds of infections in mid-July 2021). This event disrupted Thailand's healthcare system due to an unanticipated shortage of medical equipment, personnel, and infrastructure, and disruption of the supply chains for medical supplies. In late 2021, messenger RNA (mRNA) vaccines were made available as a booster vaccine to the national program.

By early December 2021, the first imported case of the Omicron variant was declared, and breakthrough infections were reported with evidence of low vaccine efficacy. Thailand recommended halving the period between administering the second dose of a COVID-19 vaccine and a booster dose to strengthen individuals' immunity against the Omicron variant [26]. This policy helped reduce the severity of symptoms and the death rate [2]. In the second trimester of 2023, more than 75% of the population in Thailand had been fully vaccinated, mostly with viral vector and mRNA vaccines, while those receiving booster shots stood at around 47% [2]. To date, 4.7 million people in Thailand have been confirmed to be infected (7% of the total population), with 242 new or recurrent cases per day. The average death rate was 1 per day, compared to the death rate during the peak of the Delta variant of 300 per day. The herd immunity threshold is unlikely to be reached because of waning vaccine-generated immunity and the emergence of new Omicron variants [20].

3.2. Establishing Home Isolation Using the Find-Test-Trace-Isolate-Support System

The find-test-trace-isolate-support (FTTIS) system is recognized as a core element of public health services [27]. Both finding and testing are core requirements of an early screening process, especially with asymptomatic diseases. Inadequate testing often underestimates the actual number and spread of COVID-19 cases. We identified three aspects involved in increasing finding, testing, and tracing rates: (1) active surveillance, (2) scaling up detection capacity, and (3) reverse contact tracing.

Thailand addressed the first aspect by employing frontline health volunteers responsible for collecting daily health information from individuals who had returned to their hometowns from other provinces and locals requiring quarantine. Individuals from high-risk areas were required to provide a clear travel timeline and undergo a preliminary test at a sub-district health promotion hospital. If the test result was negative, an officer would issue a certificate of non-infection, allowing them to return home and resume their daily activities in accordance with the Ministry of Public Health's guidelines. In the case of positive test results, the staff would issue a certificate of infection, after which the individuals had to undergo treatment and adhere to the quarantine period specified by the Ministry of Public Health.

As for the second aspect, Thailand's National Health Security Office and Ministry of Public Health announced that people at high risk of COVID-19 could request free COVID-19 testing and tracing at public and private hospitals across Thailand [28]. The goal was to increase people's access to emergency care and improve their chances of survival. The Thai government met the associated costs of this testing and tracing initiative through the Department of Disease Control (under the Communicable Disease Act B.E. 2558 [2015]) and the Universal Coverage for Emergency Patients program. Under the government's health benefits package, people testing positive for COVID-19 were provided with free COVID-19 treatment, meals, and transportation. This policy was applied to individuals in public healthcare facilities (hospitals and "hospitels" [hotels with a hospital service]), HI, and "community isolation" (CI).

RT-PCR remains the mainstay of confirming SARS-CoV-2 infections. Strategies were introduced in Thailand to enhance specimen collection procedures. The measures included providing a drive-through PCR testing service and using mobile teams to shorten turnaround and reduce the use of materials. These changes were a response to the timing of PCR testing relative to infection onset, assay-detection limitations, and the need to transport collected specimens.

To increase testing efficacy and accuracy, high-risk individuals had to be prioritized for PCR testing during the pandemic. Siriraj Hospital, a large-scale university hospital in Bangkok, implemented RT-PCR-based assays with respiratory specimens as a gold standard for COVID-19 diagnosis. The assay was a probe-based qualitative RT-PCR, the AllplexTM

2019-nCoV Assay (Seegene, Seoul, Republic of Korea). The targeted COVID-19 genes detected included nucleocapsid (N), envelope (E) of Sarbecovirus and RNA-dependent RNA polymerase (RdRp) of COVID-19 [29]. The aim was to ensure that patients could promptly be provided with the most appropriate treatment. In compliance with national guidelines, in late February 2022, patients who tested positive for COVID-19 after using an antigen test kit (ATK) no longer needed to undergo a PCR test for confirmation. They could be treated the same as those with positive PCR testing. Siriraj Hospital's screening data demonstrated that between 1 April and 26 October 2021, only 11.2% of 78,000 PCR tests were positive for COVID-19, while the positive result rate increased to 30% and 35–45%, respectively, during the outbreaks in August 2021 and March 2022.

The number of days post symptom onset (PSO) was determined based on the difference between the date of the RT-PCR testing and the date of the first reported symptoms coherent with COVID-19. For asymptomatic individuals, the day from the first positive SARS-CoV-2 PCR testing was used. The durations of illness onset to first hospital admission, to first Favipiravir treatment, and to discharge up to 14 days were measured. Favipiravir was the recommended anti-viral therapy, especially in patients at high risk for COVID-19 pneumonia within 48 h, and was given for 5 days, but the duration could be extended to as long as 14 days based on the patient's clinical severity. The dose was 1800 mg twice daily on the first day followed by 800 mg twice daily [30].

However, COVID-19 infection has unique characteristics that remain poorly understood and impact the effectiveness of FTTIS strategies. These attributes relate to transmission during asymptomatic stages, unpredictable disease severity, long COVID-19 symptoms, and viable treatment options [31,32]. While the following principally describes lessons learned using the FTTIS system in Thailand, experiences in other countries are referred to when relevant.

Digital technologies are widely adopted as a crucial element for FTTIS programs. Nussbaumer-Streit [33] and others [34,35] recommended using a combination of effective quarantine and other nonpharmacological interventions to delay the peak of COVID-19 incidence and reduce treatment costs and the mortality rate. Thailand decided to extend the WHO recommendations regarding COVID-19 quarantine and isolation [36] by (1) encouraging individuals with mild to moderate COVID-19 symptoms to isolate themselves outside healthcare facilities, and (2) providing them with early access to antiviral medications and online medical support.

3.3. Adherence to Home Isolation and System Support

As soon as the third wave of the COVID-19 outbreak began in April 2021, the FTTIS system was needed again. In July 2021, the Delta variant continued to spread and became the dominant variant in the capital city, where it accounted for up to 90% of infections. At the same time, the vaccination rate was still insufficient. In June 2021, HI and CI were implemented nationwide to combat an overwhelming demand for hospital beds [25]. After the initial COVID-19 outbreak, there was an unprecedented surge in the use of social media platforms such as ZOOM and Line in Thailand and other countries. Communication technology companies and hospitals promoted such applications to minimize the community spread of COVID-19 and provide contactless medical consultations. The HI management system developed by the Siriraj Hospital obliged patients to communicate with health professionals via the Line application. Through this application, educational information was provided to patients to raise their awareness of the disease, and patients provided frequent updates on their symptoms and concerns. The patient information was also used to create a dashboard for early effective responses and quality improvements [27]. HI was a hybrid between virtual and on-the-ground medical care and support, in that hospital staff could monitor patients via cell (mobile) phone consultation while providing medicine, medical devices, and meals using local providers. Figure 1 depicts the mobile-health (m-health) workflow for managing COVID-19 in the HI system at Siriraj Hospital. During the pandemic waves in Thailand, a 10-to-14-day quarantine was initially implemented per the policies of the US Centers for Disease Control and Prevention, the WHO, and Thailand's recommendations [37]. However, during the later Omicron pandemic, many countries (including Thailand) reduced the isolation period to 5 to 10 days to reduce the disruption to people's lives and improve patient turnaround [38].

4. Discussion

The results show three key attributes of HI that make it particularly well-suited for responding to public health emergencies such as the COVID-19 pandemic: (1) the use of FTTIS strategies aided by digital tools (for instance, pulse oximeters, social media applications, and video conferencing), (2) the presence of a multidisciplinary team, and (3) the use of support systems for the procurement and effective administration of treatment regimens, the provision of food and antiviral medications, and the provision of referrals. Across these areas, we identified several measures that had a substantial impact on the success of the HI strategy in responding to COVID-19. Our insights can aid other healthcare teams in preparing for the next pandemic.

4.1. Digital Tools to Secure Isolation

Communication technology companies and hospitals promoted these applications to minimize the community spread of COVID-19 and provide contactless medical consultations. Due to the urgent need to communicate through technology, we elected to use the freeware application "Line" (Line Corporation, Tokyo, Japan) as the standard portal for connecting with patients. A deciding factor in favor of this particular application was that most people in Thailand were regular users. The HI management system used the Line application in two ways:

- Enrollment: To accept and confirm the enrollment of patients assigned to HI. Their data were collected and confirmed using an application programming interface.
- Monitoring: To record, analyze, and summarize the data that patients input into the management system.

The patient information was sent to a server that was monitored by medical staff and was also used to create a dashboard for effective early responses and quality improvements [27].

4.2. Team Preparedness

Multidisciplinary rapid response teams were crucial in ensuring that affected people, families, and their community received standard holistic care. During the Delta wave, hundreds of hospital staff were recruited for the service. The most vital step was triage. Patients with risk factors were admitted to a hospital or hospitel, whereas those with mild to moderate COVID-19 who met specific criteria (as shown in Figure 1) were isolated and treated at home. The medical team for 150 patients comprised 10 nurses, 7 physicians, 1 or 2 pharmacists, 10 administrative staff, a logistics team, and back-office staff. Studies have shown that adherence to HI is associated with fast responses via an online face-to-face communication platform, reassurance about the disease prognosis, well-defined quarantine procedures, and prompt referral to a hospital when needed [39].

4.3. Supporting System

Food and other medical supplies were delivered directly to patients' homes. Medical staff performed clinical assessments at least twice daily. Under the HI strategy, essential medicines, including antivirals, antipyretic drugs, cold remedies and oral dexamethasone for treating COVID-19 pneumonia, were available for the patients. HI significantly shortened treatment times, allowing patients to begin therapy within hours of their HI admission.

However, HI was only suitable for caring for patients with mild to moderate symptoms and was not designed for handling severely ill patients. If a patient's condition deteriorated, rapid transfer to a hospital was immediately coordinated by HI staff. By isolating and treating only mild to moderate cases, the HI strategy freed up the country's limited healthcare resources and improved the distribution of patients with COVID-19 within the healthcare system, improving the overall quality of health services.

A previous report [40] has reported high rates of mental health problems among intensivists, including anxiety, depression, burnout, high workload, isolation and compassion fatigue. HI helped ameliorate several collateral issues, including the physical and mental exhaustion of healthcare workers, avoiding a rapid deterioration of hospitals' physical infrastructures and addressing the growing backlog of routine healthcare procedures by keeping inpatient and outpatient numbers at manageable levels during pandemic waves. A previous study [41] showed that the HI system helped in the recovery of COVID-19 associated depression and anxiety as well as self-rated health. Healthcare companies should also establish clear policies and behavioral guidelines for staff, emphasizing patient autonomy and the necessity of treatments and the need for psychological support for healthcare workers and measures to alleviate their workload.

The strengths of the HI strategy were: (1) the establishment of timely and effective interactions between patients and healthcare professionals, (2) the creation of a good standard of holistic care, and (3) the prompt delivery of needed antiviral drugs to infected patients. Previous meta-analysis [42] and our data from the current investigation [30,43] demonstrate that early access to medical treatment resulted in significant clinical improvements and improved survival rates. Conducting quarantine and isolation at home rather than in a hospital or "hospitel" has fewer mental health consequences because patients are confined to a familiar environment. Furthermore, HI consultations are more effective than conventional in-person outpatient treatment, since compliance is enforced by the online approach and system.

There are several advantages to isolating infected individuals in hospital facilities. The self-isolation of mild cases at home can lead to some degree of noncompliance, as it is impossible to confine patients at home and they are free to move around. Data from the HI system in Iran [44] showed that patients experiencing muscle pain and shortness of breath paid less attention to isolation, although increased communication between healthcare professionals and patients improved the likelihood of complete isolation. Therefore, it is crucial to focus on determinant factors for successful isolation to prevent disease transmission within households and the local community. Moreover, poor network services and limited wireless signal coverage are barriers to online consultations [45]. A multi-nation study, "Effects of home confinement on multiple lifestyle behaviors during the COVID-19 outbreak (ECLB-COVID19)," conducted during the early period of the COVID-19 pandemic, revealed that COVID-19 home isolation could potentially lead to reduced physical activity and increased sedentary behavior [46]. Additionally, if food is not provided during HI, food consumption and meal patterns tend to become unhealthy. While isolation is an essential measure for managing COVID-19, a more detailed and customized HI system needs to be developed to mitigate the negative lifestyle behaviors and physical and mental impacts that may arise during COVID-19 HI.

5. Conclusions

HI can provide substantial benefits to patients with mild to moderate symptoms through added convenience, fast access to healthcare specialists, and prompt treatment. Online HI systems are tailored to meet patients' needs and enhance the effectiveness of improving patients' health and saving lives. Effective and frequent interactions between patients and medical staff via telemedicine are fundamental to successful HI strategies. In addition, they foster collaboration among healthcare professionals, researchers, policymakers, and the community to address the challenges faced by healthcare workers and patients.

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