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Characteristics and Outcomes of 1220 Patients with SARS-Cov-2 Infection Hospitalized in Central Tuscany Area (Italy): New Models of Hospital Management during the Phase 1 of Covid-19 Emergency

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ABSTRACT

Covid-19 emergency deeply impacted on hospitals, both on organizational patterns and structural reorganization. Patients with Covid-19 disease were mainly treated in hospitals; therefore, a big number of data was recorded during the pandemic phase. The analysis of these data could be helpful to understand some aspect of the clinical course of disease. At the moment, limited information is available concerning features of clinical presentation and outcomes of patients requiring hospitalization.

The present study has been conducted on data recorded in the period between February 24, 2020 and May 18, 2020, during Covid-19 emergency, in the hospitals belonging to Central Tuscany Local Health Authority network. Hospitalization, discharge, mortality, length of stay, distribution about age and gender have been evaluated in a large area of Tuscany (Italy), with a total population exceeding 1,600,000 inhabitants.

The analysis of these data highlights that Covid-19 disease leads to a higher hospitalization and mortality rate in males. In addition, in male population, the mean age of diagnosis and death was lower. Moreover, the strategy of hospital reorganization, based on high care medical setting, outside intensive care unit, resulted an effective model of hospital management to counteract Covid-19 emergency. Finally, the present study underlines the importance of creation of low care units, outside of the hospital setting, to reduce the hospital bed occupancy during the phase one of Covid-19 emergency.

INTRODUCTION

Central Tuscany Local Health Authority (CT-LHA) is born in 2016 by merging of four former LHAs, each of them covering a district based on a big/medium town (Florence, Pistoia, Prato, Empoli) [1,2]. Currently, this organization, headquartered in Florence and including 13 hospitals and 220 territorial health structures, manage public health services for over 1.600.000 inhabitants living in this large area [3]. CT-LHA is the largest health authority in Tuscany, where health services are also provided by two other LHAs (Northwest and Southeast LHA) and 3 university centers located in the cities of Florence, Siena and Pisa. For the extension of its territory and the number of patients managed, CT-LHA can be considered one of the most important and widespread in Italy.

Following World Health Organization (WHO) declaration of public health international emergency due to Covid-19 (30/01/2020) [4] and National Declaration of health emergency (31/01/2020) [5], Tuscany started to organize "ad hoc" strategies to counteract SARS-Cov-2 epidemic outbreak.

Only seven of the 13 hospitals, according to their characteristics, structures, organization and ability to manage severe emergencies, were chosen and reorganized to treat Covid-19 patients. Consequently, Hospital departments not directly involved in Covid-19 treatment, underwent to a severe reduction, reorganization and optimization of human and structural resources.

At first, the seven Covid-19 hospitals managed the incoming cases using the normal amount of beds of each operating unit; as the emergency spread through the area and the number of cases rapidly raised, new Covid-19 positive areas were created. At the peak of the infection (in central Tuscany around the first week of April) [6], 582 medical ordinary beds, outside Intensive Care Units (ICU), were used and the strategy was focused on the institution of high care medical setting with the possibility of Non Invasive Ventilation (NIV).

So far, limited information is available describing the clinical presentation and outcomes of patients requiring hospitalization for Covid-19 disease. In the literature, morbidity and mortality resulted higher in male population [7,8].

Goal of this analysis is the description of the features and outcomes of patient with Covid-19 recovered in CT-LHA hospitals, in not ICU medical settings, between 24/02/2020 and 18/05/2020, that is the date of the end of pandemic phase 1, according to Regional regulation n. 56 - 57/2020 [9,10].

MATERIALS AND METHODS

All consecutive patients who required hospital admission in non-ICU beds, in one of the seven hospitals with Covid-19 specific setting, between 24/02/2020 and 18/05/2020, with severe acute respiratory syndrome related to SARS-CoV-2 infection, confirmed by positive result on polymerase chain reaction testing of a nasopharyngeal sample, were included.

Data have been extracted from CT-LHA's IT database. All hospitalizations have been tagged with diagnostic code 078.89, according with Health Ministry indications [11], describing SARS-CoV-2 infection. To ensure the completeness of data, each hospital carried out a check of computerized medical records, adding the diagnosis code if missing. Data collected by each hospital, concerning patient demographic information and outcomes, including lengths of hospitalization, discharge and mortality, were processed and analyzed. Length of hospitalization was considered from the admission to discharge or time of death or the end of the study period, without including stay in emergency department.

RESULTS

Total amount of hospitalizations was of 1220, splitted among 7 hospitals in the percentages shown in table 1. Case distribution reflects quite faithfully the ordinary geographic distribution of the population. Florence area with its 4 hospitals ordinary collects 51% of CT catching area and has recorded 48% of total hospitalizations during Covid-19 emergency. Small spreads were shown in Pistoia hospital where ordinary collection is 18% of the CT catching area and has recorded 24% of total hospitalizations in the same period; the same happened in Empoli hospital whose catching area is ordinary around 15% and recorded only 10% of hospitalizations.

Average age of hospitalized patients was 71.9 years (Table 2); differences related to gender show that 652 were male (53% of the total, average age 69.1) versus 568 females (47% of the total, average age 75.1). Average length of stay for the total amount considered was 12.8 day with no difference between genders.

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Table 1: Total hospitalizations, percentage on the total hospitalizations, catching area, percentage on catching area.

Hospital	Hospitalizations (n)	% hospitalizations on total	Catching area (n)	% catching area on total
Santo Stefano (Prato)	224	18%	257716	16%
San Jacopo (Pistoia)	293	24%	292473	18%
Mugello (Florence)	40	3%	63847	4%
Santa Maria Nuova (Florence)	104	9%	378839	23%
Santa Maria Annunziata (Florence)	256	21%	184599	11%
San Giovanni di Dio (Florence)	181	15%	209302	13%
San Giuseppe (Empoli)	122	10%	241884	15%
Total	1220	100%	1628660	100%

Table 2: Total hospitalizations by hospital, percentage of hospitalizations on CT LHU's total, percentage by gender and age, average total stay by hospital and by gender.

Hospital	Male (n)	Percentage of male on male total	Female (n)	Percentage of female on female total	Average age (years)	Average length of stay (days)	Average male age (years)	Average male length of stay (days)	Average female age (years)	Average female length of stay (days)
Santo Stefano (Prato)	124	55%	100	45%	71.3	13.0	68.0	13.2	75.3	12.8
San Jacopo (Pistoia)	154	53%	139	47%	71.5	12.9	68.8	12.8	74.6	13.0
Mugello (Florence)	16	40%	24	60%	72.0	11.5	7.8	12.9	70.9	10.5
Santa Maria Nuova (Florence)	55	53%	49	47%	71.1	9.8	69.7	9.8	72.7	9.9
Santa Maria Annunziata (Florence)	137	54%	119	46%	72.4	12.5	68.7	12.3	76.7	12.7
San Giovanni di Dio (Florence)	93	51%	88	49%	75.4	14.2	72.4	13.8	78.6	14.6
San Giuseppe (Empoli)	73	60%	49	40%	68.6	13.3	66.9	13.9	71.1	12.4
Total	652	53%	568	47%	71.9	12.8	69.1	12.8	75.1	12.7

The total amount of deaths in the considered period was 252, 21% on total hospitalized patients (Table 3). Among 252 dead patients, 144 were male (22% of total hospitalized males) and 108 were female (19% of total hospitalized females). Average age of died patients was 83.4 years, after an average length of stay in hospital of 9.7 days. On a gender base analysis, average age was 81.6 years after 10.3 days in males versus 85.8 years and 8.8 days of length of stay in females.

940 patients (77% of total hospitalizations) were discharged, including 496 males (76% of hospitalized males) and 444 females (78% of hospitalized females), until 18/05/2020 (Table 4). Average age was 68.7 years after an average hospitalization time of 13.6 days. On a gender base analysis, average age was 65.5 years in males and 72.2 in females; no significant differences in average length of stay between genders and compared to general recorded data.

DISCUSSION

Since a novel coronavirus was first identified in Wuhan, Hubei province in China in December 2019, the number of cases increased abruptly, with the infection spreading rapidly to other Chinese cities and too many other countries around the world [7]. In the present study data, concerning hospitalization, discharge, mortality, length of stay, distribution about age and gender, were recorded in the period between February 24, 2020 and May 18, 2020, in 7 hospitals managed by CT-HLA and dedicated to receive and treat patients with SARS-Cov2 infection. The total amount of hospitalizations in the 7 different hospitals reflects the geographical distribution of the population, thus confirming a homogenous virus transmission on the whole CT-LHA area. Recorded difference between hospitalizations (24%) and catchment area (18%) in Pistoia could be explained by an infective cluster developed in this area. Empoli's performance, on the contrary, could be explained by a lesser virus circulation in this area. Both hypotheses need specific focuses and thorough investigations to be confirmed.

We observed an inversion in male/female hospitalization ratio compared to general population, usually greater for females (52% *vs* 48%); this is significant for a typical clinical expression of the viral infection in males, needing a greater frequency of hospital assistance and hospitalization than in females. Considering the deaths' outputs, we can affirm again that this virus is responsible of more aggressive symptoms in male patients and a worst prognosis compared to female patients. Differences in age reflects again differences recorded in total hospitalizations and in population too and this distribution is similar to that reported from China and USA [7,8].

San Giovanni di Dio Hospital (Florence) has recorded an average age (75.4 years) higher than in the other hospitals and overall in CT-LHA; this is probably related to the fact that people living close to this hospital and attending its services is the oldest in the area, having a life expectation of 82.4 years from birth versus 81.6 years of average age in CT-LHA. For the same reason also a longer time of hospitalization (14.2 days) compared to an average time of 12.8

Table 3: Number of total deaths by hospital, percentage of deaths on hospitalized, number of deaths by gender, percentage of deaths by gender, average age by gender, average length of stay before death by gender.

Hospital	Deaths (n)	Percentage of deaths on total	Male deaths (n)	Percentage of male deaths on male total	Female deaths (n)	Percentage of female deaths on female total	Average age of deaths (years)	Average length of stay of deaths (days)	Average male age of deaths (years)	Average male length of stay of deaths (days)	Average female age of deaths (years)	Average female length of stay of deaths (days)
Santo Stefano (Prato)	39	17%	24	19%	15	15%	79.5	13.3	76.7	15.0	83.9	10.7
San Jacopo (Pistoia)	54	18%	32	21%	22	16%	83.6	9.8	81.4	10.6	86.7	8.6
Mugello (Florence)	8	20%	3	19%	5	21%	84.9	7.5	88.7	8.7	82.6	6.8
Santa Maria Nuova (Florence)	21	20%	14	25%	7	14%	84.1	7.4	81.4	7.1	89.6	7.9
Santa Maria Annunziata (Florence)	53	21%	28	20%	25	21%	82.9	8.5	81.4	8.4	84.6	8.6
San Giovanni di Dio (Florence)	49	27%	27	29%	22	25%	84.8	9.0	83.6	9.0	86.3	9.1
San Giuseppe (Empoli)	28	23%	16	22%	12	24%	86.4	9.9	85.3	11.0	87.8	8.4
Total	252	21%	144	22%	108	19%	83.4	9.7	81.6	10.3	85.8	8.8

Table 4: Number of total discharges by hospital, percentage of discharges on hospitalized, number of discharges by gender, percentage of discharges by gender, average age by gender, average length of stay before discharge by gender.

Hospital	Discharges (n)	Percentage of discharges on total	Male discharges (n)	Percentage of male discharges on male total	Female discharges (n)	Percentage of female discharges on female total	Average age of discharges (years)	Average length of stay of discharges (days)	Average male age of discharges (years)	Average male length of stay of discharges (days)	Average female age of discharges (years)	Average female length of stay of discharges (days)
Santo Stefano (Prato)	180	80%	96%	77%	84	84%	69.5	12.9	65.7	12.7	73.8	13.2
San Jacopo (Pistoia)	221	75%	116	75%	105	76%	67.6	13.7	648	13.4	70.6	13.9
Mugello (Florence)	32	80%	13	81%	19	79%	68.8	12.5	70.3	13.8	67.8	11.5
Santa Maria Nuova (Florence)	82	79%	41	75%	41	84%	67.9	10.5	65.7	10.7	70.2	10.2
Santa Maria Annunziata (Florence)	201	79%	109	80%	92	77%	65.6	13.5	65.5	13.3	74.4	13.8
San Giovanni di Dio (Florence)	132	73%	66	71%	66	75%	71.9	16.1	67.9	15.8	76.0	16.5
San Giuseppe (Empoli)	92	75%	55	75%	37	76%	63.7	14.3	62.3	14.7	65.7	13.6
Total	940	77%	55	75%	37	76%	63.7	14.3	62.3	14.7	65.7	13.6

in CT-LHA and an average discharges' hospitalization time clearly higher than in the other hospital (16.1 *vs* 13.6) were recorded in San Giovanni di Dio hospital.

The study shows a lower mortality than literature [7,8]. This is probably the result of the CT-LHA choice to give great importance to creation in all 7 hospitals of high care beds outside ICU setting, characterized by multi-professional and multidisciplinary assistance. This strategy allowed not only to minimize hospitalizations in ICU beds, but also to provide a better health care to patients recovered in ICUs that were able to hospitalize only those patients who needed intubation without a full occupancy of ICU-beds.

Also, the average length of stay is quite low. This is the result of the implementation of discharge procedures towards territorial structures, in particular towards low care hospital with H24 medical and nursing care, created ad hoc for the management of Covid-19 cases in post-discharge.

The strength of this study is represented by the manual review of the data by Health Directors of each of the seven hospitals involved on electronic health record database.

On the contrary a main limitation is represented by coexistence of Covid-19 codification as secondary diagnosis in hospital admissions for other reasons so the total amount of patients hospitalized just for Covid-19 disease could be slightly overrated. We are planning to run a specific study on this aspect.

CONCLUSION

Covid-19 disease has created significant management difficulties at the beginning as pathogenesis, clinic manifestations and evolution

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were unknown. Therefore, first experiences and parameters control, compared with international literature and homologous working group's experiences led to significantly better approaches and treatments resulting in higher medical performances.

Covid-19 disease has mainly affected subjects frail by age and consequently for comorbidity whose influence we reserve the right to evaluate in a further study.

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