

Too early for admission? A Telemedicine follow up comparison of mild COVID-19 patients from the Emergency Department and Clinics

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ABSTRACT

Objective: Mildly symptomatic COVID-19 patients may seek medical attention either in the Emergency Department (ED) or Ambulatory Clinics (AC). However, it is unclear if ED patients have different characteristics and outcomes than AC patients when discharged under telemedicine surveillance, which we explored in this study.

Methods: Patients with mild or asymptomatic COVID-19 disease referred to a multidisciplinary Telemedicine clinical service (TM-CS) program in an urban tertiary-care hospital, between June 2020 and February 2021, were evaluated. Those referred from ED were labeled “ED Group” and ones from AC as “AC Group.” Their characteristics, clinical features and outcomes including telemedicine parameters, subsequent ED visits, hospital admission, oxygen requirements, intensive care unit (ICU) admission, and mortality were compared.

Results: Out of 1132 confirmed non-admitted COVID-19 patients, 526 with mild (89%) or asymptomatic (11%) disease were enrolled in TM-CS. Majority of these were referred from ED ($n = 370$; 70%) and rest ($n = 156$, 30%) from the AC. Patients in the ED group compared to AC group, had higher BMI (28.9 vs. 27.5), higher Charlson Comorbidity Index (1.4 vs. 0.9), and higher incidence of comorbidities (50% vs. 22%), $P \leq 0.01$. However, there were no differences in the ED and AC groups in subsequent ED visits (26% vs. 24%), hospital admission (18% vs. 15%), oxygen requirements (5% vs. 4%), ICU admission (1% vs. 2%), and mortality (0.3% vs. 0.6%), respectively ($P > 0.40$).

Conclusion: Significant number of mild COVID-19 patients head to the ED for initial assistance but have similar outcomes to AC patients. TM-CS could be a safe alternative for follow-up monitoring of these patients.

Keywords: Clinic, COVID-19, emergency department, monitoring, outcome, telemedicine

Introduction

COVID-19 disease severity ranges from asymptomatic infection to mild, moderate, severe, and critical illness. Mild cases make up roughly 80% of all the symptomatic patients.^[1] The intuitive scenario would dictate that these patients would stay at home and only those with moderate disease or severe symptoms would seek medical attention. However, amidst the fear and apprehension created by the pandemic, a lot of patients with mild symptoms end up seeking medical attention and reassurance. Some of them are seen in ambulatory setting for their disease and others flock to the emergency department (ED) to be evaluated. This not only burdens the ED but also may deter patients with other illnesses from seeking timely care.^[2] Even though most of these mildly symptomatic

COVID-19 patients are discharged home, concern remains as 15–30% of them may bounce back because of deterioration of their symptoms and 2–14% can progress to critical disease or die.^[3-6] Discharging these patients, who feel symptomatic enough to come to ED yet not sick enough to be admitted, without any supervision or follow-up may be risky.

Telemedicine is the remote diagnosis and treatment of patients by a health care provider through means of telecommunication technology. Telemedicine clinical service (TM-CS) has been used infrequently in the past.^[7] However, with the COVID-19 pandemic, it experienced unprecedented growth with some centers reporting more than 2000% increase in its utilization.^[8] For COVID-19 patients, it was used initially in primary as well as tertiary care ambulatory settings.^[9,10] Its scope expanded,

and telemedicine was also found to be helpful in monitoring of COVID-19 in large scale general populations as well as in COVID-19 patients after their hospital discharge.^[11-14]

The role of TM-CS was also evaluated in a handful of studies among patients seen in the ED. One study looked at low risk patients with “COVID-19 symptoms” and found telemedicine as a safe alternative, but this group only had 35% confirmed COVID-19 patients.^[15] Another study evaluated outcomes of “suspected” COVID-19 patients discharged from ED to telemedicine, but the study had no comparison group.^[16] A few other studies included ED discharged patients as part of their general telemedicine cohorts and not as a specific studied population.^[11,12,14] These handful of reports had small sample sizes and reiterated the need for further studies. A direct comparison of characteristics and outcome of mildly symptomatic COVID-19 patients seen in the ED and the clinics is also lacking.

Telemedicine follow-up may be an alternative for ED patients with mild COVID-19 but, as described above, its safety and efficacy need further evaluation. Two questions remain that need further exploration. First, is there a difference in the characteristics of COVID-19 patients with mild disease whose initial presentation is the ED as compared to those seen in an ambulatory clinic (AC) setting? Second, after discharge from the ED or AC to telemedicine, is there any difference in outcomes between the patients in the two groups? Our study was done to answer these questions.

Methods

Study hospital description

The study was conducted in King Faisal Specialist Hospital and Research Center, Jeddah, which is a large urban tertiary care teaching hospital. The hospital has ambulatory care clinics and comprehensive inpatient services with over 500 beds including 52 beds in the ED. The hospital staff and their families are also insured by the hospital and form part of the overall patient population.

Illness severity definition

Asymptomatic disease

These were individuals with no complaints of any signs and symptoms of COVID-19. These were diagnosed incidentally due to screening protocols in place.

Mild illness

Individuals who had any of the various signs and symptoms of COVID-19 (e.g., fever, cough, sore throat, malaise, headache, muscle pain, nausea, vomiting, diarrhea, loss of taste, and smell) but who did not have shortness of breath, dyspnea, or abnormal chest imaging.^[17]

COVID-19 TM-CS

This was formulated like what has been reported by some other healthcare systems, as a primary care physician led, interprofessional, team-based remote monitoring program.^[18] A designated team comprising of nurses, primary care physicians with Infectious Disease team backup, and coordinators that contacted the patient through the telephone for follow-up of their COVID-19 symptoms and arranged for ED re-evaluation or direct hospital admission in case of any deterioration. TM-CS was formulated with existing hospital personnel and resources, without incurring any additional expenses.

Workflow of COVID-19 TM-CS

Patients from ED or ACs with asymptomatic or mild confirmed COVID-19 were enrolled in COVID-19 TM-CS. The patient would then be sent home with quarantine instructions. The default enrollment in TM-CS was 10 days; however, this could be modified by the TM-CS physician if needed. Once enrolled, the TM-CS nurse would send the patient digital pamphlets regarding COVID-19 alarming symptoms, guidance for monitoring of any warning signs and emergency contact numbers in case of any deterioration. The TM-CS nurse, following a checklist, would call and get daily clinical update from the patients, reassure them regarding expected symptoms or refer them to the TM-CS physician in case of any worsening symptoms or new warning signs. The TM-CS physician would contact only the referred patients and triage whether they needed to be taken back to the ED, needed direct admission, or could stay at home under. The patient if admitted to the hospital may still be re-enrolled for the TM-CS after their discharge. At the end of the 10-day telemonitoring period, the TM-CS physician would discharge the recovered patients from the service or extend the enrollment on a day-to-day basis if needed. The TM-CS work hours were 7:30 AM till 5 PM including weekends. If patients had any of the warning signs as explained to them after the working hours, they were told to come to the ED and not wait till morning for TM-CS guidance.

Study period, inclusion exclusion criteria and comparison groups

The study period was from June 2020 till February 2021.

Inclusion criteria

All adult patients 18 years or older with confirmed COVID-19 infection diagnosed by reverse transcription-polymerase chain reaction either in the ED or ambulatory setting and referred to the TM-CS were included in the study.

Exclusion criteria

Patients who did not have a confirmed diagnosis of COVID-19, were younger than 18 years or those COVID-19 patients that

were referred to TM-CS post hospitalization for COVID-19 infection were excluded from the study.

Comparison groups

The patients who presented to ED and were diagnosed with COVID-19 but deemed not sick enough to be admitted to the hospital and discharged home after enrollment in TM-CS were labeled as “ED Group.” Those referred from AC to TM-CS were called “AC Group.” Some of the patients were asymptomatic and were included because they came with other complaint or for a scheduled procedure, and their screening COVID-19 PCR came positive.

Characteristics and outcome measures evaluated

Patient demographics, underlying comorbidities, Charlson comorbidity index, underlying established and possible risk factors for COVID-19,^[19] symptoms, characteristics, medications prescribed in initial COVID-19 visit, and parameters during telemedicine surveillance were recorded. Outcome measures included revisit to ED for symptom deterioration, hospital, and intensive care unit (ICU) admission, requirement for oxygen, need for intubation and in-hospital mortality.

Data analyses

Descriptive statistics were used to organize the collected data. Data were expressed as mean and standard deviation for continuous variables, and number and percentage for categorical variables. Data were analyzed using *t*-test for continuous variables and Fisher’s exact test for categorical variables, as appropriate. All statistical tests were 2-tailed with significance set at $P < 0.05$.

Results

These are briefly summarized in Figure 1. There were a total of 1132 patients diagnosed with COVID-19 during the study period out of which 526 non-admitted mildly symptomatic patients were enrolled in the TM-CS. 51 asymptomatic or mildly symptomatic patients were not enrolled in the TM-CS for various reasons and were excluded from the study. 370 (70%) of the enrolled patients were from the “ED Group” while remaining 156 (30%) patients were in the “AC Group.” The demographics of the included patients are described in Table 1. Patients had an average age of 45 and a majority did not have a known COVID-19 exposure. Those in the ED group as compared to AC patients had higher BMI (28.9 vs. 27.5), higher Charlson Comorbidity Index (1.4 vs. 0.9), and were more likely to be comorbid tertiary care patients (50% vs. 22%), and with higher proportion of cardiovascular disorders and immunocompromised status than Ambulatory group patients, $P \leq 0.03$.

Table 2 describes the characteristics of the patients on their initial visit during which COVID-19 was diagnosed. The symptoms were more or less the same in the two groups, except those patients who presented to ED were more likely to be febrile. Patients in the ED group when compared to Ambulatory Group, had slightly longer symptom duration (3 vs. 2 days), higher incidence of mild disease (94% vs. 77%), were more likely to get a chest radiograph despite no difference in oxygen saturation (46% vs. 7%), and were more likely to get acetaminophen and oral antibiotics, $P < 0.001$. The asymptomatic patients were diagnosed primarily in the ambulatory setting and 76% of these were employees diagnosed after exposure screening or as part of serial monitoring in the high-risk areas of the hospital.

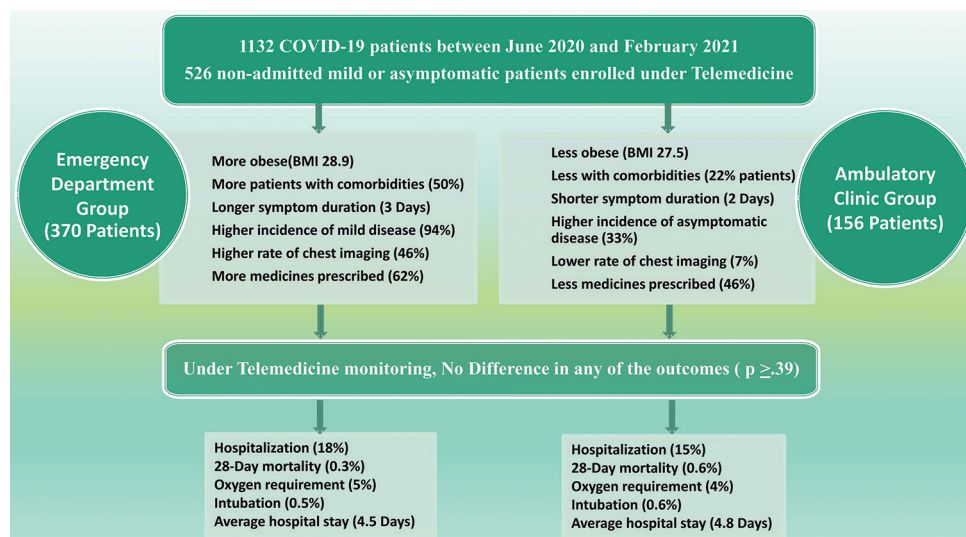


Figure 1: Baseline characteristics and outcomes of COVID-19 patients under telemedicine in the emergency department and ambulatory clinic groups

Table 1: Patient demographics

Characteristic	Combined (n=526)	ED Group (n=370)	AC Group (n=156)	P-value
Age, years, mean (SD)	44.6 (14.7)	45.1 (14.7)	43.4 (14.7)	0.22
Gender, n (%)				
Male	240 (46)	169 (46)	71 (46)	0.99
Female	286 (54)	201 (54)	85 (54)	
BMI, kg/m ² Mean (SD)	28.5 (5.9)	28.9 (6.1)	27.5 (5)	0.01
Charlson comorbidity index, mean (SD)	1.3 (1.9)	1.4 (2)	0.9 (1.7)	0.006
Score 0, n (%)	299 (57)	198 (54)	101 (65)	0.02
Score 1, n (%)	55 (10)	38 (10)	17 (11)	0.87
Score>2, n (%)	172 (33)	134 (36)	38 (24)	0.008
Type of patient, n (%)				
Employee	224 (43)	122 (33)	102 (65)	<0.001
Employee family	84 (16)	64 (17)	20 (13)	0.24
Comorbid tertiary care	218 (41)	184 (50)	34 (22)	<0.001
Most common established risk factors, n (%)				
Diabetes mellitus, type 2	78 (15)	55 (15)	23 (15)	1
Obesity/severe obesity	183 (35)	135 (36)	48 (31)	0.22
Cardiovascular disorders	70 (13)	57 (15)	13 (8)	0.03
Solid organ transplant	25 (5)	22 (6)	3 (2)	0.07
Cancer	30 (6)	25 (7)	5 (3)	0.14
Chronic kidney disease	30 (6)	22 (6)	8 (5)	0.83
On hemodialysis	12 (2)	10 (3)	2 (1)	0.52
Most common possible risk factors, n (%)				
Hypertension	105 (20)	79 (21)	26 (17)	0.23
Other immunocompromised	44 (8)	42 (11)	2 (1)	<0.001
Diabetes mellitus, type 1	18 (3)	14 (4)	4 (3)	0.60
Known positive contact, n (%)	228 (43)	162 (44)	66 (42)	0.77

n: Number; SD: Standard deviation; ED: Emergency department; AC: Ambulatory clinics

Table 3 details the parameters during the telemedicine monitoring. During the enrollment period, physicians only had to call a patient on average twice. Symptoms lasted for an extra day in the ED group and ED patients were more likely to get oral antibiotics prescribed by the TM-CS physician, $P \leq 0.04$. There was a total of 135 (26%) patients who came back to ED, either through the TM-CS or on their own afterhours as per the guidelines of the TM-CS. 45 of these 135 patients were admitted to the hospital and rest were discharged back under TM-CS. In addition, there were 44 patients who were admitted directly to the hospital bypassing ED as per the clinical assessment of the TM-CS physician.

Table 4 describes the outcome measures in the cohort. There were no differences between the ED or Ambulatory group. Out of 89 admitted patients with an average hospital length of stay of 4.5 days, 23 ended up requiring oxygen. There were 7 ICU admissions and 2 patients died; one in ED and the other in Ambulatory Group. There was no difference in the ED group and AC group in ED revisit (26% vs. 24%), hospital

admission (18% vs. 15%), requirement of oxygen (5% vs. 4%), ICU admission (1% vs. 2%) and mortality (0.3% vs. 0.6%), respectively ($P > 0.4$).

Discussion

As of October 2021, we are seeing a decline in the surge of Coronavirus Disease 2019 (COVID-19) in some parts of the world, which has led to the relaxation of restrictions and opening of the economies. However, the devastation and havoc of the disease is still in full swing in many other regions especially where the new variants of COVID-19 are rampant and there is severe shortfall of vaccine availability. In a global world, this may be another calm before the storm for the current low prevalence areas, and if the vaccine roll out against the variants is not completed soon enough, the risk of another surge remains for them.^[20] For this reason, we need to be prepared and maximize resource utilization for any possible future resurgence to avoid the same situation faced in the year 2020 when healthcare systems were stretched beyond limits. Our study describes the safety and feasibility of telemedicine

Table 2: Characteristics on initial visit in which COVID-19 diagnosed

Characteristic	Combined (n=526)	ED Group (n=370)	AC Group (n=156)	P-value
Main presenting complaints, n (%)				
Fever	294 (56)	238 (64)	56 (36)	<0.001
Cough	249 (47)	179 (48)	70 (45)	0.50
Malaise/body aches	212 (40)	146 (39)	66 (42)	0.56
Sore throat	158 (30)	100 (27)	58 (37)	0.02
Headache	149 (28)	107 (29)	42 (27)	0.67
Gastrointestinal symptoms	93 (18)	83 (22)	10 (6)	<0.001
Shortness of breath	70 (13)	58 (16)	12 (8)	0.01
Runny nose	65 (12)	40 (11)	25 (16)	0.11
Loss of Smell/Taste	50 (10)	38 (10)	12 (8)	0.41
Symptom duration before diagnosis, days (SD)*	2.7 (2.4)	3 (2.3)	2 (2.3)	<0.001
Disease severity, n (%)				
Asymptomatic	58 (11)	22 (6)	36 (23)	<0.001
Mild disease	468 (89)	348 (94)	120 (77)	<0.001
Chest radiograph, n (%)	183 (35)	172 (46)	11 (7)	<0.001
Oxygen saturation, % (SD)	96.8 (9.3)	96.4 (9.9)	97.7 (7.6)	0.14
Medications prescribed				
Acetaminophen	303 (58)	231 (62)	72 (46)	<0.001
Azithromycin	74 (14)	62 (17)	12 (8)	0.005
Other oral antibiotic	37 (7)	35 (9)	2 (1)	<0.001
Enoxaparin	15 (3)	12 (3)	3 (2)	0.56
Favipiravir	14 (3)	11 (3)	3 (2)	0.76
Steroids	13 (2)	9 (2)	4 (3)	1

n: Number, SD: Standard deviation, ED: Emergency department, AC: Ambulatory clinics. *Excluding asymptomatic patients

Table 3: Parameters during telemedicine monitoring

Parameter during telemedicine care	Combined (n=526)	ED Group (n=370)	AC Group (n=156)	P-value
Duration for which patients enrolled in telemedicine, days (SD)	10.2 (1.7)	10.1 (1.8)	10.1 (1.2)	1
Number of days physician called the patients, days (SD)*	1.7 (1.4)	1.7 (1.5)	1.8 (1.1)	0.45
Symptoms lasted after enrollment, days (SD)*	6.4 (4.1)	6.6 (4.1)	5.6 (4.1)	0.01
Medications prescribed by telemedicine team, n (%)				
Acetaminophen	50 (10)	39 (11)	11 (7)	0.25
Oral antibiotic	45 (9)	38 (10)	7 (4)	0.04
Antitussives	12 (2)	11 (3)	1 (1)	0.12
Steroids	18 (3)	13 (4)	5 (3)	1
Favipiravir	13 (2)	11 (3)	2 (1)	0.36
Patients brought back to ED by Telemedicine team for re-evaluation, n (%)	81 (15)	61 (16)	20 (13)	0.19
Patient came on their own to ED after hours, n (%)	54 (10)	37 (10)	17 (11)	0.75
Patients with 2 ED visits, n (%)	26 (5)	16 (4)	10 (6)	0.37
Total number of ED visits	161	119	42	0.25
Days followed in Telemedicine clinic before ED revisit, days (SD)*	4.5 (3)*	4.6 (3.3) [†]	5.6 (4.2) [‡]	0.003
Patients admitted to hospital on revisit to ED, n (%)	45 (9)	31 (8)	14 (9)	0.86
Patients admitted to hospital directly by Telemedicine team bypassing ED, n (%)	44 (8)	35 (9)	9 (6)	0.22

n: Number, SD: Standard deviation, ED: Emergency department, AC: Ambulatory clinics; *n=135; [†]n=102; [‡]n=37

for mildly symptomatic COVID-19 patients discharged from the ED and would help in future triaging systems where the

initial ED visit can be diverted through ambulatory or fast track setups to TM-CS.

Table 4: Comparison of outcomes between groups

Outcomes	Combined (n=526)	ED Group (n=370)	AC Group (n=156)	P-value
Total patients hospitalized, n (%)	89 (17)	66 (18)	23 (15)	0.44
28-day/In hospital mortality, n (%)	2 (0.4)	1 (0.3)	1 (0.6)	0.51
Patients required oxygen anytime, n (%)	23 (4)	17 (5)	6 (4)	0.81
Patients without any comorbidity requiring oxygen, n (%)	5 (1)	5 (1)	0	0.27
Patients admitted to intensive care unit, n (%)	7 (1)	4 (1)	3 (2)	0.42
High flow oxygen, n (%)	6 (1)	3 (0.8)	3 (2)	0.37
Non-invasive ventilation, n (%)	2 (0.4)	1 (0.3)	1 (0.6)	0.51
Invasive ventilation/Intubation, n (%)	3 (0.6)	2 (0.5)	1 (0.6)	1
Total number of hospital days	390	280	110	0.38
Duration of hospital stay, days, Mean (SD)	4.5 (3.7)*	4.5 (3.7) [‡]	4.8 (3.7) [‡]	0.39

ED: Emergency Department; AC: Ambulatory clinics; *n=89; [‡]n=66; [§]n=23

Patients with mild COVID-19 symptoms can still progress to severe or critical disease anywhere after 7–10 days of initial presentation.^[21] Patients who are older and with comorbidities are at increased risk of deterioration than young patients and those with no comorbidities.^[22] However, when we have a pandemic with infected population that has exceeded 140 million and counting, exceptions to the usual rule do occur and younger patients with no comorbidities also succumb to the disease and add up to astounding numbers.^[23] Without any sort of clinical supervision or guidance, the fear and anguish from the possible fatal consequences of the disease may force many patients with low risk and mild symptoms to flock to the ED. This may be the reason that out of a total of 1132 diagnosed COVID-19 patients, 370 with mild symptoms presented to the ED and did not need admission. Even though the initial visit may not lead to admission, our results show that almost one in five (18%) of these patients will eventually get admitted to the hospital, as reported by some other investigators.^[4,5]

Patients in our study were mostly middle aged, similar to other telemedicine studies for COVID-19 patients.^[9,15] This could be because elderly patients even with mild symptoms tend to get admitted to the hospital given their higher risk of deterioration.^[1,3,4] Our cohort was similarly divided between employees and tertiary care patients, with employees mostly enrolled through AC and tertiary care patients through the ED. Half of the patients, mainly employees enrolled through clinics, had a Charlson Comorbidity Index of 0. The patients referred from ED, however, were more likely to have underlying comorbidities and hence were the riskier of the two groups.^[19] Nonetheless, their eventual outcomes were comparable to the patients seen in the clinics and reinforces the fact that their initial ED visit could have been avoided.

The presenting symptoms on initial visit were comparable to what is reported in literature, though fever was more common in patients who presented to the ED.^[1,22] Patients presented to the ED slightly earlier than those who came to the clinics, but nonetheless the time to seek initial medical help of a median of around 3 days is like what has been reported in other

studies.^[5,9,15] About 89% of the patients had mild disease and only few were asymptomatic, and these largely comprised of employees diagnosed in the ambulatory setting. The inclusion of mostly mildly symptomatic patients with normal oxygen saturations in our study reflect the characteristics of a population infected with COVID-19 that truly did not need inpatient care at the time of initial diagnosis. This is in line with other telemedicine populations that included stable patients.^[9-11,14,15] Despite mild symptoms and normal pulse oximetry, half of the ED group ended up having a chest radiograph and significantly higher proportion of them received oral antibiotics than the Ambulatory group. This overutilization of diagnostic or therapeutic modalities has been reported before in literature amongst ED patients with non-COVID diagnoses.^[24]

TM-CS was arranged utilizing existing resources and reassigning duties of the clinical staff. Consolidating services to improve efficiency is a necessity in a pandemic.^[25] Even though nurse called each patient daily, physician only had to call a patient on average twice during the 10-day period. 26% of the patients had a repeat ED visit and one third of these were eventually admitted to the hospital. The repeat ED visit was after an average of 4.5 days of enrollment in TM-CS, or around 7 days from onset of symptoms which is similar timeline as reported for COVID-19 patients admitted to the hospital.^[26] There were an additional 8% of patients who were admitted directly by the COVID TM-CS bypassing the ED. This constituted half of the total hospital admissions and saved resources by avoiding ED visit for these patients.

There were only 2 deaths (0.4%) in the cohort, one in the ED and one in the Ambulatory group. None died at home. Hence, despite having more comorbidities, patients in the ED group had similar outcomes to AC group patients under TM-CS. The comparable extremely low rates in both ED and AC groups in terms of hospital admission, ICU admission, requirement of oxygen, and intubation and death highlights the fact that the even the comorbid ED patients fared very well under TM-CS medical supervision. Because the patients were brought back before ensuing respiratory failure, the good outcomes are

not surprising and endorse the reports that patients admitted to the hospital before requiring supplemental oxygen have significantly less mortality than those who present with hypoxia.^[3]

Our study has a few limitations. It is a single center experience and results may vary in other hospitals. The TM-CS worked only during daytime and impact of a 24/7 service may be different. We could not compare our cohort with patients having mild disease who were discharged without TM-CS due to very few such patients in our health system. Half of our patients were without comorbidities and results could be different for patients with multiple comorbidities.

Conclusions

COVID-19 patients with mild symptoms may seek help early in the disease and many of them flock to the ED. The patients seen in ED have more comorbidities than those seen in the ambulatory setting. However, despite the higher comorbidities, there was no difference in any of the outcomes between the clinic and ED patients. One in four of the mild COVID-19 patients will eventually come back to ED for reassessment and 17% will get admitted to the hospital regardless if their initial visit was in the ED or clinic. Mortality is extremely low, and the patients had an excellent outcome under telemedicine monitoring. Hospitals can safely divert these mild COVID-19 patients from the ED by setting up fast track triage and telemedicine referral systems inside or next to the ED.

Authors' Declaration Statements

The scientific and ethical approval for the study was obtained from the Institutional Review Board of the institution under IRB number 2021-07 with approval date 28 February 2021. Informed consent was waived by the IRB for this retrospective study.

Availability of data and material

The data used in this study are available and will be provided by the corresponding author on a reasonable request.

Competing interests

None.

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Authors' Contributions

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Saeedi, Elaf M. Alzarnougi], Formal analysis and investigation: [Abdullah Alraddadi, Afnan Afifi, Muhammad Ali Akhtar, Abeer N Alshukairi]; Writing - original draft preparation: [Imran Khalid, Maryam Imran, Manahil Imran]; Writing - review and editing: [Tabindeh Jabeen Khalid, Mohammad Saeedi, Elaf M. Alzarnougi, Abdullah Alraddadi, Afnan Afifi, Muhammad Ali Akhtar, Abeer N Alshukairi]; Supervision: [Imran Khalid].

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