Management and Outcome of COVID-19 Positive and Negative Patients in French Emergency Departments During the First COVID-19 Outbreak: A Prospective Controlled Cohort Study

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Introduction: Few studies have investigated the management of COVID-19 cases from the operational perspective of the emergency department (ED). We sought to compare the management and outcome of COVID-19 positive and negative patients who presented to French EDs.

Methods: We conducted a prospective, multicenter, observational study in four EDs. Included in the study were adult patients (≥18 years) between March 6–May 10, 2020, who were hospitalized, and whose presenting symptoms were evocative of COVID-19. We compared the clinical features, management, and prognosis of patients according to their confirmed COVID-19 status.

Results: Of the 2,686 patients included in this study, 760 (28.3%) were COVID-19 positive. Among them, 364 (48.0%) had hypertension, 228 (30.0%) had chronic cardiac disease, 186 (24.5%) had diabetes, 126 (16.6%) were obese, and 114 (15.0%) had chronic respiratory disease. The proportion of patients admitted to intensive care units (ICU) was higher among COVID-19 positive patients (185/760, 24.3%) compared to COVID-19 negative patients (206/1,926, 10.7%; P <0.001), and they required mechanical ventilation (89, 11.9% vs 37, 1.9%; P <0.001) and high-flow nasal cannula oxygen therapy (135, 18.1% vs 41, 2.2%; P <0.001) more frequently. The in-hospital mortality was significantly higher among COVID-19 positive patients (139, 18.3% vs 149, 7.7%; P <0.001).

Conclusion: Emergency departments were on the frontline during the COVID-19 pandemic and had to manage potential COVID-19 patients. Understanding what happened in the ED during this first outbreak is crucial to underline the importance of flexible organizations that can quickly adapt the bed capacities to the incoming flow of COVID-19 positive patients. [West J Emerg Med. 2022;23(6)897–906.]
INTRODUCTION
The coronavirus disease 2019 (COVID-19) pandemic was declared on March 11, 2020, by the World Health Organization. From December 31, 2019–January 2021, 98,280,844 cases were confirmed worldwide, among which 32,848,998 were in Europe. France was one of the countries most impacted by the COVID-19 pandemic, with 3,130,629 confirmed cases and 74,800 deaths during this period. The first outbreak started in France at the beginning of March 2020, and containment was officially established from March 17–May 11, 2020.

French emergency departments (ED) were on the frontline during the COVID-19 outbreak and oversaw patient triage, based on COVID-19 suspicion, as they were in other countries. The role of the ED in patient triage was crucial to contain and isolate the suspected COVID-19 cases. The need for a dynamic in patient flow processing has been highlighted, and several hospital emergency management plans have been proposed, including a before-admission triage center. Several studies have focused on the outcomes of ED patients during the COVID-19 pandemic, but few have investigated the management of COVID-19 cases from the perspective of EDs. However, the need to understand how to manage these patients in EDs is necessary to avoid crowding, guarantee the safety of healthcare workers, anticipate the future need for beds and staff members, and to be able to continue caring for non-COVID-19 patients.

As the number of COVID-19 cases was rapidly increasing in France at the beginning of March 2020 we set up the COVID-ER cohort study. Our goal was to provide an exhaustive description over time of the management and outcome of patients exposing to French ED for COVID-19 suspicion from March-May 2020 and to determine whether they were different depending on the patients’ COVID-19 status. We describe the characteristics associated with COVID-19 diagnosis confirmation and prognosis, including admission to the intensive care unit (ICU) and all-cause mortality.

METHODS
Study Design and Setting
We conducted a multicenter prospective observational cohort study March 6–May 10, 2020 in four French EDs within three university hospitals (Hôpital Edouard Herriot, Centre Hospitalier Lyon Sud, and Hôpital de la Croix-Rousse) and one general hospital (Hôpital de Villefranche) in and around Lyon. The Lyon urban area is the second largest in France with a population of 1.6 million. The three university EDs are in urban hospitals: two of them receive more than 40,000 ED visits per year, while the third has 80,000 visits annually. The ED of the general hospital is suburban and has 50,000 ED visits per year. This study complied with the Declaration of Helsinki, and was approved by both the institutional ethics committee of the Hospices Civils of Lyon (number [n°] 20-47) and the Comission Nationale de l’Informatique et des Libertés (CNIL, French commission for data protection; n° 20-090), as required by French law. This paper complies with the STROBE guidelines for reporting observational studies. Per French legislation, only oral consent was required. This was approved by the ethics committee of the Hospices Civils of Lyon (20-47) and the CNIL (n° 20-090). All patients were informed that their data was being collected as part of the COVID-ER study via written notice and had the opportunity to object to the collection of their information.

Selection of Participants
We included in the study all adult patients (≥18 years) presenting to the ED for suspected COVID-19 (with symptoms evocative of severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2]) infection and requiring hospitalization. We classified the clinical presentation of suspected COVID-19 patients according to their level of severity: level 1 represented the most critical patients, who were initially managed in the ED and then admitted to the ICU for intubation; levels 2 and 3 were managed in the ED. Level 4 cases met none of the criteria for severity when compared to levels 1-3; hence, they were not managed in the ED and were sent home with medical advice (Supplementary Figure S1). Healthcare workers who were infected did not go to work and were managed by the occupational health service of each hospital.
hospital. However, if they were in respiratory distress, they
could present to the ED.

We excluded patients without symptoms of SARS-CoV-2
infection, as well as patients with another confirmed infectious
diagnosis in the ED such as intra-abdominal, skin and soft tissue
infection, or genitil and urinary tract infection, and those with
suspected meningitis. Also excluded were COVID-19-suspected
patients who did not require hospitalization and were sent home
without testing, due to the limited availability of SARS-CoV-
2-specific reverse transcriptase polymerase chain reaction (RT-
PCR) tests in France at the time of the study.

Patients were tested for SARS-CoV-2 infection using
RT-PCR on respiratory samples. The RT-PCR assays were
performed using the RdRp IP2-IP4 primers and probes
per Institut Pasteur protocol, which is used in France for
SARS-CoV-2 detection. This protocol, detecting two targets
in the RdRp gene, was adapted on the Panther Fusion
molecular system for high throughput diagnostics (Holologic
Inc, Marlborough, MA). A confirmed case of COVID-19
was defined as a SARS-CoV-2-specific positive RT-PCR
test. In cases of multiple sampling during hospitalization,
we classified the final virological diagnostic as positive if
one of the samples had tested positive. We compared
the management and outcome between COVID-19 positive and
negative patients among the population included.

Data Collection and Processing

We collected the following data for each patient from
electronic health records: demographic characteristics
(age, gender, place of residence, functional independence,
healthcare worker status); and clinical characteristics
(symptoms and vital signs at ED admission, size, weight,
chronic underlying comorbidities, smoking status). The
chronic underlying diseases considered were as follows:
hypertension; diabetes; clinical heart failure (NYHA
functional class III or IV); obesity (body mass index
[BMI]≥30 kilograms per meter squared); chronic respiratory
disease defined as chronic restrictive or obstructive pulmonary
disease; chronic kidney disease (glomerular filtration rate <90
milliliters per minute); chronic neurological disorder; chronic
hematological disease; immunosuppression; transplant;
cirrhosis; dementia (if it had been documented by a Mini-
Mental State Examination score under 24); malignancy
(defined as current malignancy with or without metastasis);
psychosis; and human immunodeficiency virus infection. We
also collected laboratory findings (other viral and bacterial
infection) and radiology findings (chest computed tomography
[CT]). A CT was considered positive for COVID-19 if there
were features evocative of COVID-19: ground-glass opacity;
crazy-paving pattern; sub-pleural bands of consolidations,
reversed halo sign; and lung consolidations.

We collected the vital signs recorded in the ED and
during hospitalization for the whole cohort. We also collected
patient management data: admission from the ED to the ICU
or conventional hospitalization, secondary admission from
conventional hospitalization to the ICU; ventilation support;
decision to withhold or withdraw life-sustaining treatments;
and re-hospitalization within 30 days after discharge.

Primary Data Analysis

Continuous variables were expressed as mean ±
SD, or median (interquartile range [IQR]) for duration, and
categorical variables as count (percentage). We compared
the characteristics of COVID-19 positive and COVID-19
negative patients using chi square and Fisher’s exact tests,
or the Wilcoxon rank-sum test. Comparisons of outcomes
between the COVID-19 positive and COVID-19 negative
groups were performed using logistic regression for binary
outcomes and using linear regression with logarithmic
transformation for delays.

We performed multivariate analyses to take into account
putative confounding factors. Adjustments were performed
on factors that displayed the greatest imbalance between
COVID-19 positive and negative patients, except factors
related to the condition at admission, and that were associated
with most of the different outcomes in univariate analyses.
The effect of COVID-19 status on the outcomes was adjusted
for age, gender, BMI, smoking status, loss of autonomy
(correlated with the place of residence), chronic respiratory
disease, malignancy, bacterial infection, and oxygen
requirement. The viral infection status was not included
in multivariate analyses due to multicolinearities. Unless
specified otherwise, the P-values reported corresponded to
the ones of multivariate analyses. P-values were considered
significant below 0.05. We performed analyses using R,
version 3.6.1. (R Core Team [2019], Vienna, Austria, https://
www.R-project.org/).

RESULTS

From March 6–May 10, 2020, 20,341 patients presented
to the participating EDs, of whom 7,199 (35.4%) were
hospitalized and 2,789 were suspected of SARS-CoV-2
infection. A total of 2,686 patients were eventually included
in our study (1,926 COVID-19 positive patients and 760
COVID-19 negative patients (Figure 1).

Patient Characteristics According to COVID-19 Status

The mean ± SD age of COVID-19 positive patients was
71.5 ± 16.5 years, of whom 618 (81.6%) presented from
home and 119 (15.7%) from long-term care facilities. A total of 395 (52.1%)
COVID-19 positive patients were referred
by emergency medical services. Hypertension was present
in 364 (48.0%) COVID-19 positive patients; chronic cardiac
disease in 228 (30.0%); diabetes in 186 (24.5%); obesity in
126 (16.6%); and chronic respiratory disease in 114 (15.0%)
(Table 1).

Oxygen was required upon arrival at the EDs for 179
(23.6%) COVID-19 positive patients, and for 134 (18.3%)
COVID-19 negative patients. A total of 215 (30.6%) COVID-19 positive patients presented to the EDs more than seven days after symptom onset while 315 (19.0%) COVID-19 negative patients did, and 105 (15.0%) COVID-19 positive patients presented during the first 24 hours after symptom onset (while 613 (36.9%) COVID-19 negative patients did). Fever was encountered in 536 (70.5%) COVID-19 positive patients, dyspnea in 494 (65.0%), cough in 420 (55.3%), weakness in 399 (52.5%), and anosmia in 51 (6.7%). Bacterial infection was found in 57 (9.3%) COVID-19 positive patients and co-viral infection in eight (2.5%). A total of 454 (59.7%) COVID-19 positive patients had a CT evocative of COVID-19, while 237 (12.3%) COVID-19 negative patients did (Table 1).

ICU Admission and Ventilation Support
A total of 185 (24.3%) COVID-19 positive patients were admitted to the ICU while 206 (10.7%) COVID-19 negative patients were admitted (odds ratio [OR] 2.24 [1.57; 3.20]; P < 0.001). The proportion of patients secondarily admitted to the ICU was also higher among COVID-19 positive patients compared to COVID-19 negative patients (OR 5.90 [3.47; 10.24]; P < 0.001). Invasive mechanical ventilation and high-flow nasal cannula oxygen therapy were more often used for COVID-19 positive than negative patients (OR 6.82 [3.87, 12.42]; P < 0.001, and OR 10.08 [5.89, 17.87]; P < 0.001, respectively (Table 2).

Conventional Hospitalization
The number of conventional hospitalizations was higher among COVID-19 negative patients compared to COVID-19 positive patients (P = 0.036; Table 2). Among the 673 COVID-19 positive patients who were conventionally hospitalized, 53 (7.9%) were discharged early (<48 hours) from the hospital, while 408 (23.9%) COVID-19 negative patients were discharged early (Figure 2).

Mortality and Decisions to Withhold or Withdraw Life-sustaining Treatments
Mortality during hospitalization was significantly higher among COVID-19 positive patients compared to COVID-19 negative patients (OR 3.33, [2.02, 5.50]; P < 0.001). Among the 185 COVID-19 positive patients who were admitted to the ICU, 46 (24.9%) died, compared to 32/206 (15.6%) ICU-admitted COVID-19-negative patients. Among the 673 COVID-19 positive patients who were conventionally hospitalized, 92 (9.7%) died, compared to 109/1,756 (6.2%) COVID-19 negative patients (Table 2). Only one (0.1%) COVID-19 positive patient compared to eight (0.4%) COVID-19 negative patients died in the ED (Figure 2). The number of decisions to withhold or withdraw life-sustaining treatments was higher during hospitalization concerning COVID-19 positive patients than COVID-19 negative patients (OR 2.08 [1.31, 3.28]; P = 0.002), and there was no significant difference in EDs (OR 1.81 [0.85, 3.72], P = 0.113 (Table 2).
Table 1. Clinical, radiological, and laboratory characteristics of patients according to their COVID-19 status.

| Characteristics                          | COVID-19 negative patients (n = 1,926, 71.7%) | COVID-19 positive patients (n = 760, 28.3%) | P       |
|------------------------------------------|-----------------------------------------------|---------------------------------------------|---------|
| Age (years)                              | 70.8 ± 18.6                                   | 71.5 ± 16.5                                 | 0.731   |
| Female gender                            | 976 (50.7%)                                   | 330 (43.4%)                                 | <0.001  |
| Living place (n = 2,653)                 |                                               |                                             | 0.014   |
| Home                                     | 1,579 (83.3%)                                 | 618 (81.6%)                                 |         |
| Long-term care facilities                | 226 (11.9%)                                   | 119 (15.7%)                                 |         |
| Other hospital                           | 54 (2.8%)                                      | 11 (1.5%)                                   |         |
| Homeless                                 | 6 (0.3%)                                       | 1 (0.1%)                                    |         |
| Other                                    | 31 (1.6%)                                      | 8 (1.1%)                                    |         |
| Referred to ED by (n = 2,648)            |                                               |                                             | <0.001  |
| Emergency medical services               | 853 (45.1%)                                   | 395 (52.1%)                                 |         |
| General practitioners                    | 497 (26.3%)                                   | 201 (26.5%)                                 |         |
| Individual decision                      | 295 (15.6%)                                   | 86 (11.3%)                                  |         |
| Other                                    | 245 (13.0%)                                   | 76 (10.0%)                                  |         |
| Loss of autonomy                         | 602 (31.3%)                                   | 196 (25.8%)                                 | 0.006   |
| Healthcare worker (n = 2,558)            | 22 (1.2%)                                      | 17 (2.3%)                                   | 0.055   |
| Current smoker (n = 2,002)               | 296 (20.1%)                                   | 36 (6.8%)                                   | <0.001  |
| BMI (n = 2,427)                          | 25.79 ± 6.26                                  | 26.66 ± 5.54                                | <0.001  |
| Comorbidities                            |                                               |                                             |         |
| Hypertension                             | 919 (47.8%)                                   | 364 (48.0%)                                 | 0.981   |
| Chronic cardiac disease                  | 696 (36.2%)                                   | 228 (30.0%)                                 | 0.003   |
| Diabetes                                 | 471 (24.5%)                                   | 186 (24.5%)                                 | 1       |
| Chronic respiratory disease              | 482 (25.1%)                                   | 114 (15.0%)                                 | <0.001  |
| Obesity                                  | 322 (16.7%)                                   | 126 (16.6%)                                 | 0.976   |
| Chronic kidney disease                   | 220 (11.5%)                                   | 70 (9.2%)                                   | 0.111   |
| Immunosuppression                        | 226 (11.8%)                                   | 28 (3.7%)                                   | <0.001  |
| Malignancy                               | 203 (10.6%)                                   | 31 (4.1%)                                   | <0.001  |
| Dementia                                 | 132 (6.9%)                                     | 60 (7.9%)                                   | 0.392   |
| Chronic neurological disorder            | 90 (4.7%)                                      | 34 (4.5%)                                   | 0.907   |
| Chronic hematological disease            | 51 (2.7%)                                      | 7 (0.9%)                                    | 0.009   |
| Cirrhosis                                | 44 (2.3%)                                      | 10 (1.3%)                                   | 0.144   |
| Psychosis                                | 39 (2.0%)                                      | 11 (1.4%)                                   | 0.400   |
| Transplant                               | 22 (1.1%)                                      | 6 (0.8%)                                    | 0.547   |
| HIV infection                            | 11 (0.6%)                                      | 6 (0.8%)                                    | 0.590   |
| Vital signs at ED admission              |                                               |                                             |         |
| Temperature (°C) (n = 2,627)             | 37.11 ± 1.07                                   | 37.58 ± 1.08                                | <0.001  |
| Oxygen saturation (n = 2,620)            | 94.78 ± 4.67                                   | 92.62 ± 5.40                                | <0.001  |
| Oxygen requirement                       | 353 (18.3%)                                   | 179 (23.6%)                                 | 0.003   |
| Time since symptom onset (n = 2,361)     |                                               |                                             | <0.001  |
| <24 hours                                | 613 (36.9%)                                   | 105 (15.0%)                                 |         |
| <7 days                                  | 731 (44.1%)                                   | 382 (54.4%)                                 |         |
| <15 days                                 | 207 (12.5%)                                   | 181 (25.8%)                                 |         |
| ≥15 days                                 | 108 (6.5%)                                     | 34 (4.8%)                                   |         |

Data are expressed as count (percentage), or mean ± SD.
COVID-19, coronavirus disease 2019; ED, emergency department; BMI, body mass index; HIV, human immunodeficiency virus.
Outcome of COVID-19 Positive and Negative Patients in French EDs During COVID-19 Outbreak

Table 1. Continued.

| Characteristics                        | COVID-19 negative patients (n = 1,926, 71.7%) | COVID-19 positive patients (n = 760, 28.3%) | P       |
|----------------------------------------|-----------------------------------------------|---------------------------------------------|---------|
| **Symptoms** (n from 2,669 to 2,686)  |                                               |                                             |         |
| Fever                                  | 916 (47.6%)                                   | 536 (70.5%)                                 | <0.001  |
| Dyspnea                                | 1,036 (53.8%)                                 | 494 (65.0%)                                 | <0.001  |
| Cough                                  | 759 (39.5%)                                   | 420 (55.3%)                                 | <0.001  |
| Weakness                               | 748 (38.8%)                                   | 399 (52.5%)                                 | <0.001  |
| Diarrhea                               | 251 (13.1%)                                   | 168 (22.1%)                                 | <0.001  |
| Nausea or vomiting                     | 339 (17.6%)                                   | 87 (11.4%)                                  | <0.001  |
| Myalgia                                | 148 (7.7%)                                    | 84 (11.1%)                                  | 0.007   |
| Headache                               | 198 (10.3%)                                   | 86 (11.3%)                                  | 0.503   |
| Confusion                              | 198 (10.3%)                                   | 80 (10.5%)                                  | 0.926   |
| Abdominal pain                         | 339 (14.8%)                                   | 57 (7.5%)                                   | <0.001  |
| Anosmia                                | 34 (1.8%)                                     | 51 (6.7%)                                   | <0.001  |
| Rhinorrhea/congestion                  | 56 (2.9%)                                     | 26 (3.4%)                                   | 0.570   |
| Sore throat                            | 40 (2.1%)                                     | 10 (1.3%)                                   | 0.242   |
| Joint pain                             | 37 (1.9%)                                     | 11 (1.4%)                                   | 0.497   |
| Bacterial infection (n = 2,126)        | 221 (14.6%)                                   | 57 (9.3%)                                   | <0.001  |
| Viral infection (n = 814)              | 34 (6.8%)                                     | 8 (2.5%)                                    | 0.011   |
| **Type of Viral infection**             |                                               |                                             |         |
| Influenza A                            | 13 (2.9%)                                     | 4 (1.3%)                                    | <0.224  |
| Influenza B                            | 5 (1.1%)                                      | 3 (1.0%)                                    | 1       |
| RSV                                    | 6 (1.4%)                                      | 4 (1.3%)                                    | 1       |
| Rhinovirus                             | 7 (5.7%)                                      | 0 (0.0%)                                    | 0.305   |
| Metapneumovirus                        | 3 (2.3%)                                      | 0 (0.0%)                                    | 0.748   |
| Adenovirus respiratory                 | 1 (0.8%)                                      | 1 (2.3%)                                    | 0.985   |
| **Positive CT chest (n = 1,686)**      |                                               |                                             | <0.001  |
| Positive                               | 237 (12.3%)                                   | 454 (59.7%)                                 |         |
| Negative                               | 949 (49.3%)                                   | 46 (6.1%)                                   |         |
| Not done                               | 740 (38.4%)                                   | 260 (34.2%)                                 |         |

Data are expressed as count (percentage), or mean ± SD.
COVID-19, coronavirus disease 2019; ED, emergency department; CT, computed tomography; RSV, respiratory syncytial virus.

suggested that among COVID-19 suspected patients, factors such as positive COVID-19 status, oxygen requirement, and male gender were at risk for ICU admission and mortality. Mortality also increased with age, malignancy, and bacterial infection.

The characteristics of the COVID-19 positive patients in our study broadly reflect those reported in other studies, especially in terms of symptoms and comorbidities. The rate of obesity was low, about two times lower than in the United States of America (US). These trends are consistent with the prevalence of obesity in the general population in France and the US. COVID-19 positive patients had a higher median age than patients in China, the US, and Italy, but a similar median age compared to patients in the United Kingdom (UK). These differences may be explained by the different recruitment methods that were used. We did not include ambulatory patients, who are most often younger, but we did include all hospitalized patients (corresponding to older patients who are more vulnerable and frail).

The proportion of COVID-19 positive patients admitted to the ICU was higher compared to previous studies conducted in the US (New York) and the UK. Several factors may explain these differences. First, the availability of ICU beds is different between countries. At the time of this study, the ICUs in our study were not overloaded but still reached maximum capacities despite a 30% increase in the number of beds during the first COVID-19 outbreak. Second, we included secondary ICU admissions in the follow-up, which were more numerous than primary admissions (unlike in the previously mentioned
Table 2. Outcomes of patients according to their COVID-19 status.

| Outcomes                                                                 | COVID-19 negative patients (n = 1,926) | COVID-19 positive patients (n = 760) | P        |
|--------------------------------------------------------------------------|----------------------------------------|--------------------------------------|----------|
| Destination from ED                                                      |                                        |                                      |          |
| Intensive care units                                                    | 162 (8.4%)                             | 86 (11.3%)                           | 0.036*   |
| Conventional hospitalization                                            | 1,756 (91.2%)                          | 673 (88.6%)                          |          |
| Died in ED                                                              | 8 (0.4%)                               | 1 (0.1%)                             |          |
| Secondary admission from wards to intensive care units (n = 2,461)      | 44 (2.5%)                              | 99 (14.7%)                           | <0.001   |
| Time from ED admission to secondary admission to ICU (days), median [IQR] (n = 114) | 1.72 [0.82 - 3.64]                     | 2.76 [0.96 - 4.53]                   | p=0.312# |
| All transfers to ICU                                                    | 206 (10.7%)                            | 185 (24.3%)                          | < 0.001  |
| Ventilator support                                                      |                                        |                                      |          |
| Invasive mechanical ventilation (n = 2,650)                            | 37 (1.9%)                              | 89 (11.9%)                           | < 0.001  |
| High-flow nasal cannula (n = 2,648)                                    | 41 (2.2%)                              | 135 (18.1%)                          | < 0.001  |
| Non-invasive ventilation (n = 249)                                      | 94 (4.9%)                              | 55 (7.4%)                            | 0.633    |
| Length of hospital stay (days) median [IQR] (n = 2,365)                 | 6 [2 - 11]                             | 10 [6 - 15]                          | < 0.001  |
| Decision to withhold or withdraw life-sustaining treatments:           |                                        |                                      |          |
| In ED                                                                   | 90 (4.7%)                              | 53 (7.0%)                            | 0.133    |
| During hospitalization                                                  | 221 (11.5%)                            | 151 (19.9%)                          | < 0.002  |
| Death during hospitalization                                            | 149 (7.7%)                             | 139 (18.3%)                          | < 0.001  |
| Death after a decision to withhold or withdraw life-sustaining treatments (n = 288) | 105 (70.5%)                            | 96 (69.1%)                           | 0.340    |
| Time from ED admission to death (days) median [IQR] (n = 276)           | 4.63 [1.70 - 10.84]                    | 8.80 [3.66 - 14.90]                  | 0.127    |
| Outcome after hospital discharge (n = 2,181)                            |                                        |                                      |          |
| Return to home                                                          | 1,382 (84.9%)                          | 397 (71.7%)                          | < 0.001  |
| Rehabilitation department                                               | 245 (15.1%)                            | 157 (28.3%)                          | < 0.001  |
| Re-hospitalization within 30 days after discharge (n = 2,366)          | 293 (16.7%)                            | 56 (9.2%)                            | 0.088    |

P-values from multivariate analyses (adjusted for age, gender, body mass index, smoking status, loss of autonomy, chronic respiratory disease, malignancy, bacterial infection, viral co-infection, and oxygen requirement) unless specified # univariate analysis with Wilcoxon rank-sum test,* univariate analysis with Fisher’s exact test. Data are expressed as count (percentage), unless specified otherwise. 

ED, emergency department; COVID-19, coronavirus disease 2019; IQR, interquartile range; ICU, intensive care unit.

Figure 2. COVID-19 positive and COVID-19 negative patients’ management. 
ED, emergency department; ICU, intensive care unit; COVID-19, coronavirus disease 2019.
Table 3. Univariate and multivariate analyses of factors associated with intensive care unit admission (directly from emergency departments or secondarily from ward).

| Variable                     | Level | OR [95% CI]   | P-value | OR [95% CI]   | P-value |
|------------------------------|-------|---------------|---------|---------------|---------|
| COVID-19 positive            | Yes   | 2.69 [2.16; 3.35] | <0.001  | 2.24 [1.57; 3.20] | <0.001  |
| Age                         | ≤50   | 1             | <0.001  | 1             | <0.001  |
|                             | 51-65 | 1.62 [1.15; 2.28] | 1.36 [0.83; 2.23] |            |
|                             | 66-80 | 1.20 [0.87; 1.65] | 1.02 [0.64; 1.64] |            |
|                             | ≥81   | 0.39 [0.27; 0.56] | 0.31 [0.18; 0.56] |            |
| Gender                      | Men   | 2.26 [1.80; 2.83] | <0.001  | 1.84 [1.32; 2.60] | <0.001  |
| BMI                         | <20   | 1             | 0.002   | 1             | 0.245   |
|                             | 20-25 | 1.09 [0.71; 1.66] | 0.83 [0.49; 1.42] |            |
|                             | 25-30 | 1.72 [1.14; 2.60] | 1.27 [0.75; 2.17] |            |
|                             | >30   | 1.65 [1.07; 2.55] | 1.04 [0.60; 1.81] |            |
| Current smoker              | Yes   | 1.22 [0.90; 1.66] | 0.203   | 1.25 [0.80; 1.92] | 0.324   |
| Loss of autonomy            | Yes   | 0.44 [0.34; 0.58] | <0.001  | 0.66 [0.43; 1.02] | 0.063   |
| Chronic respiratory disease | Yes   | 1.20 [0.94; 1.54] | 0.150   | 1.01 [0.69; 1.46] | 0.950   |
| Immunosuppression           | Yes   | 0.70 [0.47; 1.06] | 0.081   | -             | -       |
| Malignancy                  | Yes   | 0.55 [0.22; 1.38] | 0.164   | 0.37 [0.20; 0.65] | <0.001  |
| Bacterial infection         | Yes   | 1.33 [0.96; 1.83] | 0.092   | 1.54 [0.99; 2.36] | 0.055   |
| Viral co-infection          | Yes   | 0.66 [0.25; 1.70] | 0.361   | -             | -       |
| Oxygen requirement          | Yes   | 2.95 [2.34; 3.72] | <0.001  | 4.30 [3.00; 6.17] | <0.001  |

COVID-19, coronavirus disease 2019; BMI, body mass index; OR, odds ratio; CI, confidence interval.

Table 4. Univariate and multivariate analyses of factors associated with death during hospitalization.

| Variable                     | Level | OR [95% CI]   | P-value | OR [95% CI]   | P-value |
|------------------------------|-------|---------------|---------|---------------|---------|
| COVID-19 positive            | Yes   | 2.67 [2.08; 3.42] | <0.001  | 3.33 [2.02; 5.50] | <0.001  |
| Age                         | ≤50   | 1             | <0.001  | 1             | <0.001  |
|                             | 51-65 | 4.68 [1.58; 13.80] | 1.77 [0.50; 8.28] |            |
|                             | 66-80 | 11.05 [4.02; 30.39] | 3.93 [1.32; 16.94] |            |
|                             | ≥81   | 22.53 [8.31; 61.09] | 6.76 [2.26; 29.25] |            |
| Gender                      | Men   | 1.27 [0.99; 1.62] | 0.060   | 1.96 [1.21; 3.24] | 0.006   |
| BMI                         | <20   | 1             | 0.127   | 1             | 0.313   |
|                             | 20-25 | 1.05 [0.66; 1.69] | 0.74 [0.38; 1.49] |            |
|                             | 25-30 | 0.69 [0.41; 1.14] | 0.51 [0.25; 1.08] |            |
|                             | >30   | 0.74 [0.43; 1.28] | 0.79 [0.38; 1.70] |            |
| Current smoker              | Yes   | 0.35 [0.20; 0.62] | <0.001  | 0.68 [0.25; 1.60] | 0.399   |
| Loss of autonomy            | Yes   | 2.71 [2.11; 3.47] | <0.001  | 1.63 [0.98; 2.71] | 0.058   |
| Chronic respiratory disease | Yes   | 0.81 [0.60; 1.11] | 0.179   | 0.90 [0.51; 1.53] | 0.696   |
| Immunosuppression           | Yes   | 1.08 [0.72; 1.63] | 0.702   | -             | -       |
| Malignancy                  | Yes   | 1.46 [1.02; 2.09] | 0.043   | 1.94 [1.03; 3.52] | 0.039   |
| Bacterial infection         | Yes   | 1.72 [1.22; 2.44] | 0.003   | 2.52 [1.49; 4.17] | 0.001   |
| Viral co-infection          | Yes   | 0.18 [0.03; 1.36] | 0.028   | -             | -       |
| Oxygen requirement          | Yes   | 3.44 [2.66; 4.45] | <0.001  | 2.67 [1.66; 4.28] | <0.001  |

COVID-19, coronavirus disease 2019; BMI, body mass index; OR, odds ratio; CI, confidence interval.
studies where they were not always considered). They correspond to patients who worsened secondarily within an average of 1-2 days. This point was also made by Singer et al who emphasized the need to take secondary ICU admissions into account to better estimate ICU capacities. Indeed, they demonstrated that for every 100 persons under investigation who are admitted to the hospital, nine will require immediate ICU admission but another 12 will require ICU or invasive mechanical ventilation within 2-3 days. Finally, the use of mechanical ventilation for COVID-19 positive patients was similar to its use in other studies whereas the rates of high-flow nasal cannula oxygen therapy and non-invasive ventilation were higher in our study, suggesting that practices differ across countries.

The mortality rate observed herein was lower compared to the one reported in the US or in Italy. This could be due to differences in healthcare systems between the UK and Europe and in the proportion of ICU beds to hospital beds, as previously suggested. In addition, patient comorbidities and drug exposure (including glucocorticoids) may differ between cohorts.

The decisions to withhold and withdraw life-sustaining treatments during the COVID-19 pandemic have been rarely studied due to the difficulty of collecting data regarding the a priori-decided level of care. In the current study, we report a high prevalence of these decisions concerning COVID-19 positive patients. However, there was no difference in the number of these decisions prior to death between COVID-19 positive and negative patients. We believe this can be explained by the fact that the COVID-19 health crisis led healthcare teams to anticipate the potential aggravation of a patient’s condition. Indeed, it has been previously shown that there was little anticipation regarding end-of-life decisions in the ED and that the management of such decisions should be improved. The decision-making process is especially difficult in the context of emergency medicine due to lack of time, absence of anticipation in treating chronic diseases, and restrictions of access to families as a result of the pandemic. Therefore, the healthcare teams faced several challenges with these decisions for which the consequences have not been well assessed.

Understanding what happened during this first outbreak in the EDs included in this study is crucial to anticipate other health crises. Emergency departments are on the frontline during this type of crisis and must also manage potential COVID-19 patients, which contributes to the healthcare burden and ED crowding. In Australia, despite the low rate of COVID-19 positive cases, an increasing number of ED patients are likely to require isolation because the testing criteria have been broadened. The same has been reported in New York EDs where more than two thirds of all the admissions were patients suspected of COVID-19.

LIMITATIONS
This study has several limitations. First, we included primarily university hospitals, which have a greater ICU capacity; this certainly influenced the ICU admission rate. Second, the study was conducted only during the first outbreak and over a reduced period. Since then, practices have changed: the test criteria are broader; corticosteroids (mainly dexamethasone) have been introduced systematically for the most critical patients; and there has been an increase in physician expertise. Finally, the baseline comparison group could have been made up of patients admitted to the EDs prior to the COVID-19 outbreak in order to estimate the impact of the outbreak on the EDs; nevertheless, comparing patients admitted for COVID-19 suspicion and with a similar severity (probably only the most severe patients actually came to the EDs during the first lockdown) allowed us to limit the discrepancies in terms of baseline characteristics between groups. We probably had some false negatives especially during early phases of testing. Moreover, we did not initially include gastrointestinal symptoms as a presentation given the limited knowledge of COVID-19 at the beginning of the pandemic. Finally, despite the use of a multivariable model, we could not exclude residual confounders.

CONCLUSION
This first outbreak of COVID-19 helped us to better quantify the need for ICU beds and to underline the importance of flexible organization to quickly adapt conventional and ICU capacities to the incoming flow into EDs of COVID-19 positive patients.

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