

An Accelerated Hospital Observation Pathway to Reduce Length of Stay for Patients With COVID-19

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Surges in patient volume from COVID-19 continue to strain hospital capacity across the world.¹⁻⁸ Hospitals have expanded treatment areas, redistributed personnel, and shifted care to alternative locations.⁹⁻¹⁵ As clinical experience and evidence for managing COVID-19 accumulated, reduction of hospital length of stay (LOS) for infected patients emerged as another strategy to maintain hospital capacity.¹⁶⁻¹⁹

Many patients who are hospitalized because of COVID-19 require only brief stays.¹⁹⁻²¹ Indications for short-stay hospitalization include transient vital sign abnormalities, symptom management, initiation of intravenous therapies, and monitoring for risk of deterioration.²² Patients with moderate illness due to COVID-19 may warrant only observation-level care, although the use of dedicated observation units has not been described and criteria to define observation status for reimbursement have not been defined. Despite rapid stabilization, patients discharged after a short hospitalization may benefit from continued symptom monitoring at home, given the potential for unanticipated deterioration and prolonged symptoms.²³⁻²⁵

To reduce hospital LOS for patients with COVID-19 and ensure adequate postdischarge monitoring, we implemented the COVID Accelerated Care Pathway (CACP). The CACP consists of a hospital observation protocol for patients with moderate-severity COVID-19 infection and enrollment in a text message-based remote monitoring service following discharge from the hospital.²⁶ In this study, we estimate changes in hospital LOS for CACP patients compared with a propensity score-matched cohort. We also evaluate the association between pathway implementation and hospital LOS for all patients with COVID-19.

METHODS

Data Sources, Study Population, and Outcomes

We conducted a retrospective cohort study of hospitalized patients with COVID-19 in a single large, urban academic hospital. We used electronic health record data to identify patients admitted to the CACP from December 14, 2020, the date of pathway implementation, to January 31, 2021. For comparison, we identified a propensity score-matched

ABSTRACT

OBJECTIVES: Strategies to maintain hospital capacity during the COVID-19 pandemic included reducing hospital length of stay (LOS) for infected patients. We sought to evaluate the association between LOS and enrollment in the COVID Accelerated Care Pathway, which consisted of a hospital observation protocol and postdischarge automated text message-based monitoring.

STUDY DESIGN: Retrospective matched cohort study of patients hospitalized from December 14, 2020, to January 31, 2021.

METHODS: Participants were patients who presented to the emergency department with acute infection due to COVID-19, required hospitalization, and met pathway inclusion criteria. Participants were compared with a propensity score-matched cohort of patients with COVID-19 admitted to the same hospital during the 7 weeks preceding and following pathway implementation.

RESULTS: There were 44 patients in the intervention group and 83 patients in the propensity score-matched cohort. The mean (SD) hospital LOS for patients in the intervention group was 1.7 (2.6) days compared with 3.9 (2.3) days for patients in the matched cohort (difference, -2.2 days; 95% CI, -3.3 to -1.1). In the intervention group, 2 patients (5%; 95% CI, 0%-15%) were rehospitalized within 14 days compared with 8 (10%; 95% CI, 4%-17%) in the matched cohort.

CONCLUSIONS: Patients with COVID-19 who were managed through an accelerated hospital observation protocol and postdischarge monitoring service had reduced hospital LOS compared with patients receiving standard care. Hospital preparedness for future public health emergencies may involve the design of pathways that reduce the time that patients spend in the hospital, lower cost, and ensure continued recovery upon discharge.

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cohort of patients with COVID-19 admitted to non-critical care units at the same hospital from October 26, 2020, to January 31, 2021. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.²⁷ The University of Pennsylvania institutional review board approved this study as a quality improvement initiative.

TAKEAWAY POINTS

An accelerated care pathway combined an observation protocol with postdischarge remote monitoring, reducing length of stay by more than 2 days for select patients hospitalized for COVID-19.

- ▶ Reducing length of stay expands hospital capacity during public health emergencies.
- ▶ Observation criteria and protocols have not been described for COVID-19.
- ▶ Mobile health technology can follow patients after hospital discharge to ensure continued recovery.
- ▶ Pathways that transform care during and after hospitalization have implications beyond COVID-19, with potential benefits for patients, payers, and health systems.

Study Participants

Patients presenting to the emergency department (ED) were enrolled in the CACP at the time of disposition. All CACP patients were confirmed to have COVID-19 through laboratory testing obtained in the ED and symptoms consistent with active infection. Development of the algorithm to identify potential candidates for the CACP has previously been described.¹⁸ Patients were eligible for the CACP if the emergency physician deemed them to be inappropriate for discharge from the ED based on symptom burden (dyspnea, pain, fatigue, nausea, vomiting), vital sign abnormalities, and high-risk comorbidities. Patients were excluded if they exhibited the following criteria at any time during the ED evaluation: hypoxia at rest (oxygen saturation [SpO_2] $\leq 92\%$), tachypnea (respiratory rate > 24), hypotension (mean arterial pressure < 70), altered mental status, and recent hospital care for COVID-19. Patients with new ambulatory oxygen requirements (ambulatory $\text{SpO}_2 < 94\%$), evidence of pneumonia on chest radiograph, age older than 60 years, or fever (temperature $> 101^\circ\text{F}$) were preferentially included in the CACP, although patients deemed to require hospitalization for other reasons were also included in the CACP.

Study Intervention

CACP patients received hospital-level care in 3 dedicated negative-pressure rooms within an existing ED observation unit (EDOU). Prior to introduction of the CACP, the EDOU had not accepted patients with recent or known COVID-19 infection. When all 3 rooms were occupied, all subsequent eligible patients received standard medical admission instead. Patients were managed by an advanced practice provider (APP) under supervision of an emergency medicine physician. Upon admission to the EDOU, case managers immediately engaged patients and families to anticipate discharge needs, including assessment of home safety, transportation barriers, outpatient follow-up appointments, and the need for supplemental oxygen at home.

Clinicians used a checklist to determine whether patients were eligible for discharge, including improvement of symptoms present at the time of admission, ability to eat and drink, and stable oxygen requirement for 24 hours. Patients with increasing oxygen requirements, increased work of breathing, or LOS greater than 48 hours were transferred to an inpatient medical unit.

Upon discharge home, patients were offered to enroll in 1 of 2 text message-based remote monitoring services (COVID Pulse Enhanced and COVID Watch) offered in both English and Spanish.

These services sent twice-daily automated text messages inquiring about their symptoms.²⁶ The COVID Pulse Enhanced service also provided patients with pulse oximeters and asked them to input pulse oximeter readings. Patients who reported worsening or new symptoms received a phone call from a registered nurse. Patients were also called for report of hypoxia, defined as (1) SpO_2 less than 95% with change from prior reading by -3% or (2) any SpO_2 less than 90%. If necessary, clinical concerns were escalated to an on-call APP or physician. Patients could also request a 24/7 nursing callback at any time via text message. Patients with emergent concerns were directed to return immediately to the ED. A case manager received daily reports regarding patient engagement in the first 24 hours following discharge and assisted patients in negotiating technological or other barriers. The texting program continued to contact patients until they reported symptom resolution but did not extend more than 14 days after hospital discharge.

Patients were allowed to decline enrollment in the remote monitoring program; others were deemed ineligible because of language or technical barriers. Patients who required higher-intensity postdischarge monitoring or skilled clinical services including nursing and physical therapy, as determined by the clinical or case management teams, were provided with home health services rather than text message-based services.

Patients in the comparison group received usual care, which involved admission to a standard hospital ward unit. These units included both teaching services with physician trainees and hospitalist units with APPs. Patients on these units also received standard case management and discharge planning services. No standard discharge checklist or continuous process to reevaluate patients for discharge was known to be employed across these units. At the time of discharge, patients were offered enrollment in the COVID Watch monitoring services as well as home health services at the discretion of the clinical teams and case managers.

Outcomes

The intervention group consisted of patients in the CACP between December 14, 2020, and January 31, 2021. We compared this intervention group with a matched cohort of patients with COVID-19 admitted to non-critical care units in the same hospital between October 26, 2020, and January 31, 2021. The matched cohort was derived from the group of patients admitted to the hospital when

the CACP was not available (either prior to the intervention or when all CACP beds were occupied) as well as patients not selected for the CACP. The primary outcome was hospital LOS. We defined the start of hospitalization as the time the ED clinician reported the case to the inpatient team and end as the time patients physically departed from their bed.

We describe additional process outcomes for patients admitted to the CACP, including disposition (home vs inpatient medical unit), enrollment in outpatient monitoring services, and repeat ED and hospital encounters within 14 days of discharge from the index hospitalization. To identify readmissions at hospitals unaffiliated with the index hospital, we obtained data from HealthShare Exchange, a regional health information exchange. For patients enrolled in COVID Pulse Enhanced, we describe patient-reported changes in clinical status requiring escalation to clinicians as well as the outcomes of those escalations. Monitoring data are reported only for patients enrolled in the COVID Pulse Enhanced program, not those in COVID Watch.

We collected patient characteristics including age, sex, race/ethnicity, and payer source. We also determined whether patients had diagnosed comorbid conditions at the time of hospitalization including hypertension, diabetes, chronic kidney disease, chronic obstructive pulmonary disease, asthma, history of venous thromboembolism, congestive heart failure, and cancer. We captured key ED vital signs (minimum pulse oximetry, maximum pulse rate, maximum temperature) and ED laboratory testing (white blood cell count, blood urea nitrogen). Finally, we determined whether patients had findings on attending radiologist interpretation of an initial chest radiograph, classified as normal vs abnormal (indeterminate/definite evidence of pneumonia).

Analysis

We summarized unadjusted patient outcomes using descriptive statistics. In the primary adjusted analysis, we estimated propensity scores using a multivariable logistic regression model using the demographic and clinical variables listed earlier.²⁸ We used 3:1 nearest-neighbor propensity score matching with replacement, yielding good balance between the CACP intervention group and the matched cohort.²⁹⁻³¹ There was sufficient overlap in the propensity score distributions between the 2 groups to ensure that the positivity assumption was not violated. The use of replacement in this matching strategy allowed patients in the comparison group to be matched with multiple patients in the intervention group. We used a *t* test to compare the means of the treatment and matched comparison groups. We performed 2 additional sensitivity analyses limiting the comparison group to patients hospitalized either (1) before the intervention was available (October 26, 2020, to December 13, 2020) or (2) while the intervention was available (December 14, 2020, to January 31, 2021).

In a secondary analysis, we sought to determine whether the introduction of the CACP was associated with a change in the hospital LOS for all patients with COVID-19 who were not initially admitted to

critical care units. We performed 2 separate interrupted time-series analyses that examined changes in (1) mean weekly hospital LOS for all COVID-19 patients admitted to non-critical care units at the intervention hospital and (2) mean weekly hospital LOS for similar patients admitted to 4 nearby comparison hospitals within the same health system. For both analyses, we compared the mean weekly hospital LOS for 7 weeks before CACP implementation (October 26, 2020, to December 13, 2020) with that for the 7 weeks after CACP implementation (December 14, 2020, to January 31, 2021). We report average marginal effects to describe the difference in hospital LOS between the pre- and postintervention time periods for each hospital group. No other interventions designed to affect hospital LOS were known to the authors at the time of the CACP intervention. All analyses were conducted using Stata version 16.1 (StataCorp LLC); a *P* value of less than .05 was considered statistically significant.

RESULTS

During the study period, 44 patients were enrolled in the CACP. During the comparison period, 459 patients were admitted with COVID-19 to non-critical care hospital units, 83 of whom were included in the propensity score-matched cohort. Patient characteristics for all groups are shown in [Table 1](#). We report standardized mean differences for covariates before and after matching in the [eAppendix](#) (available at [ajmc.com](#)).³²

Primary Outcome

For CACP patients, the mean (SD) hospital LOS was 1.7 (2.6) days. For the unmatched comparison group, the mean (SD) hospital LOS was 5.5 (5.3) days. In the propensity score-matched cohort, the mean (SD) hospital LOS was 3.9 (2.3) days. We estimate that patients in the CACP comparison group had 2.2 fewer hospital days (95% CI, 1.1-3.3; *P* = .001). Sensitivity analyses restricting the comparison group to either the preintervention or postintervention periods demonstrated similar results.

Secondary Analysis

In the interrupted time-series analysis, implementation of the CACP was significantly associated with reduction in mean hospital LOS for all patients with COVID-19 at the intervention hospital (-2.2 days; 95% CI, -3.8 to -0.6) for the 7-week period after CACP implementation ([Figure](#)). Among patients with COVID-19 treated at comparison hospitals, there was no statistically significant change in mean hospital LOS (-0.6 days; 95% CI, -1.6 to 0.4) between the same time periods.

Intervention Process Outcomes

Of the 44 CACP patients, 38 (86%; 95% CI, 73%-95%) patients were discharged home directly from the observation unit. The remaining 6 patients (14%; 95% CI, 5%-27%) required inpatient admission and were transferred to a standard hospital unit. In the intervention group, 6 patients (14%; 95% CI, 5%-27%) returned to an ED for

reevaluation within 14 days, and 2 (5%; 95% CI, 0%-15%) were readmitted to a hospital within 14 days. In the matched comparison group, 8 patients (10%; 95% CI, 4%-17%) returned to an ED, and all were rehospitalized. Additional outcomes are shown in **Table 2**.

In the CACP intervention group, 19 patients (40%) were enrolled in COVID Pulse Enhanced and engaged with the automated texting service. Of those patients, 10 (53%) reported no worsening symptoms or hypoxia, 3 (16%) reported worsening symptoms, 4 (21%) reported only hypoxia, and 2 (5%) reported both (**Table 3**). The recommendation for 7 patients requiring escalation to the clinical team was to continue outpatient management, whereas 2 patients were instructed to return to the ED.

DISCUSSION

In this study, we estimate that an intervention to streamline hospital throughput for COVID-19 patients, involving protocols for a 3-bed observation unit and remote monitoring services after discharge, reduced hospital LOS by more than 2 days per patient. The hospital also experienced a 2-day reduction in hospital LOS for all non-critical care admissions for COVID-19. Together, these results suggest that implementation of an efficient observation pathway for patients with COVID-19 may have a meaningful impact on LOS and bed capacity and that postdischarge monitoring services can have value in both expediting discharge and preventing readmissions.

In the United States, hospitals designate patients who are anticipated to require short hospitalization to be admitted under observation status, with reimbursement according to an outpatient payment scale.³³ However, the approach to delivering observation services varies among hospitals.^{34,35} The use of dedicated observation units has previously been shown to reduce patient LOS, lower cost, and improve patient satisfaction.³⁶ Additional evidence suggests that observation units with condition-specific protocols and close coordination with the ED offer the greatest efficiency in terms of LOS and cost.^{34,37} During the COVID-19 pandemic, hospitals cohorted patients with COVID-19 because of concerns around infection control and staff safety.³⁸ However, it is not known whether hospitals widely adopted COVID-19-specific units with the explicit goal of delivering protocolized services

TABLE 1. Characteristics of Patients With COVID-19 Enrolled in COVID Accelerated Care Pathway Compared With Standard Hospital Admission to Non-Critical Care Units, October 26, 2020, to January 31, 2021

Characteristic	Intervention group	Unmatched comparison group	Matched comparison group
	COVID Accelerated Care Pathway (n = 44)	Standard hospital admission (n = 459)	Matched cohort (n = 83)
Patient characteristics			
Age in years, mean (SD)	46.6 (20.1)	59.4 (17.3)	46.0 (17.4)
Sex, n (%)			
Female	27 (61.4)	220 (47.9)	50 (60.2)
Male	17 (38.6)	239 (52.1)	33 (39.7)
Race/ethnicity, n (%)			
Non-Hispanic White	10 (22.7)	171 (37.3)	19 (22.9)
Non-Hispanic Black	19 (43.2)	230 (50.1)	38 (45.8)
Other	15 (34.1)	58 (12.6)	26 (31.3)
Payer, n (%)			
Commercial	18 (40.9)	157 (34.2)	34 (41.0)
Medicare	12 (27.3)	212 (46.2)	24 (28.9)
Medicaid	14 (31.8)	90 (19.6)	25 (30.1)
Emergency department vital signs			
Minimum oxygen saturation, %, mean (SD)	95.3 (3.6)	93.0 (5.1)	95.1 (3.8)
Maximum pulse rate, beats per minute, mean (SD)	98.8 (18.0)	97.2 (20.1)	99.2 (17.9)
Maximum temperature, ° F, mean (SD)	99.3 (1.2)	99.4 (1.4)	99.3 (1.4)
History of comorbid illness, n (%)			
Hypertension	15 (34.1)	254 (55.3)	26 (31.3)
Diabetes	11 (25.0)	145 (31.6)	19 (22.9)
Chronic kidney disease	2 (4.6)	102 (22.2)	6 (7.2)
Chronic obstructive pulmonary disease/asthma	8 (18.2)	94 (20.5)	17 (20.4)
Venous thromboembolism	3 (6.8)	72 (15.7)	6 (7.2)
Congestive heart failure	1 (2.3)	54 (11.8)	2 (2.4)
Cancer	4 (9.1)	109 (23.8)	7 (8.4)
Emergency department diagnostic testing			
White blood cell count, cells per mm ³ , mean (SD)	6.4 (2.7)	6.5 (3.3)	6.1 (3.4)
Blood urea nitrogen, mg per dL, mean (SD)	15.1 (8.4)	22.9 (18.4)	13.8 (9.6)
Chest x-ray, n (%)			
Normal	23 (52.3)	139 (30.3)	44 (53.0)
Abnormal/indeterminate	21 (47.8)	320 (69.7)	39 (46.9)

resulting in accelerated discharge. Our study suggests that even small, dedicated hospital observation units have potential to save resources.

Importantly, this intervention extended beyond the time of hospital discharge to monitor and, if necessary, respond to changes in patient conditions at home. In the context of the variable course

FIGURE. Interrupted Time-Series Analysis of Weekly Mean Length of Stay for Hospitalized Patients With COVID-19, for Intervention and Comparison Hospitals, October 26, 2020, to January 31, 2021

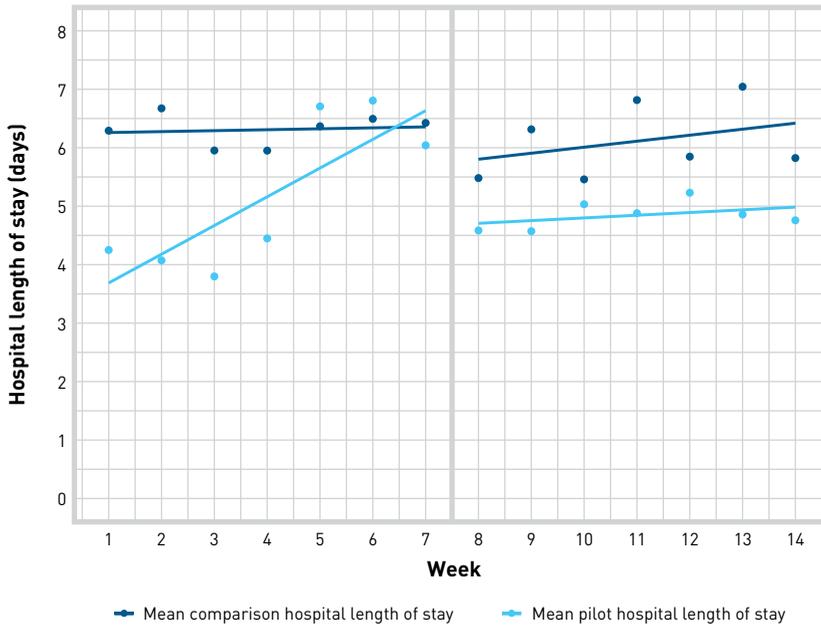


TABLE 2. Patient Outcomes for COVID Accelerated Care Pathway Compared With Matched Comparison Group of Patients Receiving Standard Hospital Admission to Non-Critical Care Units

Outcome	Enrolled in COVID Accelerated Care Pathway n = 44	Matched comparison group n = 83
Total hospital length of stay, hours, mean (SD)	41.9 (21.9)	94.7 (51.2)
Emergency department length of stay, hours, mean (SD)	6.2 (2.3)	7.3 (3.8)
Hospital disposition, n (%)		
Home	38 (86%)	59 (71%)
Home health services	6 (14%)	20 (24%)
Nursing or rehabilitation facility	0 (0%)	4 (5%)
Enrollment in outpatient monitoring services at hospital discharge, n (%)		
COVID Pulse Enhanced	19 (43%)	Not eligible
COVID Watch	14 (32%)	47 (57%)
Home health services	6 (14%)	20 (24%)
Declined monitoring services	2 (5%)	10 (12%)
Ineligible for monitoring services	3 (7%)	6 (7%)
Repeat visit to emergency department within 14 days of discharge from index hospital encounter, n (%)	6 (14%)	8 (10%)
Repeat hospitalization within 14 days of discharge from index hospital encounter, n (%)	2 (5%)	8 (10%)
Died within 30 days, n (%)	0 (0%)	0 (0%)

for some patients with COVID-19, the goal of monitoring was to facilitate appropriate returns to the hospital if patients were worsening while also preventing unnecessary return visits.²³ Another goal is to reduce LOS for the index hospitalization. Clinicians may be more likely to discharge patients sooner with assurance that patients will continue to be closely monitored at home. Previous studies have found that readmission rates for COVID-19 may be high compared with other disease conditions.^{20,24,25} Although it is difficult to compare readmission outcomes for patients among different studies given disparate inclusion criteria and variable follow-up periods, only 2 (5%) of patients enrolled in the CACP required rehospitalization within 14 days.

The pandemic has forced transformation of the health care system. Hospitals will be compelled to review and adapt successful innovations in care, not just to prepare for future epidemics but also to improve efficiency in the management of routine illness, as they cope with the financial impact of the pandemic as well as consequences of delayed medical care. Protocol-driven observation units have previously been shown to be effective for a variety of conditions, including chest pain, transient ischemic attack, and asthma.³⁷ The CACP adapted those existing models and added a new mechanism for monitoring and coordinating care for patients after discharge. Hospitals may consider developing models that incorporate telemedicine and remote monitoring technologies for other disease conditions. Important considerations include whether these conditions are amenable to protocol-based hospital care, whether patients can be reliably monitored following discharge, and the financial implications of shifting care to observation status for payers as well as hospitals.

Limitations

This study has several limitations. First, we cannot infer that the intervention caused the reduction in LOS. Rapid implementation of a randomized controlled trial was not feasible during these peak pandemic weeks. The propensity score approach attempts to mitigate bias but does not account for unobserved patient characteristics. For this reason, we extended the comparison group to the 7-week period prior to

the intervention, although this addition may introduce bias related to timing, with differences in hospital volume and other factors that may determine LOS. A second, and related, limitation is that the secondary time-series analysis cannot adjust for surges in hospital volume due to COVID-19. Surge volumes may have bidirectional effect on hospital LOS, both exerting pressure to discharge patients but also causing greater resource and personnel strain, which may limit the ability to discharge patients. A third limitation is that patients who were deemed to require observation care in the CACP might have been eligible for outpatient management and other therapeutics, such as monoclonal antibody treatment. However, in this study as in most hospitals, patients are deemed appropriate for hospital services for a variety of reasons and at the discretion of their treating physicians. This study sought to evaluate system changes for patients who were already deemed to require inpatient care rather than attempt to change decisions in disposition. Fourth, this study was conducted in a single large academic hospital and may not be generalizable to other settings. Finally, interpretation of the outcomes of the remote monitoring service is limited due to the availability of data for only the COVID Pulse Enhanced program, although the program functioned similarly to COVID Watch.

CONCLUSIONS

We implemented the CACP for patients anticipated to require short hospitalization for illness due to COVID-19. Using a propensity score matching approach, we estimate that the CACP reduced hospital LOS by more than 2 days per patient. Future studies of similar interventions for patients, not only during pandemic illness but also for other common disease conditions, may seek to expand these findings through randomized controlled trials and cost-effectiveness studies. ■

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TABLE 3. Posthospital Outcomes for COVID Accelerated Care Pathway Patients Enrolled in Automated Text Message–Based Monitoring Service, December 14, 2020, to January 31, 2021

Outcome	Enrolled in COVID Pulse Enhanced n = 19
Patient-reported status change	
No change in symptoms or oxygenation reported	10 (53%)
Reported change in symptoms only	3 (16%)
Reported change in oxygenation ≥ 3%	4 (21%)
Reported change in symptoms and oxygenation ≥ 3%	2 (5%)
Highest level of outpatient clinical escalation	
Not applicable	10 (53%)
RN	4 (21%)
APP	3 (16%)
MD	2 (5%)
Outcome of clinical escalation	
Not applicable	10 (53%)
Continue outpatient management	7 (37%)
Return to emergency department	2 (5%)
Duration of enrollment, days, mean (SD)	11.8 (4.6)
Patient satisfaction	
Net promoter score	91%

APP, advanced practice provider; MD, medical doctor; RN, registered nurse.

(SBP, AUM, ACL, KCH, MB, KCL); obtaining funding (ASK, MKD, KCL); administrative, technical, or logistic support (ASK, AUM, KHC, ACL, KCH, SM, NMa, AMH, EB, NO, NK, MB, AX, KCL); and supervision (MKD, ACL, KCL).

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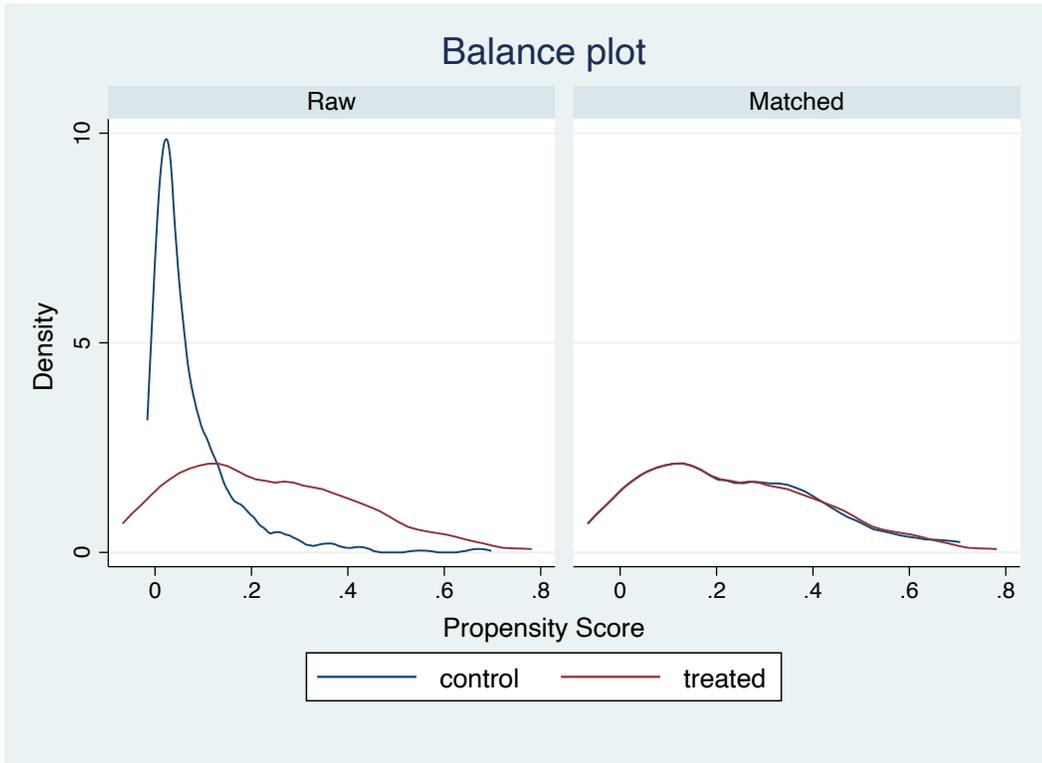
eAppendix Table

Standardized mean differences for covariates before and after propensity score matching

		Treatment group N = 44 mean or %	Unmatched comparison group N = 459 mean or %	Matched comparison group N = 83 mean or %	SMD before matching	SMD after matching
Patient Characteristics						
Age, years		46.6	59.5	46.0	-0.68	0.05
Sex						
	Male	38.6%	52.0%	39.7%	--	--
	Female	61.4%	48.0%	60.2%	0.27	0.02
Race/Ethnicity						
	NH-White	22.7%	37.3%	22.9%	--	--
	NH-Black	43.2%	50.0%	45.8%	-0.14	-0.03
	Other	34.1%	12.7%	31.3%	0.52	0.02
Payer						
	Commercial	40.1%	34.0%	41.0%	--	--
	Medicare	27.3%	46.3%	28.9%	-0.40	-0.03
	Medicaid	32.6%	19.7%	30.1%	0.28	0.03
Emergency Department Vital Signs						
Minimum oxygen saturation, % (mean (SD))		95.3	93.0	95.1	0.52	0.05
Maximum pulse rate, beats per minute (mean (SD))		98.8	97.3	99.2	0.08	-0.02
Maximum temperature, degrees Fahrenheit (mean)		99.3	99.5	99.3	-0.09	0.01
History of co-morbid illness						
Hypertension		34.1%	55.5%	31.3%	-0.44	0.05
Diabetes		25.0%	31.7%	22.9%	-0.15	0.03
Chronic kidney disease		4.5%	22.3%	7.2%	-0.54	-0.09
COPD/asthma		18.2%	20.5%	20.4%	-0.06	-0.06
Venous thromboembolism		6.8%	15.7%	7.2%	-0.28	0.0
Congestive heart failure		2.3%	11.8%	2.4%	-0.38	0.0
Cancer		9.1%	23.8%	8.4%	-0.40	0.03
Emergency Department Diagnostic Testing						
White blood cell count, cells per mm ³ (mean)		6.4	6.5	6.1	-0.03	0.09
Blood urea nitrogen, mg per dL (mean)		15.2	22.9	13.8	-0.54	0.13
Chest x-ray						
	Normal	52.3%	30.0%	53.5%	--	--
	Abnormal/in determinate	47.7%	70.0%	46.5%	-0.45	0.05

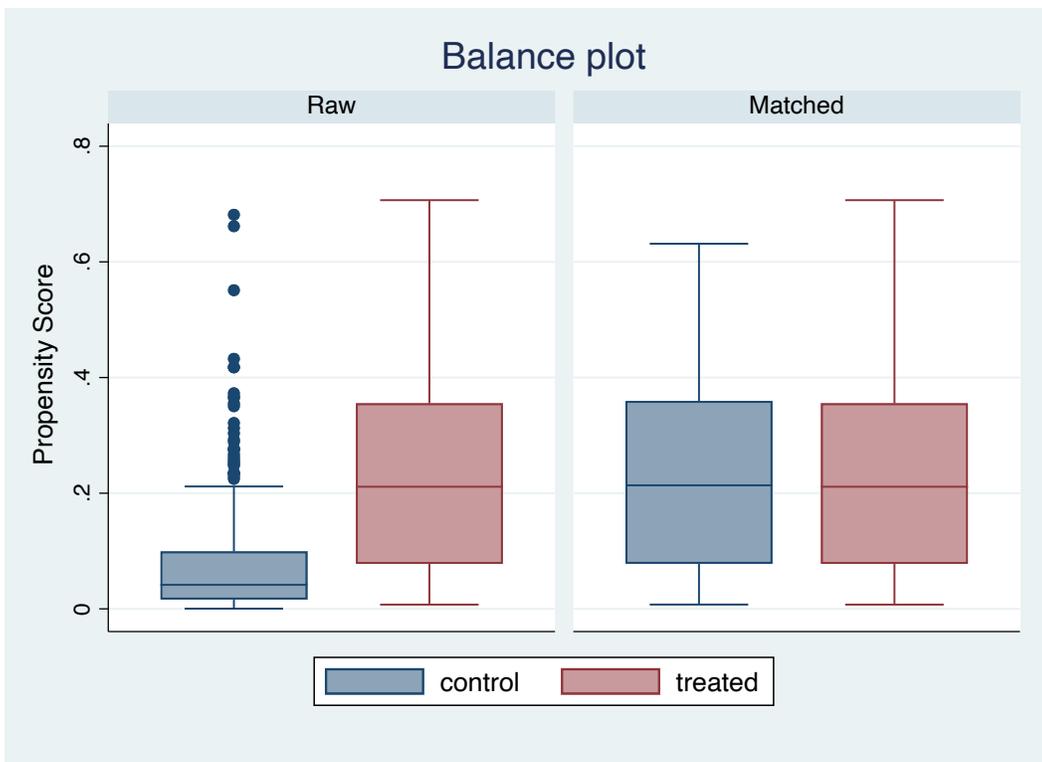
eAppendix Figure 1

Kernel density plot of propensity scores for treatment and comparison groups, before and after propensity score matching



eAppendix Figure 2

Box and whisker plot of propensity scores for treatment and comparison groups, before and after propensity score matching



eAppendix Figure 3

Plot of standardized percentage bias for covariates before and after propensity score matching

