

Cardiac patient care during a pandemic: how to reorganise a heart failure unit at the time of COVID-19

European Journal of Preventive
Cardiology
2020, Vol. 27(11) 1127–1132
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Cardiology 2020
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DOI: 10.1177/2047487320925632
journals.sagepub.com/home/cpr



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Abstract

To date, the pandemic spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has involved over 100 countries in a matter of weeks, and Italy suffers from almost 1/3 of the dead cases worldwide.

In this report, we show the strategies adopted to face the emergency at Centro Cardiologico Monzino, a mono-specialist cardiology hospital sited in the region of Italy most affected by the pandemic, and specifically we describe how we have progressively modified in a few weeks the organization of our Heart Failure Unit in order to cope with the new COVID-19 outbreak. In fact, on the background of the pandemic, cardiovascular diseases still occur frequently in the general population, but we observed consistent reduction in hospital admissions for acute cardiovascular events and a dramatic increase of late presentation acute myocardial infarction. Despite a reduction of healthcare workers number, our ward has been rearranged in order to take care of both COVID-19 and cardiovascular patients. In particular according to a triple step procedure we divided admitted patients in confirmed, suspected and excluded cases (respectively allocated in “red”, “pink” and “green” separated areas).

Due to the absence of definite guidelines, our aim was to describe our strategy in facing the current emergency, in order to reorganize our hospital in a dynamic and proactive manner. To quote the famous Italian writer Alessandro Manzoni ‘It is less bad to be agitated in doubt than to rest in error.’

Keywords

COVID-19, heart failure unit, cardiac care

Received 10 April 2020; accepted 22 April 2020

Still it was not absolutely the plague; the use of the word was prohibited, it was a pestilential fever, the adjective was preferred to the substantive, – then, not the true plague, – that is to say, the plague, but only in a certain sense, – and further, combined with poison and witchcraft. Such is the absurd trifling with which men seek to blind themselves, wilfully abstaining from a sound exercise of judgment to arrive at the truth.

Alessandro Manzoni, The Betrothed

1620. It well highlights how uncertainty reigns at the beginning of hard times, such as the current COVID-19 outbreak, and how we should always be ready promptly to change our point of view, beliefs and behaviours dynamically. To date, the pandemic spread of severe acute respiratory syndrome

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Introduction

In 1827 Alessandro Manzoni wrote about the plague in Milan in his famous novel *The Betrothed*,¹ settled in

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coronavirus 2 (SARS-CoV-2) has affected over 100 countries in a matter of weeks, and Italy suffers from almost one-third of the dead cases worldwide.² Few studies have shown how cardiovascular diseases have a strong negative impact on mortality in admitted COVID-19 patients, being more frequent in the most severe cases (up to 25% of the intensive care patients).³ Moreover, arrhythmias, acute coronary syndromes, increases in high-sensitivity cardiac troponin levels, myocarditis, cardiac arrest and acute heart failure are frequently seen in this clinical context.³ It is not clear whether these cardiac conditions are unspecific complications of the higher cardiometabolic demand provoked by COVID-19, the infection-related pro-thrombotic status and inflammatory cascade, direct effects of the virus on cardiomyocytes or simply the results of the higher chance of cardiac patients being seriously infected. Against the background of the pandemic, cardiovascular diseases, which are the first cause of death in western countries, still occur frequently in the general population. However, in the metropolitan

area of Milan, in the past few weeks we observed an up to 50% reduction in hospital admissions for acute cardiovascular events and a dramatic increase of late presentation acute myocardial infarction, due to either security issues (fear of getting viral infection at the hospital) or the increase in emergency response time. In the present paper we describe how our heart failure unit, which used to have 18 rooms for up to 36 hospitalised patients and a large outpatient facility, changed during the COVID-19 pandemic in the past few weeks.

Heart failure unit during COVID-19 pandemic: the way we change our ward

The organisation model of our heart failure unit has been evolving on a daily basis from the mid to end of February 2020, reflecting the increasing number of COVID-19 cases and the growing awareness that this unprecedented situation needed phenomenal teamwork and commitment of the entire personnel (Figure 1). In our hospital and specifically in our heart failure unit,

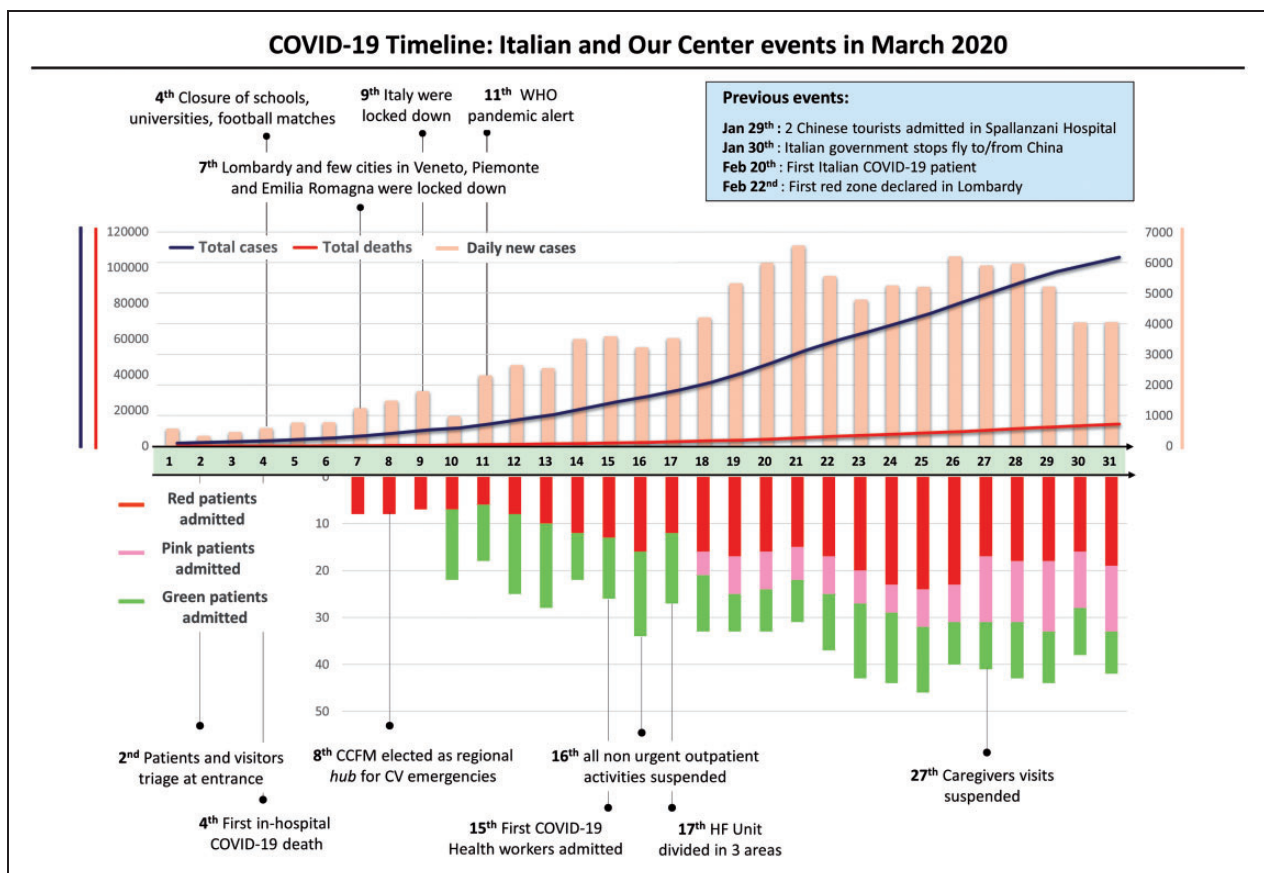


Figure 1. Timeline of events determining the organisation changes in our hospital. In the upper part of the figure we report the Italian epidemiological data and government measures in response to the pandemic. In parallel, in the lower part of the figure we show the strategies adopted in our hospital and the admission rates according to the different areas (green area: COVID-19-negative patients, pink area: suspected COVID-19 patients but with no clear biological evidence, red area: confirmed positive patients).

the organisation changed according to epidemiological data, new clinical needs and government measures. Since the beginning of March we suspended all non-urgent in-hospital activities. Moreover, we have suspended and managed by phone calls or e-mails all non-urgent outpatient visits as we postponed all research protocol visits. A few urgent clinical evaluations were performed in our heart failure outpatient facility, only after fever and respiratory symptoms were excluded in a triage section at the hospital entrance. After a week, our hospital being exclusively dedicated to cardiovascular diseases, the local government decided to convert it into a hub for the treatment of cardiovascular emergencies. This decision was made according to the national recommendations for the management of the COVID-19 pandemic, that built up a hub-and-spoke system to have separate management of infected and non-infected patients (Figure 1). However, inpatients positive for SARS-CoV-2 were increasing progressively. Of note, few COVID-19 patients were already hospitalised due to heart failure when the first Italian patient was identified, thus an in-hospital contagion cannot be excluded. Moreover, with regard to the entire hospital, when the first cases were identified, all healthcare workers started wearing surgical masks during all hospital activities while head covers, eye protection, gloves, gowns and FFP2/FFP3

masks (available in case of aerosol-generating procedures) became fundamental for providing care to infected patients.⁴ Moreover, as non-invasive ventilation (mostly continuous positive-airways pressure; CPAP) was recognised as a fundamental treatment option, new respirators were provided. All suspected and confirmed COVID-19 cases were isolated in dedicated single rooms and wore surgical face masks. Separated ‘clean’ and ‘dirty’ pathways were organised for investigations such as chest computed tomography (CT) which needed immovable instruments.

With regard to our heart failure unit in particular, it was divided into three separate sections: a ‘green’ area in which all COVID-19-negative patients were collected, a ‘pink’ area in which suspected patients but with no clear biological evidence of SARS-CoV-2 infection were isolated, and a ‘red’ zone in which definitive COVID-19 patients were gathered, thus creating a dedicated cohort isolation. The latter solution was mainly implemented to cope with the lack of personal protective equipment (PPE) and to save time, in order to let healthcare workers not change PPE when moving from one patient to another. The algorithm for patient allocation in the three zones is reported in Figure 2. A similar grouping strategy was done in the intensive care unit. Again for disposable equipment shortage a dedicated room was put into action in order to re-use gowns and

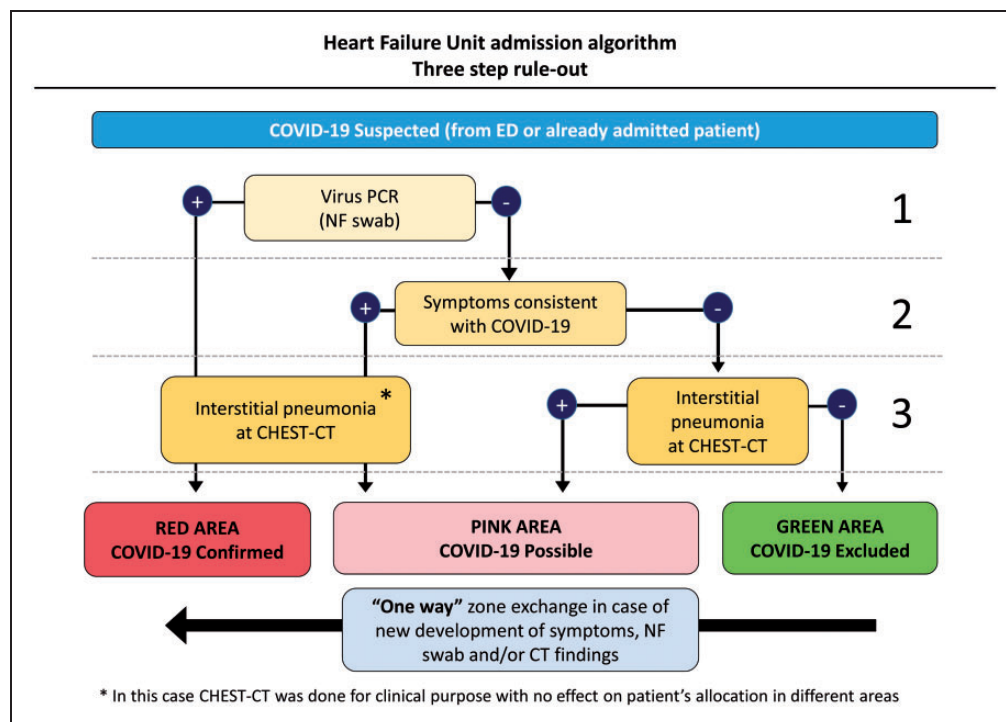


Figure 2. Proposed heart failure unit admission algorithm. We adopted a three-step strategy to determine the patient admission flow in the hospital. In order to prevent in-hospital contagion, only patients with triple negative results can be admitted to the green area. ED: emergency department; NF: nasopharyngeal; PCR: polymerase chain reaction.

eye protection after a specific disinfection procedure through a special kit.⁵ In the red zone, a total of eight fully equipped beds with ECG and peripheral oxygen capillary saturation (SpO₂) monitoring were dedicated to definite COVID-19 patients. At the entrance of the 'red' area a gate was created, where all PPE was available and posters with wearing instructions were well evident to everyone. Inside this area, all is considered to be contaminated by SARS-CoV-2: patients, medical instruments (including ECG and echocardiograph) and even pens, papers and lunch boxes. All of us needed to do our best not to spread the virus outside the 'red' zone. In the 'pink' area, in the absence of a positive swab, patients were housed in full monitored (ECG, oxygen saturation, respiratory rate) double-door single-bed rooms with limited contact with the staff. A cordless telephone was provided in every room to facilitate communication with the patients.

As fever has been reported as one of the peculiar symptoms of the disease (more than 85% of the confirmed cases), body temperature was checked in all the admitted patients three times per day in order to detect new-onset infections. In this regard a 'one way' (green→pink→red) zone exchange was possible based on eventual changes in clinical, radiological and polymerase chain reaction (PCR) data (Figure 2).

As contagion among healthcare workers became a reality, we started measuring the temperature every day at the hospital entrance; we also had to reduce the presence of personnel to guarantee daily activities, having some of us at home, well and ready to work if needed. These needs were counterbalanced by the growing burden of care we had to face with and by

new tasks all of us were on call for. Of interest, self-selected personnel according to age were involved in COVID-19 patient care, as younger personnel appeared to be at lower risk of severe complications. Despite the extensive use of appropriate PPE, a total number of 12 resident healthcare professionals got sick with 'flu-like symptoms during the past month, mostly in the first 2 weeks of the outbreak; in particular five out of 20 nurses including the head nurse, three out of five social health workers and four out of 19 physicians (Figure 3). Among all the healthcare workers at the hospital two cardiologists, two anaesthesiologists, three head nurses and six nurses were admitted and treated in the COVID-19 department. A previously healthy, normal weight, non-smoking 52-year-old cardiologist from our group was admitted to our unit and was treated with a mixture of emotional aspects and strict rules. Our colleague had a 10-day history of high fever, recurrent syncope events, dyspnoea and cough and, according to the general recommendations, he was confined at home. On 15 March a chest CT scan (Figure 4) was performed showing a picture consistent with interstitial pneumonia with typical radiological signs of crazy paving and ground glass opacities. He had moderate signs of respiratory failure (arterial blood gas analysis showed mild hypoxia and hypocapnia with partial pressure oxygen of 69 mmHg and partial pressure carbon dioxide of 30 mmHg). A swab was repetitively negative, but serology was performed showing both IgM and IgG antibodies for SARS-CoV-2. On 17 March the patient was transferred to the newly created 'pink area' and therapy with hydroxyclozoquine

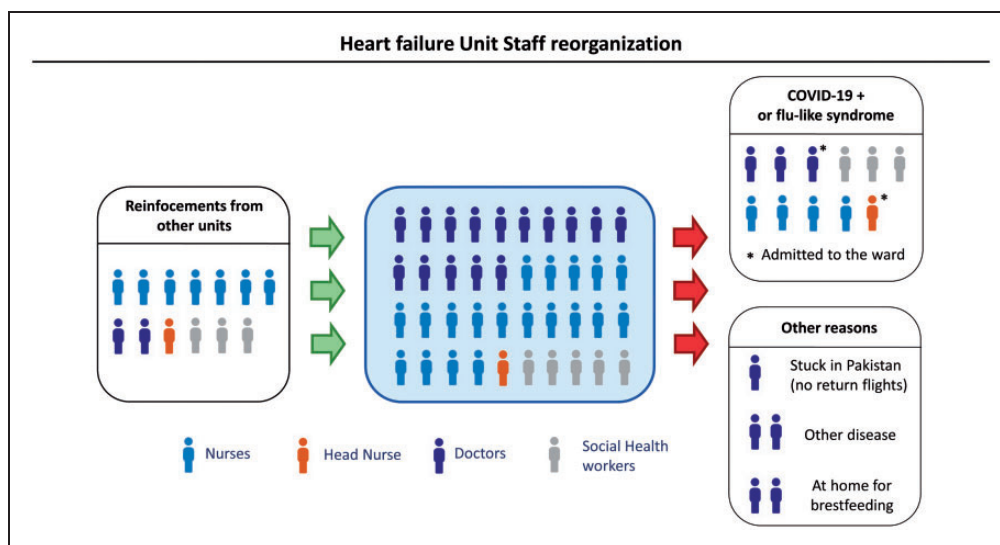


Figure 3. Changes in the heart failure unit staff organisation due to direct and indirect consequences of the Covid-19 pandemic. Colours identify different roles in the unit: blue, doctors; light blue, nurses; orange, head nurse; grey, social health workers.



Figure 4. Chest X-ray showing bilateral opacification (b) that was not evident on a previous X-ray of the same patient 6 years before (a). (c) and (d) Chest computed tomography scan demonstrating typical radiological signs of crazy paving and ground glass opacities consistent with interstitial pneumonia severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) related.

and lopinavir/ritonavir was started together with nasal cannula oxygen and antibiotics. A bacterial superinfection (positive streptococcal pneumonia urinary antigen) was documented, so corticosteroid therapy was not started in the first place. After a slow but progressive clinical worsening which required prolonged CPAP therapy, on 20 March the patient was transferred and enrolled in a clinical trial with tocilizumab. He was finally discharged home on 6 April in better clinical shape, as he texted on the Whatsapp site of the department, usually dedicated to shift organisation and advice. To transfer the patient was a difficult decision which split our group into two parts. Even if the entire department (medical and non-medical staff) was putting all possible effort into our colleague's care, taking care of a suffering friend – sadly a quite common situation in the actual period – was a really hard task and, in the end, transferring him to a more specialised facility was probably the right and more lucid choice, as documented by the following clinical course. To stay with our favourite writer 'in hindsight the pits are full' (Alessandro Manzoni, *The Betrothed*).¹

To compensate for the reduction of heart failure unit healthcare workers two physicians, six nurses, three social care workers and one head nurse have been called on a voluntary basis from other departments. Moreover, we organised the medical activity in shifts in a daily schedule according to the number and the complexity of admitted patients, in order to reduce in-hospital infections, PPE demand and medical personnel exhaustion. Two breast-feeding cardiologists have been left home while two more people were unavailable (one cardiologist stuck in her family house in Pakistan due to the lack of return flights and one cardiologist at home with another disease) (Figure 3). Two data managers, one sleep study technician and three secretaries were left home with smart-working facilities. So that even during the pandemic we were able to collect clinical data by electronic charts and start more than five retrospective and prospective trials on COVID-19 patients.

Last but not least, we had to reduce minimum caregiver visits of hospitalised patients for the first week of this emergency; however, soon after it was completely forbidden, increasing the psychological burden of the

disease, we tried to relieve this partially with daily phone calls to caregivers, keeping them updated on the clinical conditions of their loved ones.

COVID-19 or not COVID-19, we had to take care of both

Despite our hospital being elected as a regional hub for cardiovascular patients who needed urgent care and/or procedures, in the past month a large number of suspected COVID-19 cases were assessed in our emergency department. Most of them self-presented, usually because of an already known cardiac condition being previously managed in our centre or, more likely, due to the insidious clinical picture of coronavirus infection that could share clinical presentation with cardiac diseases (acute coronary syndromes, worsening heart failure, pulmonary embolism, vascular disease or myocarditis). A total of 124 subjects were admitted to our heart failure unit, now the COVID-19–heart failure unit (66% men). Among the admitted patients 78 had at least one positive swab, while 20 more cases had chest CT findings consistent with interstitial pneumonia, leading to a total number of 98 confirmed COVID-19 patients admitted. Sixty-three (50.8%) admitted patients were discharged home, 18 (14.5%) died during the hospitalisation (14 men, 78%), 15 (12.1%) were transferred to other hospitals mostly for intensive care needs (10 men, 67%) and 28 (22.6%) are to date still hospitalised. The high rate of deaths and transfers could reflect our population characteristics, with most of the patients affected to various degrees by cardiac diseases, mostly heart failure. Patients who experienced COVID-19 pneumonia and were stable enough to be discharged home, were provided with a home monitor device, a T shirt with sensors able to detect heart rate, a full 12-lead ECG, respiratory rate and track respiratory motions (L.I.F.E. Italia).⁶ The values could be seen by a server and, in case, were live monitored.

Due to the increasing number of COVID-19 patients in mid-March, 15 beds in the ‘green zone’ were moved onto another hospital floor and managed by dedicated staff. This was done with the purpose of protecting fragile patients from inhospital contagion, because these ‘green’ patients were mainly affected by severe heart failure and to be admitted to the new ‘green’ floor strict ‘triple rule-out’ criteria must be respected (Figure 2). Thanks to this peculiar organisation, we were able to take care of several patients with cardiovascular disease needing hospitalisation, but without COVID-19.

Among others we managed a 62-year-old male patient with left ventricle assist device (LVAD) pump

thrombosis, despite optimal anticoagulation therapy, all the way from the emergency department to the operating room, where a LVAD exchange was performed, and then to the intensive care unit.

In conclusion, we have described how we have modified our heart failure unit during the past month with the aim of continuing to treat our severe heart failure patients, protecting them from inhospital contagion, an eventuality with catastrophic consequences. In parallel, we attempted to cope with the increasing number of COVID-19 patients, trying not to get infected ourselves. The overwhelming velocity of the pandemic forced us to reorganise in a dynamic, proactive manner and to take rapid, arbitrary, innovative decisions. To quote again Alessandro Manzoni ‘It is less bad to be agitated in doubt than to rest in error.’ (Alessandro Manzoni, *The column of infamy*, 1840).⁷

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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