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Title

The protocol and clinical characteristics of patients under "at-home care" for coronavirus disease 2019 in South Korea: a retrospective cohort study

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Abstract

Objective

As the number of patients with coronavirus disease 2019 (COVID-19) increased, at-home care was introduced for the first time in South Korea. This study aimed to analyze the characteristics and outcomes of patients who were treated under at-home care.

Design, setting, and participants

This retrospective cohort study targeted patients under at-home care for COVID-19 in Yeoungdeungpo-gu in Seoul, Korea, from October 18, 2021, to December 12, 2021.

Results

During the study period, a total of 1,422 patients were enrolled in this study, and 9,579 patient days were managed. Those over 60 years accounted for the most (22.7% [n=323]), and 82.8% did not have underlying conditions. The median length of care for patients was 8 days (interquartile range: 5-10). During the study period, a total of 986 (69.3%) patients were released from quarantine, 82 (5.8%) patients were transferred to facilities, and 354 (24.9%) patients were under at-home care. The common cause of transfer was sustained fever (n = 30, 36.6%), followed by dyspnea and desaturation (n = 17, 20.7%). Factors associated with transfer were diabetes (odds ratio [OR]: 3.591, 95% confidence interval [CI]: 1.488-8.665, $P = 0.004$), pregnancy (OR: 5.839, 95% CI: 1.035-32.935, $P = 0.046$), and being pre-symptomatic at diagnosis (OR: 4.015, 95% CI: 1.559-10.337, $P = 0.004$).

Conclusions

There were no specific problems related to patient safety when operating at-home care. For safe at-home care, patients with risk factors such as diabetes or those with newly presented

symptoms need more careful monitoring, and it is necessary to prepare for an appropriate response to the emergency.

Keywords: COVID-19; home care; protocol; outcome

Strengths and limitations of this study:

- The study emphasizes the need to prepare for an appropriate response to an emergency during at-home care.
- This was a single-center retrospective cohort study.
- This study depicted the early phase of at-home care for patients with COVID-19.

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first discovered in Wuhan, China in December 2019, and since the World Health Organization announced the pandemic in March 2020, there have been approximately 290 million confirmed cases of coronavirus disease 2019 (COVID-19) worldwide, as of December 2021.[1,2] With the development of vaccines, the number of confirmed cases in the United States and Europe seemed to be decreasing, but due to the easing of the quarantine measures and the presentation of new variants, the number of confirmed cases was skyrocketing again. There was no difference in the domestic situation. With the start of vaccination, the overall quarantine level was relieved. However, subsequently, the fourth epidemic occurred in Korea. In addition, emerging new variants have led to the updating of new confirmed cases every day.[3]

During each epidemic situation, the medical system faced a crisis, and it was accompanied by difficulties in allocating medical personnel, supplies, and beds. During the initial epidemic, community treatment centers (CTC) for asymptomatic or mild patients were operated to fill the medical gap in Korea.[4–6] As the epidemic progressed, it became difficult to cope with the increasing number of patients with COVID-19 by CTC alone. The occurrence of pediatric and psychological problems was another challenge for the CTC setting.[7,8]

As the COVID-19 pandemic protracted, the Korean government modified its policy for management of critically ill patients with COVID-19. The domestic metropolitan area introduced at-home care as an alternative to a deficient medical system. This is the first home healthcare system for the management and monitoring of patients suffering from infectious diseases in Korea. To overcome the current COVID-19 pandemic and prepare for a new novel infectious disease, a well-established at-home care system is required. In this study, we aimed

to introduce the protocol of at-home care that is being implemented in our institution and analyze the characteristics and outcomes of patients under at-home care during the COVID-19 pandemic.

MATERIALS AND METHODS

Study design, setting and study population

This was a retrospective cohort study that used medical records. Kangnam Sacred Heart Hospital is a secondary medical institution with 572 beds located in Yeongdeungpo-gu, Seoul, South Korea. Our institution signed an agreement with Yeongdeungpo-gu administration as an at-home care medical institution on October 5, 2021, and started operating on October 18, 2021. All patients who were under at-home care in Kangnam Sacred Heart Hospital between October 18, 2021, and December 12, 2021, were included in this study.

Criteria for enrollment and release from quarantine

Enrollment criteria

In Korea, policies for the care of patients with COVID-19 were changed, and the criteria for at-home care were also changed on November 26, 2021.

Before November 26, 2021, the Korea Centers for Disease Control and Prevention classified patients with asymptomatic and mild symptoms under 70 years of age without hospitalization factors (mental change after symptom onset of COVID-19, dyspnea, uncontrolled fever with antipyretics, uncontrolled diabetes mellitus (DM), hemodialysis, patients treated for chronic lung disease, asthma, heart failure, coronary artery disease, patients under chemotherapy or immunosuppressant, uncontrolled symptomatic psychiatric disease, bedridden states, obese [body mass index > 30], pregnant with symptoms such as abdominal pain, labor, vaginal bleeding, severe childhood or with a high risk of dyspnea, cyanosis, chest depression, poor oral intake, or dehydration, diagnosed with chronic lung disease/cardiac disease/metabolic

disease/abnormal immune system, under immunosuppressant, respiratory function or excretion problem, or risk of aspiration) as candidates for at-home care, with consent. In patients over 60 years, only those who had been vaccinated, were registered for at-home care. Patients in need of care, such as minors and those with disabilities, were required to be accompanied by a protector.[9] The exclusion criteria were as follows: 1) those who lived in a residential environment vulnerable to infection due to difficulty in blocking contact with others; 2) when communication for non-face-to-face health care and quarantine management was difficult for the patient or protector.

From November 26, patients confirmed of having COVID-19 were all allocated to at-home care, except in the following cases: 1) those who had hospitalization factor (mental change after symptom onset of COVID-19, dyspnea, uncontrolled fever with antipyretics longer than 3 days, uncontrolled DM, hemodialysis, patients treated for chronic lung disease, asthma, heart failure, coronary artery disease, patients under chemotherapy or immunosuppressant, uncontrolled symptomatic psychiatric disease, bedridden states, pregnant with symptoms such as abdominal pain, labor, vaginal bleeding, severe childhood or with high risk of dyspnea, cyanosis, chest depression, poor oral intake, or dehydration, diagnosed with chronic lung disease/cardiac disease/metabolic disease/abnormal immune system, under immunosuppressant, respiratory function or excretion problem, or risk of aspiration), 2) those who lived in a residential environment vulnerable to infection, 3) minor, disabled or over 70 years who required care but could not be quarantined together with a protector, 4) those who were deemed too difficult to treat with at-home care by the head of the local government.[10]

Criteria for release from quarantine

Symptomatic patients were released from quarantine 10 days after the symptom onset.[9] Asymptomatic patients were released from quarantine 10 days after the diagnosis. The quarantine date was extended, depending on the occurrence of symptoms, and the final decision for release was made by the medical staff.

Intervention

Kangnam Sacred Heart Hospital operated at-home care by targeting patients with COVID-19 residing in Yeongdeungpo-gu. The at-home care program involved four medical doctors and five nurses in one monitoring room. They operated during the day and used an on-call system at night. One doctor was in-charge per day, but a backup doctor was designated in case of an emergency. Nurses worked in two shifts, with two nurses during the daytime and evening and one during the night for the on-call system.

Yeondeungpo-gu public health center classified patients with COVID-19 for at-home care according to the enrollment criteria and supplied items necessary for at-home care such as antipyretics, oxygen saturation monitor, thermometer, and phone numbers of related medical institutions. The patients to be managed were registered as outpatients with assigned doctors every day so that prescriptions were available if needed. The list of patients under at-home care was secured through the public health center and updated daily.

The monitoring room was equipped with computers, monitors, and smartphone devices. Patients checked their blood pressure and body temperature and uploaded the data in their smartphone applications. Nurses called the patient at 9 a.m. and 5 p.m. every day to check the patient's vital signs and symptoms and update patient information on electronic health records.

If the patient had symptoms and wanted to take medication, the doctor interviewed the patient and prescribed the medicine. The prescription was sent to the public health center by fax. After prescribing the medicine at the pharmacy, the person in charge of the public health center delivered the medicine to the patient's house. If the patient had persistent fever, desaturation, or worsening of clinical symptoms, the doctor interviewed the patient and decided whether to transfer the patient to other facilities, such as CTC or hospitals, according to the severity. The public health center assigned an ambulance and medical institution and transported.

The medical staff checked the list of patients who were subject to release from quarantine and whether it was possible to release from quarantine according to the criteria, every day. The results were reported to the public health center.

Data collection and Statistical analysis

Data regarding patient characteristics such as age, sex, enrollment date, release from quarantine date, transfer date (if transferred), symptoms, and medical prescription were collected through a retrospective medical record review.

Continuous variables were presented as mean ± standard deviation (SD) or median (interquartile range [IQR]), as appropriate. Statistical significance was assessed using the chi-square test and Fisher's exact test for categorical variables. Non-categorical variables were tested using the two-sided unpaired t-test or Mann–Whitney U test. The factors associated with transfer were calculated using a logistic regression model. Statistical significance was set at $P < 0.05$. Statistical analyses were performed using IBM SPSS ver. 27 (IBM SPSS Inc., Armonk, NY, USA).

Patient and public involvement

None (not applicable to this type of study).

RESULTS

Baseline characteristics of study population

During the study period, 1,453 patients were registered. Three patients moved to another district, and 28 patients were excluded from at-home care on the day of admission due to other causes of admission, such as severe symptoms at diagnosis. A total of 1,422 patients and 9,574 patient days were managed under at-home care at Kangnam Sacred Heart Hospital. The number of patients managed daily is shown in Figure 1.

Among 1,422 patients, 725 (51.0%) were men, and the median age was 40 (IQR: 27-58, range: 0-87) years (Table 1). Those over 60 years accounted for the most (22.7% [n = 323]), followed by those in their 30's (18.5% [n = 263]). Most of them (n = 1,177; 82.8%) did not have underlying conditions, and hypertension (n = 153; 10.8%) was the most common comorbidity. Approximately 16.4% (n = 233) of patients under at-home care were asymptomatic. There were 209 cases of drug prescriptions in 176 (12.4%) patients. On average, 3.7 (SD: 3.73, range: 0-16 per day) prescriptions were requested per day. Symptoms for the prescribed drugs are described in Table 2. The most common symptom was cough (n = 115; 55.8%), followed by sputum (n = 62; 30.1%), and sore throat (n = 54; 26.2%). The number of night call was 68 cases (range: 0-6 cases per day) which was an average of 1.2 (SD: 1.64) night call per day.

Table 1. Baseline characteristics of patients under at-home care system (n = 1422)

Characteristics	Total (N = 1422) No (%)	Released from quarantine (N = 986) No (%)	Transferred (N = 82) No (%)	*P*-value

Sex				0.873
Male	725 (51.0)	508 (51.5)	43 (52.4)	
Female	697 (49.0)	478 (48.5)	39 (47.6)	
Age, years, mean (range)	40 (0-87)	40 (0-83)	45 (1-87)	0.051
0-9	156 (11.0)	109 (11.1)	3 (3.7)	
10-19	122 (8.6)	73 (7.4)	10 (12.2)	
20-29	151 (10.6)	112 (11.4)	8 (9.8)	
30-39	263 (18.5)	194 (19.7)	14 (17.1)	
40-49	186 (13.1)	120 (12.2)	11 (13.4)	
50-59	221(15.5)	152 (15.4)	11 (13.4)	
≥ 60	323 (22.7)	225 (22.9)	25 (30.5)	
Underlying conditions				
hypertension	153 (10.8)	99 (10.0)	15 (18.3)	0.020
diabetes	43 (3.0)	28 (2.8)	7 (8.5)	0.005
thyroid disease	22 (1.5)	17 (1.7)	0 (0)	0.231
psychiatric disorder	12 (0.8)	10 (1.0)	1 (1.2)	0.860
pregnancy	6 (0.4)	4 (0.4)	2 (2.4)	0.018
others*	53 (3.7)	26 (2.6)	5 (6.1)	
none	1177 (82.8)	820 (83.2)	60 (73.2)	0.022
Symptoms				0.009
Asymptomatic	233 (16.4)	159 (16.1)	7 (8.5)	
Pre-symptomatic	160 (11.3)	89 (9.0)	15 (18.3)	

Symptomatic	1029 (72.4)	738 (74.8)	60 (73.2)	
Medicine prescription	176 (12.4)	117 (11.9)	21 (25.6)	0.020
Transfer to healthcare facilities	82 (5.8)			
Hospitals			51 (62.2)	
Community treatment center			31 (37.8)	
Median days from symptoms to diagnosis, days (IQR)	2 (1-4)	2 (1-4)	2 (1-3.75)	0.307
Median days from diagnosis to management, days (IQR)	1 (0-1)	1 (0-2)	0 (0-1)	< 0.001
Median management days ***, days (IQR)	8 (5-10)	8 (6-10)	3 (2-4.25)	< 0.001

IQR: Interquartile range

* epilepsy, autoimmune disease, liver disease, asthma, bronchiectasis, angina, cerebrovascular disease, ulcerative colitis

** conjunctivitis, urticaria, nausea, diarrhea

*** release from quarantine and transferred patients, excluded under management

Table 2. Symptoms for prescription medication (n = 209)

Symptoms*	No. (%)
Cough	115 (55.8)
Sputum	62 (30.1)
Sore throat	54 (26.2)
Nasal congestion	38 (18.4)
Rhinorrhea	33 (16.0)
Fever	17 (8.3)
Headache	14 (6.8)
Myalgia	8 (3.9)
Conjunctivitis	7 (3.4)
Gastrointestinal symptoms	7 (3.4)
Other**	10 (4.9)

* allow duplicates

** sleep disorder, febrile sense, underlying disease

The median length from symptoms to diagnosis was 2 (IQR: 1-4) days, and from diagnosis to management was 1 (IQR: 0-1) day. The median length of care for patients was 8 days (IQR: 5-10). During the study period, a total of 986 (69.3%) patients were released from quarantine, 82 (5.8%) patients were transferred to CTC or hospitals, and 354 (24.9%) patients were under at-home care.

Characteristics according to transfer

A total of 83 (5.8%) patients were transferred. Fifty-one (62.2%) patients were transferred to

the hospital and others were transferred to CTC (n = 31; 37.8%). Sex and age did not differ significantly according to the transfer (Table 1). Among the transferred patients, 52.4% (n = 43) were male, and patients over 60 years (n = 25; 30.5%) were mostly transferred. Patients with comorbidities were significantly more likely to be transferred than those who were released from quarantine (25.8% vs. 16.8%, P = 0.022). The proportion of patients with hypertension and DM was significantly higher in transferred patients (10.0% vs. 18.3%, P = 0.020, 2.8% vs. 8.5%, P = 0.005). The proportion of pregnant women was significantly higher in the transferred patients (0.4% vs. 2.4%, P = 0.018). The median management duration of at-home care was 8 (IQR: 6-10) days for release from quarantine and 3 (IQR: 2-4.25) days for transferred patients.

The common cause of transfer was sustained fever (n = 30; 36.6%) (Table 3). Seventeen patients (20.7%) were transferred because of dyspnea, and their oxygen saturation was less than 90%. Median 5 (IQR: 4-8) days were taken from symptom onset to transfer request and, median 3 (IQR: 2-5) days were required from diagnosis to transfer request. Most transfers (n = 61; 75.5%) were made on the same day as the transfer requests. For 21 (25.6%) patients, it took 1 day for the allocation of a bed after request. One patient required 2 days and one patient required 3 days for transfer. All patients with dyspnea were transferred on the same day.

Table 3. Reasons for transfer (n = 82)

Reasons	No. (%)
Sustained fever	30 (36.6)
Dyspnea/desaturation	17 (20.7)
Patients wanted	13 (15.9)

Cough/chest pain	9 (11.0)
Resident with family	5 (6.10)
Minor	4 (4.9)
Aggravation of underlying disease	2 (2.4)
As protector	1 (1.2)
Old age	1 (1.2)

Risk factors for transfer

The factors associated with transfer are shown in Table 4. In univariate analysis, age and sex were not significantly associated with transfer. The presence of underlying disease (odds ratio [OR]: 1.811, 95% confidence interval [CI]: 1.081-3.035, $P = 0.024$), hypertension (OR: 2.006, 95% CI: 1.104-3.644, $P = 0.022$), DM (OR: 3.193, 95% CI: 1.350-7.553, $P = 0.008$), and pregnancy (OR: 6.137, 95% CI: 1.107-34.023, $P = 0.038$) were significantly associated with transfer. On multivariate analysis, we found no significant association of age and sex with transfer. DM (OR: 3.591, 95% CI: 1.488-8.665, $P = 0.004$), pregnancy (OR: 5.839, 95% CI: 1.035-32.935, $P = 0.046$), and being pre-symptomatic (OR: 4.015, 95% CI: 1.559-10.337, $P = 0.004$) were independent risk factors for transfer.

Table 4. Factors associated with transfer

	Univariate analysis			Multivariate analysis		
Variables	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Sex, female	0.964	0.614-1.513	0.873	0.742	0.579-1.476	0.742

Age						
0-9	0.385	0.100-	0.167	0.439	0.112-	0.238
10-19	1.918	1.491	0.191	2.169	1.723	0.126
20-29	reference	0.723-	reference	reference	0.804-	reference
30-39	0.982	5.086	0.982	0.957	5.849	0.924
40-49	0.605		0.605	1.371		0.521
50-59	0.978	0.411-	0.978	0.961	0.384-	0.937
> 60	0.300	2.483	0.300	1.346	2.386	0.518
		0.498-			0.523-	
		3.306			3.596	
		0.395-			0.360-	
		2.601			2.566	
		0.677-			0.547-	
		3.544			3.315	
Underlying	1.811	1.081-	0.024	0.662	0.219-	0.465
disease		3.035			1.999	
Hypertension	2.006	1.104-	0.022	2.106	0.682-	0.196
		3.644			10.208	
Diabetes	3.193	1.350-	0.008	3.591	1.488-	0.004
mellitus		7.553			8.665	
Pregnancy	6.137	1.107-	0.038	5.839	1.035-	0.046
		34.023			32.935	
Symptoms						

Asymptomatic	reference		reference	reference		reference
Pre-symptomatic	3.828	1.505-9.741	0.005	4.015	1.559-10.337	0.004
Symptomatic	1.847	0.829-4.115	0.134	1.983	0.880-4.469	0.099

OR: Odds ratio, CI: Confidence interval

DISCUSSION

Despite the increase in vaccination against COVID-19, the number of confirmed cases worldwide has been increasing due to the easing of quarantine measures, waning of vaccination immunity, and the emergence of new SARS-CoV-2 variants.[1] Because of the limitations of medical manpower and resources, such as hospital beds, at-home care was introduced in Korea. As this system was introduced for the first time in Korea, in this study, we aimed to explain the initial operating protocol and results.

In Korea, since the first COVID-19 outbreak in Daegu, in 2020, CTC have been operating in the face of the COVID-19 epidemic. Some facilities such as dormitories and hotels were converted to isolation units for patients with COVID-19, and a monitoring system for patients with the stationed medical staff was established. This system was flexibly operated according to the trend in the number of confirmed cases. To operate CTC, it is necessary to provide a space for isolation of patients and stay of medical staff. To prepare such facilities, a certain period was required, and after the increase in the number of confirmed cases, there were difficulties in arranging space and medical staff. In the case of a short-term epidemic, it could be managed, but as the epidemic became longer and the number of confirmed cases increased, like the fourth epidemic in Korea, there was a limit to the management through CTC. The

medical system was saturated due to the number of confirmed cases and the increase in the number of patients with severe cases; therefore, the government of the Republic of Korea changed the policy for the management of patients with severe cases. As a result, at-home care was introduced in Korea. Before the fourth epidemic, some local governments operated at-home care by a public health center for certain patients, such as children and their parents, or patients who were healthy and young. As the fourth epidemic began, at-home care expanded the target and region to all over the country and was managed by the hospital from October 2021.

With the COVID-19 pandemic, some countries, including the United States, quarantined asymptomatic or mild patients in their homes, without hospitalization.[11–14] At-home care in Korea was a system that monitored patients twice a day over the phone. Procurement of necessary supplies and transfer systems were established and managed. Through this system, some solutions have been suggested for medical problems that could be missed due to simple home isolation alone.

Entering quarantine facilities, such as CTC, due to COVID-19 could cause psychological problems. Approximately 30% of patients admitted to CTC complained of psychological problems due to isolation in an unfamiliar environment.[8] In particular, in the case of pediatric patients, when considering psychological factors and diagnosis time after symptom onset, which might be the transmission period had passed, isolation in CTC or hospital was somewhat disadvantageous.[7] At-home care compensated for the psychological disadvantages of the CTC by maintaining quarantine in a familiar environment, especially with family.

Respiratory symptoms such as cough, sputum, sore throat, fever, and anosmia were symptoms

of COVID-19.[4,5,15] In this study, cough was the most common symptom for which medicines were prescribed. Most prescribed medicines were for respiratory symptoms, but there were also cases of digestive symptoms, conjunctivitis, or sleep disorder. As the COVID-19 epidemic prolonged and many patients were treated under at-home care, strategic preparedness was required so that medicines for respiratory symptoms and for other possible symptoms could be smoothly supplied to the patients. In some cases, there was a shortage of medications that were being taken in cases of underlying conditions. This indicated that during the quarantine period, there may be a need for an alternative to the prescription of the medicine that was currently being taken, such as a proxy prescription.

Elderly patients and pregnant women have a high risk of acute exacerbation and severity.[16–18] Comorbidities such as hypertension and DM were other risk factors for disease aggravation in patients with COVID-19.[18] In this study, DM and pregnancy were the risk factors for transfer, along with the pre-symptomatic status. Although age did not show a significant association with the transfer, 30.5% of the transferred patients were older than 60 years. At-home care patients with underlying conditions or old age needed more thorough management with caution.

In this study, 5.8% of the patients were transferred to the CTC or hospitals. In a previous study of CTC that treated asymptomatic or mild COVID-19 patients, the transfer rate ranged from 0.7% to 10.3%.[4,6,19,20] Patients transferred for worsening of symptoms requested a transfer at a median of 5 days after symptom onset and a median of 3 days from diagnosis. The duration from diagnosis to transfer was different on comparison with a previous study reporting a median of 3.5 days to 11 days.[4,6,15,19] This duration was shorter in the present study because all patients with COVID-19 were under at-home care as a basic treatment, the

proportion of patients who wished to be transferred to the CTC or hospitals and that of patients who faced difficulties in self-isolation was as high as 22.0%. The patients were transferred quickly after the diagnosis. In approximately 55% of cases in this study, transfer requests were made within 5 days of symptom onset. However, in the remaining 45%, symptoms worsened 6 days after symptom onset. Some reported that symptoms were aggravated between 4 and 14 days after symptom onset.[21,22] At the beginning of at-home care, monitoring was maintained for 10 days from symptom onset. However, the monitoring duration was subsequently modified to 7 days and additional monitoring for 3 days is required was determined depending on symptoms. Patients with risk factors were monitored thoroughly, as there were some patients who needed to be transferred to the CTC or hospitals even at the end of monitoring (7 days post-management).

This system was not a monitoring and treatment system that checks the patient in real-time. The worsening of symptoms may have been missed. This risk was even greater in patients who received at-home care alone. In addition, if the patient did not feel any symptoms even when the condition worsened, the patient might have been left unattended. Difficulty in responding to emergent situations was another problem. Since the patient was not treated in the same space as medical personnel, it took time to directly contact the medical personnel, even if the symptoms were monitored. In addition, after confirming the transfer, it took time to assign and implement emergency measures. Unlike CTC, if a transfer was delayed, proper medical measures such as oxygen supply were also delayed, which could prove to be fatal to patients. Therefore, there is a need for a system that secures and utilizes an ambulance and an available emergency bed for at-home care patients in advance.

Currently, in a situation where the number of patients with COVID-19 has skyrocketed and the

basic treatment policy has been switched to at-home care, the number of patients receiving at-home care is continuously increasing. Because at-home care was a system in which medical staff directly interviewed patients twice a day over the phone, medical personnel were needed for this. Administrative personnel were also required to allocate patients, deliver supplies, and deliver drugs through prescriptions. In the beginning, management of patients with the help of assigned medical personnel was possible, but as the number of patients increased, management by the existing staff became difficult. This may lead to difficulties in identifying patients and responding to patients. In preparing for the continuing epidemic, measures should be taken on how to procure the required manpower.

This study had some limitations. First, this was a single-center study. As at-home care has been expanded to cover the entire nation and all patients confirmed of having COVID-19, it is necessary to analyze the additional data of the results of at-home care. Second, this study analyzed the result of the early phase of at-home care. It was a point in time when the setting was not completely established. Thus, additional system supplementation is required.

CONCLUSION

Due to the increase in the number of confirmed cases beyond those that medical facilities could handle at-home care was an unavoidable option. For safe at-home care, patients with risk factors such as DM require more careful monitoring, and it is necessary to prepare for an appropriate response to the emergency.

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Contributors

YBS conceptualized the manuscript, manuscript editing. JJP contributed to data curation, data analysis and manuscript writing. JL, SHN and YKC contributed to acquisition of data. All authors have read and approved the submission.

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Competing Interests

None declared.

Patient consent for publication

Not required

Ethics approval

The study was approved by the Institutional Review Board (IRB) of Kangnam Sacred Heart Hospital (IRB No.: 2021-11-035-001), and the requirement for informed consent was waived.

Data availability statement

No data available.

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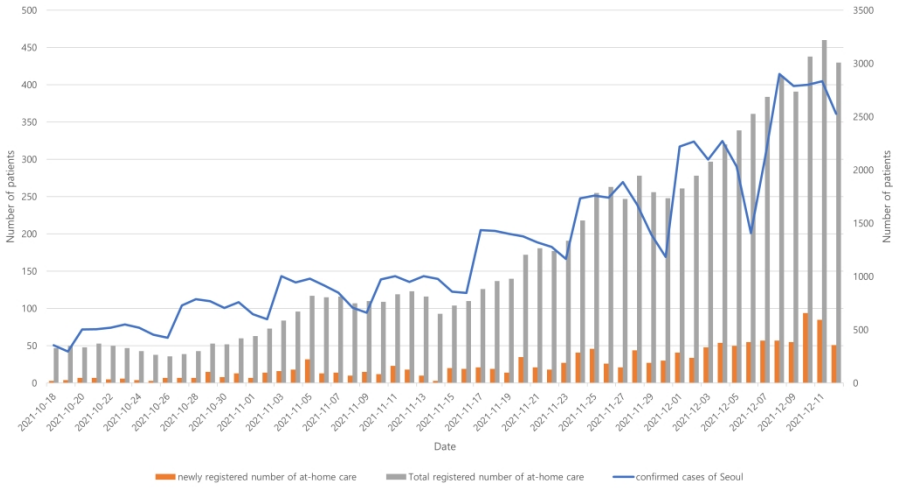
Figure legend

Figure 1. Trends of number of patients with COVID-19 in this study and in Seoul, South Korea



Trends of number of patients with COVID-19 in this study and in Seoul, South Korea

338x190mm (300 x 300 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2	Retrospective cohort study
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2, 3	abstract
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5	introduction
Methods				
Study design	4	Present key elements of study design early in the paper	6	Materials and methods-study design, setting and study population
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,9	Materials and methods-study design, setting and study population Materials and methods - data collection and statistical analysis
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	7, 8	Materials and methods - criterial for enrolment and and release from quarantine
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case		

Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9	Materials and methods - data collection and statistical analysis
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9	Materials and methods - data collection and statistical analysis
Bias	9	Describe any efforts to address potential sources of bias		
Study size	10	Explain how the study size was arrived at	6	Materials and methods-study design, setting and study population

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why		
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9	Materials and methods - data collection and statistical analysis
		(*b*) Describe any methods used to examine subgroups and interactions		
		(*c*) Explain how missing data were addressed		
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy		
		(*e*) Describe any sensitivity analyses		
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11	results
		(b) Give reasons for non-participation at each stage	11	results
		(c) Consider use of a flow diagram		
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11	Results-Table1
		(b) Indicate number of participants with missing data for each variable of interest	11	results
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	11,12	Results-Table 1
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	11-13	Results-Table 1
		Case-control study—Report numbers in each exposure category, or summary measures of exposure		
		Cross-sectional study—Report numbers of outcome events or summary measures		
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-18	Results-Table 4
		(*b*) Report category boundaries when continuous variables were categorized		
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses		
Discussion				
Key results	18	Summarise key results with reference to study objectives	18	discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22	discussion
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-22	discussion
Generalisability	21	Discuss the generalisability (external validity) of the study results	18-22	discussion
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	23	funding

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

The protocol and clinical characteristics of patients under "at-home care" for coronavirus disease 2019 in South Korea: a retrospective cohort study

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Title

The protocol and clinical characteristics of patients under "at-home care" for coronavirus disease 2019 in South Korea: a retrospective cohort study

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ABSTRACT

Objective

As the number of patients with coronavirus disease 2019 (COVID-19) increased, at-home care was introduced for the first time in South Korea. This study aimed to analyze the characteristics and outcomes of patients who were treated under at-home care.

Design, setting, and participants

This retrospective cohort study targeted patients under at-home care for COVID-19 in Yeoungdeungpo-gu in Seoul, Korea, from October 18, 2021, to December 12, 2021. The public health center selected eligible patients for at-home care and registered with our institution. Nurses monitored patients and doctors decided to transfer healthcare facilities and release the quarantined patients according to their symptoms.

Outcome Measures: Patient characteristics during the course of at-home care

Results

A total of 1,422 patients were enrolled and 9,579 patient days were managed. Most patients were aged 60 years and older (22.7% [n=323]), and 82.8% did not have underlying conditions. The median length of care for patients was 8 days (interquartile range: 5-10). During the study period, 986 (69.3%) patients were released from quarantine, 82 (5.8%) patients were transferred to facilities, and 354 (24.9%) patients were still under at-home care at the end of the study period. The most common cause of transfer was sustained fever (n = 30, 36.6%), followed by dyspnea and desaturation (n = 17, 20.7%). Factors associated with transfer were diabetes (odds ratio [OR]: 3.591, 95% confidence interval [CI]: 1.488-8.665, P = 0.004), pregnancy (OR: 5.839, 95% CI: 1.035-32.935, P = 0.046), and being pre-symptomatic at

diagnosis (OR: 4.015, 95% CI: 1.559-10.337, $P = 0.004$).

Conclusions

There were no specific problems related to patient safety when operating at-home care. Patients with risk factors such as diabetes were more likely to be transferred to healthcare facilities. For safe at-home care, it is necessary to prepare for an appropriate response to the emergency.

Keywords: COVID-19; home care; protocol; outcome

Strengths and limitations of this study:

- The study emphasizes the need to prepare for an appropriate response to an emergency during at-home care.
- This was a single-center retrospective cohort study.
- This study depicted the early phase of at-home care for patients with COVID-19.

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first discovered in Wuhan, China in December 2019, and since the World Health Organization announced the pandemic in March 2020, there have been approximately 290 million confirmed cases of coronavirus disease 2019 (COVID-19) worldwide, as of December 2021.[1,2] With the development of vaccines, the number of confirmed cases in the United States and Europe seemed to be decreasing, but due to the easing of quarantine measures and the presentation of new variants, the number of confirmed cases skyrocketed again. There was no difference in the domestic situation. With the start of vaccination, the overall quarantine level was relieved. However, subsequently, a fourth epidemic occurred in Korea. In addition, emerging new variants have led to the updating of new confirmed cases every day.[3]

During each epidemic situation, the medical system faced a crisis, and it was accompanied by difficulties in allocating medical personnel, supplies, and beds. During the initial epidemic, community treatment centers (CTC) for asymptomatic or mild patients were operated to fill the medical gap in Korea.[4–6] As the epidemic progressed, it became difficult to cope with the increasing number of patients with COVID-19 with CTCs alone. The occurrence of pediatric and psychological problems was another challenge for the CTC setting.[7,8]

As the COVID-19 pandemic protracted, the Korean government modified its policy for management of critically ill patients with COVID-19. The domestic metropolitan area introduced at-home care as an alternative to a deficient medical system. This is the first home healthcare system for the management and monitoring of patients suffering from infectious diseases in Korea. To overcome the current COVID-19 pandemic and prepare for a new novel infectious disease, a well-established at-home care system is required. In this study, we aimed

to introduce an at-home care protocol that is being implemented through our institution and analyze the characteristics and outcomes of patients under at-home care during the COVID-19 pandemic.

MATERIALS AND METHODS

Study design, setting, and study population

This was a retrospective cohort study that used medical records. Kangnam Sacred Heart Hospital is a secondary university hospital with 572 beds located in Yeongdeungpo-gu, Seoul, South Korea. This institution provides internal medicine, surgery, and pediatric intensive care units, as well as an emergency center and outpatient department. This institution is responsible for treating patients mainly in the local constituency. Our institution signed an agreement with Yeongdeungpo-gu administration to become a provider of at-home medical care on October 5, 2021, and started operating as such on October 18, 2021. All patients under at-home care via Kangnam Sacred Heart Hospital between October 18, 2021, and December 12, 2021, were included in this study.

Criteria for patient enrollment and release from quarantine

In Korea, COVID-19 was designated as a Class 1 legal infectious disease, which required all confirmed patients to report to public health authorities and to be quarantined for a set period. The person in charge of the public health center conducted an interview of all patients with confirmed diagnoses of COVID-19 and determined whether at-home care was appropriate or if they required hospital admission. Patients who could be treated at home and who provided

consent to public health were registered at our institution as at-home care patients.

On November 26, 2021, policies for the care of patients with COVID-19 were changed, as were the criteria for at-home care. Before this date, asymptomatic confirmed COVID-19 patients and those with mild symptoms under 70 years of age with no risk of hospitalization were eligible to receive at-home care. From November 26, 2021, onward, all patients were eligible to receive at-home care and were admitted to healthcare facilities only if there was a need for hospitalization.

Enrollment criteria

Before November 26, 2021, the Korea Centers for Disease Control and Prevention classified patients with asymptomatic and mild symptoms under 70 years of age as candidates for at-home care, following consent, except in the presence of the following risk factors for hospitalization: mental change after symptom onset of COVID-19, dyspnea, uncontrolled fever with antipyretics, uncontrolled diabetes mellitus (DM), hemodialysis, patients treated for chronic lung disease, asthma, heart failure, coronary artery disease, patients under chemotherapy or immunosuppressant, uncontrolled symptomatic psychiatric disease, bedridden states, obese (body mass index > 30), pregnant with symptoms such as abdominal pain, labor, vaginal bleeding, childhood or with a high risk of dyspnea, cyanosis, chest depression, poor oral intake, or dehydration, diagnosed with chronic lung disease/cardiac disease/metabolic disease/abnormal immune system, under immunosuppressant, respiratory function or excretion problem, or risk of aspiration. In patients over 60 years, only those who had been vaccinated were registered for at-home care. Patients in need of care, such as minors and those with disabilities, were required to be accompanied by a caregiver.[9] The exclusion criteria were as follows: 1) those who lived in a residential environment vulnerable to infection

due to difficulty in distancing or 2) when communication for non-face-to-face healthcare and quarantine management was difficult for the patient or caregiver.

From November 26, 2021, patients with a confirmed COVID-19 diagnosis were all allocated to at-home care, except in the following cases: 1) those who had the aforementioned risk factors for hospitalization, 2) those who lived in a residential environment vulnerable to infection, 3) individuals that were minors, disabled, or over the age of 70 years who required care but could not be quarantined together with a caregiver, 4) those who were deemed ineligible for treat with at-home care by the local government head (e.g. owing to a legal problem, etc.).[10]

Criteria for release from quarantine

Symptomatic patients were released from quarantine 10 days after symptom onset.[9] Asymptomatic patients were released from quarantine 10 days after diagnosis. The quarantine date was extended depending on the occurrence of symptoms, and the final decision for release was made by the medical staff.

Intervention

Kangnam Sacred Heart Hospital operated at-home care by targeting patients with COVID-19 residing in Yeongdeungpo-gu. The at-home care program involved four medical doctors and five nurses in one monitoring room. They operated during the day and used an on-call system at night. One doctor was in-charge per day, but a backup doctor was designated in case of an emergency. Nurses worked in two shifts, with two nurses during the daytime and evening and one during the night for the on-call system.

The Yeondeungpo-gu public health center classified patients with COVID-19 for at-home care

according to the enrollment criteria and supplied items necessary for at-home care such as antipyretics, an oxygen saturation monitor, a thermometer, and phone numbers of related medical institutions. The patients to be managed were registered as outpatients with assigned doctors every day so that prescriptions were available if needed. The list of patients under at-home care was secured through the public health center and updated daily.

The monitoring room was equipped with computers, monitors, and smartphones. Patients checked their blood pressure and body temperature and uploaded the data via smartphone applications. Nurses called the patient at 9 a.m. and 5 p.m. every day to check the patient's vital signs and symptoms and update patient information on electronic health records. If the patient had symptoms and wanted to take medication, the doctor interviewed the patient and prescribed the medicine. The prescription was sent to the public health center by fax. After prescribing the medicine at the pharmacy, the person in charge of the public health center delivered the medicine to the patient's house. If the patient had persistent fever, desaturation, or worsening clinical symptoms, the doctor interviewed the patient and decided whether to transfer the patient to another facility at the discretion of that doctor, such as a CTC or hospital, according to severity. The public health center assigned an ambulance and medical institution and transported the patient accordingly.

The medical staff checked the list of patients who were subject to release from quarantine daily and assessed whether it was possible to release them from quarantine according to the criteria. When those under quarantine were released, at-home care and monitoring also ended. The results were then reported to the public health center.

Data collection and statistical analysis

Data regarding patient characteristics such as age, sex, enrollment date, release from quarantine date, transfer date (if transferred), symptoms, and medical prescription were collected through a retrospective medical record review.

Continuous variables were presented as mean ± standard deviation (SD) or median (interquartile range [IQR]), as appropriate. Statistical significance was assessed using the chi-squared test and Fisher's exact test for categorical variables. Non-categorical variables were tested using the two-sided unpaired t-test or Mann–Whitney U test. The factors associated with transfer were calculated using a logistic regression model. Statistical significance was set at $P < 0.05$. Statistical analyses were performed using SPSS ver. 27 (IBM, Armonk, NY).

Patient and public involvement

None (not applicable to this type of study).

RESULTS

Baseline characteristics of study population

During the study period, 1,453 patients were registered. Three patients moved to another district, and twenty-eight patients were excluded from at-home care on the day of admission due to other causes of admission, such as severe symptoms at diagnosis. A total of 1,422 patients and 9,574 patient days were managed under at-home care at Kangnam Sacred Heart Hospital. The number of patients managed daily is shown in Figure 1.

Among 1,422 patients, 725 (51.0%) were male, and the median age was 40 (IQR: 27-58, range: 0-87) years (Table 1). Most patients were over 60 years (22.7% [n = 323]), followed by those

in their 30s (18.5% [n = 263]). Most (n = 1,177; 82.8%) did not have underlying conditions. Hypertension (n = 153; 10.8%) was the most common comorbidity. Approximately 16.4% (n = 233) of patients under at-home care were asymptomatic. There were 209 cases of drug prescriptions in 176 (12.4%) patients. On average, 3.7 ± 3.73 (range: 0-16) prescriptions were requested per day. Symptoms for the prescribed drugs are described in Table 2. The most common symptom was cough (n = 115; 55.8%), followed by sputum (n = 62; 30.1%) and sore throat (n = 54; 26.2%). Night calls occurred in 68 cases which was an average of 1.2 ± 1.64 (range: 0-6 cases) night calls per day.

Table 1. Baseline characteristics of patients under at-home care system (n = 1422)

Characteristics	Total (N = 1422) N (%)	Released from quarantine (N = 986) N (%)	Transferred (N = 82) N (%)	*P*-value
Sex				0.873
Male	725 (51.0)	508 (51.5)	43 (52.4)	
Female	697 (49.0)	478 (48.5)	39 (47.6)	
Mean age, years (range)	40 (0-87)	40 (0-83)	45 (1-87)	0.051
0-9	156 (11.0)	109 (11.1)	3 (3.7)	
10-19	122 (8.6)	73 (7.4)	10 (12.2)	
20-29	151 (10.6)	112 (11.4)	8 (9.8)	
30-39	263 (18.5)	194 (19.7)	14 (17.1)	

40-49	186 (13.1)	120 (12.2)	11 (13.4)	
50-59	221(15.5)	152 (15.4)	11 (13.4)	
≥60	323 (22.7)	225 (22.9)	25 (30.5)	
Underlying conditions				
Hypertension	153 (10.8)	99 (10.0)	15 (18.3)	0.020
Diabetes	43 (3.0)	28 (2.8)	7 (8.5)	0.005
Thyroid disease	22 (1.5)	17 (1.7)	0 (0)	0.231
Psychiatric disorder	12 (0.8)	10 (1.0)	1 (1.2)	0.860
Pregnancy	6 (0.4)	4 (0.4)	2 (2.4)	0.018
Others*	53 (3.7)	26 (2.6)	5 (6.1)	
None	1177 (82.8)	820 (83.2)	60 (73.2)	0.022
Symptoms				0.009
Asymptomatic	233 (16.4)	159 (16.1)	7 (8.5)	
Pre-symptomatic	160 (11.3)	89 (9.0)	15 (18.3)	
Symptomatic	1029 (72.4)	738 (74.8)	60 (73.2)	
Medicine prescription	176 (12.4)	117 (11.9)	21 (25.6)	0.020
Transfer to healthcare facilities	82 (5.8)			
Median days from symptoms to diagnosis, days (IQR)	2 (1-4)	2 (1-4)	2 (1-3.75)	0.307
Median days from diagnosis to	1 (0-1)	1 (0-2)	0 (0-1)	< 0.001

management, days (IQR)				
Median management days **, days (IQR)	8 (5-10)	8 (6-10)	3 (2-4.25)	< 0.001

IQR: interquartile range

* Epilepsy, autoimmune disease, liver disease, asthma, bronchiectasis, angina, cerebrovascular disease, ulcerative colitis

** Release from quarantine and transferred patients, excluded under management

Table 2. Symptoms for prescription medication (n = 209)

Symptoms*	No. (%)
Cough	115 (55.8)
Sputum	62 (30.1)
Sore throat	54 (26.2)
Nasal congestion	38 (18.4)
Rhinorrhea	33 (16.0)
Fever	17 (8.3)
Headache	14 (6.8)
Myalgia	8 (3.9)
Conjunctivitis	7 (3.4)
Gastrointestinal symptoms	7 (3.4)

Other**	10 (4.9)

* Allowed duplicates

** Sleep disorder, febrile sense, underlying disease

The median length from symptoms to diagnosis was 2 days (IQR: 1-4), and 1 day (IQR: 0-1) from diagnosis to management. The median length of care for patients was 8 days (IQR: 5-10). During the study period, 986 (69.3%) patients were released from quarantine, 82 (5.8%) patients were transferred to CTCs or hospitals, and 354 (24.9%) patients were still under at-home care when the study period ended. No patients under at-home care died during the study period.

Characteristics according to transfer

A total of 83 (5.8%) patients were transferred. Sex and age did not differ significantly according to the transfer (Table 1). Among the transferred patients, 52.4% (n = 43) were male, and patients over 60 years (n = 25; 30.5%) were most frequently transferred. Patients with comorbidities were significantly more likely to be transferred than those who were released from quarantine (25.8% vs. 16.8%, $P = 0.022$). The proportion of patients with hypertension and DM was significantly higher in transferred patients (10.0% vs. 18.3%, $P = 0.020$, 2.8% vs. 8.5%, $P = 0.005$). The proportion of pregnant women was significantly higher in the transferred patients (0.4% vs. 2.4%, $P = 0.018$). The median management duration of at-home care was 8 days (IQR: 6-10) for release from quarantine and 3 days (IQR: 2-4.25) for transferred patients.

The most common cause of transfer was sustained fever (n = 30; 36.6%) (Table 3). Seventeen patients (20.7%) were transferred because of dyspnea, and their oxygen saturation was less

than 90%. The time from symptom onset to transfer request was a median 5 days (IQR: 4-8), and a median 3 days (IQR: 2-5) were required from diagnosis to transfer request. Most transfers (n = 61; 75.5%) were made on the same day as the transfer requests. For 21 (25.6%) patients, it took 1 day to allocate a bed after the request. One patient required 2 days and one patient required 3 days for transfer. All patients with dyspnea were transferred on the same day.

Table 3. Reasons for transfer (n = 82)

Reasons	No. (%)
Sustained fever	30 (36.6)
Dyspnea/desaturation	17 (20.7)
Patients wanted	13 (15.9)
Cough/chest pain	9 (11.0)
Resident with family	5 (6.1)
Minor	4 (4.9)
Aggravation of underlying disease	2 (2.4)
As caregiver	1 (1.2)
Old age	1 (1.2)

Risk factors for transfer

The factors associated with transfer are shown in Table 4. In univariate analysis, age and sex were not significantly associated with transfer. The presence of underlying disease (odds ratio [OR]: 1.811, 95% confidence interval [CI]: 1.081-3.035, $P = 0.024$), hypertension (OR: 2.006,

95% CI: 1.104-3.644, *P* = 0.022), DM (OR: 3.193, 95% CI: 1.350-7.553, *P* = 0.008), and pregnancy (OR: 6.137, 95% CI: 1.107-34.023, *P* = 0.038) were significantly associated with transfer. On multivariate analysis, we found no significant association of age or sex with transfer. DM (OR: 3.591, 95% CI: 1.488-8.665, *P* = 0.004), pregnancy (OR: 5.839, 95% CI: 1.035-32.935, *P* = 0.046), and being pre-symptomatic (OR: 4.015, 95% CI: 1.559-10.337, *P* = 0.004) were independent risk factors for transfer.

Table 4. Factors associated with transfer

	Univariate analysis			Multivariate analysis		
Variables	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Female sex	0.964	0.614-1.513	0.873	0.742	0.579-1.476	0.742
Age						
0-9 years	0.385	0.100-1.491	0.167	0.439	0.112-1.723	0.238
10-19 years	1.918		0.191	2.169		0.126
20-29 years	reference	0.723-5.086	reference	reference	0.804-5.849	reference
30-39 years	0.982		0.982	0.957		0.924
40-49 years	0.605		0.605	1.371		0.521
50-59 years	0.978	0.411-2.483	0.978	0.961	0.384-2.386	0.937
>60 years	0.300	0.498-3.306	0.300	1.346	0.523-3.596	0.518
		0.395-2.601			0.360-2.566	

		0.677-3.544			0.547-3.315	
Underlying disease	1.811	1.081-3.035	0.024	0.662	0.219-1.999	0.465
Hypertension	2.006	1.104-3.644	0.022	2.106	0.682-10.208	0.196
Diabetes mellitus	3.193	1.350-7.553	0.008	3.591	1.488-8.665	0.004
Pregnancy	6.137	1.107-34.023	0.038	5.839	1.035-32.935	0.046
Symptoms						
Asymptomatic	reference		reference	reference		reference
Pre-symptomatic	3.828	1.505-9.741	0.005	4.015	1.559-10.337	0.004
Symptomatic	1.847	0.829-4.115	0.134	1.983	0.880-4.469	0.099

OR: odds ratio, CI: confidence interval

DISCUSSION

Despite the increase in vaccination against COVID-19, the number of confirmed cases worldwide has been increasing due to the easing of quarantine measures, waning vaccination immunity, and the emergence of new SARS-CoV-2 variants.[1] Because of the limitations of medical manpower and resources, such as hospital beds, at-home care was introduced in Korea.

As this system was introduced for the first time in Korea, we aimed to explain the initial operating protocol and results.

In Korea, since the first COVID-19 outbreak in Daegu in 2020, CTCs have been operating in the face of the COVID-19 epidemic. Some facilities, such as dormitories and hotels, were converted to quarantine units for patients with COVID-19, and a monitoring system for patients with stationed medical staff was established. This system was flexibly operated according to trends in the number of confirmed cases. To operate a CTC, it is necessary to provide a space for both quarantining patients and working medical staff. To prepare such facilities, a certain period was required, and after the increase in the number of confirmed cases, there were difficulties in arranging space and medical staff. This could be managed in the case of a short-term epidemic, but as the epidemic became longer and the number of confirmed cases increased, like during the fourth epidemic in Korea, there was a limit to the management through CTCs. The medical system was saturated due to the number of confirmed cases and the increase in the number of patients with severe cases; therefore, the government of the Republic of Korea changed the policy for the management of severely ill patients. As a result, at-home care was introduced in Korea. Before the fourth epidemic, some local governments operated at-home care by a public health center for certain patients, such as children and their parents, or patients who were healthy and young. As the fourth epidemic began, at-home care expanded its target to all over the country and was managed by hospitals from October 2021.

With the COVID-19 pandemic, some countries, including the United States, quarantined asymptomatic or mild patients in their homes without hospitalization.[11–14] At-home care in Korea was a system that monitored patients twice a day over the phone. Procurement of necessary supplies and transfer systems were established and managed. Through this system,

some solutions have been suggested for medical problems that could be missed due to simple home quarantine alone.

Entering quarantine facilities, such as a CTC, due to COVID-19 could cause psychological problems. Approximately 30% of patients admitted to a CTC complained of psychological problems due to quarantine in an unfamiliar environment.[8] In particular, when considering psychological factors and diagnosis time after symptom onset in pediatric patients, which might be after the transmission period had passed, quarantine in a CTC or hospital was somewhat disadvantageous.[7] At-home care compensated for the psychological disadvantages of CTCs by maintaining quarantine in a familiar environment, especially with family.

Respiratory symptoms such as cough, sputum, sore throat, fever, and anosmia were symptoms of COVID-19.[4,5,15] In this study, cough was the most common symptom for which medicines were prescribed. Most prescribed medicines were for respiratory symptoms, but there were also cases of digestive symptoms, conjunctivitis, or sleep disorder. As the COVID-19 epidemic persisted and many patients were treated under at-home care, strategic preparedness was required so that medicines for respiratory symptoms and other possible symptoms could be smoothly supplied to patients. In some cases, patients ran out of medications that were being taken in cases of underlying conditions. This indicated that, during the quarantine period, there may be a need for an alternative to the prescription of medicines for underlying conditions such as hypertension.

Elderly patients and pregnant women have a high risk of acute exacerbation and severity.[16–18] Comorbidities such as hypertension and DM were other risk factors for disease aggravation in patients with COVID-19.[18] In this study, DM and pregnancy were risk factors for transfer,

along with pre-symptomatic status. Although age was not significantly associated with transfer, 30.5% of transferred patients were older than 60 years. At-home care patients with underlying conditions or old age needed more thorough management with caution.

In this study, 5.8% of patients were transferred to CTCs or hospitals. In a previous study of CTCs that treated asymptomatic or mild COVID-19 patients, the transfer rate ranged from 0.7% to 10.3%.[4,6,19,20] Patients transferred for worsening of symptoms requested a transfer at a median of 5 days after symptom onset and a median of 3 days from diagnosis. The duration from diagnosis to transfer was different on comparison with a previous study reporting a median of 3.5 days to 11 days.[4,6,15,19] This duration was shorter in the present study because all patients with COVID-19 were under at-home care as a basic treatment, and the proportion of patients who wished to be transferred to a CTC or hospital and that of patients who faced difficulties in self-quarantine was as high as 15.9% and 6.1%, respectively. Patients were transferred quickly after diagnosis. In approximately 55% of cases in this study, transfer requests were made within 5 days of symptom onset. However, in the remaining 45%, symptoms worsened 6 days after symptom onset. Some reported that symptoms were aggravated between 4 and 14 days after symptom onset.[21,22] Patients with risk factors were monitored thoroughly, as there were some patients who needed to be transferred to a CTC or hospital even at the end of monitoring.

This system was not a monitoring and treatment system that checks a patient in real time. The worsening of symptoms may have been missed. This risk was even greater in patients who received at-home care alone. In addition, if the patient did not feel any symptoms even when the condition worsened, the patient might have been left unattended. Difficulty in responding to emergent situations was another problem. Since the patient was not treated in the same space

as medical personnel, it took time to directly contact the medical personnel, even if the symptoms were monitored. In addition, after confirming the transfer, it took time to assign and implement emergency measures. Unlike in a CTC, if a transfer was delayed, proper medical measures such as oxygen supply were also delayed, which could prove to be fatal to patients. Therefore, there is a need for a system that secures and utilizes an ambulance and an available emergency bed for at-home care patients in advance.

Currently, in a situation where the number of patients with COVID-19 has skyrocketed and the basic treatment policy has been switched to at-home care, the number of patients receiving at-home care is continuously increasing. Because at-home care was a system in which medical staff directly interviewed patients twice a day over the phone, medical personnel were needed for this. Administrative personnel were also required to allocate patients, deliver supplies, and deliver drugs through prescriptions. In the beginning, patient management with the help of assigned medical personnel was possible, but as the number of patients increased, management by the existing staff became difficult. This may lead to future difficulties in identifying patients and responding to patients. In preparing for the continuing epidemic, measures should be taken on how to procure the required manpower.

This study had some limitations. First, this was a single-center study. As at-home care has been expanded to cover the entire nation and all patients confirmed to have COVID-19, it is necessary to analyze additional data of the results of at-home care. Second, this study analyzed the results of the early phase of at-home care, which was a point in time when the setting was not completely established. Thus, additional system supplementation is required.

CONCLUSION

Due to the increase in the number of confirmed cases beyond those that medical facilities could handle, at-home care was an unavoidable option. Patients with risk factors such as DM were more likely to be transferred to healthcare facilities. For safe at-home care, it is necessary to prepare for an appropriate response to the emergency.

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None

Contributors

YBS conceptualized and edited the manuscript. JJP contributed to data curation, data analysis, and manuscript writing. JL, SHN, and YKC contributed to acquisition of data. All authors have read and approved the submission.

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Competing interests

None declared.

Ethics approval

The study was approved by the Institutional Review Board (IRB) of Kangnam Sacred Heart Hospital (IRB No.: 2021-11-035-001), and the requirement for informed consent was waived.

Data availability statement

No data available.

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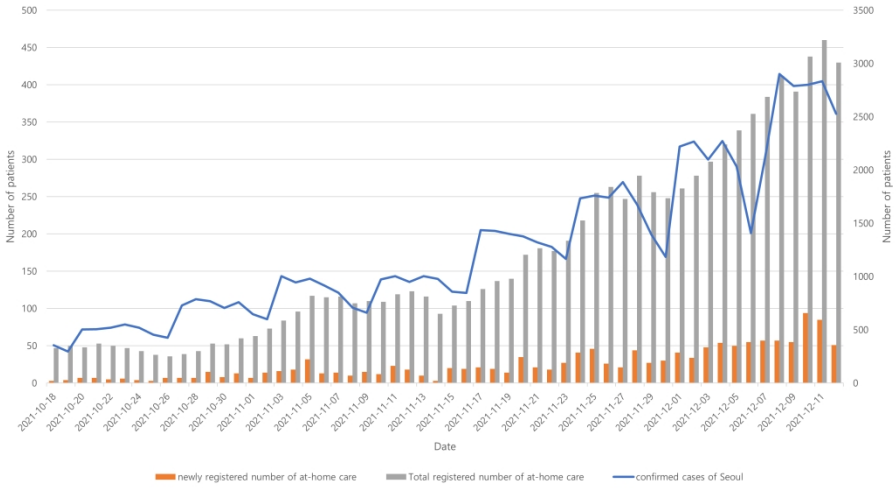
Figure legend

Figure 1. Trends of number of patients with COVID-19 in this study and in Seoul, South Korea



Trends of number of patients with COVID-19 in this study and in Seoul, South Korea

338x190mm (300 x 300 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2	Retrospective cohort study
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2, 3	abstract
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5	introduction
Methods				
Study design	4	Present key elements of study design early in the paper	6	Materials and methods-study design, setting and study population
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,9	Materials and methods-study design, setting and study population Materials and methods - data collection and statistical analysis
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	7, 8	Materials and methods - criterial for enrolment and and release from quarantine
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case		

Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9	Materials and methods - data collection and statistical analysis
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9	Materials and methods - data collection and statistical analysis
Bias	9	Describe any efforts to address potential sources of bias		
Study size	10	Explain how the study size was arrived at	6	Materials and methods-study design, setting and study population

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why		
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9	Materials and methods - data collection and statistical analysis
		(*b*) Describe any methods used to examine subgroups and interactions		
		(*c*) Explain how missing data were addressed		
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy		
		(*e*) Describe any sensitivity analyses		
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11	results
		(b) Give reasons for non-participation at each stage	11	results
		(c) Consider use of a flow diagram		
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11	Results-Table1
		(b) Indicate number of participants with missing data for each variable of interest	11	results
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	11,12	Results-Table 1
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	11-13	Results-Table 1
		Case-control study—Report numbers in each exposure category, or summary measures of exposure		
		Cross-sectional study—Report numbers of outcome events or summary measures		
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-18	Results-Table 4
		(*b*) Report category boundaries when continuous variables were categorized		
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses		
Discussion				
Key results	18	Summarise key results with reference to study objectives	18	discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22	discussion
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-22	discussion
Generalisability	21	Discuss the generalisability (external validity) of the study results	18-22	discussion
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	23	funding

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

The protocol and clinical characteristics of patients under "at-home care" for coronavirus disease 2019 in South Korea: a retrospective cohort study

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Title

The protocol and clinical characteristics of patients under "at-home care" for coronavirus disease 2019 in South Korea: a retrospective cohort study

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ABSTRACT

Objective

As the number of patients with coronavirus disease 2019 (COVID-19) increased, at-home care was introduced for the first time in South Korea. This study aimed to analyze the characteristics and outcomes of patients who were treated under at-home care.

Design, setting, and participants

This retrospective cohort study targeted patients under at-home care for COVID-19 in Yeoungdeungpo-gu in Seoul, Korea, from October 18, 2021 to December 12, 2021. The public health center selected eligible patients for at-home care and registered with our institution. Nurses monitored patients, and doctors decided to transfer healthcare facilities and release the quarantined patients according to their symptoms.

Outcome Measures: Patient characteristics during the course of at-home care

Results

A total of 1,422 patients were enrolled and 9,579 patient days were managed. Most patients were aged ≥60 years (22.7% [n=323]), and 82.8% did not have underlying conditions. The median length of care for patients was 8 days (interquartile range: 5−10 days). During the study period, 986 (69.3%) patients were released from quarantine, 82 (5.8%) patients were transferred to facilities, and 354 (24.9%) patients were still under at-home care at the end of the study period. The most common cause of transfer was sustained fever (n = 30, 36.6%), followed by dyspnea and desaturation (n = 17, 20.7%). Factors associated with transfer were diabetes (odds ratio [OR]: 3.591, 95% confidence interval [CI]: 1.488−8.665, P = 0.004), pregnancy (OR: 5.839, 95% CI: 1.035−32.935, P = 0.046), and being pre-symptomatic at

diagnosis (OR: 4.015, 95% CI: 1.559−10.337, $P = 0.004$).

Conclusions

There were no specific problems related to patient safety when operating at-home care. Patients with risk factors, such as diabetes, were more likely to be transferred to healthcare facilities. For safe at-home care, it is necessary to prepare for an appropriate response to the emergency.

Keywords: COVID-19; home care; protocol; outcome

Strengths and limitations of this study:

- This was the first study to introduce at-home care protocol for patients with COVID-19.
- This was a single-center retrospective cohort study.
- This study depicted the early phase of at-home care for patients with COVID-19.

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first discovered in Wuhan, China, in December 2019, and since the World Health Organization announced the pandemic in March 2020, there have been approximately 290 million confirmed cases of coronavirus disease 2019 (COVID-19) worldwide, as of December 2021.[1,2] With the development of vaccines, the number of confirmed cases in the United States and Europe seemed to be decreasing, but due to the easing of quarantine measures and the presentation of new variants, the number of confirmed cases skyrocketed again. There was no difference in the domestic situation. With the start of vaccination, the overall quarantine level was relieved. However, subsequently, a fourth epidemic occurred in Korea. In addition, emerging new variants have led to the updating of new confirmed cases daily.[3]

During each epidemic situation, the medical system faced a crisis, and it was accompanied by difficulties in allocating medical personnel, supplies, and beds. During the initial epidemic, community treatment centers (CTC) for asymptomatic or mild patients were operated to fill the medical gap in Korea.[4–6] As the epidemic progressed, it became difficult to cope with the increasing number of patients with COVID-19 with CTCs alone. The occurrence of pediatric and psychological problems was another challenge for the CTC setting.[7,8]

As the COVID-19 pandemic protracted, the Korean government modified its policy for the management of critically ill patients with COVID-19. The domestic metropolitan area introduced at-home care as an alternative to a deficient medical system. This is the first home healthcare system for the management and monitoring of patients suffering from infectious diseases in Korea. To overcome the current COVID-19 pandemic and prepare for a novel infectious disease, a well-established at-home care system is required. In this study, we aimed

to introduce an at-home care protocol that is being implemented through our institution and analyze the characteristics and outcomes of patients under at-home care during the COVID-19 pandemic.

MATERIALS AND METHODS

Study design, setting, and study population

This was a retrospective cohort study that used medical records. Kangnam Sacred Heart Hospital is a secondary university hospital with 572 beds located in Yeongdeungpo-gu, Seoul, South Korea. This institution provides internal medicine, surgery, and pediatric intensive care units, as well as an emergency center and outpatient department. This institution is responsible for treating patients mainly in the local constituency. Our institution signed an agreement with Yeongdeungpo-gu administration to become a provider of at-home medical care on October 5, 2021 and started operating as such on October 18, 2021. All patients under at-home care via Kangnam Sacred Heart Hospital between October 18, 2021 and December 12, 2021, were included in this study.

Criteria for patient enrollment and release from quarantine

In Korea, COVID-19 was designated as a Class 1 legal infectious disease, which required all confirmed patients to report to public health authorities and to be quarantined for a set period. The person in charge of the public health center interviewed all patients with confirmed diagnoses of COVID-19 and determined whether at-home care was appropriate or if they required hospital admission. Patients who could be treated at home and who provided consent

to public health center were registered at our institution as at-home care patients.

On November 26, 2021, policies for the care of patients with COVID-19 were changed, as were the criteria for at-home care. Before this date, asymptomatic confirmed COVID-19 patients and those with mild symptoms under 70 years of age with no risk of hospitalization were eligible to receive at-home care. From November 26, 2021, onward, all patients were eligible to receive at-home care and were admitted to healthcare facilities only if there was a need for hospitalization.

Enrollment criteria

Before November 26, 2021, the Korea Centers for Disease Control and Prevention classified patients with asymptomatic and mild symptoms under 70 years of age as candidates for at-home care, following consent, except in the presence of the following risk factors for hospitalization: mental change after symptom onset of COVID-19, dyspnea, uncontrolled fever with antipyretics, uncontrolled diabetes mellitus (DM), hemodialysis, patients treated for chronic lung disease, asthma, heart failure, coronary artery disease, patients under chemotherapy or immunosuppressant, uncontrolled symptomatic psychiatric disease, bedridden states, obese (body mass index >30 kg/m^2), pregnant women with symptoms, such as abdominal pain, labor, vaginal bleeding, childhood or with a high risk of dyspnea, cyanosis, chest depression, poor oral intake, or dehydration, diagnosed with chronic lung disease/cardiac disease/metabolic disease/abnormal immune system, under immunosuppressant, respiratory function or excretion problem, or risk of aspiration. Among patients over 60 years of age, only those who had been vaccinated were registered for at-home care. Patients in need of care, such as minors and those with disabilities, were required to be accompanied by a caregiver.[9] The exclusion criteria were as follows: 1) those who lived in a residential environment vulnerable

to infection due to difficulty in distancing or 2) when communication for non-face-to-face healthcare and quarantine management was difficult for the patient or caregiver.

From November 26, 2021, patients with a confirmed COVID-19 diagnosis were all allocated to at-home care, except in the following cases: 1) those who had the aforementioned risk factors for hospitalization, 2) those who lived in a residential environment vulnerable to infection, 3) individuals that were minors, disabled, or over the age of 70 years who required care but could not be quarantined together with a caregiver, 4) those who were deemed ineligible for at-home care treatment by the local government head (e.g., due to a legal problem, etc.).[10]

Criteria for release from quarantine

Symptomatic patients were released from quarantine 10 days after symptom onset.[9] Asymptomatic patients were released from quarantine 10 days after diagnosis. The quarantine date was extended depending on the occurrence of symptoms, and the final decision for release was made by the medical staff.

Intervention

Kangnam Sacred Heart Hospital operated at-home care by targeting patients with COVID-19 residing in Yeongdeungpo-gu. The at-home care program involved four medical doctors and five nurses in one monitoring room. They operated during the day and used an on-call system at night. One doctor was in-charge per day, but a backup doctor was designated in case of an emergency. Nurses worked in two shifts, with two nurses during the daytime and evening and one during the night for the on-call system.

The Yeondeungpo-gu public health center classified patients with COVID-19 for at-home care

according to the enrollment criteria and supplied items necessary for at-home care, such as antipyretics, an oxygen saturation monitor, a thermometer, and phone numbers of related medical institutions. The patients to be managed were registered as outpatients with assigned doctors every day so that prescriptions were available if needed. The list of patients under at-home care was secured through the public health center and updated daily.

The monitoring room was equipped with computers, monitors, and smartphones. Patients checked their blood pressure and body temperature and uploaded the data via smartphone applications. Nurses called the patient at 9 a.m. and 5 p.m. daily to check the patient's vital signs and symptoms and update patient information on electronic health records. If the patient had symptoms and wanted to take medication, the doctor interviewed the patient and prescribed the medicine. The prescription was sent to the public health center by fax. After prescribing the medicine at the pharmacy, the person in charge of the public health center delivered the medicine to the patient's house. If the patient had persistent fever, desaturation, or worsening clinical symptoms, the doctor interviewed the patient and decided whether to transfer the patient to another facility at the discretion of that doctor, such as a CTC or hospital, according to severity. The public health center assigned an ambulance and medical institution and transported the patient accordingly.

The medical staff checked the list of patients who were subject to release from quarantine daily and assessed whether it was possible to release them from quarantine according to the criteria. When those under quarantine were released, at-home care and monitoring also ended. The results were then reported to the public health center.

Data collection and statistical analysis

Data regarding patient characteristics, such as age, sex, enrollment date, release from quarantine date, transfer date (if transferred), symptoms, and medical prescription, were collected through a retrospective medical record review.

Continuous variables are presented as mean ± standard deviation (SD) or median (interquartile range [IQR]), as appropriate. Statistical significance was assessed using the chi-squared test and Fisher's exact test for categorical variables. Non-categorical variables were tested using the two-sided unpaired t-test or Mann–Whitney U test. The factors associated with transfer were calculated using a logistic regression model. Statistical significance was set at $P < 0.05$. All statistical analyses were performed using SPSS ver. 27 (IBM, Armonk, NY).

Patient and public involvement

None.

RESULTS

Baseline characteristics of study population

During the study period, 1,453 patients were registered. Three patients moved to another district, and twenty-eight patients were excluded from at-home care on the day of admission due to other causes of admission, such as severe symptoms at diagnosis. Finally, a total of 1,422 patients and 9,574 patient days were managed under at-home care at Kangnam Sacred Heart Hospital. The number of patients managed daily is shown in Figure 1.

Among 1,422 patients, 725 (51.0%) were male, and the median age was 40 (IQR: 27−58, range: 0−87) years (Table 1). Most patients were over 60 years of age (22.7% [n = 323]), followed by

those in their 30s (18.5% [n = 263]). Further, most patients (n = 1,177; 82.8%) did not have underlying conditions, and hypertension (n = 153; 10.8%) was the most common comorbidity. Approximately 16.4% (n = 233) of patients under at-home care were asymptomatic. There were 209 cases of drug prescriptions in 176 (12.4%) patients. On average, 3.7 ± 3.73 (range: 0−16) prescriptions were requested per day. Symptoms for the prescribed drugs are described in Table 2. The most common symptom was cough (n = 115; 55.8%), followed by sputum production (n = 62; 30.1%) and sore throat (n = 54; 26.2%). Night calls occurred in 68 cases which was an average of 1.2 ± 1.64 (range: 0−6 cases) night calls per day.

Table 1. Baseline characteristics of patients under at-home care system (n = 1422)

Characteristics	Total (N = 1422) N (%)	Released from quarantine (N = 986) N (%)	Transferred (N = 82) N (%)	*P*-value
Sex				0.873
Male	725 (51.0)	508 (51.5)	43 (52.4)	
Female	697 (49.0)	478 (48.5)	39 (47.6)	
Mean age, years (range)	40 (0−87)	40 (0−83)	45 (1−87)	0.051
0−9	156 (11.0)	109 (11.1)	3 (3.7)	
10−19	122 (8.6)	73 (7.4)	10 (12.2)	
20−29	151 (10.6)	112 (11.4)	8 (9.8)	
30−39	263 (18.5)	194 (19.7)	14 (17.1)	

40−49	186 (13.1)	120 (12.2)	11 (13.4)	
50−59	221(15.5)	152 (15.4)	11 (13.4)	
≥60	323 (22.7)	225 (22.9)	25 (30.5)	
Underlying conditions				
Hypertension	153 (10.8)	99 (10.0)	15 (18.3)	0.020
Diabetes	43 (3.0)	28 (2.8)	7 (8.5)	0.005
Thyroid disease	22 (1.5)	17 (1.7)	0 (0)	0.231
Psychiatric disorder	12 (0.8)	10 (1.0)	1 (1.2)	0.860
Pregnancy	6 (0.4)	4 (0.4)	2 (2.4)	0.018
Others*	53 (3.7)	26 (2.6)	5 (6.1)	
None	1177 (82.8)	820 (83.2)	60 (73.2)	0.022
Symptoms				0.009
Asymptomatic	233 (16.4)	159 (16.1)	7 (8.5)	
Pre-symptomatic	160 (11.3)	89 (9.0)	15 (18.3)	
Symptomatic	1029 (72.4)	738 (74.8)	60 (73.2)	
Medicine prescription	176 (12.4)	117 (11.9)	21 (25.6)	0.020
Transfer to healthcare facilities	82 (5.8)			
Cumulative percentage of duration from symptom onset to transfer (%)				
3 days			18.3	

5 days			54.9	
7 days			74.4	
10 days			95.1	
14 days			100	
Median days from symptoms to diagnosis, days (IQR)	2 (1−4)	2 (1−4)	2 (1−3.75)	0.307
Median days from diagnosis to management, days (IQR)	1 (0−1)	1 (0−2)	0 (0−1)	< 0.001
Median management days **, days (IQR)	8 (5−10)	8 (6−10)	3 (2−4.25)	< 0.001

IQR: interquartile range

* Epilepsy, autoimmune disease, liver disease, asthma, bronchiectasis, angina, cerebrovascular disease, ulcerative colitis

** Release from quarantine and transferred patients, excluded under management

Table 2. Symptoms for prescription medication (n = 209)

Symptoms*	No. (%)
Cough	115 (55.8)

Sputum production	62 (30.1)
Sore throat	54 (26.2)
Nasal congestion	38 (18.4)
Rhinorrhea	33 (16.0)
Fever	17 (8.3)
Headache	14 (6.8)
Myalgia	8 (3.9)
Conjunctivitis	7 (3.4)
Gastrointestinal symptoms	7 (3.4)
Other**	10 (4.9)

* Allowed duplicates

** Sleep disorder, febrile sense, underlying disease

The median length from symptoms to diagnosis was 2 days (IQR: 1−4 days), and 1 day (IQR: 0−1 day) from diagnosis to management. The median length of care for patients was 8 days (IQR: 5−10 days). During the study period, 986 (69.3%) patients were released from quarantine, 82 (5.8%) patients were transferred to CTCs or hospitals, and 354 (24.9%) patients were still under at-home care when the study period ended. No patients under at-home care died during the study period.

Characteristics according to transfer

A total of 83 (5.8%) patients were transferred. Sex and age did not differ significantly according to the transfer (Table 1). Among the transferred patients, 52.4% (n = 43) were male, and

patients over 60 years of age (n = 25; 30.5%) were most frequently transferred. Patients with comorbidities were significantly more likely to be transferred than those who were released from quarantine (25.8% vs. 16.8%, $P = 0.022$). The proportion of patients with hypertension and DM was significantly higher among transferred patients (10.0% vs. 18.3%, $P = 0.020$, 2.8% vs. 8.5%, $P = 0.005$). The proportion of pregnant women was significantly higher among transferred patients (0.4% vs. 2.4%, $P = 0.018$). The median management duration of at-home care was 8 days (IQR: 6−10 days) for release from quarantine and 3 days (IQR: 2−4.25 days) for transferred patients.

The most common cause of transfer was sustained fever (n = 30; 36.6%) (Table 3). Seventeen patients (20.7%) were transferred because of dyspnea, and their oxygen saturation was <90%. The time from symptom onset to transfer request was a median 5 days (IQR: 4−8 days), and a median 3 days (IQR: 2−5 days) were required from diagnosis to transfer request. Most transfers (n = 61; 75.5%) were made on the same day as the transfer requests. For 21 (25.6%) patients, it took 1 day to allocate a bed after the request. One patient required 2 days and one patient required 3 days for transfer. All patients with dyspnea were transferred on the same day.

Table 3. Reasons for transfer (n = 82)

Reasons	No. (%)
Sustained fever	30 (36.6)
Dyspnea/desaturation	17 (20.7)
Patients wanted	13 (15.9)
Cough/chest pain	9 (11.0)

Resident with family	5 (6.1)
Minor	4 (4.9)
Aggravation of underlying disease	2 (2.4)
As caregiver	1 (1.2)
Old age	1 (1.2)

Risk factors for transfer

The factors associated with transfer are shown in Table 4. In univariate analysis, age and sex were not significantly associated with transfer. The presence of underlying disease (odds ratio [OR]: 1.811, 95% confidence interval [CI]: 1.081−3.035, $P = 0.024$), hypertension (OR: 2.006, 95% CI: 1.104−3.644, $P = 0.022$), DM (OR: 3.193, 95% CI: 1.350−7.553, $P = 0.008$), and pregnancy (OR: 6.137, 95% CI: 1.107−34.023, $P = 0.038$) were significantly associated with transfer. On multivariate analysis, we found no significant association of age or sex with transfer. DM (OR: 3.591, 95% CI: 1.488−8.665, $P = 0.004$), pregnancy (OR: 5.839, 95% CI: 1.035−32.935, $P = 0.046$), and being pre-symptomatic (OR: 4.015, 95% CI: 1.559−10.337, $P = 0.004$) were independent risk factors for transfer.

Table 4. Factors associated with transfer

	Univariate analysis			Multivariate analysis		
Variables	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Female sex	0.964	0.614−1.513	0.873	0.742	0.579−1.476	0.742
Age						
0−9 years	0.385	0.100−1.491	0.167	0.439	0.112−1.723	0.238

10−19 years	1.918	0.723−5.086	0.191	2.169	0.804−5.849	0.126
20−29 years	reference		reference	reference		reference
30−39 years	0.982	0.411−2.483	0.982	0.957	0.384−2.386	0.924
40−49 years	0.605	0.498−3.306	0.605	1.371	0.523−3.596	0.521
50−59 years	0.978	0.395−2.601	0.978	0.961	0.360−2.566	0.937
>60 years	0.300	0.677−3.544	0.300	1.346	0.547−3.315	0.518
Underlying disease	1.811	1.081−3.035	0.024	0.662	0.219−1.999	0.465
Hypertension	2.006	1.104−3.644	0.022	2.106	0.682−10.208	0.196
Diabetes mellitus	3.193	1.350−7.553	0.008	3.591	1.488−8.665	0.004
Pregnancy	6.137	1.107−34.023	0.038	5.839	1.035−32.935	0.046
Symptoms						
Asymptomatic	reference		reference	reference		reference
Pre-symptomatic	3.828	1.505−9.741	0.005	4.015	1.559−10.337	0.004
Symptomatic	1.847	0.829−4.115	0.134	1.983	0.880−4.469	0.099

OR: odds ratio, CI: confidence interval

DISCUSSION

Despite the increase in vaccination against COVID-19, the number of confirmed cases worldwide has been increasing due to the easing of quarantine measures, waning vaccination

immunity, and the emergence of new SARS-CoV-2 variants.[1] Because of the limitations of medical manpower and resources, such as hospital beds, at-home care was introduced in Korea. As this system was introduced for the first time in Korea, we aimed to explain the initial operating protocol and results.

In Korea, since the first COVID-19 outbreak in Daegu in 2020, CTCs have been operating in the face of the COVID-19 epidemic. Some facilities, such as dormitories and hotels, were converted to quarantine units for patients with COVID-19, and a monitoring system for patients with stationed medical staff was established. This system was flexibly operated according to trends in the number of confirmed cases. To operate a CTC, it is necessary to provide a space for both quarantining patients and working medical staff. To prepare such facilities, a certain period was required, and after the increase in the number of confirmed cases, there were difficulties in arranging space and medical staff. This could be managed in the case of a short-term epidemic, but as the epidemic became longer and the number of confirmed cases increased, like during the fourth epidemic in Korea, there was a limit to the management through CTCs. The medical system was saturated due to the number of confirmed cases and the increase in the number of patients with severe cases; therefore, the government of the Republic of Korea changed the policy for the management of severely ill patients. As a result, at-home care was introduced in Korea. Before the fourth epidemic, some local governments operated at-home care by a public health center for certain patients, such as children and their parents, or patients who were healthy and young. As the fourth epidemic began, at-home care expanded its target to all over the country and was managed by hospitals from October 2021.

With the COVID-19 pandemic, some countries, including the United States, quarantined asymptomatic or mild patients in their homes without hospitalization.[11–14] At-home care in

Korea was a system that monitored patients twice a day over the phone. Procurement of necessary supplies and transfer systems were established and managed. Through this system, some solutions have been suggested for medical problems that could be missed due to simple home quarantine alone.

Entering quarantine facilities, such as a CTC, due to COVID-19 could cause psychological problems. Approximately 30% of patients admitted to a CTC complained of psychological problems due to quarantine in an unfamiliar environment.[8] In particular, when considering psychological factors and diagnosis time after symptom onset in pediatric patients, which might be after the transmission period had passed, quarantine in a CTC or hospital was somewhat disadvantageous.[7] At-home care compensated for the psychological disadvantages of CTCs by maintaining quarantine in a familiar environment, especially with family.

Respiratory symptoms, such as cough, sputum production, sore throat, fever, and anosmia, were symptoms of COVID-19.[4,5,15] In the present study, cough was the most common symptom for which medicines were prescribed. Most prescribed medicines were for respiratory symptoms, but there were also cases of digestive symptoms, conjunctivitis, or sleep disorder. As the COVID-19 epidemic persisted and many patients were treated under at-home care, strategic preparedness was required so that medicines for respiratory symptoms and other possible symptoms could be smoothly supplied to patients. In some cases, patients ran out of medications that were being taken in cases of underlying conditions. This indicated that, during the quarantine period, there may be a need for an alternative to the prescription of medicines for underlying conditions, such as hypertension.

Elderly patients and pregnant women have a high risk of acute exacerbation and severity.[16–

18] Comorbidities, such as hypertension and DM, were other risk factors for disease aggravation in patients with COVID-19.[18] In the present study, DM and pregnancy were risk factors for transfer, along with pre-symptomatic status. Although age was not significantly associated with transfer, 30.5% of transferred patients were older than 60 years. At-home care patients with underlying conditions or old age required more thorough management with caution.

In the present study, 5.8% of patients were transferred to CTCs or hospitals. In a previous study of CTCs that treated asymptomatic or mild COVID-19 patients, the transfer rate ranged from 0.7−10.3%.[4,6,19,20] Patients transferred for worsening of symptoms requested a transfer at a median of 5 days after symptom onset and a median of 3 days from diagnosis. The duration from diagnosis to transfer was different on comparison with a previous study reporting a median of 3.5−11 days.[4,6,15,19] This duration was shorter in the present study because all patients with COVID-19 were under at-home care as a basic treatment, and the proportion of patients who wished to be transferred to a CTC or hospital and that of patients who faced difficulties in self-quarantine was as high as 15.9% and 6.1%, respectively. Patients were transferred quickly after diagnosis. In approximately 55% of cases in this study, transfer requests were made within 5 days of symptom onset. However, in the remaining 45%, symptoms worsened 6 days after symptom onset. Some studies reported that symptoms were aggravated between 4 and 14 days after symptom onset.[21,22] As COVID-19 epidemic prolonged, the monitoring period of at-home care was changed from 10 days to 7 days, and the remaining 3 days were either monitored or not depending on symptoms. Patients with risk factors were monitored thoroughly, as there were some patients who needed to be transferred to a CTC or hospital even at the end of monitoring.

This system was not a monitoring and treatment system that checks a patient in real time. The worsening of symptoms may have been missed. This risk was even greater in patients who received at-home care alone. In addition, if the patient did not feel any symptoms even when the condition worsened, the patient might have been left unattended. Difficulty in responding to emergent situations was another problem. Since the patient was not treated in the same space as medical personnel, it took time to directly contact the medical personnel, even if the symptoms were monitored. In addition, after confirming the transfer, it took time to assign and implement emergency measures. Unlike in a CTC, if a transfer was delayed, proper medical measures, such as oxygen supply, were also delayed, which could prove to be fatal to patients. Therefore, there is a need for a system that secures and utilizes an ambulance and an available emergency bed for at-home care patients in advance.

Currently, in a situation where the number of patients with COVID-19 has skyrocketed and the basic treatment policy has been switched to at-home care, the number of patients receiving at-home care is continuously increasing. Because at-home care was a system in which medical staff directly interviewed patients twice a day over the phone, medical personnel were needed for this. Administrative personnel were also required to allocate patients, deliver supplies, and deliver drugs through prescriptions. In the beginning of the COVID-19 epidemic, patient management with the help of assigned medical personnel was possible, but as the number of patients increased, management by the existing staff became difficult. This may lead to future difficulties in identifying patients and responding to patients. In preparing for the continuing epidemic, measures should be taken on how to procure the required manpower.

This study had some limitations. First, this was a single-center study. As at-home care has been expanded to cover the entire nation and all patients confirmed to have COVID-19, it is

necessary to analyze additional data of the results of at-home care. Second, this study analyzed the results of the early phase of at-home care, which was a point in time when the setting was not completely established. Thus, additional system supplementation is required.

CONCLUSION

Due to the increase in the number of confirmed cases beyond those that medical facilities could handle, at-home care was an unavoidable option. Patients with risk factors, such as DM, were more likely to be transferred to healthcare facilities. For safe at-home care, it is necessary to prepare for an appropriate response to the emergency.

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Contributors

YBS conceptualized and edited the manuscript. JJP contributed to data curation, data analysis, and manuscript writing. JL, SHN, and YKC contributed to acquisition of data. All authors have read and approved the submission.

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Competing interests

None declared.

Ethics approval

The study was approved by the Institutional Review Board (IRB) of Kangnam Sacred Heart Hospital (IRB No.: 2021-11-035-001), and the requirement for informed consent was waived.

Data availability statement

No data available.

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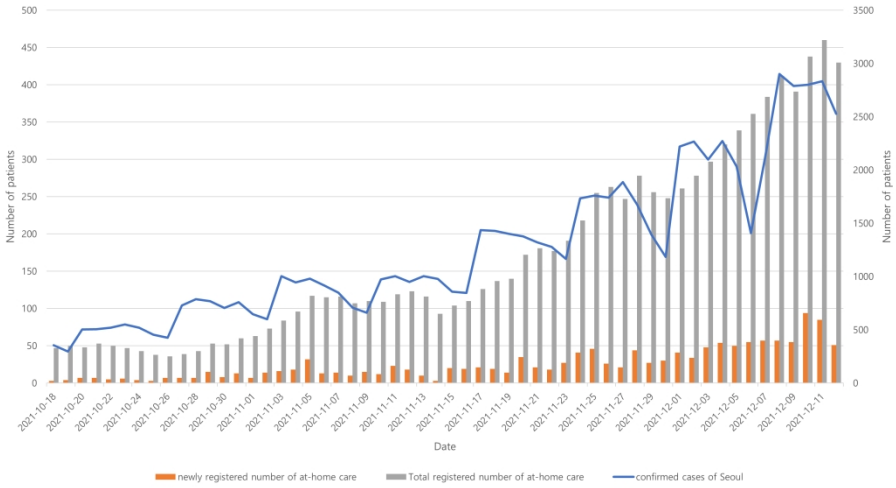
Figure legend

Figure 1. Trends of number of patients with COVID-19 in this study and in Seoul, South Korea



Trends of number of patients with COVID-19 in this study and in Seoul, South Korea

338x190mm (300 x 300 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2	Retrospective cohort study
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2, 3	abstract
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5	introduction
Methods				
Study design	4	Present key elements of study design early in the paper	6	Materials and methods-study design, setting and study population
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,9	Materials and methods-study design, setting and study population Materials and methods - data collection and statistical analysis
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	7, 8	Materials and methods - criterial for enrolment and and release from quarantine
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case		

Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9	Materials and methods - data collection and statistical analysis
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9	Materials and methods - data collection and statistical analysis
Bias	9	Describe any efforts to address potential sources of bias		
Study size	10	Explain how the study size was arrived at	6	Materials and methods-study design, setting and study population

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why		
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9	Materials and methods - data collection and statistical analysis
		(*b*) Describe any methods used to examine subgroups and interactions		
		(*c*) Explain how missing data were addressed		
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy		
		(*e*) Describe any sensitivity analyses		
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11	results
		(b) Give reasons for non-participation at each stage	11	results
		(c) Consider use of a flow diagram		
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11	Results-Table1
		(b) Indicate number of participants with missing data for each variable of interest	11	results
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	11,12	Results-Table 1
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	11-13	Results-Table 1
		Case-control study—Report numbers in each exposure category, or summary measures of exposure		
		Cross-sectional study—Report numbers of outcome events or summary measures		
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-18	Results-Table 4
		(*b*) Report category boundaries when continuous variables were categorized		
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		

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Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses		
Discussion				
Key results	18	Summarise key results with reference to study objectives	18	discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22	discussion
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-22	discussion
Generalisability	21	Discuss the generalisability (external validity) of the study results	18-22	discussion
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	23	funding

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.