# Clinical characteristics and management of COVID-19 patients accessing the emergency department in a hospital in Northern Italy in March and April 2020

## Caratteristiche cliniche e nella gestione dei pazienti COVID-19 che accedevano al pronto soccorso in un ospedale del Nord Italia in marzo e aprile 2020

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## ABSTRACT

**BACKGROUND:** the emergency due to SARS-CoV-2 pandemic struck the national and regional health system that needed an effort to reorganise and increase resources to cope with a sudden, uncertain, and previously unknown situation. This study was conducted in the immediate aftermath of this difficult period.

**OBJECTIVES:** to describe clinical characteristics, short-term outcomes, and management of SARS-CoV-2 positive patients that accessed the emergency department (ED) of the San Luigi Gonzaga hospital of Orbassano (Turin district, Piedmont Region, Northern Italy) in March and April 2020. Furthermore, this study aimed at investigating if a difference in patients characteristics, clinical management, and outcomes was present during time.

**DESIGN:** comparison of different periods in a clinical cohort.

**SETTING AND PARTICIPANTS:** for each patient who accessed the ED and tested positive for SARS-CoV-2 swab, the ED medical record was collected and a descriptive analysis was performed on demographical characteristics, pre-existing comorbidities, parameters measured at triage, imaging exams results, lab tests results, separately for patients admitted at the ED in four different periods.

**MAIN OUTCOME MEASURES:** discharge from ED, admission to hospital wards (low and high intensity of care), short term in-hospital mortality, hospital length of stay. The association between patients' characteristics and the main outcomes was measured using multivariable logistic models.

**RESULTS:** age of patients increased significantly from March to April, together with female prevalence and associated comorbid conditions. A significant difference in symptoms at presentation was not observed nor it was in laboratory test results. Severity at triage and need of intensive care resources were higher in the first weeks, together with the typical clinical presentation with respiratory failure and imaging with signs of bilateral interstitial pneumonia. Accordingly, in-hospital mortality was higher in the first period. Nevertheless, nearly half of patients in the first period were discharged directly from ED showing mild COVID-19 cases. On the contrary, in April an increasing need of hospitalisation in low intensity of care beds was observed, whereas mild cases stopped to access the ED.

### WHAT IS ALREADY KNOWN

- **SARS-CoV-2 pandemic struck the national and regional health system that needed an effort to reorganise and increase resources to cope with a sudden, uncertain, and previously unknown situation.**
- **Differences in clinical presentation during the pandemic period have been observed in China and a study identified a novel SARS-CoV-2 mutation in Europe.**

### WHAT THIS STUDY ADDS

- **During the first two months of emergency in Piedmont Region (Northern Italy), there was a change over time in type of COVID-19 patients accessing to the emergency department of a regional hospital, who became older and with a more severe COVID-19 syndrome.**
- **During the first two months of emergency in Piedmont Region, outcomes of COVID-19 patients improved over time with less needs of high intensity of care.**

**CONCLUSIONS:** the results of this study suggest that in few weeks of COVID-19 epidemic both management of the patients at the hospital level – and probably at territorial level resulting in a different population who accessed to the ED – and the clinical characteristics of the COVID-19 patients changed.

**Keywords:** COVID-19, hospital management, emergency department, in-hospital mortality

## RIASSUNTO

**INTRODUZIONE:** l'emergenza dovuta alla pandemia di SARS-CoV-2 ha colpito il sistema sanitario nazionale e regionale, che ha dovuto riorganizzarsi e aumentare le risorse per fare fronte a una situazione improvvisa, incerta e nuova.

**OBIETTIVI:** descrivere le caratteristiche cliniche, gli outcome a breve termine e la gestione dei pazienti positivi al SARS-CoV-2 che hanno avuto un accesso al pronto soccorso (PS) dell'ospedale San Luigi Gonzaga di Orbassano (TO) nei mesi di marzo e aprile 2020 e valutare se vi sia stata una differenza temporale nelle caratteristiche dei pazienti, nella gestione clinica e nei loro *outcome*.

**DISEGNO:** confronti di diversi periodi temporali in una coorte clinica.

**SETTING E PARTECIPANTI:** sono state raccolte le cartelle cliniche di tutti i pazienti che hanno avuto un accesso in PS e il cui tampone è risultato positivo per SARS-CoV-2. Le caratteristiche demografiche, le comorbidità preesistenti, i parametri misurati al triage, i risultati degli esami diagnostici e i risultati dei test di laboratorio sono stati descritti separatamente per quattro periodi temporali.
**PRINCIPALI MISURE DI OUTCOME:** dimissione dal PS, tipo di reparto di trasferimento (a bassa o alta intensità di cura), mortalità intraospedaliera a breve termine, lunghezza del ricovero. L'associazione tra caratteristiche dei pazienti e i principali outcome è stata misurata utilizzando modelli di regressione logistica multivariati.
**RISULTATI:** l'età dei pazienti è aumentata tra marzo e aprile, così come la prevalenza di donne e le comorbidità associate. Non si è osservata una differenza di sintomi all'accettazione o di risultati dei test di laboratorio. La gravità clinica al triage e il bisogno di intensità delle cure sono stati più elevati nelle prime settimane, così come la presentazione clinica di insufficienza respiratoria e gli esami diagnostici con segni di polmonite interstiziale bilaterale. Concordemente, la mortalità intraospedaliera è stata più alta nel primo periodo. Tuttavia, circa metà dei pazienti del primo periodo è stata dimessa dal PS senza ricovero in quanto casi lievi di COVID-19. Al contrario, in aprile è aumentato il numero dei ricoverati, anche se in reparti a bassa intensità, mentre vi è stata una diminuzione di accessi in PS dei casi lievi.
**CONCLUSIONI:** i risultati dello studio suggeriscono che nelle prime settimane di pandemia di SARS-CoV-2 sono cambiate sia le procedure di gestione dei pazienti a livello ospedaliero – e, probabilmente, anche sul territorio, come suggerito dalla differente popolazione che ha avuto accesso al PS – sia le caratteristiche cliniche e anagrafiche dei pazienti COVID-19.

**Parole chiave:** COVID-19, gestione ospedaliera, pronto soccorso, mortalità ospedaliera

## INTRODUCTION

On January 9th 2020, the World Health Organisation (WHO) declared the identification of a new Coronavirus responsible for severe pneumonias in China, and classified it as SARS-CoV-2. This virus is the cause of a respiratory disease that was called 'COVID-19'. The first two cases in Italy were identified on February 19th and, from then on, a wave of the pandemic outbreak occurred, with 232,997 confirmed infected cases and 33,415 deaths at the end of May.[1]

The Piedmont (a Region located in Northern Italy with a population of about 4 million inhabitants) is the second region in Italy for number of cases (more than 30,000 at the end of May, cumulative incidence: 703.26 per 100,000) and the epidemic curve raised dramatically after the 15th of March, with over 400 new infected subjects per day until the end of April,[2] as shown in figure 1.

Patients with COVID-19 complain of cough, diarrhoea, nausea, vomiting, fever, headache, sore throat, anosmia, ageusia, weakness, and dyspnoea;[3,4] SARS-CoV-2 infection is confirmed through nasopharyngeal and/or oropharyngeal swabs. While the majority of cases proceed with a benign or mild clinical course, some develop interstitial pneumonia with severe respiratory failure and need of intensive care resources.

At the beginning of the pandemic, swabs were mainly performed at the emergency departments (EDs) where symptomatic patients arrived without a previous contact with the National Health System. After few weeks, the implementation of new tasks for several health local services let part of COVID-19 suspected patients to be managed directly at their home.[5]

Differences in clinical presentation during the pandemic period have been observed in China[6] and a study identified a novel SARS-CoV-2 mutation in Europe, leaving room for the hypothesis that the virus is also evolving during time.[7] Moreover, a gradual improvement of therapeutic plans improved patients' outcomes during time[8] and the containment measures differently applied by each country may have changed patients' sociodemographic characteristics.

The aim of this study was to investigate if clinical characteristics, short-term outcomes, and management of SARS-CoV-2 positive patients that accessed the ED of the San Luigi Gonzaga hospital changed over time from March to April 2020.

## MATERIALS AND METHODS

In this study, all SARS-CoV-2 positive patients that acceded to the ED of the San Luigi Gonzaga hospital in Orbassano (TO), Italy, from the 1st March to the end of May 2020 were retrospectively recruited. Due to the small number of infected cases acceded to the hospital in May (a total of 5 patients), the analyses were restricted to patients recruited in the first two months of the study.

For each patient, the ED digital medical record with data regarding medical history, clinical presentation, symptoms, diagnostic tests (blood tests, imaging), treatment, and respiratory support performed in the ED was obtained.

The study was approved by the hospital ethical committee (protocol 5257 01.04.2020) and was conducted in line with the Helsinki declaration.

### STATISTICAL ANALYSIS

A descriptive analysis was performed on demographic characteristics, pre-existing comorbidities, parameters measured at triage, imaging exams results, lab tests results, and outcome from ED (discharge or not discharge), separately for patients admitted at the ED in four different periods (1st-15th March, 16th-31st March, 1st-15th April, 16th-30th April 2020). Continuous variables were expressed as median and interquartile range (IQR), categorical variables as frequencies and percentages.

Kruskal-Wallis was used in order to analyse differences in distribution of continuous variables through the four periods, Fisher's Exact and chi² tests were used to compare categorical variables through the four periods where appropriate.
Multivariable logistic regressions have been performed to estimate the odds ratio (OR) of the admission periods (reference period: the first two weeks of March) on the ED outcome (discharge or not discharge), considering patients' age, gender, and comorbidities.
Additional analyses have been conducted on the subgroup of hospitalised patients, describing and evaluating the differences in hospital wards, length of stay, and in-hospital mortality separately for the four periods.
Furthermore, in hospitalised patients, multivariable logistic regressions of the admission periods adjusting by patients' age, gender, and comorbidities have been performed considering two different outcomes:
**1.** admission in different level of care wards: intensive care unit (ICU) and high dependency unit (HDU) vs internal medicine ward;
**2.** in hospital mortality.
All the analyses were performed using R software (version 3.6.2). Statistical confidence level was fixed considering a first type error alpha equal to 0.05.

## RESULTS

Among 2,450 patients admitted in the ED from the beginning of March till the end of April 2020, 1,027 (42%) underwent a nasopharyngeal swab: 224 (9%) patients resulted positive to SARS-CoV-2 and were included in this study.
Table 1 shows the demographic characteristics of the patients according to the four calendar periods. The number of ED visits by patients who tested positive changed over time, with a peak at the end of March. The age of the patients increased significantly (p<0.001) over time from a median age lower than 60 years in the first period to a median age above 80 years in the end of April. The gender distribution of patients changed over time (p=0.017): the percentage of males, initially larger (63.3%) than the percentage of females (36.7%), decreased during the first three periods and they were overturned at the first period of April (64.1% of females and 35.9% of males). Nearly 15% of patients were health professionals.
Table 2 shows the characteristics of the patients included in the study regarding:

- comorbidities and previous chronic conditions;
- triage parameters;
- diagnostic imaging exams;
- laboratory tests;
- symptoms;
- emergency department outcomes.

Nearly half of patients in the first two periods were affected by hypertension, while prevalence of hypertension increased to 60% in the last two periods.
Interestingly, the prevalence of previous chronic conditions (always higher than 65%) changed over time (p=0.017), reaching the totality of patients in the last period. Accordingly, the Charlson comorbidity index (CCI) significantly increased over time (p=0.009), mainly consisted of cerebrovascular diseases, solid tumours, and a significantly increase of dementia.
A statistically significant difference of the triage evaluation over time was observed (p=0.041): around 65% of patients received an immediate/urgent evaluation both in the first and in the last period, while more than half of the patients admitted between 16th March and 15th April received a delayed/expectant evaluation. Among patients evaluated immediate/urgent at triage, the Fisher's exact test highlighted a significant different distribution of ED discharge (p<0.001) and respiratory support (p <0.001) over time: indeed, more than half of the patients evaluated as immediate/urgent at triage in the first period were then discharged from ED (56%) and without any respiratory support (63%), while almost all of those evaluated as urgent in the last three periods died or were admitted to hospital (96%, 93%, and 100%, respectively) and furthermore received a respiratory support (31%, 65%, 82%).
The median values of $PaO_2/FiO_2$ show that this parameter was out of the normal range in at least half of the patients in each period. According to the decline of oxygen saturation, respiratory supports have been provided differently over time (p=0.007), above all in the last period (76.5% of the patients).

| DEMOGRAPHICAL CHARACTERISTICS | | 1ST -15TH MARCH MEDIAN [IQR] | 16TH-31ST MARCH MEDIAN [IQR] | 1ST-15TH APRIL MEDIAN [IQR] | 16TH-30TH APRIL MEDIAN [IQR] | P-VALUE |
|---|---|---|---|---|---|---|
| | | No. (%) | No. (%) | No. (%) | No. (%) | No. (%) |
| No. | | 30 | 113 | 64 | 17 | |
| AGE | | 56.7 [47.3;73.4] | 59.8 [48.9;75.8] | 73.0 [58.4;83.0] | 80.1 [72.8;89.1] | <0.001# |
| GENDER | Male | 19 (63.3) | 66 (58.4) | 23 (35.9) | 8 (47.1) | 0.017° |
| | Female | 11 (36.7) | 47 (41.6) | 41 (64.1) | 9 (52.9) | |
| HEALTHCARE EMPLOYEE | No | 28 (93.3) | 97 (85.8) | 50 (78.1) | 15 (88.2) | 0.279§ |
| | Yes | 2 (6.7) | 16 (14.2) | 14 (21.9) | 2 (11.8) | |

# Kruskal-Wallis test / *test di Kruskal-Wallis* ° Chi² test / *test del chi²* § Fisher's exact test / *Test esatto di Fisher* IQR: Interquartile Range / *range interquartile*

Table 1. Demographical characteristics of the sample.
Tabella 1. Caratteristiche demografiche del campione.

| CHARACTERISTICS | | 1ST -15TH MARCH MEDIAN [IQR] NO. (%) | 16TH-31ST MARCH MEDIAN [IQR] NO. (%) | 1ST-15TH APRIL MEDIAN [IQR] NO. (%) | 16TH-30TH APRIL MEDIAN [IQR] NO. (%) | PVALUE |
|---|---|---|---|---|---|---|
| **COMORBIDITIES AND PREVIOUS CHRONIC CONDITIONS** | | | | | | |
| **HYPERTENSION** | No | 13 (54.2) | 52 (52.5) | 21 (39.6) | 5 (35.7) | 0.329§ |
| | Yes | 11 (45.8) | 47 (47.5) | 32 (60.4) | 9 (64.3) | |
| **OBESITY** | BMI<30 kg/m2 | 29 (96.7) | 101 (89.4) | 61 (95.3) | 15 (88.2) | 0.382§ |
| | BMI≥30 kg/m2 | 1 (3.3) | 12 (10.6) | 3 (4.7) | 2 (11.8) | |
| **PREVIOUS CHRONIC CONDITIONS** | No | 6 (21.4) | 37 (33.0) | 17 (27.0) | 0 (0.0) | 0.017§ |
| | Yes | 22 (78.6) | 75 (67.0) | 46 (73.0) | 17 (100.0) | |
| | CCI | 0.0 [0.0;2.0] | 0.0 [0.0;2.0] | 1.00 [0.0;2.0] | 2.00 [1.0;3.0] | 0.009# |
| **COMORBIDITIES** | none | 20 (66.7) | 68 (60.2) | 37 (57.8) | 7 (41.2) | 0.316§ |
| | one | 6 (20.0) | 27 (23.9) | 20 (31.2) | 4 (23.5) | |
| | more than one | 4 (13.3) | 18 (15.9) | 7 (10.9) | 6 (35.3) | |
| **TRIAGE PARAMETERS** | | | | | | |
| **TRIAGE EVALUATION** | delayed/expectant | 8 (33.3) | 66 (59.5) | 37 (57.8) | 6 (35.3) | 0.041° |
| | immediate/urgent | 16 (66.7) | 45 (40.5) | 27 (42.2) | 11 (64.7) | |
| **TEMPERATURE** | <37 | 9 (40.9) | 38 (36.2) | 25 (39.7) | 9 (56.3) | 0.125§ |
| | 37-37.5 | 1 (4.5) | 18 (17.1) | 17 (27.0) | 1 (6.3) | |
| | ≥37.5 | 12 (54.6) | 49 (46.7) | 21 (33.3) | 6 (37.5) | |
| **$PAO_2/FIO_2$** (mmHg) Normal range 350-400 | | 352.4 [276.1;395.2] | 331.0 [248.8;409.5] | 328.6 [271.4;385.7] | 283.3 [221.4;327.4] | 0.371# |
| **RESPIRATORY SUPPORT** | No | 19 (67.9) | 46 (43.0) | 36 (58.1) | 4 (23.5) | 0.007§ |
| | Yes | 9 (32.1) | 61 (57.0) | 26 (41.9) | 13 (76.5) | |
| **DIAGNOSTIC IMAGING EXAMS** | | | | | | |
| **ULTRASOUND RESULTS** | Consolidation | 0 (0.0) | 2 (2.1) | 1 (2.1) | 0 (0.0) | |
| | Irregular pleural line | 0 (0.0) | 1 (1.1) | 0 (0.0) | 0 (0.0) | |
| | Focal B lines | 1 (4.5) | 12 (12.8) | 4 (8.3) | 0 (0.0) | |
| | Multiple b lines ("light beam") | 5 (22.7) | 29 (30.9) | 8 (16.7) | 3 (25.0) | |
| | Pleural effusion | 0 (0.0) | 0 (0.0) | 2 (4.2) | 2 (16.7) | |
| | Normal lung ultrasound scan | 16 (72.7) | 50 (53.2) | 33 (68.8) | 7 (58.3) | |
| **X-RAY RESULTS** | Pneumonia | 6 (23.1) | 19 (17.9) | 12 (21.1) | 4 (25.0) | |
| | Bilateral pneumonia | 4 (15.4) | 41 (38.7) | 16 (28.1) | 6 (37.5) | |
| | Normal | 16 (61.5) | 46 (43.4) | 29 (50.9) | 6 (37.5) | |
| **CT RESULTS** | Focal ground glass lesion | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (14.3) | |
| | Bilateral ground glass lesions | 0 (0.0) | 0 (0.0) | 1 (12.5) | 2 (28.6) | |
| | Diffuse ground glass lesions | 0 (0.0) | 1 (33.3) | 0 (0.0) | 1 (14.3) | |
| | Consolidation | 0 (0.0) | 1 (33.3) | 0 (0.0) | 0 (0.0) | |
| | Normal CT scan | 1 (100.0) | 1 (33.3) | 7 (87.5) | 3 (42.9) | |
| **LAB TESTS** | | | | | | |
| **WHITE BLOOD CELL** (K/µL) | | 5.9 [4.2;6.8] | 6.0 [4.7;8.0] | 5.7 [4.6;8.3] | 8.1 [5.2;11. 5] | 0.273# |
| **C-REACTIVE PROTEIN** (mg/dL) | | 1.6 [0.5;6.9] | 4.8 [1.4;11.4] | 6.3 [1.5;11.6] | 8.9 [2.7;15.8] | 0.061# |
| **PROCALCITONIN** (ng/mL) | | 0.06 [0.04;0.08] | 0.09 [0.04;0.21] | 0.08 [0.05;0.18] | 0.10 [0.05;0.42] | 0.349# |
| **LDH** (U/L) | | 241.5 [174.0;349.5] | 343.0 [219.5;460.5] | 329.0 [225.5;411.5] | 315.5 [269.3;507.8] | 0.035# |
| **LDH** | <243 (U/L) | 12 (50.0) | 29 (28.2) | 17 (33.3) | 4 (25.0) | 0.212§ |
| | ≥243 (U/L) | 12 (50.0) | 74 (71.8) | 34 (66.7) | 12 (75.0) | |
| **PLATELETS** (%) | | 178.0 [131.0;217.8] | 193.0 [148.0;237.0] | 185.0 [166.8;240.5] | 198.0 [188.3;296.5] | 0.326# |
| **LYMPHOCYTES** | (KµL) | 1.14 [0.98;1.81] | 1.12 [0.70;1.48] | 1.08 [0.82;1.38] | 1.20 [0.86;1.55] | 0.481# |
| **LYMPHOCYTES** | ≤0.9 (KµL) | 6 (24.0) | 42 (38.5) | 22 (36.7) | 6 (37.5) | 0.787§ |
| | 0.9-5.2 (KµL) | 19 (76.0) | 65 (59.6) | 36 (60.0) | 10 (62.5) | |
| | ≥5.2 (KµL) | 0 (0.0) | 2 (1.8) | 2 (3.3) | 0 (0.0) | |
| **SYMPTOMS** | | | | | | |
| **COUGH** | No | 8 (30.8) | 41 (39.0) | 17 (31.5) | 11 (64.7) | 0.081° |
| | Yes | 18 (69.2) | 64 (61.0) | 37 (68.5) | 6 (35.3) | |
| **DYSPNOEA** | No | 14 (56.0) | 40 (39.6) | 28 (54.9) | 8 (47.1) | 0.232° |
| | Yes | 11 (44.0) | 61 (60.4) | 23 (45.1) | 9 (52.9) | |
| **DIARRHOEA, NAUSEA, VOMITING** | No | 21 (84.0) | 84 (84.0) | 36 (81.8) | 16 (94.1) | 0.743§ |
| | Yes | 4 (16.0) | 16 (16.0) | 8 (18.2) | 1 (5.9) | |
| **FEVER** | No | 4 (16.0) | 18 (17.1) | 8 (13.1) | 4 (23.5) | 0.747§ |
| | Yes | 21 (84.0) | 87 (82.9) | 53 (86.9) | 13 (76.5) | |
| **HEADACHE** | No | 25 (100.0) | 96 (96.0) | 41 (93.2) | 17 (100.0) | 0.552§ |
| | Yes | 0 (0.0) | 4 (4.0) | 3 (6.8) | 0 (0.0) | |
| **SORE THROAT** | No | 22 (84.6) | 87 (84.5) | 41 (83.7) | 17 (100.0) | 0.365§ |
| | Yes | 4 (15.4) | 16 (15.5) | 8 (16.3) | 0 (0.0) | |
| **EMERGENCY DEPARTMENT OUTCOMES** | | | | | | |
| **DISCHARGED** | | 14 (46.7) | 39 (34.5) | 19 (29.7) | 1 (5.9) | 0.025§ |
| **NOT DISCHARGED** | | 16 (53.3) | 74 (65.5) | 45 (70.3) | 16 (94.1) | |

# Kruskal-Wallis test / *test di Kruskal-Wallis* ° Chi2 test / *test del chi2* § Fisher's exact test / *Test esatto di Fisher* **BMI:** body mass index / *indice di massa corporea* **IQR:** Interquartile Range / *range interquartile* **CCI:** Charlson Comorbidity Index / *indice di comorbidità di Charlson* **CT:** computed tomography / *tomografia computerizzata* **LDH:** lactate dehydrogenase / *lattato deidrogenasi*

Table 2. Characteristics of patients admitted at emergency department between March 1st and April 30th 2020.
Tabella 2. Caratteristiche dei pazienti accettati in pronto soccorso tra il 1° marzo e il 30 aprile.

As suggested by national guidelines, ultrasound and x-ray have been mainly performed at arrival in ED, more than 70% and 85%, respectively, in each period, while CT has been performed just in atypical presentations, in case of uncertainty or complicated situations. Typical lung ultrasound patterns were observed, previously described[9] as multiple B lines with light beam or pleural irregularity, mainly in the first two periods, whereas pleural effusion was present in a minority of cases. More than half of the patients had a negative ultrasound: the percentage of negative and atypical ultrasound findings (focal B lines, consolidation and pleural effusion) increased in the last two periods. X-ray exams showed unilateral or bilateral pneumonia, resulting positive in about half of the patients.

Examining laboratory test results, an inflammatory state was observed in many patients affected by COVID-19: C-reactive protein median values were always out of the normal and increased over time (p=0.061). Similarly, LDH median values changed over time (p=0.035) and were almost always higher than the normality threshold, meaning that more than half of the patients had values out of the norm, as well as it occurred for procalcitonin.

All the patients admitted to the ED were symptomatic and symptoms did not significantly change over time. The symptoms most commonly reported were dyspnoea and cough. In addition, 83.6% of subjects reported fever in the previous days.

A total of 73 patients were discharged (quarantined at home in isolation), while 151 patients were admitted to another hospital ward (No. 147) or transferred to another hospital (No. 2) or died at the ED (No. 2). The number of patients transferred to their own home significantly decreased over time (p=0.025), being almost abated in the last period.

Details for hospitalised patients after ED are presented in table 3. Nearly half of them were admitted to HDU (37%) and ICU (19%) in the first period. The admission in HDU was still 44% in the second period, then significantly decreased (p=0.038). Accordingly, deaths during the hospitalisation decreased over time, except for the last period and the length of stay for hospitalised people decreased from a median of 27 days in the first period to 15 days in the last one.

In table 4 and 5 results from multivariable logistic regression analyses are presented for short-term outcome (discharge from ED) and medium-term outcomes (admission to ICU or HDU and death during hospitalisation), respectively. The models confirmed the results observed in univariate analyses, showing that over time hospitalisations of COVID-19 patients increased; nonetheless, hospitalised patients obtained more favourable outcomes.

## DISCUSSION

After China, Italy was the second most affected country in the first months of SARS-CoV-2 pandemic[10] and the Italian National Health System was one of the most involved in responding to the immediate health care needs at the beginning of this emergency. EDs, together with pre-hospital emergency systems, had to define new pathways and to create new protocols to warrant timely and effective care for the affected individuals and to limit spread of the disease on health care providers/hospital staff and on other inpatients. The whole health system needed to re-organise out-of-hospital resources and to create additional surge capacity especially for Intensive Care Resources (ICU beds, ventilators, Continuous Positive Airway Pressure – CPAP) and for personal protective equipment supply. The relative novelty of this clinical syndrome, the uncertainties in management and in containment measures and many controversial information added confusion to the entire process.[11] In the experience of the authors on the field, a difference was perceived between the first weeks and the following period, but evidence is lacking and only hypotheses have been made about a change in virulence or the effect of lock-down measures. Thus, this study aimed to evaluate in a systematic way these impressions trying to identify a trend in the SARS-CoV-2 epidemic timeline. In this scenario, at least in the first weeks of outbreak, the ED served not only as a first line resource for acute patient care, but also as a support for the Italian National Health Service to identify new cases and as a safety-net for general practitioners (GPs) until a synergic coordinated system was available. The findings of the present study are in line with these considerations: the number of cases admitted to ED increased in March, reaching the peak of num-

| CHARACTERISTICS | | 1ST -15TH MARCH MEDIAN [IQR] No. (%) | 16TH-31ST MARCH MEDIAN [IQR] No. (%) | 1ST-15TH APRIL MEDIAN [IQR] No. (%) | 16TH-30TH APRIL MEDIAN [IQR] No. (%) | P-VALUE |
|---|---|---|---|---|---|---|
| **NUMBER** | | 16 | 73 | 44 | 16 | |
| **HOSPITAL WARD** | internal medicine | 7 (43.8) | 39 (53.4) | 32 (74.4) | 11 (68.8) | 0.038§ |
| | sub intensive care | 6 (37.5) | 32 (43.8) | 10 (23.3) | 5 (31.2) | |
| | intensive care | 3 (18.8) | 2 (2.7) | 1 (2.3) | 0 (0.0) | |
| **DEATH** | No | 9 (56.2) | 46 (63.0) | 32 (72.7) | 9 (56.2) | 0.509° |
| | Yes | 7 (43.8) | 27 (37.0) | 12 (27.3) | 7 (43.8) | |
| **LENGTH OF STAY (DAYS)** | | 27.0 [13.3;46.5] | 17.0 [8.0;27.0] | 16.0 [7.5;25.5] | 15.00 [9.0;24.5] | 0.172# |

# Kruskal-Wallis test / *test di Kruskal-Wallis* ° Chi² test / *test del chi²* § Fisher's exact test / *Test esatto di Fisher*

Table 3. Characteristics of hospitalized patients.
Tabella 3. Caratteristiche dei pazienti ospedalizzati.

| | | OR | (95%CI) | P-VALUE |
|---|---|---|---|---|
| **ADMISSION PERIOD** | 16th-31st March vs 1st-15th March | 2.15 | (0.71-6.66) | 0.176 |
| | 1st-15th April vs 1st-15th March | 1.38 | (0.38-4.99) | 0.622 |
| | 16th-30th April vs 1st-15th March | 6.06 | (0.62-144.20) | 0.163 |
| **AGE** | | 1.11 | (1.07-1.15) | <0.001 |
| **GENDER** | female vs male | 0.41 | (0.18-0.90) | 0.029 |
| **CCI** | | 1.49 | (1.04-2.33) | 0.051 |

**OR:** Odds ratio / *odds ratio* **CCI:** Charlson Comorbidity Index / *indice di comorbidità di Charlson*

Table 4. Multivariable logistic regression of the admission period to emergency department on the short-term outcome (not discharged versus discharged from emergency department).
Tabella 4. Regressione logistica multivariata per l'outcome a breve termine (non dimesso rispetto vs dimesso da pronto soccorso) rispetto ai periodi di accesso al pronto soccorso.

| | | | OR | (95%CI) | P-VALUE |
|---|---|---|---|---|---|
| **A** | **ADMISSION PERIOD** | 16th-31st March vs 1st-15th March | 0.58 | (0.17-1.90) | 0.375 |
| | | 1st-15th April vs 1st-15th March | 0.34 | (0.08-1.29) | 0.117 |
| | | 16th-30th April vs 1st-15th March | 0.59 | (0.12-2.83) | 0.517 |
| | **AGE** | | 0.97 | (0.94-0.99) | 0.022 |
| | **GENDER** | female vs male | 0.61 | (0.28-1.32) | 0.210 |
| | **CCI** | | 0.79 | (0.62-0.98) | 0.041 |
| **B** | **ADMISSION PERIOD** | 16th-31st March vs 1st-15th March | 0.67 | (0.19-2.37) | 0.528 |
| | | 1st-15th April vs 1st-15th March | 0.24 | (0.06-0.97) | 0.047 |
| | | 16th-30th April vs 1st-15th March | 0.40 | (0.08-1.99) | 0.268 |
| | **AGE** | | 1.08 | (1.05-1.13) | <0.001 |
| | **GENDER** | female vs male | 0.74 | (0.32-1.68) | 0.475 |
| | **CCI** | | 1.12 | (0.91-1.39) | 0.275 |

**OR:** Odds ratio / *odds ratio* **CCI:** Charlson Comorbidity Index / *indice di comorbidità di Charlson*

Table 5. (A) Multivariable logistic regression of the admission period to Emergency Department on the first medium-term outcome (subintensive or intensive care unit admission versus internal medicine ward admission, among hospitalized patients); (B) Multivariable logistic regression of the admission period to Emergency Department on the second medium-term outcome (death during hospitalization, among hospitalized patients).
Tabella 5. (A) Regressione logistica multivariata rispetto al primo outcome a medio termine (ricovero in terapia intensiva o subintensiva versuvss ricovero in reparto di medicina, nei pazienti ospedalizzati); (B) Regressione logistica multivarariata rispetto al secondo outcome a medio termine (morte durante l'ospedalizzazione, nei pazienti ospedalizzati).

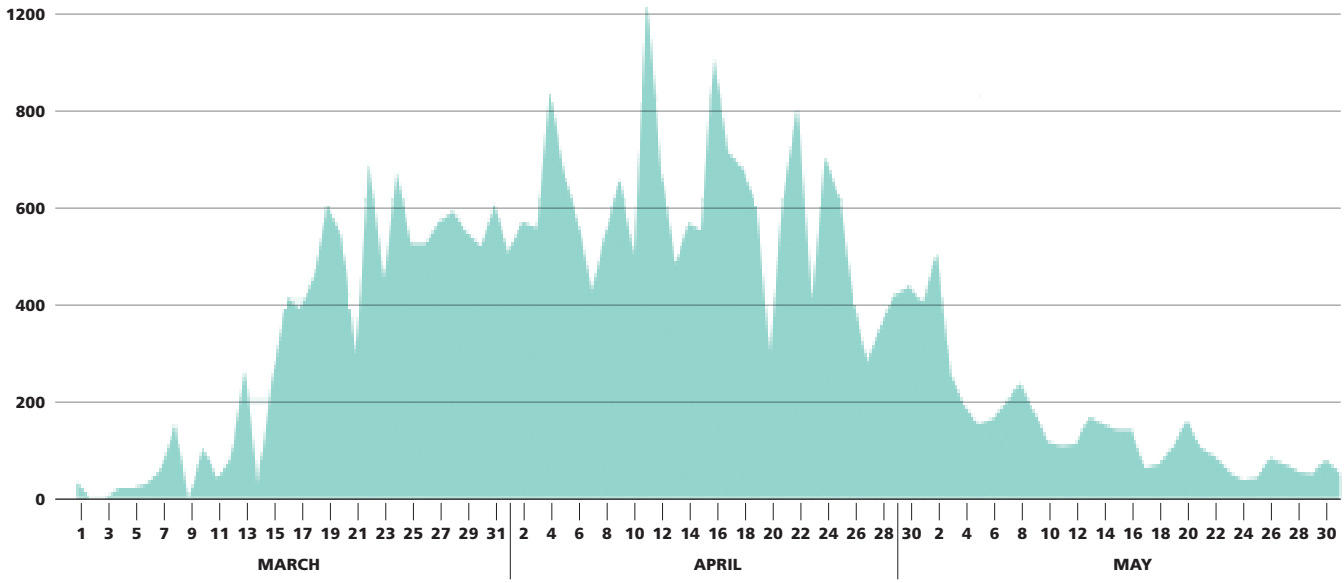


Figure 1. Number of SARS-CoV-2 infected cases from 1st of March to 31st of May, Piedmont Region (Northern Italy). Data retrieved from Civil Defence database (available from: https://github.com/pcm-dpc/COVID-19/blob/master/dati-regioni/dpc-covid19-ita-regioni.csv).
Figura 1. Numero di casi SARS-CoV-2 tra il 1° marzo e il 31 maggio, Regione Piemonte. Dati tratti dal database della Protezione civile (disponibile all'indirizzo: https://github.com/pcm-dpc/COVID-19/blob/master/dati-regioni/dpc-covid19-ita-regioni.csv).

ber of admitted patients in the second part of March, even if patients admitted to ED in the first two weeks of March were younger, presented with mild symptoms, according both to the laboratory tests results and imaging features, and with a higher probability to be discharged at home after the ED access.

The second period of March was characterized by a considerable afflux of relatively young patients in their fifties, mainly affected by interstitial pneumonia with typical findings at chest X-ray and lung ultrasound, with an important rise in infection markers and lactic dehydrogenase levels. Nearly half of patients needed respiratory support, suggesting that their health status was poorer than the one of the patients in the first period. However, the perceived severity expressed by triage evaluation was similar to those arriving at the beginning of the month, suggesting that the first cases could have been over-triaged because of the novelty of the situation. This is in line with the experience of Lombardy Region and it is common in all healthcare systems where the emergency system is used to rapid turnover and prepared to increase its capacity to cope with unexpected events.[12]

The majority of published data in China, Italy, and USA focused on the first month of outbreak;[13-15] however, in the data here presented, the characteristics of patients admitted in ED changed drastically after the first two weeks of outbreak. In April, the number of COVID-19 admitted to ED progressively decreased, whereas the age of the patients increased significantly ($p<0.001$). Similar results were observed by Petrilli et al. in the City of New York with a shift of two weeks, due to the different pandemic period in Italy and USA,[16] and it is probably in part due to the outbreaks identified in residential care homes.

The change in number of patient's admission in March and April only partially reflects the trend of outbreak in Piedmont Region (figure 1) that, after the increase in the second part of March, still increased in the first part of April and decreased more slowly in the last observed period. This fact, together with the lower percentage of discharged patients after ED visit, suggests that a different organisation of COVID-19 patient care was effective in Piedmont, both from National Health Service and GPs. In fact, a reduction of inappropriate accesses of patients with mild symptoms was observed, suggesting a better management at GPs level. With regard to demographic distribution, a male prevalence was observed also in this study, similarly to previous findings.[17] Interestingly, this pattern was overturned in the last two periods in April, after public health measures of containment were applied in Piedmont Region, reducing the spread of the disease in the active adult population. In fact, after the application of lockdown measures, the SARS-CoV-2 outbreaks were mainly among health professionals and residents of residential care homes.

This change in population characteristics is also evident looking at comorbidities at the moment of admission. In fact, as expected, the number of patients presenting one or more comorbidities increased overtime together with the increase in median age.

The patients admitted in the month of April were impossible to treat as out-patients, because they were older, with several comorbid conditions, and showed altered laboratory tests and higher need of respiratory support than patients previously assisted. Anyway, they appeared to have less typical findings of COVID-19 pneumonia at first level imaging.

Regarding patients' outcomes, the admission in HDU was higher in the month of March (almost a half of patients) and then decreased, while an increase in medical wards (low intensity of care wards) was observed in the last two periods. Furthermore, even if older patients with a higher prevalence of comorbidities were admitted, a decrease in the access to the ICU and in the length of stay for hospitalised people was evident. Mortality tended to decrease during the hospitalisation, except for the last period (16th-30th April). Petrilli et al.[16] showed that in New York critical illness and mortality decreased over time. They advocated an improvement in outcomes over time due to familiarity with the disease, ongoing iteration of protocols and practices in response to observed outcomes, and initiation of new treatments. Similarly in Piedmont Region, an improvement in diagnostic path, outpatients healthcare reorganisation, and improvement in guidelines for therapy and hospital care for COVID-19 patients was observed during outbreak period.[18,19]

The main limitation of this study is the limited sample size composed of patients recruited in a single hospital in the province of Turin. However, it is likely that the consecutive collection of all patients admitted to the ED in the reference hospital of a large area of the province is representative at least of the Regional management of the SARS-CoV-2 epidemic.

In conclusion, the results of this study suggest that in few weeks of COVID epidemic changed the management of the COVID-19 patients at the hospital level and probably at territorial level, resulting in a different population who accessed to the ED both from baseline characteristics and clinical outcomes.

**Conflicts of interest:** none declared.

**Acknowledgments:** all the information was registered in a dedicated area of the web EPICLIN platform (https//new.epiclin.it/it/studies), developed by Clinical Epidemiology Unit of the 'Città della salute e della scienza' University Hospital. The Authors would like to thank the Epiclin-COVID working group for the CRF setting and the support in the data managing and the Health Management and the General Direction of the San Luigi Gonzaga hospital for the contribution to data collection.

**Submission date:** 16.07.2020
**Accepterd on:** 26.09.2020

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