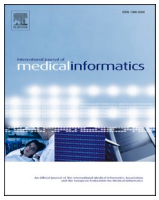
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

International Journal of Medical Informatics 177 (2023) 105111

Contents lists available at ScienceDirect

International Journal of Medical Informatics

journal homepage: www.elsevier.com/locate/ijmedinf



Experiences of patients and their caregivers in a Virtual Ward in Singapore: A descriptive qualitative study

Stephanie Q Ko [a], Crystal Min Siu Chua [b], Shu Hua Koh [c], Yee Wei Lim [d,e], Shefaly Shorey [b,*]

[a] Division of Advanced Internal Medicine, Department of Medicine, National University Hospital, 1E Kent Ridge Road, 119228 Singapore, Singapore
[b] Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, Level 2, Clinical Research Centre, Block MD11, 10 Medical Drive, 117597 Singapore, Singapore
[c] NUHS Community Care Team, National University Health System, 5 Lower Kent Ridge Road, 119074 Singapore, Singapore
[d] Yong Loo Lin School of Medicine, National University of Singapore, Singapore, 1E Kent Ridge Road, Singapore 119228, Singapore
[e] Medical Affairs – Research, Innovation & Enterprise, Alexandra Hospital, National University Health System, 378 Alexandra Road, 159964 Singapore, Singapore

ARTICLE INFO

Keywords:
High-risk patients
Virtual Ward
Model of care
Qualitative study
Interviews

ABSTRACT

Background: The experiences of COVID-19 patients admitted to Virtual Wards and their caregivers are under-explored in Asian communities. A COVID-19 Virtual Ward (CVW) was recently established in Singapore.
Aim: This study aims to describe the experiences of high-risk COVID-19 patients admitted to a Virtual Ward and their caregivers in a multi-racial Asian community.
Methods: A descriptive qualitative study was conducted from November 2021 to March 22 among high-risk COVID-19 patients and their caregivers who had been admitted to a CVW. The CVW involved teleconsultation whereby patients submitted their vital signs via a chatbot on their mobile phone and were supported remotely by a team of allied health professionals. In-depth interviews were conducted with patients and their caregivers and analyzed thematically.
Findings
The findings were supported by three themes. First, CVW admissions were perceived to be safe and effective. The second emerging theme related to the benefits and burdens of receiving care at home. The benefits of CVW were perceived comfort and familiarity with the home environment, while burdens included ensuring discipline in submitting health data and self-isolating from other household members. Last, the role of external factors such as informal support, paid domestic workers, and work arrangements was highlighted by the participants. Overall, key enablers for a successful CVW experience were the availability of social support, timely care from the care team, and 24/7 access to the team.
Conclusion: In conclusion, CVW was perceived as a safe and effective strategy to manage high-risk patients at home. We recommend that Virtual Wards should be further developed to expand bed capacity in both pandemic and non-pandemic settings.

1. Introduction

The shortage of hospital beds and manpower caused by surges in COVID-19 has accelerated the development of COVID-19 Virtual Wards (CVW). Virtual Wards have been defined as "any interaction between patients and/or members of their circle of care, occurring remotely, using any forms of communication or information technologies, to facilitate or maximize the quality and effectiveness of patient care." [1]. Virtual Wards have been implemented to provide care for patients with COVID-19 in the United Kingdom (UK), the United States (US), Canada, Australia, and China; these all have three key features: (1) program-specific admission criteria, (2) vital signs monitoring, and (3) telecommunication (telephone, video calls, via websites, applications, or chatbots) [2–6]. In these studies, Virtual Wards were established to be safe [3] while reducing hospital utilization [4]. Virtual Wards in England, Australia, and Canada have also been associated with high patient and caregiver satisfaction [5–7].

As the hospital-at-home service of the National University Health

* Corresponding author.
E-mail addresses: stephanie_qianwen_ko@nuhs.edu.sg (S.Q. Ko), nurccms@nus.edu.sg (C.M.S. Chua), shu_hua_koh@nuhs.edu.sg (S.H. Koh), amdclyw@nus.edu.sg (Y.W. Lim), nurssh@nus.edu.sg (S. Shorey).

https://doi.org/10.1016/j.ijmedinf.2023.105111
Received 16 December 2022; Received in revised form 23 May 2023; Accepted 27 May 2023
Available online 1 June 2023

System (NUHS) covering Western Singapore, NUHS@Home started Singapore's first COVID-19 Virtual Ward for high-risk COVID-19 patients to be treated at home [8]. We previously explored the experiences of patients and caregivers of the NUHS@Home program [9]. Due to infection control concerns in managing COVID-19 patients, CVW differed from regular NUHS@Home protocols in two key ways: first, contact with the care team was largely via teleconsultation rather than home visits; second, vital signs were self-monitored using a chatbot rather than Bluetooth connected devices.

How patients and caregivers experience CVW has not been explored in Singapore, but it has been researched in other countries. Research has shown that participants in the United Kingdom, the United States, Australia, and Canada have found CVW acceptable [4,5,10,11]. Facilitators to CVW in these countries included patients' commitment level to self-monitoring and having support from family, friends, and the CVW care team [4,5,10,11]. However, barriers to successful CVW included technological issues, quality of medical equipment (e.g., oximeters), and timely access to critical care [4,5,10,11].

Such experiences in Asian communities may differ from Western communities for three reasons. First, Asian patients tend to be more likely to depend on healthcare providers for their recovery [12]. Second, caregiving and domestic support structures differ, where Southeast Asian patients are both less likely to live alone [13] and more likely to employ stay-in domestic helpers [14]. Third, as the prevailing policy in Singapore for the first 15 months of the pandemic was to institutionalize all COVID-19 patients in hospitals or treatment facilities, being treated at home was unfamiliar to patients and caregivers. Although our prior evaluation of NUHS@Home has shown positive patient experiences [9], whether these apply to COVID-19 is uncertain.

To our knowledge, this is the first qualitative study of a COVID-19 Virtual Ward in Asian communities; the findings can be used to inform the planning of future virtual home-based acute care services across a variety of Asian contexts. The study aims to describe the experiences of high-risk COVID-19 patients admitted to a Virtual Ward and their caregivers in a multi-racial Asian community.

2. Methodology

2.1. Study design

A descriptive qualitative study was performed for patients admitted to the NUHS@Home CVW from November 2021 to March 2022. All patients discharged from the COVID-19 Virtual Ward were invited for an interview. Caregivers of these patients were also invited if they assisted the patient with either activity of daily living or with medical decision-making. Interviews with patients and caregivers were conducted independently. The study received ethics approval from the National Health Group Domain Specific Review Board: Reference Number: 2021/00896. Findings were reported following the Consolidated Criteria for Reporting Qualitative Research Checklist (COREQ) as Supplementary Table 1 [15].

2.2. COVID-19 Virtual Ward

2.2.1. Patient population

Patients were referred via three pathways: (1) Early discharge for COVID-19 patients admitted to the three hospitals in Western Singapore; (2) Admission avoidance for COVID-19 patients attending any of the three Emergency Departments in Western Singapore; or (3) Admission avoidance for patients referred from outpatient or primary care facilities. Patients referred from primary care facilities were screened and referred to this program by the Case Management Task Group of the Ministry of Health which centrally triaged COVID-19-positive cases.

The inclusion criteria for the CVW were (1) high-risk for deterioration from severe COVID-19, yet clinically stable to receive treatment at home (e.g., not requiring supplemental oxygen), and (2) able to self-isolate from uninfected household members. High-risk clinical criteria evolved with policy changes and prevailing variants but generally included patients who were either: (1) elderly and not fully vaccinated, (2) multiple comorbidities (e.g., chronic respiratory disease, heart failure), or (3) immunocompromised (patients with organ transplant, cancer on chemotherapy, hematological malignancy, retroviral disease or non-cancer conditions on immunosuppressive treatment).

All referrals were screened by CVW physicians over teleconsultation, and if eligible, they were admitted to the CVW. CVW admission was optional: patients could decide to be admitted to a hospital or COVID-19 treatment facilities instead. These treatment facilities were similar to hospital wards and provided round-the-clock in-person care by healthcare professionals, but did not have intensive care facilities. The cost of care was borne by the Ministry of Health as per prevailing government policy.

2.2.2. Teleconsultations and remote vital signs monitoring

Once admitted to CVW, patients remained in self-isolation in their homes with daily communications with the care team. The consultations were protocolized involving vital signs review, symptom assessment, and medication review. Besides physicians and nurses, the CVW team comprised allied health professionals: pharmacists for medication review and counseling, and dieticians for patients with reduced oral intake.

Patients were instructed on how to measure their vital signs using a thermometer, pulse oximeter, and blood pressure machine. Devices were delivered to patients if they did not already have them. Patients or an identified caregiver were enrolled on a chatbot via their mobiles; the chatbot provided an automated push notification three times a day with an online form to submit their vital signs. Submitted readings were synchronized to an online clinical dashboard. There was a protocol for the care team to follow up on abnormal or unsubmitted vital signs via phone call.

During the recovery phase (2nd week of illness), video consultations were reduced to every other day, and vital signs monitoring was reduced to twice daily. If patients required prolonged isolation (3rd week of illness), video consultations were conducted on an as-needed basis, and vital signs monitoring was reduced to once daily. All patients had access to the care team 24/7 via a hotline.

Additional clinical assessments were conducted by the physicians based on the following escalation criteria: (1) the patients reported severe symptoms related to shortness of breath, (2) acute exacerbations of symptoms, or (3) abnormal vital signs. When necessary, hospital admission was arranged for further patient evaluation.

All patients were assessed by a physician with a video consultation upon discharge. Patients were discharged and released from self-isolation based on prevailing local government guidelines.

2.2.3. Home visits and medication delivery

During this period, the CVW care team also collaborated with private on-demand medical house-call services to provide home visits for nursing procedures, such as blood taking, infusion of intravenous fluids or administration of COVID-19 therapeutics, or peripherally inserted central catheter (PICC) flushing. Oral medications, including both symptomatic medications and chronic disease medications, were delivered to patients as required.

2.3. Data collection and analysis

The interviewer was a female nursing research assistant (C.C.) who was supervised by a qualitative research expert (S.S.). The latter has no prior relationship with the participants and was not involved in patient care. Due to the COVID-19 pandemic restrictions at the time of data collection, interviews were conducted via secured phone calls. Participants were anonymized through pseudonyms and interview data were coded using identification numbers. Through a virtual consent process,

participants were informed of the study's purpose, their rights to withdraw, and that their participation was strictly voluntary and confidential. On average, interviews were conducted one week (between one to three weeks) after the patients were discharged from CVW.

The interview guide was developed based on the literature [2,9], and the clinical expertise of the co-authors (S.Q.K. and Y.W.L.) and then piloted among one participant. No changes were made to the pilot interview; hence it was also added to the final analysis. Most interviews were conducted in English, where they were audio recorded, and transcribed by the interviewer (C.C.). Interviews in Mandarin were manually transcribed and translated into English by C.C. who is fluent in both languages. The accuracy of the translations was checked by other bilingual team members.

These interviews were thematically analyzed using Braun and Clark's six-step inductive approach [16]: (1) familiarizing with data, (2) forming initial codes, (3) exploring potential themes, (4) reviewing themes, (5) defining and naming themes, and (6) finalizing the findings. Two researchers (C.C. and S.S.) independently analyzed the data and discussed extensively to identify the themes. Any discrepancies were resolved through a third researcher (S.Q.K.).

3. Results

From November 2021 to March 2022, 37 potential participants were approached for an interview through purposive sampling, which four declined due to busy schedules. Overall, 33 interviews were conducted (18 patients and 15 caregivers). None of the patients and caregivers were related to each other. The average duration of the interviews was 35 min. The mean age of the patients and caregivers was 54 (standard deviation, SD 16.5) and 49 (SD 8.3), respectively. Their demographic characteristics are illustrated in Table 1.

Three themes were developed: (1) CVW admission was safe and effective, (2) Benefits and burdens of receiving care at home, and (3) Role of external factors in the CVW experience. The themes and subthemes are illustrated in Fig. 1.

3.1. Theme 1: CVW admission was safe and effective

Participants understood that they were considered high-risk as indicated by their physicians. Despite so, many found care in the CVW safe and effective. As such, most of the participants had a positive experience with CVW and would have chosen this model of care again, under similar conditions. This theme is supported by three subthemes: (1) A "safe" experience, (2) An appropriate level of care, and (3) Approachable, accessible, and timely access from the care team.

Table 1
Characteristics of study participants.

Characteristics	Patients (n = 18)	Caregivers (n = 15)
Age (mean, SD)	54 (16.5)	49 (8.3)
Sex (%, n)		
Male	8 (44.4)	8 (53.5)
Female	10 (55.5)	7 (46.7)
Race/Ethnicity (%, n)		
Chinese	13 (72.2)	14 (93.3)
Malay	3 (16.7)	0
Indian	2 (11.1)	1 (6.7)
Living arrangements (%, n)		
With Spouse/parents/children/others	15 (83.3)	15 (100.0)
Alone	3 (16.7)	0
Employment (%, n)		
Employed	12 (66.7)	11 (73.3)
Unemployed/retired	6 (33.3)	4 (26.7)
Number of participants with paid domestic helpers (%, n)	2 (11.1)	8 (53.3)

3.1.1. A "safe" experience

Most participants perceived that CVW was safe. Some even found it "safer" compared to the hospital, as they perceived lower infection exposure as compared to the hospital setting.

> *"…[the hospital was] not suitable for me because I'm under chemo [therapy]… [patients in the hospital] keep coughing…[they were] not wearing masks… So, I chose to go back [home, where] it was safer…"* [Patient, female, 55 yo].

3.1.2. An appropriate level of care

Although these were high-risk patients, many felt that CVW has provided them with the "right amount of care" and believed that healthcare resources could be allocated to those who need it more.

> *"…I feel very well taken care of in the COVID Virtual Ward…although it's not like they are physically there, but it's really the right amount of care that I need…it [also] helps to cut the amount of workload [for the healthcare providers]…I'm very thankful…"* [Patient, female, 36 yo].

3.1.3. Approachable, accessible, and timely access from the care team

Based on our findings, it was suggested that easy access to care teams via daily calls, video consultations, and immediate feedback from their care teams were important for the success of CVW. Additionally, participants felt that it was "very assuring" that essential supplies or services were promptly delivered to them (e.g., nursing services, medication, vital sign equipment). They also perceived that they needed to receive timely access to medical attention in the form of quick response to abnormal vital sign readings, and a 24-hour emergency hotline. To provide more assurance on timely access to medical attention, participants suggested that the chatbot should prompt them as to when the care team would be contacting them, should an abnormal reading be reported. More assurance can also be provided if participants could receive care from the same doctor.

> *"If there is any problem, it can be solved immediately. I don't even have to hit that [emergency] hotline. As soon as I submit [an abnormal vital sign reading], they [the care team will] automatically call me."* [Caregiver, female, 58 yo].
>
> *"Every time… [it was] a different doctor… to some, it might cause some confusion…Perhaps we could have [been] informed that it will be a different doctor."* [Patient, male, 49 yo].

3.2. Theme 2: Benefits and burdens of receiving care at home

The benefits of CVW were perceived comfort, familiarity with the home environment, and closer proximity to loved ones. This is supported by the first two subthemes: (1) Comfort and familiarity in one's home, and (2) Close proximity with loved ones. Conversely, some participants reported burdens related to CVW, which are described in the last two subthemes: (3) Self-monitoring at home, and (4) Taking up COVID-19 precautions at home.

3.2.1. Comfort and familiarity in one's home

Patients reported being *"in the comfort of my home"*, resulting in a better quality of sleep and appetite. CVW also brought familiarity, which was especially important to a specific group of high-risk patients - the elderly or those with dementia.

> *"… [the patient has]…dementia, [so] she doesn't really recognize a lot of people. Having her at home when she recognizes me, will [has] help[ed] her a lot.* [Caregiver, male, 41 yo].

3.2.2. Close proximity with loved ones

Close proximity to loved ones was highlighted as an important factor when considering CVW. This was especially important to elderly

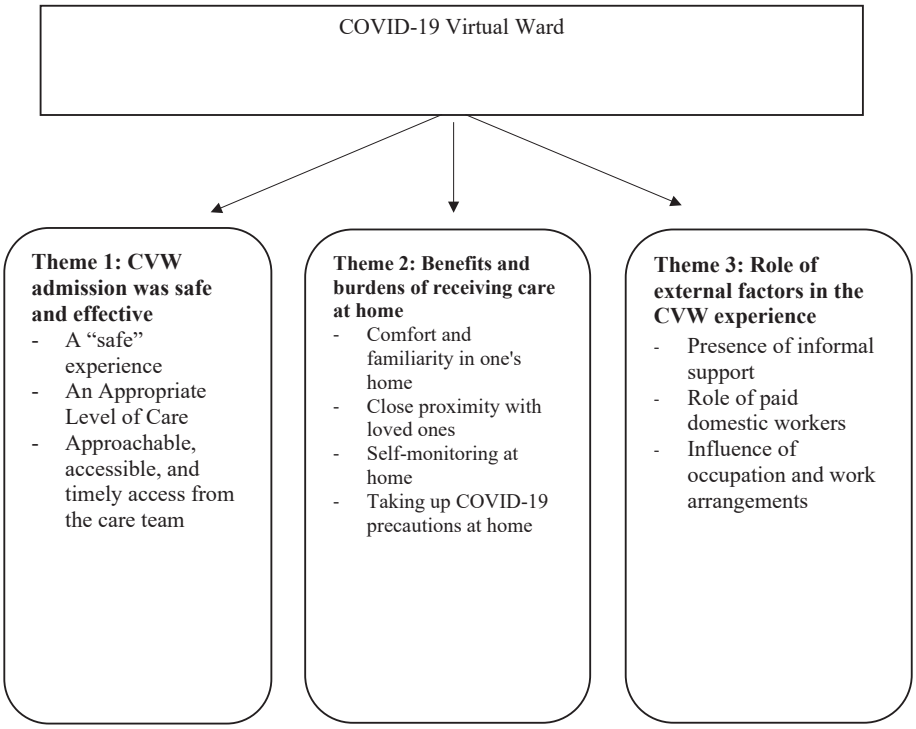


Fig. 1. Overview of themes and subthemes.

patients who *"don't speak any English"* or did not know how to use phones to communicate with their family members. Given the COVID-19 visitor restrictions in the hospitals, many family members felt that CVW is a good alternative where they could be closer to the patients.

> *"…once she [the patient] was warded at the hospital, I don't know what is going on. Because no visitors are allowed, no caregivers are allowed…you hear so many horror stories on the newspaper, some old people just passed away in the ward without all the close family members. That's my worry."* [Caregiver, female, 56 yo].

3.2.3. Self-monitoring at home

While most participants had no difficulties taking vital signs at the designated time, some had to ensure they awoke early (before 8AM) to submit their vitals at the correct time, which they felt required *"discipline"*. Nonetheless, many suggested that it was manageable and essential to *"make sure that the readings are taken"* and that the patient's conditions were *"stable"*. The use of the chatbot to enter their vital signs was also deemed manageable. However, some caregivers expressed that they had to help the older patients with the chatbot. Push notifications sent through the chatbot during a designated time were also helpful.

> *"…they [the care team] will give me [an] alert that it's time to send the vital sign information…[I will] key in…my mum's IC [Identification Card number], then they will offer you [to key in the vital signs in the chatbot], it's very easy to operate."* [Caregiver, female, 56 yo].

3.2.4. Taking up COVID-19 precautions at home

Most participants *"don't find any inconvenience"* with adhering to COVID-19 precautions, which they felt necessary to minimize the spread of COVID-19 in their homes.

However, some reported challenges when dealing with elderly patients who had difficulties with self-isolation, as these patients either *"get forgetful"* when self-isolating or had low health literacy and did not understand the importance of self-isolation. It was common for participants to order food deliveries during self-isolation to deliver the necessities. However, food delivery was challenging for those who have financial difficulties.

> *"My parents were… "chapalang" [without care] …They just did things their own way…they were using the same toilet, even though they have … so many other toilets in the house. And I'm like, "Dad, I told you, you cannot share the same toilet as Mum." [Caregiver, female, 52 yo].*
> *"…we are not a very well-to-do family, we have to fork out [food] delivery charges…It was quite tough… we really skimp on our spending." [Patient, male, 41 yo].*

3.3. Theme 3: Role of external factors in the CVW experience

Several external factors influenced the patient and caregiver's experiences of CVW. This theme is represented by three subthemes: (1) Presence of informal support, (2) Role of paid domestic workers, and (3) Influence of occupation and work arrangements. Please note that not all patients interviewed had informal or formal caregivers living with them - three lived alone and did not have domestic help.

3.3.1. Presence of informal support

Informal support from caregivers and family members helped to provide food for patients while they self-isolate and ensure surface cleaning and disinfection. Many participants in this study resided in a multi-generational household and thus, "took turns" with caregiving duties between family members. Patients who stayed alone turned to family members, neighbors, or friends for support. Conversely, CVW was perceived to be challenging for participants without social support or felt that this model of care will not be suitable for older adults with lower literacy, and limited social support. Having tech-savvy and English-literate caregivers was important in assisting patients who were not.

> *"[My friend] only [stays] a block away…[she will] buy breakfast…If you want to do this…the person has [the patient needs to have] some kind of support system." [Patient, female, 33 yo].*
> *"We know how to use [the vital sign monitoring] because we [are] only 50 + [years old], and we understand English. For old people, I think it's*

not suitable… they don't know English. They don't know how to measure their blood pressure, [and] oximeter…" [Patient, female, 55 yo].

3.3.2. Role of paid domestic workers

In addition, formal support from domestic helpers was important, and was commonly hired in the patients' households. In some cases, caregivers heavily depend on these domestic helpers to provide daily care for patients, and they would not have opted for CVW without this additional help.

"[if] I don't have a helper, I will just admit her [to the hospital] because I can't cope." [Caregiver, female, 56 yo].

3.3.3. Influence of occupation and work arrangements

Besides domestic helpers, our findings suggest that participants with flexible work schedules were more likely to find CVW manageable. Conversely, patients may find getting support from their workplace challenging when they are admitted to the CVW, because they are at home rather than in the hospital.

"We only got the documentation [medical certificate] after the discharge…So that really stresses me… I get pressurized from my employers [asking me] like when am I coming back to work." [Patient, male, 41 yo].

4. Discussion

This qualitative study analyzed the perceptions and experiences of high-risk COVID-19 patients and their caregivers receiving a CVW model of care as a substitute for inpatient hospitalization. Overall, CVW was perceived to be a safe and effective alternative to in-patient hospitalization, with other benefits such as better comfort and being closer to loved ones. The positive response to the CVW model of care was similar to international studies in the UK, Canada, and Australia [3,5,6].

In our CVW, we extended the care model to accommodate a variety of high-risk COVID-19 patients (elderly, patients with comorbidities, or immunocompromised). In this group, key enablers include social support, approachable staff, and easy access to medical attention; key challenges shared by participants in this study were largely by caregivers who had to assist their elderly relatives with the chatbot and adherence to isolation measures. Most patient participants had formal or informal caregivers, with only three living alone. Perhaps, this was why patient participants did not report facing challenges during CVW.

Despite previous reports of Virtual Ward care lacking interpersonal interactions with healthcare providers [5], our study participants felt reassured and well-supported by the CVW team. Most participants felt that the care provided was appropriate, attributing it to daily telecommunication and quick intervention in emergencies. This is consistent with previous research indicating that technology can support close interactions with the care team [17].

The critical role of formal and informal caregivers, for example, in monitoring patients and assisting them with telecommunication, was a recurring theme. This was congruent with prior research [5,18]. CVWs in the UK reported that most patients lived alone [19,20], hence, caregiver support had to be achieved by caregivers moving in with patients or frequent telephone calls to check on patients [17]. In contrast, all patients in our study resided with or near their caregivers and family members, a common household structure in Singapore and other Asian societies [21]. However, our participants did find caring for elderly patients with low health and technological literacy challenging. This was consistent with previous studies that highlight caregiver stress when attending to elderly patients [18]. Therefore, Virtual Ward care teams must include caregivers as key stakeholders in caring for the patient, proactively identify patients with a higher risk of caregiver stress, and provide reassurance and education to alleviate caregiver stress.

Stay-in foreign domestic helpers provided caregiving support by assisting in activities of daily living for elderly patients in this study. Dependence on these domestic helpers was so prominent that some caregivers from our study would not opt for CVW without their helpers. Domestic helpers are frequently employed in Asia and the Middle East (e.g., Singapore, Hong Kong, and Saudi Arabia) [14], making them additional key stakeholders of CVW. Due to difficulties with access, domestic helpers were not able to be included as participants in this study.

The overall positive patient experiences in this study suggest that CVW is an effective strategy in treating high-risk COVID-19 patients. However, these attitudes may have been influenced by the bed shortages and isolation criteria during the height of the pandemic. Patients and caregivers in our study may have been more likely to accept remote care to help minimize risk to themselves and their family members and may feel differently about self-monitoring and home recovery in non-pandemic contexts.

4.1. Limitations, strengths, and implications for future recommendations

Due to COVID-19 restrictions, the interviews were conducted over the phone, and hence, non-verbal cues were not collected and evaluated. Furthermore, findings may have been influenced by recall bias as interviews were conducted at least one week after CVW experiences. Moreover, our study did not include the experiences of other major stakeholders (e.g., CVW staff and domestic helpers), and hence, future research is needed to explore the experiences of these stakeholders. Nonetheless, this is the first qualitative study to describe the experiences of high-risk COVID-19 patients and their caregivers in a CVW in Singapore. Findings can be transferable to CVWs serving high-risk patients, and those in the Asian context.

From our findings, we have three key recommendations. First, CVW was not only found to be safe and effective but also suggested to be well-received in Asian communities that value being in the comfort of their homes surrounded by family members. Second, a two-way multimodal use of technology (voice calls, video calls, and text platforms) is an effective strategy to ensure virtual care is delivered promptly. Third, to further support caregivers of patients admitted to virtual wards, care teams may consider strategies like arranging meal delivery to assist with logistical concerns or wearables to assist with patients' inability to self-monitor vital signs. In assessing patients for suitability for CVW care, care teams should also consider that patients who are not able to self-manage, for example, because of low health literacy, or have an available caregiver in isolation may not be suitable candidates for CVW.

4.2. Conclusion

CVWs are novel in Singapore, and the research on this model of care in Asian communities is limited. Our findings suggest that with the aid of telecommunication and self-monitoring of vital signs, patients and caregivers believed that they were safe and effective alternatives to hospital care. Virtual Wards should continue to expand their scope beyond COVID-19 to provide more alternatives to inpatient hospitalization.

Author contributions

All authors contributed to the study's conception and design. The first author, Stephanie Qianwen Ko, was responsible for data collection, data analysis, and writing of this manuscript. The last author, Shefaly Shorey, was responsible for the data analysis, and writing of this manuscript. The second author, Crystal Min Siu Chua, was responsible for the data collection, and writing of this manuscript. The remaining two authors, Shu Hua Koh and Yee Wei Lim were responsible for the data analysis, critical review, and the edit of the manuscript. All authors have contributed significantly and agreed with the contents of the

manuscript.

Source of funding

This research was funded by an evaluation grant from the Ministry of Health Office for Healthcare Transformation (MOHT) and a Health Services Research Grant from the National Medical Research Council. The funder declared no commercial interest in this study and played no role in the design, analysis, or interpretation of this qualitative data, or the writing of this paper. No conflict of interest has been declared by the authors.

Ethics approval

The study received ethics approval from the National Health Group Domain Specific Review Board: Reference Number: 2021/00896.

Standards of reporting

COREQ.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Data Access, Responsibility, and Analysis

The principal investigator had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Data Sharing Statement

The datasets during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Summary table

- The COVID-19 pandemic has resulted in the accelerated development of virtual wards. However, there is limited research on the experiences of this model of care in Asian contexts, and among high-risk COVID-19 patients.
- Findings suggest that participants viewed this model of care as safe, with benefits such as a high level of satisfaction, being close to family members, and a lower infection rate.
- This study contributes to the growing body of literature on COVID-19-virtual wards, which can be expanded to accommodate high-risk patients.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijmedinf.2023.105111.

References

[1] J. Shaw, T. Jamieson, P. Agarwal, B. Griffin, I. Wong, R.S. Bhatia, Virtual care policy recommendations for patient-centered primary care: findings of a consensus policy dialogue using a nominal group technique, J. Telemed. Telecare 24 (2018) 608–615, p. 609.
[2] H. Xu, S. Huang, C. Qiu, et al., Monitoring and management of home-quarantined patients with COVID-19 using a WeChat-based telemedicine system: retrospective cohort study, J. Med. Internet Res. 22 (2020) e19514.
[3] C. Vindrola-Padros, M.S. Sidhu, T. Georghiou, et al., The implementation of remote home monitoring models during the COVID-19 pandemic in England, EClinicalMedicine 34 (2021), 100799.
[4] S. Shah, K. Majmudar, A. Stein, et al., Novel use of home pulse oximetry monitoring in COVID-19 patients discharged from the emergency department identifies need for hospitalization, Acad. Emerg. Med. 27 (2020) 681–692.
[5] K.N. Dainty, M.B. Seaton, A. Estacio, et al., Virtual Specialist Care During the COVID-19 Pandemic: Multimethod Patient Experience Study, JMIR Med. Inform. 10 (2022) e37196.
[6] K. Schultz, H. Vickery, K. Campbell, M. Wheeldon, L. Barrett-Beck, E. Rushbrook, Implementation of a virtual ward as a response to the COVID-19 pandemic, Aust. Health Rev. 45 (2021) 433–441.
[7] H. Walton, C. Vindrola-Padros, N.E. Crellin, et al., Patients' experiences of, and engagement with, remote home monitoring services for COVID-19 patients: A rapid mixed-methods study, Health Expect. 25 (2022) 2386–2404.
[8] S.Q. Ko, J. Goh, Y.K. Tay, et al., Treating acutely ill patients at home: Data from Singapore, Ann. Acad. Med. Singapore 51 (2022) 392–399.
[9] S.Q. Ko, C.M.S. Chua, S.H. Koh, Y.W. Lim, S. Shorey, Experiences of Patients and Their Caregivers Admitted to a Hospital-at-Home Program in Singapore: a Descriptive Qualitative Study, J. Gen. Intern. Med. (2022) 1–8.
[10] O.R. Ferry, E.C. Moloney, O.T. Spratt, G.F. Whiting, C.J. Bennett, A virtual ward model of care for patients with COVID-19: retrospective single-center clinical study, J. Med. Internet Res. 23 (2021) e25518.
[11] E.-J. O'Malley, S. Hansjee, B. Abdel-Hadi, E. Kendrick, S. Lok, A Covid-19 virtual ward model: a preliminary retrospective clinical evaluation from a UK district general hospital, J. Prim. Care Community Health 13 (2022), 21501319211066667.
[12] H.K. Kim, M.O. Lwin, Cultural determinants of cancer fatalism and cancer prevention behaviors among Asians in Singapore, Health Commun. 36 (2021) 940–949.
[13] United Nations. Population Facts, 2019.
[14] International Labour Office. Domestic workers across the world: Global and regional statistics and the extent of legal protection, 2013.
[15] A. Tong, P. Sainsbury, J. Craig, Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups, Int. J. Qual. Health Care 19 (2007) 349–357.
[16] V. Braun, V. Clarke, Thematic analysis, American Psychological Association, 2012.
[17] H. Walton, C. Vindrola-Padros, N. Crellin, et al., Patients' and carers' experiences of, and engagement with remote home monitoring services for COVID-19 patients: a rapid mixed-methods study. medRxiv 2021.
[18] Norman G, Bennett P, Vardy ER. Virtual wards: A rapid evidence synthesis and implications for the care of older people. medRxiv 2022.
[19] Housing and Development Board. Sample Household Survey 2018: The HDB Living Experience, 2018.
[20] Office for National Statistics. Families and households in the UK: 2020. 2022.
[21] K.K. Mehta, T.L. Leng, Interdependence in Asian families: the Singapore case, J. Intergenerational Relationships 4 (2006) 117–125.