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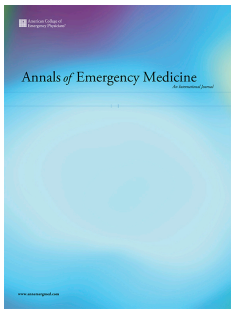

COHORT OF 4404 PERSONS UNDER INVESTIGATION FOR COVID-19 IN A NY HOSPITAL AND PREDICTORS OF ICU CARE AND VENTILATION

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MH and AJS conceived and designed the study. AJS, KM, and RF supervised the conduct of the trial and data collection. HCT managed the data, including quality control. HCT provided statistical advice on study design and analyzed the data. AJS drafted the manuscript, and all authors contributed substantially to its revision. AJS takes responsibility for the paper as a whole.

COHORT OF 4404 PERSONS UNDER INVESTIGATION FOR COVID-19 IN A NY HOSPITAL AND PREDICTORS OF ICU CARE AND VENTILATION

ABSTRACT

Study objective: Most COVID-19 reports have focused on SARS-CoV-2 positive patients. However, at the time of initial presentation, most patients' viral status is unknown. Determination of factors that predict initial and subsequent need for intensive care (ICU) and invasive mechanical ventilation (IMV) are critical for resource planning and allocation. We describe our experience with 4,404 persons under investigation (PUI) and explore predictors of ICU care and IMV at a NY COVID-19 epicenter.

Methods: We conducted a retrospective COHORT of all persons under investigation (PUI) presenting to a large academic medical center emergency department (ED) in NYS with symptoms suggestive of COVID-19. The association between patient predictor variables and SARS-CoV-2 status, intensive care unit (ICU) admission, invasive mechanical ventilation (IMV), and mortality were explored with univariate and multivariate analyses.

Results: Between March 12-April 14, 2020 we saw 4,404 PUI patients of whom 68% were discharged home, 29% were admitted to a regular floor and 3% to an ICU. 1,651 of 3,369 patients tested were SARS-CoV-2 positive to date. Of regular floor admits, 13% were subsequently upgraded to the ICU after a median (IQR) of 62 (28-106) hrs. 50 patients required IMV in the ED, 4 required prehospital IMV, and another 167 subsequently required IMV in a median (IQR) of 60 (26-99) hours after admission. Testing positive for SARS-CoV-2 and lower oxygen saturations were associated with need for ICU, IMV and death. High respiratory rates were associated with the need for ICU care.

Conclusions: PUI for COVID-19 contribute significantly to the healthcare burden beyond those ruling in for SARS-CoV-2. For every 100 admitted PUI, 9 will require ICU and/or IMV upon

arrival and another 12 within 2-3 days of hospital admission, especially PUIs with lower oxygen saturations and positive SARS-CoV-2 swabs. This information should help hospitals stay ahead of the pandemic curve.

Background

COVID-19, which originated in China in December 2019, has now reached pandemic proportions.[1] While most publications have rightfully focused on patients who had a positive PCR test for SARS-CoV-2,[2-8] stress on the health care system has also occurred due to a surge in the number of persons under investigation (PUI) with symptoms possibly but not exclusively due to COVID-19. Due to shortages in testing, delays in reporting the results of viral testing, false negatives tests, and daily fluctuations in test results within individual patients,[9, 10] all PUI should be considered to have COVID-19 until proven otherwise.

Importance

Our hospital emergency department saw its first PUI on February 7, 2020. Since then we have seen a growing number of PUIs and as of April 14, 2020 we have seen approximately 4,600 such patients with increasing SARS-CoV-2 rule in rates. Our administration and clinical services have responded by rapid expansion of our capacity including the ED and most recently the opening of a field ER tent (with the help of the NYS Department of Health, NYS Department of Environmental Conservation, NYS Department of Homeland Security and National Guard) in which many of the less ill PUI are seen. Due to nationwide shortages, it is important to be able to predict, real time, future needs for intensive care unit (ICU) beds and mechanical ventilators based on the number and type of patients arriving at the ED with suspected COVID-19 and number of admissions to regular floors. This would give critical lead time to allocate resources most wisely both now and in future anticipated pandemics, helping to stay ahead of the curve.

Goals of this investigation

In this report we present a cohort of 4,404 PUI and compare patient clinical characteristics and outcomes based on whether they test positive or negative for SARS-CoV-2. We also performed an exploratory analysis regarding patient factors that predicted the need for ICU level care, invasive mechanical ventilation, and death. It is our hope that this data will help other healthcare institutions in planning for and responding to the COVID-19 pandemic and similar future pandemics

METHODS

Study Design

We performed a structured, retrospective chart review, consistent with the recommended methodology of Kaji et al,[11] in all persons under investigation (PUI) presenting to our ED with symptoms suggestive of COVID-19. Our study followed the Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines for cross-sectional studies (http://www.equator-network.org/reporting-guidelines/strobe/). Because of the retrospective design, we received IRB approval with waiver of informed consent.

Patients and Setting

We performed a computerized search of our electronic medical records to identify all patients with a physician PUI order in the computer. In early February we added a specific computerized PUI order to our electronic medical record to indicate that the provider suspected that the patient might have COVID-19. While the definition of persons under investigation for COVID-19 has evolved, we included any patient with signs or symptoms of a flu-like illness including but not limited to: fever, cough, shortness of breath, fatigue, myalgia, sore throat, diarrhea, or loss of smell or taste. Patients of all ages were included. Eligible patients presented from March 12, 2020 to April 14, 2020. Our ED is a large, tertiary care, suburban, academic medical center with over 100,000 annual ED visits. Our medical center is also a major referral center for the county of Suffolk, NY on the eastern end of Long Island, with over 1.5 million inhabitants.

In order to expand our capacity to see PUI, on March 9, 2020 we opened a 16 bed unit in an ambulatory care pavilion that was not being used in which we saw the less ill PUI patients.

To further expand our capacity, we moved to a field tent on March 24th, 2020, on the other side of our university campus. This move was done to create more ED space while the ambulatory care pavilion was being prepared for conversion to an inpatient unit. Use of PCR testing for SARS-CoV-2 varied based on evolving CDC recommendations and availability. In general, all patients presenting to the ER tent were tested while all patients presenting to the main ED who required hospital admission and symptomatic healthcare workers were also tested.

Data Source and Collection

The source of all data was the electronic medical record. Extraction of data was performed both manually (e.g., for items present in the various clinical notes and radiology reports) and automatically (e.g., for vital signs and laboratory results). For eligible patients, we extracted demographic information, comorbidities, symptoms, exposure history, vital signs, lab results, chest XR and chest CT imaging results, disposition, (discharge to home, admission to a non-intensive floor, admission to intensive care unit [ICU]), and treatments (invasive and non-invasive mechanical ventilation). We defined all study data and variables prior to initiating the study and trained our data abstractors using a library of definitions. We periodically monitored data collection and determined the inter-observer agreement on the primary outcome on a randomly selected sample of 20 study patients. Interobserver agreement (Kappa statistic) for invasive mechanical ventilation and ICU admission was excellent (1.0 for both). Agreement for subsequent ICU upgrade was 0.89 (95% CI, 0.67-0.99).

Study Outcomes

The primary outcomes were ICU admission, invasive mechanical ventilation and mortality. Secondary outcomes were hospital admission and whether or not patients tested positive for SARS-CoV-2 PCR.

Data Analysis

Data are summarized as numbers and frequencies for nominal data and means with standard deviations (SD), or medians with inter-quartile ranges (IQR), for continuous data. For all variables and models, we only used the initial findings at ED presentation. Comparisons between groups were performed using Chi-square or Fisher's exact test for categorical data and t-tests or Mann Whitney U tests for continuous data. Exploratory multivariate analysis of the primary and secondary outcomes was performed using potential predictor variables chosen based on biological plausibility and previous reports. Level of significance was defined as a P value of 0.05 or less. The rates of ICU admission, invasive mechanical ventilation, and death were calculated using the total number of hospital admissions as the denominator.

RESULTS

General Characteristics

Between March 12, 2020 and April 14 2020, our ED saw 4,404 PUI of which 3,003 (68%) were discharged home, 1,267 (29%) were admitted from the ED to a regular floor and 122 (3%) were admitted directly from the ED to an ICU; there were 12 deaths in the ED. Of all PUI, 558 were seen in the ambulatory care pavilion and 1,422 in the field tent.

Median (IQR) age of all PUI was 47 (33-60) years, 51% were male, 11% were healthcare workers, and 3.4% were under the age of 18 years. Co-morbidities included hypertension (25%), diabetes (13%), asthma (9%), coronary artery disease (8%), chronic obstructive pulmonary disease (4%), heart failure (3%), cancer (5%), immunosuppression (4%), chronic kidney disease (4%), previous smoking (2%) and current smoking (6%).

Most common symptoms were cough (72%), fever (63%), shortness of breath (43%, with sputum in 10.4%), myalgias (23%), fatigue (14%), and diarrhea (14%). Sick contacts were reported in 41% of PUI, and exposure to a confirmed case of COVID-19 in 28%. Of 2,606 chest X rays, 1,346 (52%) had an opacity, of which 1,010 (75%) were bilateral. Of 579 chest CTs, 374 (65%) have had an opacity, of which 299 (80%) were bilateral.

Of 1,267 patients initially admitted to a regular floor, 169 (13%) were upgraded to ICU care within a median (IQR) of 62 (28-106) hours. The number of PUI and non PUI ED visits over time is presented in Figure 1. Of all patients seen, 3,369 (76.5%) were tested for SARS-CoV-2. Of 2,897 SARS-CoV-2 tests available to date, 1651 (57%) were positive and 1,246 (43%) were negative. Invasive mechanical ventilation was required in 221 patients; 4 in the prehospital setting, 50 in the ED and 167 after admission within a median (IQR) 60 (26-99) hours. Of those

intubated, 42 have been extubated and discharged, 47 have been extubated and are still admitted, and 58 died in the hospital. The remaining are still intubated. Median (IQR) length of intubation for those already extubated or who died was 6 (2-10) days. Median (IQR) time on ventilator was 4.7 days (2.6-8.5) for those who died and 7.1 (3.4-9.8) days for the survivors. Between 3/12/2020-4/14/2020 there were 103 deaths, of which 72 tested positive for SARS-CoV-2. Overall mortality rate was 103/4,404 or 2.3% (95%CI, 1.9-2.8).

Of 3,003 PUI visits which resulted in discharge directly from the ED, 187 revisited our ED during the study period; 76 were admitted to a regular floor and 5 directly to the ICU. Thirteen of the admits required IMV and, of the 76 floor admits, 12 were later upgraded to an ICU. Currently, of the 81 admitted patients 42 have been discharged home and 1 died.

Group Comparisons.

Tables 1 summarizes patient characteristics and outcomes based on the results of their PCR tests. Of note, patients testing positive for SARS-CoV-2 were more likely to have abnormal findings and bilateral opacities on chest imaging than those testing negative. Table 2 compares patients requiring invasive mechanical ventilation and those not requiring invasive mechanical ventilation. Comparison of patients based on whether they were admitted to an ICU or not are presented in supplemental Table 1. The results of the exploratory multivariate analyses are presented in supplemental Table 2a. Multivariate predictors of testing positive for SARS-CoV-2 were exposure to COVID-19, cough, fever, being Hispanic, smoking history, and hypoxemia. Multivariate predictors of ICU admission or upgrades were testing positive for SARS-CoV-2 and hypoxemia. Multivariate predictors of invasive mechanical ventilation were testing positive for

SARS-CoV-2, male sex, hypoxemia, and increased respiratory rate. Multivariate predictors of death were testing positive for SARS-CoV-2, history of COPD, age, and hypoxemia.

Outcomes by age and sex

In general, outcomes were worse in men and older patients Table 3. A comparison of ICU admissions, invasive mechanical ventilation, and mortality are presented in Table 3.

LIMITATIONS

Our study has several notable limitations. Although data capture was often contemporaneous or within 24 hours of patient contact, it still is retrospective in nature and therefore subject to all of the limitations of this study design including selection bias, errors in data entry, and residual confounding. The data regarding the frequency of SARS-CoV-2 testing should be viewed with caution since criteria for testing changed frequently based on CDC and Department of Health recommendations and local resources such as test availability. In addition, due to limited sensitivity, many patients who tested negative for SARS-C0V-2 may have had COVID-19. Importantly, our predictive models are based on the initial presentation to the ED. Obviously, changes in vital signs, laboratory values, and imaging over time are critical in predicting outcomes. We and others at our center are looking into artificial intelligence and machine learning using time series to further improve on our predictions. Importantly, our regression models should be considered exploratory and may have resulted in over fitting. While we report the number of deaths to date, mortality and case fatality rates cannot be directly calculated until all patients are either discharged alive or die while in hospital. Finally, our results are also limited to a single hospital setting near the epicenter of the COVID-19 pandemic and may not be representative of other settings.

DISCUSSION

Our data show that the burden of COVID-19 goes well beyond just those who test positive for SARS-CoV-2. This is especially true since the results of SARS-CoV-2 testing are often only known hours or days after admission and since false negative results are common. Even though outcomes were generally worse in those with positive PCR tests, need for ICU level of care, mechanical ventilation, and mortality in PUI testing negative was still considerable. We also demonstrate how quickly the percentage of PUI testing positive for SARS-CoV-2 increases over time. Our most recent data indicate that of all current admissions from the ED, more than two thirds are PUI.

While many PUI can be discharged directly from the ED with a relatively small bounce back rate, a significant percentage of patients are admitted directly to an ICU or are later upgraded to an ICU within a median of 62 hours. There are also a significant number of PUI requiring invasive mechanical ventilation, with most being intubated a median of 60 hours after hospital arrival. Thus, for every 100 PUI admitted to the hospital, 9 will require immediate ICU and/or IMV and another 12 will require ICU and/or IMV within approximately 2-3 days. When intubated, the length of mechanical ventilation is considerable, further contributing to the healthcare burden. As expected, lower oxygen saturations and testing positive for SARS-CoV-2 were both associated with need for ICU, IMV, and mortality. Male sex and respiratory rate were associated with ICU admission while a history of COPD, and age were associated with mortality. Patients testing positive for SARS-CoV-2 were more likely to have a known exposure to COVID-19, cough, fever, be Hispanic, have a smoking history, and be hypoxemic. However,

the results of viral testing were often received after the patient had already been intubated, and cannot be relied on to dictate management.

We also show that extensive findings on chest imaging (bilateral opacities) are common among PUI both with and without viral confirmation, although more common in the former. Based on our data, and in an attempt to conserve resources and limit unnecessary contamination of our CT scanner, we have modified our indication for obtaining a CT of the chest. Patients with respiratory distress, hypoxia or significant risk with bilateral opacities on a plain CXR do not get a CT. If the CXR is negative but clinical suspicion remains high, particularly in the presence of hypoxemia, dyspnea on exertion, or shortness of breath, a CT scan of the chest is performed. Obviously, serial imaging may be required after the patient is admitted based on their clinical course. While most patients discharged from the ED do well, a small minority will revisit the ED, some even requiring subsequent admission, ICU care and ventilation. Thus, it is important to emphasize to all discharged patients to return immediately to the hospital if their condition worsens.

The risk factors we report appear to be somewhat similar to those found in China, Italy, Singapore, and Washington, USA. Increasing age and comorbidities have been associated with a greater need for supplemental oxygen therapy, ICU admission, mechanical ventilation, and mortality. [4, 12-20] A prior study found that a history of cardiovascular disease, particularly hypertension was commonly observed in severely ill COVID-19 patients.[19] Symptoms of fever and cough were also common in confirmed COVID-19 cases but not predictive of disease severity.[17] Mortality, when expressed as a percentage of PUI and or COVID-19 patients that die in our cohort is similar to larger studies in China (1.4-4.3%) but lower than that reported from

Italy and Washington State likely due to a younger population and larger cohort. [3-5,14] Both Sequential Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health Evaluation (APACHE) scores have been shown to be higher in non-survivors (4.5 and 18 respectively) compared to survivors (1 and 14 respectively) while Confusion Uremia Respiratory Blood Pressure (CURB-65) was not significantly different between these groups. [19, 20] The MuLBSTA Score offers an alternate means of risk stratification specific to viral pneumonia with risk factors of age and comorbidity weighted more heavily, consistent with the COVID-19 pandemic. [21]

Our study is one of the largest to date and included not only patients with confirmed COVID-19 but also other patients who are being considered as possible COVID-19 and who also contribute to the healthcare burden. These patients are often treated similarly to COVID-19 patients and must be taken into account to better understand the full scope of the pandemic. It is our sincere hope that this information will help inform other hospitals that are not yet at the epicenter of the pandemic on how best to anticipate and prepare for ICU beds and mechanical ventilators.

In conclusion, the healthcare burden of the COVID-19 pandemic goes way beyond patients who test positive for SARS-CoV-2. For every 100 PUI admitted to the hospital, 9 will require immediate ICU and/or IMV and another 12 will require ICU/IMV within 2-3 days, with a median length of mechanical ventilation nearing one week. In general, lower oxygen saturations, and testing positive for SARS-CoV-2 were associated with worse outcomes. This information should help hospitals anticipate needs for ICU beds and mechanical ventilators thus staying ahead of the pandemic curve.

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Table 1. Comparison of COVID-19 Positive and Negative Persons Under Investigation, N=2,897 Cases with Test Results Completed

``	ALL PUIs			ADMITTED PUIs		
	COVID19+	COVID19-	Difference (95% CI)	COVID19+	COVID19-	Difference (95% CI)
DEMOGRAPHICS						
No. Patients	1651	1246		737	392	
Mean (SD) Age	50 (18)	47 (20)	3 (2 - 5)	60 (18)	62 (21)	2 (-4 – 1)
No. (%) Male	892 (54)	594 (48)	6 (3 - 10)	423 (57)	209 (53)	4 (-2 – 10)
No. (%)White	695 (42)	797 (64)	-22 (-25 - -18)	353 (48)	284 (72)	-25 (-30 - -19)
No. (%) African-American	114 (7)	97 (8)	-1 (3 – 1)	48 (7)	23 (6)	1 (-2 – 4)
No. (%) Asian	55 (3)	70 (6)	-2 (-4 - -1)	31 (4)	15 (4)	0.4 (-2 – 3)
No. (%) other	14 (1)	9 (1)	0 (-1 - 1)	8 (1)	2 (1)	0.6 (-1 – 2)
No. (%) unknown	773 (47)	273 (22)	25 (21 - 28)	297 (40)	68 (17)	23 (17-29)
No. (%) Hispanic	607 (37)	210 (17)	20 (17 - 23_	197 (27)	50 (13)	14 (9-19)
No. (%) Sick contact	745 (45)	544 (44)	1 (-2 - 5)	239 (33)	45 (12)	21 (16-26)
No.(%) COVID-19 contacts	533 (32)	387 (31)	1 (-2 - 5)	124 (17)	19 (5)	12 (8-16)
No. (%) HCW	136 (8)	259 (21)	-13 (-15 - -10)	18 (2)	6 (2)	0.9 (-0.01 - 3)
No. (%) Nursing home	113 (7)	58 (5)	1 (0.5 – 4)	107 (15)	57 (15)	0 (-4 – 4)
COMORBIDITIES, No. (%)						
HTN	461 (28)	307 (25)	3 (2 - 7)	341 (46)	201 (51)	-5 (-11 - 1)
DM	254 (15)	123 (10)	6 (3 - 8)	196 (27)	90 (23)	4 (-2 – 9)
Asthma	106 (6)	142 (11)	-5 (-7 - -3)	48 (7)	39 (10)	-3 (-7 - -.01)
CAD	122 (7)	126 (10)	-3 (-5 - -1)	102 (14)	97 (25)	-11 (-16 - -6_
COPD	59 (4)	69 (6)	-2 (-4 - -0.4)	54 (7)	57 (15)	-7 (-11 - -4)
CHF	44 (3)	63 (5)	-2 (-4 - -1)	39 (5)	59 (15)	-10 (-13 - -6)
Cancer	66 (4)	90 (7)	-3 (-5 - -2)	49 (7)	66 (17)	-10 (-14 - -7)
Immunosuppressed	66 (4)	73 (6)	-2 (-4 - -.02)	49 (7)	43 (11)	-4 (-8 - -1)
CKD	75 (5)	58 (5)	-0.1 (-2 - 2	67 (9)	50 (13)	-4 (-7 - 0)
SYMPTOMS, No. (%)						
Fever	1231 (75)	635 (51)	24 (20-27)	540 (73)	176 (45)	28 (23 - 34)
Cough	1290 (78)	837 (67)	11 (8 - 14)	544 (74)	177 (45)	29 (23 - 34)
Shortness of breath	748 (45)	439 (35)	10(7 - 14)	506 (69)	202 (52)	17 (11 - 23)
Fatigue	231 (14)	162 (13)	1 (-2 – 4)	163 (22)	72 (18)	4 (-1 – 9)
Nausea/vomiting	212 (13)	116 (9)	4 (1 - 6)	139 (19)	63 (16)	3 (-2 – 8)
Diarrhea	362 (22)	153 (12)	10 (7 - 12)	168 (23)	48 (12)	11 (6 - 15)
VITAL SIGNS						
Heart rate/min.	99 (55)	110 (406)	11 (-31 – 9)	101 (54)	124 (500)	-23 (-60 – 13)
Respiratory rate/min.	20 (6)	19 (12)	0.4 (-0.2 – 1)	22 (7)	23 (19)	-0.3 (-2 – 1)

Systolic blood pressure, mmHg	132 (22)	136 (24)	-4 (-6 - -3)	128 (25)	132 (30)	-3 (-7 - -9)
Temperature Celsius	37.4 (1.2)	37.1(2.1)	0.4 (0.3 - 0.5)	37.6 (1.6)	37.2 (3.2)	0.4 (0.1 – 0.7)
Pulse oximetry (%)	95.3 (5.5)	97.2 (2.9)	-1.9 (-2.2 - -1.5)	93 (7)	95 (4)	-3 (-4 - -2)
IMAGING, No. (%)						
None ordered	689 (42)	594 (48)	-6 (-10 - -2)	11 (1)	17 (4)	-3 (-5 - -1)
Chest X Ray ordered	944 (57)	634 (51)	6 (3 - 10)	710 (96)	360 (92)	4 (2 - 7)
Opacity(ies) on CXR	701 (74)	198 (31)	43 (39 - 48)	608 (86)	168 (47)	39 (34 - 44)
Bilateral findings	569 (81)	112 (57)	25 (18 - 31)	498 (82)	100 (60)	23 (16 - 30)
Chest CT ordered	227 (14)	212 (17)	-3 (-6 - -1)	211 (29)	188 (48)	-19 (-25 - -14)
Opacity(ies)	201 (89)	98 (46)	42 (35 - 50)	190 (90)	94 (50)	40 (32 - 48)
Bilateral findings	179 (89)	63 (65)	24 (15 - 33)	169 (89)	62 (67)	22 (13 - 32)
LABS, MEAN (SD) [n]						
Leukocytes (SD) $x10^3$	8.0 (5.2) [809]	11.4 (11.4) [457]	-3.5 (-4.4 - -2.5)	8.1 (5.3) [728]	12.0 (12.4) [376]	-3.8 (-4.9 - -2.8)
% Lymphocytes (SD)	15.6 (10.2) [797]	17.1 (12.5) [436]	-1.5 (-2.8 - -0.1)	15.0 (9.9) [719]	15.7 (12.5) [360]	-0.8 (-2.1 – 0.6)
ALT, units/L	44 (51) [785]	37 (77) [406]	7 (-0.3 – 14)	43 (48) [718]	39 (82) [356]	5 (-3 – 13)
LDH, units/L	390 (188) [744]	285 (197) [320]	105 (80 - 130)	395 (184) [701]	288 (203 [299])	107 (81 - 133)
CRP, mg/Dl	10.5 (9.2) [748]	7.0 (8.7) [335]	3.5 (2.4 - 4.7)	10.9 (9.2) [707]	7.2 (8.6) [313]	3.7 (2.5 - 4.9)
Ferritin, pg/ml	1161 (1487) [676]	612 (976) [219]	549 (338 - 759)	1158 (1470) [659]	615 (983) [214]	543 (332 - 754)
Procalcitonin, pg/ml	1.2 (8.8) [747]	2.3 (11.8) [328]	-1.1 (-2.3 – 0.2)	1.2 (9.0) [711]	2.4 (12.1) [309]	-1.2 (-2.5 – 0.2)
Troponin ng/ml	0.04 (0.14) [666]	0.05 (0.20) [331]	-0.2 (-0.4 – 0.004)	0.04 (0.14) [625]	0.06 (0.22) [291]	-.02 (-.05 - .002)
BNP, pg/ml	2608 (10527) [525]	7094 (31061) [244]	-4486 (-7457 - -1516)	2674 (10715) [502]	7582 (32412) [223]	-4908 (-8076 - -1740)
D dimer, mg/L	1021 (3891) [705]	1738 (6738) [248]	-717 (-1412 - 173)	1025 (3932) [675]	1918 (7119) [221]	-893 (-1640 - -146)
ED DISPOSITION, No. (%)						
Discharge	908 (55)	852 (68)	-13 (-17 - -10)	-	-	-
Regular Floor	678 (41)	349 (28)	13 (10 – 17)	678 (92)	348 (89)	3 (-.3 – 7)
ICU admits	59 (4)	44 (4)	0 (-1 – 1)	59 (8)	44 (11)	-3 (-7 – .3)
Died in ED	6 (0.4)	2 (0.2)	0.2 (-0.2 – 0.6)	-	-	-
Invasive ventilation, No. (%)	152 (10) [1491]	32 (3) [1194]	7 (6 - 9)	149 (26) [577]	31 (9) [340]	17 (12 - 22)
Mean (SD) length of ventilation, days	7.2 (4.4)	3.7 (3.4)	3.5 (1.6 – 5.4)	7.4 (4.3)	3.9 (3.4)	3.6 (1.7 - 5.5)
Non-invasive ventilation, No. (%)	41 (2)	21 (2)	.8 (-.3 – 1.9)	40 (5)	20 (5)	0 (-2 – 3)
Mean (SD) hospital LOS, days	1.4 (2.7)	1.1 (2.2)	0.4 (0.2 - 0.6)	4.7 (3.0)	3.9 (2.7)	0.8 (0.3 - 1.2)
Mortality (%)	74 (4.5)	22 (1.7)	3 (1 - 4)	68 (9)	20 (5)	4 (1 - 7)

SD: standard deviation, HCW: healthcare workers, HTN: hypertension, DM: diabetes mellitus, CAD: coronary artery disease, CHF: congestive heart failure, COPD: chronic obstructive pulmonary disease, LDH: lactate dehydrogenase, ALT: alanine aminotransferase, CRP: C-reactive protein.

Table 2. Comparison of Mechanically Ventilated and Non-Ventilated Persons Under Investigation.

	Admitted Persons under investigation		
	Invasive mechanical ventilation	**No invasive mechanical ventilation**	
DEMOGRAPHICS			
No. Patients*	215	875	
Mean (SD) Age	60 (15)	59 (20)	1 (-2 – 3)
No. (%) Male	145 (67)	481 (55)	12 (5 - 20)
No. (%)White	100 (47)	633 (61)	-26 (-33 - -19)
No. (%) African-American	12 (6)	61 (7)	-1 (5 – 2)
No. (%) Asian	18 (8)	28 (3)	5 (2 - 8)
No. (%) other	2 (1)	8 (1)	0 (-1 – 1)
No. (%) unknown	83 (39)	245 (28)	4 (-2 – 10)
No. (%) Hispanic	59 (27)	179 (21)	7 (1 - 13)
No. (%) Sick contact	63 (30)	203 (23)	6 (0 - 13)
No.(%) COVID contacts	38 (18)	106 (12)	6 (1 - 11)
No. (%) HCW	5 (2)	29 (3)	-1 (-4 – 2)
No. (%) Nursing home	18 (8)	126 (14)	-6 (-11 - -1)
COMORBIDITIES, No. (%)			
HTN	100 (47)	374 (43)	4 (-4 - 11)
DM	58 (27)	203 (23)	4 (-3 – 10)
Asthma	18 (8)	72 (8)	0 (-4 - 4)
CAD	32 (15)	146 (17)	-2 (-7 - 4)
COPD	20 (9)	87 (10)	-1 (-5 - 4)
CHF	14 (7)	76 (9)	-2 (-6 - 2)
Cancer	10 (5)	84 (10)	-5 (-9 - -1)
immunosuppressed	13 (6)	69 (8)	-2 (-6 – 2)
CKD	19 (9)	80 (9)	0 (-5 – 4)
SYMPTOMS, No. (%)			
Fever	152 (71)	560 (64)	7 (0 - 14)
Cough	145 (67)	572 (65)	2 (-5 – 9)
Shortness of breath	166 (77)	551 (63)	14 (7 - 21)
Fatigue	43 (20)	189 (22)	-2(-8 - 5)
Nausea/vomiting	33 (15)	167 (19)	-4 (-10 – 2)
Diarrhea	38 (18)	162 (19)	-1 (-7 – 5)
VITAL SIGNS			
Heart rate/min.	108 (85)	110 (333)	-2 (-48 – 43)
Respiratory rate/min.	25 (9)	22 (14)	3 (1 - 5)
Systolic blood pressure,	127 (26)	130 (26)	-3 (-7 – 1)

mmHg			
Temperature Celsius	37.7 (1.0)	37.4 (1.5)	0.3 (0.1 – 0.5)
Pulse oximetry (%)	90 (9)	95 (4)	-5 (-6 - -4)
IMAGING, No. (%)			
None ordered	1 (0.5)	29 (3)	-3 (-5 – 0)
Chest X Ray ordered	211 (98)	811 (93)	5 (2 - 9)
Opacity(ies) on CXR	184 (87)	560 (69)	18 (13 - 24)
Bilateral findings	160 (87)	414 (74)	13 (6 - 20)
Chest CT ordered	57 (27)	333 (38)	-11 (-19 - -4)
Opacity(ies)	48 (84)	231 (69)	15 (2 - 28)
Bilateral findings	44 (94)	181 (78)	15 (3 - 28)
LABS, MEAN (SD) [n]			
Leukocytes (SD) $x10^3$	9.6 (7.6) [211]	8.9 (6.8) [849]	0.7 (-0.4 – 1.7)
Lymphocytes (SD) $x10^3$	12.9 (8.8) [205]	16.6 (11.7) [832]	-3.7 (-.4 - -2.0)
ALT, units/L	56 (98) [211]	38 (41) [819]	18 (9 - 27)
LDH, units/L	495 (225) [201]	326 (172) [736]	169 (140 -198)
CRP, mg/dL	14.7 (10.4) [206]	8.1 (7.9) [751]	6.6 (5.3 - 7.9)
Ferritin, pg/ml	1459 (1504) [199]	841 (1194) [596]	618 (412 - 823)
Procalcitonin, pg/ml	2.6 (12.7) [208]	1.2 (9.2) [751]	1.4 (-0.2 - 2.9)
Troponin ng/ml	0.05 (0.16) [202]	0.03 (0.09) [662]	0.02 (-.002 – 0.03)
BNP, pg/ml	3566 (14783) [172]	3603 (19452) [492]	-37 (-3230 – 3157)
D dimer, mg/L	1475 (3346) [195]	1102 (5167) [626]	373 (-400 – 1145)
Non-invasive ventilation, No. (%)	29 (13)	19 (2)	11 (8 - 14)
Mean (SD) hospital LOS, days	6.5 (4.2)	4.1 (2.7)	2.4 (1.5 - 3.2)
Mortality	50 (23)	44 (5)	18 (14 - 22)

*based on patients who were vented or were discharged without being vented
SD: standard deviation, HCW: healthcare workers, HTN: hypertension, DM: diabetes mellitus, CAD: coronary artery disease, CHF: congestive heart failure, COPD: chronic obstructive pulmonary disease, LDH: lactate dehydrogenase, ALT: alanine aminotransferase, CRP: C-reactive protein.

Table 3. Outcomes for admitted patients by age and sex.

	No. (%) ICU admissions	No. (%) Invasive mechanical ventilation*	No. (%) Deaths
Age (years)			
<25	11 (19)	3 (6)	0 (0)
25-45	45 (20)	34 (17)	3 (1)
46-65	118 (22)	94 (22)	18 (3)
66-80	83 (24)	67 (25)	33 (9)
>80	33 (15)	17 (10)	41 (19)
Sex			
Male	186 (23)	145 (23)	42 (7)
Female	105 (18)	70 (15)	53 (7)

***based on patients who were mechanically ventilated or were discharged without being ventilated, n=1090**

Figure 1. Temporal variation in ED visits (upper left), admissions to a regular floor (upper right) , admissions from the ED to the ICU (bottom left), and total number of invasive mechanical ventilations from the ED and previously admitted patients (bottom right). PUI: persons under investigation.

SUPPLEMENTAL TABLES

Table 1a. Comparison of ICU and Non-ICU Admitted Persons Under Investigation

	ADMITTED PUIs		
	ANY ICU	**NO ICU**	**Difference (95%CI)**
DEMOGRAPHICS			
No. Patients	291	1098	
Mean (SD) Age	59 (18)	60 (20)	-1 (-4 – 1)
No. (%) Male	186 (64)	609 (55)	8 (2 - 15)
No. (%)White	150 (52)	642 (59)	-7 (-13 - -1)
No. (%) African-American	15 (5)	77 (7)	-2 (-5 – 1)
No. (%) Asian	22 (8)	32 (3)	5 (2 - 7)
No. (%) other	2 (1)	9 (1)	0 (-1 - 1)
No. (%) unknown	102 (35)	338 (31)	4 (-2 – 10)
No. (%) Hispanic	67 (23)	234 (21)	2 (-4 – 7)
No. (%) Sick contact	77 (27)	270 (25)	2 (-4 – 7)
No.(%) COVID contacts	48 (17)	141 (13)	4 (-1 – 8)
No. (%) HCW	7 (2)	29 (3)	0 (-2 – 2)
No. (%) Nursing home	28 (10)	162 (15)	-5 (-10 - -1)
COMORBIDITIES, NO. (%)			
HTN	138 (47)	505 (46)	1 (-5 – 8)
DM	90 (31)	251 (23)	8 (3 – 14)
Asthma	21 (7)	84 (8)	0 (-4 – 3)
CAD	45 (16)	189 (17)	-2 (-7 – 3)
COPD	21 (7)	108 (10)	-3 (-6 – 1)
CHF	21 (7)	89 (8)	-1 (-4 – 3)
Cancer	20 (7)	120 (11)	-4 (-8 – 0)
immunosuppressed	18 (6)	92 (8)	-2 (-6 – 1)
CKD	26 (9)	106 (10)	-1 (-5 – 3)
SYMPTOMS, NO. (%)			
Fever	186 (64)	73 (64)	0 (-6 – 6)
Cough	179 (62)	713 (65)	-3 (-10 – 3)
Shortness of breath	203 (70)	692 (63)	7 (1 - 13)
Fatigue	61 (21)	236 (22)	-1 (-6 – 5)
Nausea/vomiting	44 (15)	220 (20)	-5 (-1 – 0)
Diarrhea	50 (17)	232 (21)	-4 (-9 – 1)
VITAL SIGNS			
Heart rate/min.	141 (579)	99 (29)	42 (7 – 77)
Respiratory rate/min.	27 (22)	22 (8)	5 (3 - 6)
Systolic blood pressure, mmHg	127 (29)	130 (25)	-3 (-6 – 1)

Temperature Celsius	37.5 (1.0)	37.5 (2.3)	0.1 (-0.1 – 0.2)
Oxygen stauration (%)	91 (9)	94 (5)	-4 (-5 - -2)
IMAGING, NO. (%)			
None ordered	6 (2)	30 (3)	-1 (-3 – 1)
Chest X Ray ordered	283 (97)	1032 (94)	3 (-9 – 3)
Opacity(ies) on CXR	234 (83)	745 (72)	11 (5 - 16)
Bilateral findings	200 (86)	567 (76)	9 (3 - 15)
Chest CT ordered	88 (30)	367 (33)	-3 (-9 – 3)
Opacity(ies)	67 (76)	261 (71)	5 (6 - 16)
Bilateral findings	60 (91)	205 (79)	12 (2 - 23)
LABS, MEAN (SD) [n]			
Leukocytes (SD) $x10^3$	9.9 (7.2) [285]	9.1 (8.6) [1063]	0.9 (-0.2 - 2.0)
% Lymphocytes (SD)	13.2 (9.2) [277]	15.8 (11.3) [1041]	-2.6 (-4.1 - -1.2)
ALT, units/L	50 (87) [282]	43 (101) [1032]	7 (-6 – 20)
LDH, units/L	461 (222) [268]	345 (177) [949]	117 (91 - 142)
CRP, mg/dL	14.0 (10.7) [273]	9.0 (8.5) [964]	5 (4 - 6)
Ferritin, pg/ml	1342 (1401) [257]	955 (1350) [816]	387 (196 - 578)
Procalcitonin, pg/ml	3.6 (17.6) [275]	0.9 (5.3) [963]	2.7 (1.5 - 4.0)
Troponin ng/ml	0.04 (0.14) [263]	0.04 (0.16) [856]	.01 (-.02 - .03)
BNP, pg/ml	4138 (15748) [217]	3455 (19115) [672]	682 (-2130 - 3495)
D dimer, mg/L	1544 (4238) [254]	1248 (5317) [845]	296 (-419 – 1010)
Mean (SD) length of ventilation, hours	6.6 (4.3)	5.3 (5.4)	1.3 (-3.7 – 6.3)
Non-invasive ventilation, No. (%)	38 (13)	28 (3)	10 (8 - 13)
Mean (SD) hospital LOS, days	5.9 (3.7)	4.1 (2.8)	1.8 (0.9 - 2.6)
Mortality	54 (19)	41 (4)	15 (12 - 18)

SD: standard deviation, HCW: healthcare workers, HTN: hypertension, DM: diabetes mellitus, CAD: coronary artery disease, CHF: congestive heart failure, COPD: chronic obstructive pulmonary disease, LDH: lactate dehydrogenase, ALT: alanine aminotransferase, CRP: C-reactive protein.

Table 2a. Exploratory Multivariate Predictor Variables.

	OR	95% CI
COVID19+, Admitted Patients		
Male	0.98	0.73-1.3
Age (per year)	1.003	0.995-1.012
Hispanic	1.90	1.28-2.83
Smoking history	1.68	1.35-2.10
Exposure to COVID	3.05	1.78-5.22
Fever	2.25	1.65-3.07
Cough	2.52	1.82-3.49
Shortness of breath	1.09	0.80-1.50
Fatigue	1.30	0.91-1.87
Temperature	1.02	0.96-1.09
O2, per 1% decrease	1.11	1.07-1.15
ICU Admission or Upgrade, Admitted Patients		
Male	1.36	0.99-1.88
Age, per year	1.00	0.99-1.01
Hx of COPD	0.85	048-1.52
Hx of CHF	0.90	0.48-1.71
Hx of CKD	1.11	0.66-1.88
Fever	0.95	0.66-1.37
Cough	0.80	0.55-1.17
Shortness of breath	1.08	0.75-1.56
COVID+	1.57	1.07-2.30
Temperature	0.99	0.92-1.07
O2, per 1% decrease	1.09	1.06-1.12
Invasive Mechanical Ventilation, Admitted Patients		
Male	1.71	1.16-2.51
Age, per year	0.999	0.989-1.010
Fever	1.28	0.82-1,99
Cough	0.87	0.55-1.25
Shortness of breath	1.19	0.77-1.84
Smoking history	0.91	0.66-1.24
HX of asthma	1.42	0.73-2.75
Hx of COPD	1.09	0.58-2.07
COVID+	2.75	1.69-4.47
Respiratory rate	1.01	1.00-1.02
O2, per 1% decrease	1.13	1.09-1.7
Mortality, Admitted Patients		
Male	1.15	0.69-1.93
Age, per year	1.07	1.05-1.09

Hx of COPD	2.49	1.33-4.67
Hx of cancer	0.74	0.32-1.66
COVID+	2.88	1.53-5.45
O2, per 1% decrease	1.05	1.02-1.08
Temperature	0.97	0.86-1.10