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Telehealth follow up in emergency department patients discharged with COVID-like illness and exertional hypoxia



1. Introduction

New York City was the initial US epicenter of the 2020 Covid-19 global pandemic. Early models predicted a crisis of hospital capacity. Our healthcare system's nine emergency departments (EDs) developed a disaster care pathway (Fig. 1) designed to preserve inpatient capacity for the most severely ill Covid patients. The pathway included the discharge of a subgroup of patients with Covid Like Illness (CLI) who otherwise would have been admitted to the hospital [1,2]. We monitored these patients with a combination of post-ED telemedicine (virtual) follow up (VF) and remote patient monitoring (RPM) with home pulse oximetry. During the Covid-19 pandemic, telemedicine and RPM models have been described to monitor pulse oximetry (SpO₂) in patients discharged from both inpatient and ED care, including escalation protocols as intervention for clinical deterioration [3–6]. Our objective is to describe the crisis pathway we employed and assess the available outcomes.

2. Clinical protocol

Our enterprise's *Evaluation Pathway for ED Patients with Possible Covid Infection* (Fig. 1) triaged ED patients into mild, moderate and severe CLI, based on early severity classification tools [7]. Patients determined to have severe CLI were admitted to the hospital. Patients who maintained saturation above 94% were discharged with standardized Covid precautions. Patients with oxygen saturation between 90% and 94% who met additional criteria for discharge were enrolled in the follow up program. Patients were enrolled via electronic health record (EHR). All enrolled patients were discharged with a portable consumer pulse oximeter (Drive Medical MQ3200; Medline HCSM70C). Patients with exertional SpO₂ between 90 and 91% were also given a home oxygen concentrator set at 2 l oxygen (O₂) per minute via nasal cannula (SimplyGo by Philips; Esclipse by CAIRE; OxLife Independence by O2 Concepts; Inogen One G3 by Inogen). Devices were provided to patients without additional charge.

Enrolled patients were monitored post-discharge via virtual follow up (VF). VF visits were initiated within 24 h of ED discharge, performed as video visits when possible, with telephone as alternate. VF visits were attempted at least once a day for a total of 7 days, performed by advanced practice providers and physicians. Visits included an assessment of the patient's symptoms, as well measurement of pulse oximetry at rest and with exertion. At the end of each VF visit a recommendation

was made for i) continuing care at home supported by VF visits, if improving or stable; ii) discontinuation of further VF visits (and supplementary oxygen), if interval resolution of symptoms for 2 days; iii) return to ED, if worsening symptoms or hypoxia (SpO₂ less than 90%). VF providers could contact an ED attending physician in real time as an escalation pathway for clinical decision making.

Patient outcome data were collected retrospectively from 4 regional hospitals and 2 quaternary care medical centers in New York between March 29th 2020 and April 17th, 2020. Collected variables are shown in Tables 1 to 5. Additional follow-up information after the 7-day period was obtained by calling patients at 90–120 days post index visit. Patients who returned to non-study-site EDs were included in 30-day mortality rates only. For continuous variables, Student *t*-test was used for variables with normal distribution and equal variances, and Wilcoxon rank sum test was used for variables with unnormal distribution. For categorical variables, Chi-square test was used for variables whose all of the cells of a contingency table are not below 5, and Fisher's exact test was used for other variables.

3. Results

A total of 677 patients were enrolled in the program. A total of 138 patients returned to a study site ED within 7 days, 86 patients were subsequently admitted, 16 required ICU level care. The overall 30-day mortality rate was 13. Table 1 describes the demographic and baseline characteristics from the index ED visit for all patients in the cohort. Table 2 describes data pertaining to VF visits, received by 86.5% of all patients. A median number of 3 visits occurred per patient, and 58.7% of the visits were audio-only. Of the 80 patients who were instructed to return to the ED during a follow-up visit, 18 did not return but none of these patients died or were lost to follow up. Of patients who reported an exertional SpO₂ < 90% at home, 33 (57.9%) returned to an ED, and 22 (38.6%) were subsequently admitted. Table 3 describes the patients who returned to a study site ED. Those admitted on the repeat visit were older (58 vs 51, *p*-value = 0.016*) compared to those discharged home on the return visit. Additional information of patients who returned to the study site EDs within 7 days of index visit are outlined in Table 4. Table 5 describes the outcomes of patients admitted on their return visit. 79 (57.2%) were admitted to the floor, 5 (3.6%) were admitted to the step-down unit, and 2 (1.4%) were admitted to the intensive care unit (ICU) directly from the ED. Of all ED returns, there were 11 patients who died during admission, including one patient who died within 24 h of ED return (1.7%). There were 36 (5.3%) patients lost to follow-up during the 7-day study period, and 20 (2.9%) of patients documented to have returned to non-study site EDs. A total of 21 (3.1%) patients remained lost to follow-up at 120 days.

4. Discussion

This study describes the large-scale implementation of a novel post-ED care pathway utilizing telehealth virtual visits and remote patient

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Evaluation Pathway for ED Patients with Possible COVID Infection

Applies to: Adult patients presenting to the ED with symptoms possibly related to COVID-19 infection, including: fever, URI symptoms, respiratory symptoms, gastrointestinal symptoms, malaise, or fatigue.

This pathway is a guide and does NOT supersede good clinical judgement.

- All patients must perform hand hygiene and wear a surgical mask
- All patients must be placed on **droplet + contact isolation**
- Use of nebs, HFNC, NIV or other aerosolizing procedures requires **airborne + droplet + contact isolation**

Risk Factors
Age >50, HTN, DM, CVD, CKD, Lung disease, Obesity, Immunosuppression

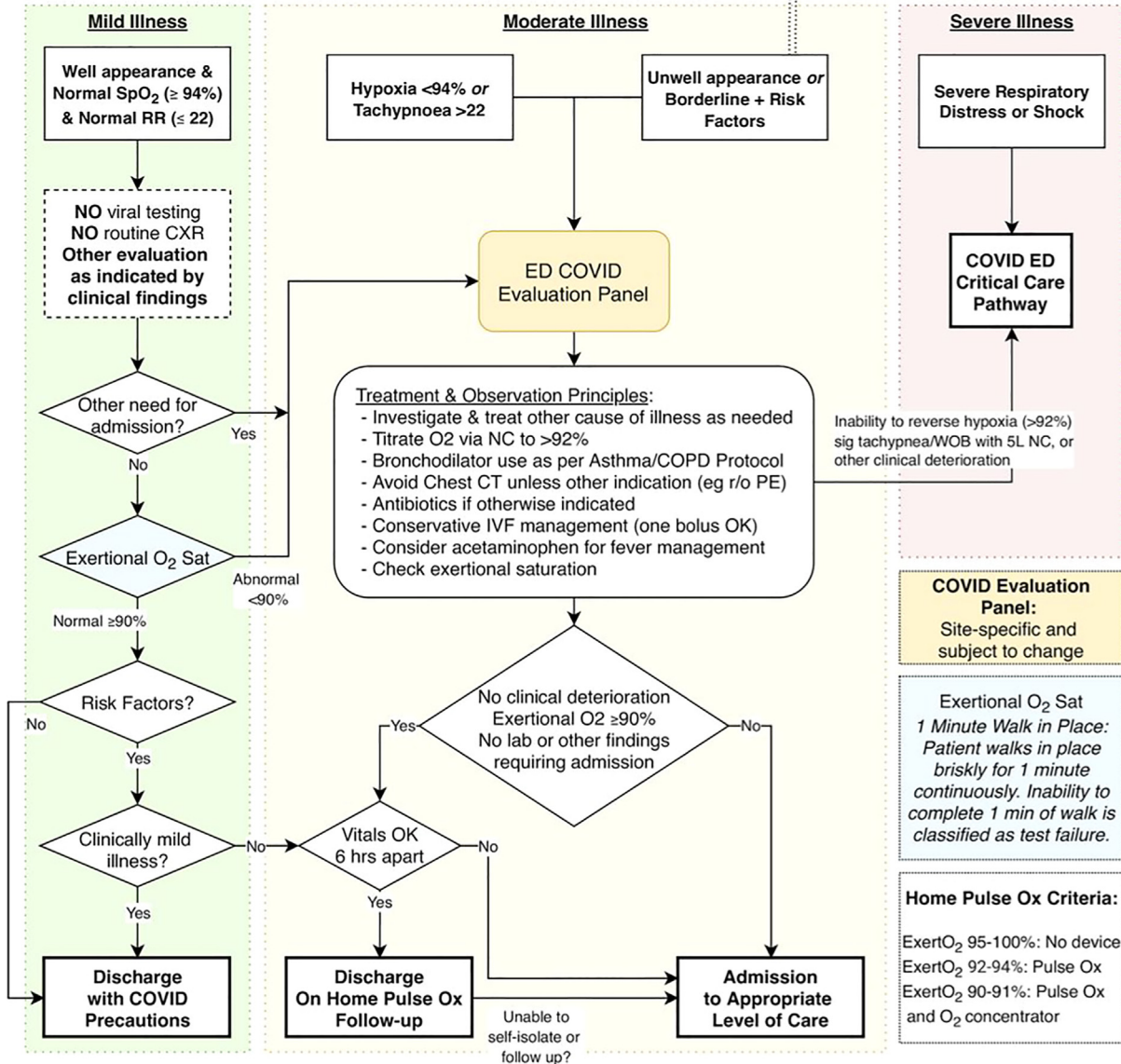


Fig. 1. Evaluation pathway for ED patients with possible COVID Infection.

monitoring for CLI patients discharged from 6 heterogeneous urban EDs. Outside of the Covid-19 crisis, this cohort would likely have been admitted to hospital. Subsequent to this study, the National Institute of Health classified Covid-19 patients with an SpO₂ < 94% as severe, requiring supplementary oxygen, admission, and therapeutic management, including corticosteroid and antiviral therapy [8, 9-16]. While the enrollment criteria of this study (SpO₂ 90–94%) are now outdated,

the care model may be useful in determining how best to use telemedicine resources and remote self-monitoring of SpO₂ to increase safety for patients with Covid-19.

The 30-day mortality of our cohort was 1.9%, significantly lower than the 10–21% inpatient mortality described in New York during approximately the same time, although there are limits to comparing these patient populations [17,18]. Common inpatient interventions not

Table 1
Index ED visits.

Characteristic	Patient (N = 677)	Pulse oximeter only (N = 483)	Pulse oximeter and O2 concentrator (N = 194)
Age – median (IQR) (N = 677)	54 (42–62)	52 (41–61)	57 (45–67)
Female sex – no. (%) (N = 677)	273 (40.3)	205 (42.4)	69 (35.6)
Days since symptom onset – median (IQR) (N = 654)	7 (4–10)	7 (4–10)	7 (4–10)
Vitals – median (IQR)			
Triage SpO2 (N = 677)	94 (93–96)	95 (93–97)	94 (92–96)
Triage RR (N = 672)	20 (18–22)	20 (18–22)	20 (18–22)
Heart Rate (N = 677)	99 (87–110)	99 (87–109)	99 (88–111)
Blood pressure (N = 674)			
Systolic	128 (116–140)	128 (117–141)	128 (116–139)
Diastolic	80 (73–85)	80 (73–86)	79 (73–85)
Temperature (N = 677)	37 (37–38)	37 (37–38)	37 (37–38)
Discharge SpO2 (%) (N = 560)	95 (94–97)	96 (94–97)	95 (93–96)
Discharge RR (breaths/min) (N = 406)	18 (18–20)	18 (18–20)	18 (18–20)
Exertional SpO2 (%) (N = 604)	93 (92–94)	94 (93–95)	91 (90–92)
Chest X-ray performed – no. (%)	443 (65.4)	289 (59.8)	154 (79.4)
Any consolidation	334 (49.3)	205 (42.4)	129 (66.5)
Unilateral Findings	279 (41.2)	169 (35.0)	110 (56.7)
Bilateral Findings	54 (8.0)	35 (7.2)	19 (9.8)
Discharged w/Antibiotics – no. (%) (N = 673)	127 (18.8)	93 (19.3)	34 (17.5)
Coexisting condition – no. (%) (N = 677)			
Hypertension	247 (36.5)	165 (34.2)	82 (42.3)
Diabetes	140 (20.7)	83 (17.2)	57 (29.4)
Chronic Vascular Disease	27 (4.0)	13 (2.7)	14 (7.2)
Chronic Kidney Disease	21 (3.1)	10 (2.1)	11 (5.7)
COPD	8 (1.2)	7 (1.4)	1 (0.5)
Interstitial Lung Disease	2 (0.3)	0 (0.0)	2 (1.0)
Asthma	74 (10.9)	62 (12.8)	12 (6.2)
Immunosuppression	8 (1.2)	6 (1.2)	2 (1.0)
Active Malignancy	11 (1.6)	10 (2.1)	1 (0.5)
At least 3 coexisting conditions	101 (14.9)	65 (13.5)	36 (18.6)
Lost to follow up during study period – no. (%)	36 (5.3)	26 (5.4)	10 (5.2)
Lost to follow up* – no. (%)	21 (3.1)	14 (2.9)	7 (3.6)
Returned to any ED – no. (%)	158 (23.3)	116 (24.0)	42 (21.6)
30-day mortality – no. (%)	13 (1.9)	10 (2.1)	3 (1.5)

performed on the VF-RPM cohort, such as general nursing care and rapid escalation of care, limit further comparisons to inpatient management during the study time.

Given 5.3% of the cohort was lost to follow up, similar models should focus on both patient education and discerning enrollment criteria. Future studies should examine the relatively low rates of video use (41%) for follow-up visits. The growing discussion regarding disparities associated with telemedicine care may play a role, although we were not able to collect race and ethnicity data [19,20]. While we became aware of some patients admitted to other hospitals during the course of initial follow-up

protocol calls, as well as the follow up calls performed at 90–120 days post index visit to determine 30-day mortality, we did not utilize other data systems to gather information on patients lost to follow up.

During the Covid-19 crisis, there has been great expansion of telemedicine care, incentivized by the US government and patients growing acceptance [21,22]. Healthcare systems who leverage telehealth technologies may offer more dynamic care during disaster scenarios. With many communities still experiencing surges in Covid-19 cases, post-ED care models incorporating telemedicine may be a useful strategy to provide flexible and safe care.

Table 2
Virtual follow-up visits.

Characteristic	Total	ED return	No ED return
Unique patients participated – no. (% of total cohort)	586 (86.5)	120 (17.7)	466 (68.8)
Index visit to first follow-up visit - days median (IQR)	1 (1–2)	1 (1–1)	1 (1–2)
Total number of visits completed	1825	320	1505
Number of visits per patient – median (IQR)	3 (2–4)	2 (1–4)	3 (2–4)
Mode of visits – no. (%)			
Video & Audio	754 (41.3)	145 (45.3)	609 (40.5)
Audio only	1071 (58.7)	175 (54.7)	896 (59.5)
Vitals – median (IQR)			
Minimum resting SpO2 (N = 498)	95 (94–97)	94 (92–96)	96 (94–97)
Minimum Exertional SpO2 (N = 441)	94 (92–96)	92 (88–95)	94 (92–96)
Exertional SpO2 below 90 – no. (%) ^a	57 (12.9)	33 (35.9)	24 (6.9)
Instructed to go to ED – no. (%)	80 (13.7)	62 (51.7)	18 (3.9)

^a Denominator 441.

Table 3
Index ED visit characteristics of patients with return visits.

Characteristic	Patient (N = 138)	Admitted on return visit (N = 86)	Discharged on return visit** (N = 52)	P value
Age – median (IQR) (N = 138)	56 (44–62)	58 (45–66)	51 (40–60)	0.016*
Female sex – no. (%) (N = 138)	53 (38.4)	28 (32.6)	25 (48.1)	0.102
Days since symptom onset – median (IQR) (N = 135)	7 (4–10)	7 (4–10)	7 (4–10)	0.944
Vitals – median (IQR)				
Triage SpO2 (N = 138)	95 (93–96)	94 (93–96)	95 (94–97)	0.082
Triage RR (N = 137)	20 (18–22)	20 (18–21)	20 (18–22)	0.426
Heart Rate (N = 138)	97 (82–108)	99 (80–110)	94 (84–105)	0.689
Blood pressure (N = 138)				
Systolic	125 (115–140)	125 (112–138)	126 (118–142)	0.281
Diastolic	79 (72–87)	78 (71–85)	82 (73–89)	0.047*
Temperature (N = 138)	37 (37–38)	38 (37–38)	37 (37–38)	0.006*
Discharge SpO2 (%) (N = 119)	95 (94–97)	95 (94–97)	97 (95–98)	0.010*
Discharge RR (breaths/min) (N = 89)	18 (18–20)	18 (18–20)	18 (18–20)	0.983
Exertional SpO2 (%) (N = 121)	93 (92–94)	93 (91–94)	94 (93–95)	0.001*
Chest X-ray performed – no. (%)	99 (71.7)	60 (69.8)	39 (75.0)	0.641
Any consolidation	77 (55.8)	51 (59.3)	26 (50.0)	0.058
Unilateral Findings	17 (12.3)	9 (10.5)	8 (15.4)	0.329
Bilateral Findings	59 (42.8)	41 (47.7)	18 (34.6)	0.329
Discharged w/Antibiotics – no. (%) (N = 136)	30 (21.7)	20 (23.3)	10 (19.2)	0.680
Coexisting condition – no. (%) (N = 138)				
Hypertension	54 (39.1)	39 (45.3)	15 (28.8)	0.081
Diabetes	31 (22.5)	20 (23.3)	11 (21.2)	0.939
Chronic vascular disease	8 (5.8)	6 (7.0)	2 (3.8)	0.710
Chronic kidney disease	4 (2.9)	2 (2.3)	2 (3.8)	0.632
COPD	2 (1.4)	1 (1.2)	1 (1.9)	1.000
Interstitial lung disease	1 (0.7)	1 (1.2)	0 (0)	1.000
Asthma	17 (12.3)	8 (9.3)	9 (17.3)	0.263
Immunosuppression	1 (0.7)	1 (1.2)	0 (0)	1.000
Active Malignancy	4 (2.9)	3 (3.5)	1 (1.9)	1.000
At least 3 coexisting conditions	25 (18.1)	19 (22.1)	6 (11.5)	0.183
30-day mortality – no. (%)	12 (8.7)	10 (11.6)	2 (3.8)	0.211

* p-value < 0.05.

** Including 1 patient deceased in ED.

Table 4
Characteristics of patients with return visits.

Characteristic	Patient (N = 138)	Admitted (N = 86)	Discharged (N = 52)**	P value
Age – median (IQR) (N = 138)	56 (44–62)	58 (45–66)	51 (40–60)	0.016*
Female sex – no. (%) (N = 138)	53 (38.4)	28 (32.6)	25 (48.1)	0.102
Days since symptom onset – median (IQR) (N = 134)	9 (6–14)	9 (7–12)	9 (6–17)	0.518
Vitals – median (IQR)				
Triage SpO2 (N = 136)	94 (91–97)	93 (89–95)	96 (94–98)	<0.001*
Triage RR (N = 135)	20 (18–24)	22 (19–25)	20 (18–20)	<0.001*
Heart Rate (N = 118)	99 (87–110)	101 (90–112)	96 (83–106)	0.067
Blood pressure (N = 117)				
Systolic	125 (112–136)	123 (111–135)	130 (114–137)	0.365
Diastolic	78 (72–85)	78 (73–85)	79 (72–85)	0.791
Temperature (N = 117)	37.2 (36.8–37.9)	37.3 (37.0–38.2)	37.0 (36.8–37.3)	0.003*
Mortality – no. (%)				
Death within 24 h of ED arrival	1 (0.7)	0 (0.0)	1 (1.9)	0.377
Death anytime during hospitalization	11 (8.0)	11 (12.8)	N/A	N/A

* p-value < 0.05.

** Including 1 patient deceased in ED.

Table 5
Characteristics of patients admitted in return visits.

Characteristic	Patient (N = 86)
Admitted to floor	79 (57.2)
Admitted to stepdown	5 (3.6)
Admitted to ICU	2 (1.4)
Admitted to ICU within 24 h of hospitalization	7 (5.1)
Admitted to ICU anytime during hospitalization	16 (11.6)
Intubated within 24 h of hospitalization	2 (1.4)
Intubated anytime during hospitalization	11 (8.0)

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