

Schiavonia Hospital response to COVID-19 outbreak: a first single-center experience

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Abstract

Introduction. On 21 February 2020, Schiavonia Hospital (SH) detected the first 2 cases of COVID-19 in Veneto Region. As a result of the underlying concomitant spread of infection, SH had to rearrange the clinical services in terms of structural changes to the building, management of spaces, human resources and supplies, in order to continue providing optimal care to the patients and staff safety. The aim of this article is to describe how SH was able to adjust its services coping with the epidemiological stages of the pandemic.

Material and methods. Three periods can be identified; in each one the most important organizational modifications are analyzed (hospital activities, logistical changes, communication, surveillance on HCW).

Results. The first period, after initial cases' identification, was characterized by the hospital isolation. In the second period the hospital reopened and it was divided into two completely separated areas, named COVID-19 and COVID-free, to prevent intra-hospital contamination. The last period was characterized by the re-organization of the facility as the largest COVID Hospital in Veneto, catching exclusively COVID-19 patients from the surrounding areas.

Conclusions. SH changed its organization three times in less than two months. From the point of view of the Medical Direction of the Hospital the challenges had been many but it allowed to consolidate an organizational model which could answer to health needs during the emergency situation.

Key words

- COVID-19 outbreak
- Italy
- hospital management
- safety

INTRODUCTION

Italy has been one of the most impacted country in the European Union by the SARS-CoV-2 pandemic. Such disease represented a challenge to the Italian NHS, in terms of remodeling services, coping with the increased hospitalization rate and growing demand of intensive care unit (ICU) beds [1-3]. In Veneto Region, on 31st March, there were 9625 confirmed COVID-19 cases, and of these 2368 (25%) were in the local health unit (ULSS) 6 Euganea healthcare authority area [4].

The ULSS 6 Euganea is one of the most populous

ULSS of the Region consisting of 101 municipalities covering an area of over 2127 sq km. On 1 January 2019, it counted 931 582 inhabitants. It is composed of five districts. In this context four Network Hospitals, two Subacute Hospital Nodes and one Hub University Hospital operate.

The first cluster of the SARS-CoV-2 epidemic in Veneto occurred in Vo' Euganeo, a town of approximately 3300 inhabitants, in the Southern Padua District. This Health District covers 46 municipalities for approximately 180 000 inhabitants.

The Schiavonia Hospital is the major Hospital Presidium of the Southern Padua District. It was built in 2014 and it has been carried out in project financing. In the same area there are also two Subacute Hospital Nodes principally dedicated to post-acute care. The Clinical Laboratory of Schiavonia Hospital is the microbiology reference center for the whole ULSS 6.

On 20 February 2020, the Hospital Infectious Diseases specialist identified two patients, both residing in Vo' Euganeo and admitted (on 16 and 19 February, respectively) with fever, type 1 respiratory failure and interstitial pneumonia, preceded by mild diarrhea. The patients were tested for common pneumotropic pathogens (common bacterial respiratory pathogens, influenza A/B viruses, parainfluenza 1-2-3-4 viruses, RSV, adenovirus, coronaviruses 229E-HKU1-OC43-NL63, human metapneumovirus, rhinovirus/enterovirus, *Bordetella pertussis*, *Chlamydomphila pneumoniae*, *Mycoplasma pneumoniae*, *Legionella* spp.), for less frequent pathogens (acid-fast bacteria, HSV, VZV, CMV, *Pneumocystis jiroveci*, *Leptospira* spp., *Coxiella* spp.) and fungal biomarkers (galactomannan, serum (1,3)- β -D-glucan). All tests resulted inconclusive. After a careful medical history, it appeared that the two patients used to attend the same local bar frequented by Chinese people. Although patients had no history of recent travel to endemic areas, it was considered appropriate to proceed with performing nasopharyngeal swabs for SARS-CoV-2. On the next day, Schiavonia Hospital confirmed the first 2 cases of COVID-19 in Veneto.

This article aims to describe the measures taken by Schiavonia Hospital to manage the current evolving challenges, including identification of risks, strategies to prevent the transmission of COVID-19 in healthcare setting, maintaining an efficient response for all patients with urgent conditions and an adequate staff support [5-8].

MATERIAL AND METHODS

Since 21st February three different periods can be identified.

The first period (21 February - 7 March 2020) started with the identification of the first two cases at Schiavonia Hospital and of the outbreak in Vo' Euganeo town. In this phase the hospital was completely closed to outpatient, except for saving-life therapies.

The second period (8 - 15 March 2020) was characterized by the hospital reopening. This could happen because all the nasopharyngeal swabs for SARS-CoV-2 carried out in health-care workers (HCW) tested negative, the trend of the epidemic was not yet known and external stakeholders and local mayors made pression for a return to routine activities. The facility was divided into two treatment areas, named COVID-19 and COVID-free, according to the regional programming, which identified Schiavonia Hospital as the only ULSS 6 facility that had to reserve an area to treat COVID-19 patients [9]. In this phase it was also established the national lockdown following the surge of the pandemic.

In the third period (16 March 2020 - 3 May 2020) Schiavonia Hospital was identified as a completely dedicated COVID-19 Hospital [10]. It was designated

COVID-19 Hospital because it is newly built, organized in separate modules and with technologies and systems suitable for supporting high volumes of medical gas (oxygen). This involved important structural and organizational changes also because before the COVID-19 emergency Schiavonia Hospital was not a hospital for treatment of infectious diseases.

On 21 February 2020 three Task Forces of different decisional levels were set up:

- a Regional Task Force (RTF), composed by the Government of Veneto Region, a regional scientific committee and Civil Protection that coordinated the regional emergency;
- an ULSS 6 Emergency Task Force (ETF), formed by ULSS 6 General Manager, Chief Medical Officer and local health authorities that coordinated both the hospital response and the Prevention Department's activities;
- an in-hospital Crisis Unit (HCU), composed by the Director and all staff of the Hospital Medical Direction, the Directors of Medical, Surgical and Diagnostic Departments, the Occupational Physician, the Director of Healthcare Professions and the Project Financing Manager.

In the next paragraphs each period is described in details, analyzing the following items:

- short description of beds disposition;
- hospital activities;
- logistical changes;
- communication;
- surveillance on HCW.

RESULTS

First period: Veneto outbreak and hospital's isolation (21 February - 7 March 2020)

Immediately after the identification of the first cases the RTF ordered the isolation of Vo' Euganeo town.

The ETF, according to the decision of the Italian Ministry of Health, ordered the closure of the hospital facility giving indications on the measures that had to be taken to manage the emergency [11]:

- nobody was allowed to enter or leave the facility;
- as a precautionary measure, access to the wards was prohibited for non-healthcare workers;
- nasopharyngeal swabs for SARS-CoV-2 were performed to all people present in the hospital at the time of closure, giving priority to patients' relatives to allow them to leave the facility in presence of a negative result. The HCU decided to test outpatients, followed by HCW and then hospitalized patients;
- swabs to inpatients were scheduled for the following day;
- Personal Protective Equipment (PPE) were provided to everybody;
- a cordon sanitaire was established to secure the area, keep order and speed up swabs transport to the Veneto reference laboratory, located in Padua;
- six special field tents were arranged outside the hospital, to be used in case of need.

At the time of closure there were 47 patients in the Emergency Room: 15 with triage yellow code, 9 with triage green code and 23 with triage white code. The

Director of the Emergency Room invited patients in the waiting area, not yet taken in charge, to move towards other ULSS 6 hospital facilities in order to be evaluated and taken in charge as soon as possible.

The HCU immediately established a quick form to screen all present people, in particular revealing presence/absence of respiratory symptoms and body temperature.

Over 600 swabs were performed during the first night. The next day the total amount rose to 1231 swabs (Table 1). Laboratory capacity reached saturation very early, therefore, in order to have the response that allowed the subject to leave the hospital, the waiting time progressively increased to on average of 18 h.

No HCW tested positive, while two other patients had positive swabs (also these patients came from Vo' Euganeo).

The total number of people resident in Vo' Euganeo at the moment of the closure of the hospital was 16 (including relatives, patients and HCW), of whom 6 tested positive: 4 patients and 2 relatives of one of them. The four patients were hospitalized in three different Units: internal medicine, ICU and orthopedics; the one recovered in ICU died on the night of February 21. His death was the first one in Italy due to COVID-19; none of the positive patients had significant comorbidities.

The three positive patients were transferred to Padua University Hospital, where the Infectious Diseases Unit was ready for the isolation of confirmed cases.

The HCU therefore defined four "transit wards" where COVID-19 patients had stayed: ER, internal medicine, ICU and orthopedics (Figure 1). The ETF decided that patients admitted in non-transit wards who tested negative, could be discharged, instead those admitted in transit wards had to remain quarantined in hospital even if dischargeable.

Surveillance on HCW

In the early phase of the outbreak, the situation was rapidly evolving so hospital guidelines were modified frequently. Due to excessive increasing of laboratory response times it was established that:

- all HCW entering shifts had to undergo nasopharyngeal swabs for SARS-CoV-2;
- HCW could leave the hospital without having to wait for swab result if asymptomatic at the end of the shift;
- if the swab tested negative HCW could continue normal work shifts;
- if the swab tested positive or they were symptomatic they had to stay home, quarantined;
- all HCW were provided with appropriate PPE.

Hospital activities

Although the hospital was closed, HCU and ETF assessed the clinical activities that had to remain guaranteed: clinical laboratory and intra-hospital surgical emergencies for inpatients, dialysis and chemotherapy, as life-saving therapies, both for inpatients and outpatients.

Dialysis and chemotherapy services could remain open for outpatients because the areas dedicated to these activities had independent entrance gates.

According to ETF priority lists, surgery and outpatient clinics had to be re-evaluated in order to define urgent cases that needed to be moved to other ULSS 6 hospitals or to outpatient settings.

The ER was closed, so the Emergency Service of Transports, coordinated at provincial level, diverted all requests to other hospitals of ULSS 6 (Table 2).

Logistical changes

These events required a rapid reorganization of the hospital as a whole.

Access control was essential to reduce the risk of viral transmission to other patients or HCW. For this reason, specific active gates were created:

- *gates for the entrance of HCW and other hospital staff*: entry times were scheduled to avoid overcrowding (6.30-8.00 for HCW, 8.00-8.30 for administrative staff); moreover, relatives could give personal belongings to dedicated staff who provided to deliver them to hospitalized patients;
- *gate for dialysis and oncology*: independent access where outpatients were identified and registered;
- *gate for pharmaceutical assistance*: independent access through which medical supplies were distributed on appointment to outpatients.

At each gate: people had to fill in a form with their personal details; body temperature was measured using infrared thermometers to recognize any person with fever; surgical masks were distributed to protect against droplet transmission.

Relatives' visits were suspended. In exceptional cases (end-of-life stage) only one person was allowed to enter, wearing proper PPE, after Medical Direction authorization.

As the HCU ordered the closure of the hospital canteen and inner bar to avoid crowding, the catering was reorganized through distribution of meals in disposable trays both for HCW and inpatients, maintaining the possibility to order differentiated meals according to patients' nutritional needs.

Table 1

Total number of nasopharyngeal swabs for SARS-CoV-2 performed during hospital closure and tested positive

Profile	N swabs	Positive test
Healthcare workers	695	0
Administrative staff	46	0
Patients	344	4
Others	146	2
Total	1231	6

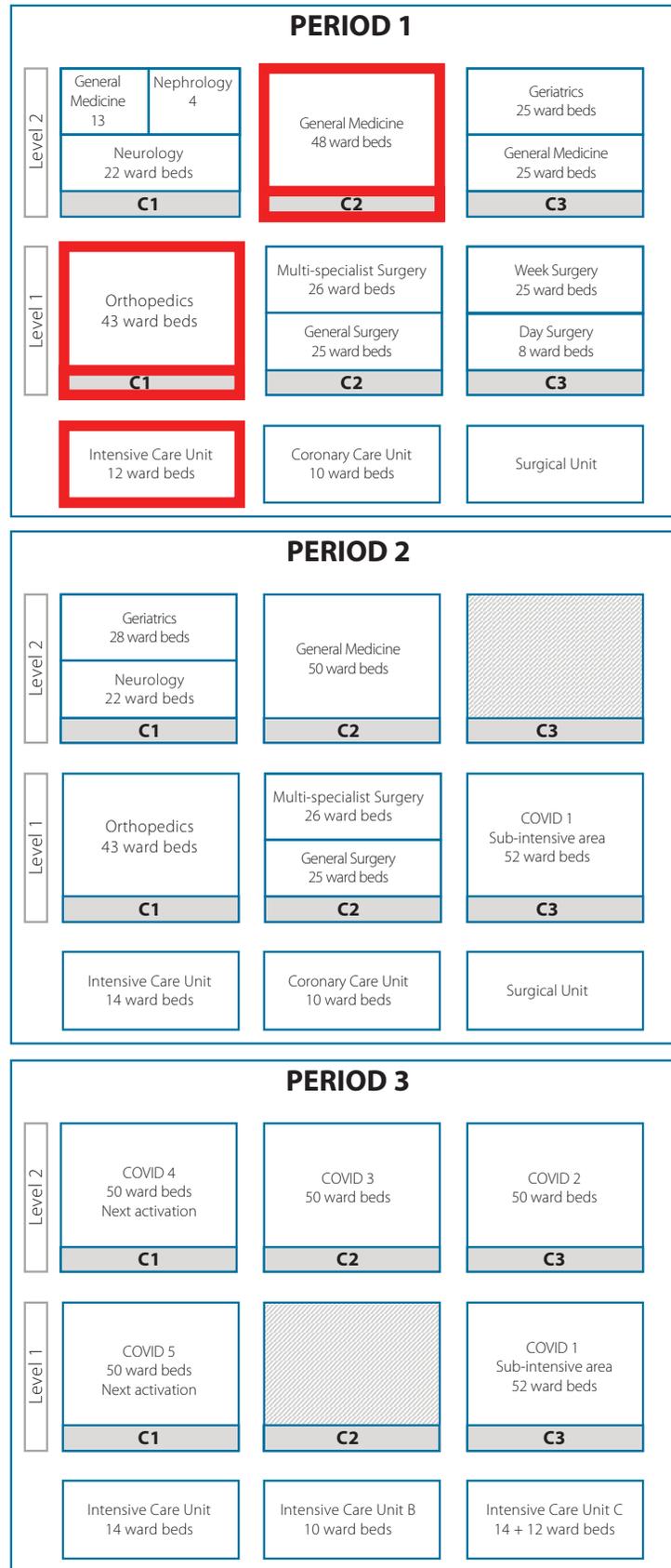


Figure 1
Changes in the arrangement of beds in the different Periods of pandemic; in Period 1 transit wards are highlighted with thick edge.

Communication

- *external communication:* Communication took place through press releases and updated posts on social media (Facebook, Instagram) to keep the population informed about the rapidly changing situation;
- *internal communication:* The ETF communicated with the hospital by registered letters. The HCU interfaced with the Department Directors who communicated the decisions taken to the respective Units.

Second period: hospital re-opening (8 - 15 March 2020)

Before the re-opening, ordered by the ETF, the hos-

pital was completely sanitized following WHO procedures.

Hospital activities

The hospital was divided into two separated areas: one dedicated to patients without infection and one to COVID-19 patients. COVID-19 area was activated in a modular way based on the availability of HCW who had been moved from other hospital sectors that had been closed.

The COVID-free area was organized in order to guarantee (Figure 1, Table 2):

- 100 beds for internal medicine (including activities of neurology, cardiology, nephrology and geriatrics);

Table 2
Reallocation of hospital activities during COVID-19 emergency

Hospital activities	Period 1			Period 2			Period 3		
	Guaranteed	Relocated to subacute hospital nodes	Relocated to other ULSS6 hospitals	Guaranteed	Relocated to subacute hospital nodes	Relocated to other ULSS6 hospitals	Guaranteed	Relocated to subacute hospital nodes	Relocated to other ULSS6 hospitals
Clinical Laboratory	X	X*		X	X*		X	X*	
Dialysis	X			X			X		
Oncology- day hospital	X			X					X
Radiotherapy	X			X			X		
Radiology	X***	X*		X			X***	X*	
Emergency Room			X	X			X**		
Time dependent pathologies (hemodynamic, stroke-trauma network, birth points)			X	X					X
Specialist outpatient visit		X		X				X	X
Ordinary hospitalization for acute patients:									
Medical Area (Covid free)			X	X					X
Surgical Area (Covid free)			X	X					X
Psychiatry	X			X			X		
Day surgery			X	X					X
Outpatient surgery			X	X					X
Digestive Endoscopy			X	X					X
Transfusion activities		X			X			X	
Pharmaceutical assistance	X			X			X		

* for outpatients.
** downgraded to Firt Aid Point.
*** for inpatients.

- 94 beds for surgical patients (orthopedics, general surgery, ENT, urology and gynecology) and 18 beds of obstetrics;
- 8 beds for pediatrics;
- outpatient services (oncology, psychiatry, radiotherapy, radiology, outpatient surgery, digestive endoscopy, clinical laboratory).

Moreover, the ER, including gynecological and pediatric ERs, were fully reactivated.

The COVID-19 area was composed of:

- an Intensive Care Unit that increased from 12 to 14 beds;
- a sub-intensive area of 52 beds of which 8 dedicated to patients who needed non-invasive ventilation and 44 beds, comparable to an infectious disease unit, managed by a multi-professional team composed by internists, geriatricians, anesthesiologists and infectious disease specialists.

Logistical changes

- *Active gates*

Emergency room: it was separated, logistically and physically, in two parallel and non-intersecting paths, one for patients with suspect COVID-19 (called R1 - Risk 1) and one for patients considered not infected (R2 - Risk 2).

The distribution of patients to R1 or R2 was due to a score determined by a specific pre-triage managed by a nurse who evaluated the presence of fever, respiratory symptoms and an epidemiological link to a positive person.

The pre-triage, for people who came to the emergency room autonomously, was performed in a field tent installed near the ER entrance. The subsequent hospital admission continued to be performed separated for suspected or confirmed positive patients and for patients considered non-infected in order to avoid as much as possible the contact between the two groups and reduce the length of stay in an often overcrowded area.

Specific gates for oncology and dialysis

Gates for the entrance of hospital staff: two different entrances for HCW were established in order to avoid bottlenecks. Unlike the previous organization, the sanitary control (temperature and presence of respiratory symptoms) was done at each unit entrance where PPE were also delivered.

Gate for outpatients or visitors: at the main entrance, dedicated staff controlled the access of people in order to avoid overcrowding. Their body temperature was measured and specific informative leaflets explaining the appropriate hygienic measures to adopt were distributed.

HCU decided to implement wall signpost and floor signage to facilitate following established routes.

- *Management of waiting rooms and of access for visitors*

The following precautionary measures were adopted: invite people to hand hygiene with hydro-alcoholic solution; arrange seats to guarantee the safety distance of at least 1 meter; prohibition of entry for care-givers, except those for of minor or disabled patients; limiting the visiting time to the wards to two hours a day for only one person per patient. No entry was allowed in the COVID-19 area.

- *COVID-19 Area: logistical aspects and training of HCW*

This area was completely separated from the others, even with specially built-in walls. Both accesses for ambulance and for HCW were completely dedicated and no access of external people was allowed.

Inside each ward a clean path and a dirty path were established, with specific filter rooms where HCW could wear and take off their PPE.

All HCW were trained on correct PPE utilization with a course of about 8 hours, organized by the Occupational Physician. Moreover, Internal Medicine and Pneumology Directors organized seminars to focus on some typical aspects of the pathology and management of non-invasive-ventilation.

Communication

- *external communication:* in addition to the first period people were encouraged to use telematic booking systems in order to avoid crowding and maintaining physical distancing measures.
- *internal communication:* as in period 1.

Third period: becoming a COVID-19 hospital (16 March 2020 - 3 May 2020)

Hospital activities

According to RTF, the ETF, ordered the suspension of all activities for outpatients at Schiavonia Hospital with the exception of dialysis, psychiatric services and radiotherapy as these units were located in different buildings and could guarantee an independent access to outpatients (Table 2).

The RTF identified the total number of beds that had to be guaranteed in the newly-formed COVID Hospital. The ETF and HCU decided how to activate them (Figure 1):

- 50 beds of intensive care unit divided in 3 sectors: ICU A of 14 beds (previously ICU of 12 beds), ICU B of 10 beds (previously coronary care unit) and ICU C of 26 beds (previously operating theatre and recovery room);
- 52 beds dedicated to patients who needed non-invasive ventilation (COVID 1);
- 200 beds of Infectious Disease, distributed in 4 units of 50 beds (COVID 2-5).

All hospitalized patients were COVID-19 positive. Also, patients who tested positive in other ULSS 6 ERs were admitted to Schiavonia Hospital which became the biggest Covid Hospital in Veneto Region.

It is important to underline that the activation of ICU and Infectious Disease units occurred in a modular way, on the basis of the availability of human resources and technological devices.

For this reason, the ETF defined an internal HCW redistribution plan, both for physicians and nurses, which involved all the hospitals of ULSS 6 in order to meet Schiavonia Hospital's increased need of human resources.

On 7 April 2020 the total number of activated beds comparing to the ETF programming was the following: 34 beds out of 50 of ICU, 52 of semi-intensive care and 100, out of 200 of infectious disease.

The HCU, according to ETF, proceeded to draw up the plan for the reallocation of activities for outpatients

and the reorganization of the emergency and urgent care network, with particular regard to time-dependent pathologies.

In addition:

- ER was downgraded to First Aid Point maintaining the separation into two different areas (R1 and R2).;
- the Clinical Laboratory became the only one in the ULSS 6 authorized by the National Government to process and store nasopharyngeal swabs for SARS-CoV-2;
- twenty-five special bio-containment chambers were set up inside the hospital rooms in order to overcome the lack of negative pressure rooms. These chambers, normally used in the military field, assure high air change volumes and prevent external air contamination each time the door is opened, avoiding the environmental transmission of potentially contagious pathogens.

Medical assistance in COVID 2-3 Units was provided by physicians regardless of specialty, e.g. also surgeons were assigned to the COVID-19 areas principally for back-office activities (e.g. to compile medical records, to contact patient's relatives etc.).

According to their clinical conditions COVID-19 patients could be distinguished into different severity classes, based on the respiratory impairment level and chest X-ray findings, which allowed to identify the appropriate care setting.

During the observation period 16 March - 7 April 2020, 329 hospitalizations (of which 39 in ICU), 5 transfers from the ICU to sub-intensive unit and 52 deaths were registered; 142 patients were discharged with an average of 6 discharges /day, no re-admission was reported.

Logistical changes

Compared with the second period no modifications in active gates was done, except for the visitors' gate that was closed as the access to hospital was prohibited.

The filter zones inside COVID-19 wards was enhanced: dedicated staff was always present to carry out the sanitary control and deliver PPE in order to reduce waste and improve efficiency. Pre-established PPE kits were made available according to the biological risk exposure of each HCW.

The Medical Direction of the Hospital evaluated daily the available stocks.

All hospital waste were considered infected so waste separation was suspended and the service of waste collection was enhanced.

Also medical records were considered contaminated: the indication was to insert them in a double plastic bag and quarantine them in a designated area for at least 14 days.

Corpses were managed according to the rules for corpses of patients with highly diffusive disease.

Surveillance on HCW

The exposure and possible infection of HCW posed a massive challenge to the delivery of medical service. In response to such situation, strategies to contain the in-hospital COVID-19 spreading were intensified ensur-

ing constant surveillance. A field tent was set up near the ER entrance to test HCW considered high risk contacts of a positive co-worker.

On 7 April 2020, 22 out of 695 HCW (3.2%) had a positive nasopharyngeal swab (18 nurses and 4 medical doctors).

A total of 10 out of 22 HCW were operating in the sub-intensive area (COVID 1) and specifically in the sector dedicated to non-invasive ventilation. The use of non-invasive mechanical ventilation can produce aerosol; therefore, the level of protection was increased to prevent further transmission in this high risk ward. All HCW were provided with waterproof overalls, filtering face pieces (FFP3), face shields, gloves and boots.

The Risk Manager identified 3 different hazard areas: high, medium and low risk. According to this classification and to the professional profile of each HCW, HCU was able to provide weekly an adequate number of PPE's kits.

Communication

• *External communication*

In comparison to previous periods the HCU decided to approve two new projects:

- tablets, configured for video-calling, were given to hospitalized patients in COVID area to facilitate communication with relatives;
- activation of a dedicated telephone number to keep relatives in touch with physicians. It was available every day from 9am to 6pm. An operator collected requests from patients' family and transmitted them to the medical staff in order to answer as soon as possible.

• *Internal communication*

In addition to period 1, a psychological support service for hospitalized patients and HCW was activated.

HCW faced enormous pressure, the emergency situation caused psychological problems such as stress, anxiety, sleep deprivation and fear. A psychological intervention plan was developed by a team of psychiatrists and psychologists of the hospital's Mental Health Unit for both patients and HCW:

- video call interview for hospitalized patients who needed psychological support for situations of stress related to their particular situation;
- video call or in person visits for HCW who needed advices and support to deal with acute work-related discomfort.

CONCLUSIONS

In less than two months Schiavonia Hospital changed its organization three times, according to regional health programming. From the point of view of the Medical Direction of the Hospital the challenges had been many and major: first of all the need to respond adequately to an health emergency and to a high number of patients, and, not less important, the need to guarantee adequate logistical, technological, administrative and personnel support in order to allow all HCW to work safely.

An important aspect was the provision of specific medical technologies (eg. medical ventilators, devices

for non-invasive ventilation, High-Flow Oxygen, C-PAP masks, etc.) and PPE. There is risk of a shortage of protective equipment during a pandemic, especially if prolonged. Measures adopted to avoid this and an inappropriate use of PPE included administrative controls and risk mapping related to HCW exposure to infection. Another improvement action to avoid inappropriate use and waste was obtained by individual distribution of pre-packed sets of PPE in filter areas before HCW started their shift.

The most critical aspect was human resources availability. To overcome this a lot of not urgent services both in Schiavonia Hospital and in other facilities were closed to reallocate HCW to COVID-19 units, according to ULSS 6 staff redistribution plan. Thanks to this we were able to open COVID-19 areas in a modular way (about 20 beds for week) according also to the epidemiological phase of the pandemic. To maximize the utilization of medical resources many doctors were asked to practice outside their area of specialty or expertise and, differentiating tasks within the multi-professional team, efficiency and safety were maintained as high as possible.

Since 4 May the hospital developed a process of gradual reopening, starting from outpatient services: clinical laboratory, ambulatory surgery unit and specialistic ambulatories.

Since 8 June also surgical and medical wards were completely operative even though with fewer hospital beds than in the pre-epidemic period.

Urgent care was guaranteed in separated settings for COVID-19 positive and negative patients, moreover all scheduled activities for COVID-19 negative patients were carried out routinely. According to the regional request, an Emergency Plan has been defined to provide a further organizational model able to respond rapidly to a possible second wave of the epidemics.

Authors' contribution

The study was designed by EM, FS, EM and DM with input from all coauthors. The manuscript was drafted by EM, FS, EM; PB, CP and AR provided critical revision for intellectual content and input in writing. JM and RV participated editing the manuscript.

Acknowledgements

The Authors are grateful to Risk Manager Arseni A, Occupational Physician Fioretto M, Project Financing Manager Melinu G, Healthcare Professions Coordinators Spanò A, Sturaro W, Stanziale S, Alfonso M for their assistance, Cesaro M for linguistic revision.

Conflict of interest statement

None.

Ethics approval

Not required.

Received on 9 May 2020.

Accepted on 13 July 2020.

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