

Proceeding Paper

# Transformation of a Ferry in a COVID-19 Ship Hospital: Crew Occupational Safety and Health Issues According to the Experience of Liguria Public Health Port Authority <sup>†</sup>

Antonello Campagna <sup>1,\*</sup> , Paolo Cremonesi <sup>2</sup> and Rosa Maria Russo <sup>1</sup>

<sup>1</sup> Italian Ministry of Health, Liguria Health Port Authority, 16126 Genova, Italy

<sup>2</sup> Department of Emergency Medicine, Galliera Hospital, 16128 Genova, Italy

\* Correspondence: camp.anto@virgilio.it

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**Abstract:** In March 2020, a ferry (Splendid G.N.V. Company, Italy) moored in the port of Genova (Northwest of Italy) was transformed into a medical care facility for COVID-19. The project intended to help infected patients that required low-intensity care, were discharged from hospitals in the Liguria Region and were not yet able to return home. The aim was to share some of the treatment burden of the completely overcrowded local ashore hospitals and to free up bed spaces for patients in the acute phase of the disease. In this work we highlighted under the health port authority perspective the safety issues that the crew faced resulting from the exceptional and very unusual allocation of ashore medical facilities on a passenger ship.

**Keywords:** COVID-19; hospital ship; crew occupational safety



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## 1. Introduction

In March 2020, a ferry (Splendid G.N.V. Company, Palermo, Italy) moored in the port of Genova (Northwest of Italy) was transformed in a very short space of time (one week) into a medical care facility for COVID-19. The project intended to help infected patients that required low-intensity care, were discharged from hospitals in the Liguria Region and were not yet able to return home. The aim was to share some of the treatment burden of the completely overcrowded local ashore hospitals and to free up bed spaces for patients in the acute phase of the disease.

The aim of the present work is to highlight the safety issues that the crew faced resulting from the exceptional and very unusual allocation of ashore medical facilities on a passenger ship.

## 2. Material and Methods

The GNV Splendid (IMO number 9015747) is a long-distance ro-ro ferry (gross tonnage of 39,139 tons, 214 m length), fitted with 567 guest cabins in total (Figure 1).

The area for hospitalization, located on deck 7, consisted of a first module of 27 cabins (23 single and 4 double beds for patients with particular needs (e.g., same family unit, etc.)), followed by a second module consisting of 25 cabins (all single beds), adjacent to the previous one. A common area—the catering zone and fresh air zone—was also set up on the outdoor deck. A plan is reported in Appendix A.

On the ferry, there was a skeleton crew of 60 members, according to the minimum safe manning of the ship. Hospital care was provided by specialized healthcare staff from ashore hospitals.

The implementation of this project and running of the hospital ship involved crew health-protection issues and infection risk management procedures that had been never

faced before. The solutions have been identified and managed by an interdisciplinary group with the cooperation of the local health service, Coast Guard, classification company, shipping company and seafarer's union under the coordination of the local maritime public health authority.



**Figure 1.** The GNV Splendid.

The main problems regarded: the air handling and ventilation system; different access/pathways for crews, healthcare staff/patients/providers; separation and clear signage between safe and unsafe areas; separation of sanitary facilities; organization of the crew/medical staff common area (mess deck); definition of working procedures and training for crew involved in the logistic services (meals preparation, maintenance); safety issues, such as oxygen tank storage; waste management including those presenting a high infection risk; and sewage discharge.

Other measures implemented on crews were the epidemiological surveillance of the crew on a daily basis, and weekly training on the infective risks of COVID-19 and the proper use of PPE.

### 3. Results

From 23 March to 18 June 2020, 191 patients were admitted onto the ship with excellent clinical results and no cases of contagion between crew members were recorded.

The actions identified by the multidisciplinary group (listed in Tables 1 and 2) have been implemented in a very short space of time.

**Table 1.** Actions taken on ship environment.

Issues	Actions
Access to the ferry	Pre-triage of patient ashore. Identification of three separated access pathways (see Figure 2). One RED right-side stern gangway further divided into (a) water side: healthcare staff and clean materials; (b) internal side: patient ambulances and dirty material. Two BLUE central gangway: ship and pantry supplies. Three GREEN left-side stern gangway: crew and external staff for technical interventions.
Air handling and ventilation	Equipment to avoid short circuits between safe and unsafe areas. Air treatment units separated for vertical zones. Additional extraction system from the patient cabins to create negative pressure.
Management of waste and bed linen	All waste from deck 7 was considered hazardous medical waste. Before leaving the hospital area, the waste containers were decontaminated externally with a chlorine solution. Dirty bed linen was placed in double bags (inner biodegradable). Waste and dirty bed linen were removed by specialized companies.
Sewage	Sewage was discharged from the ship by a barge and decontaminated with chlorine.
Therapeutic oxygen	Supplied by tanks located ashore in the port area and was not onboard.



**Figure 2.** Pathways access. 1 external side: health staff, clean material. Internal side: patient ambulances and dirty material 2 ship and pantry supplies 3 crew and external staff for technical interventions.

**Table 2.** Actions specific for crew occupational safety.

Issue	Action
New crew occupational risks	Revision of the risk assessment report. Identification and replacement of four crew members who were classified as high-risk regarding COVID-19 due to pre-existing conditions.
Separation of hospital area from other ferry areas	Bulkheads. Separated pathways. Clear signage.
Preparation of meals	Meals prepared in ferry galley. Food packaged in a disposable single-portion tray. Transport from the galley to the hospital by trolleys in a lift without an operator. The distribution to patients was carried out by car staff. Disinfection of trolley.
Mess	The health staff area was separated from the crew area.
Training and education	Crew had periodic training on the infective risks of COVID-19 and on the proper use of specific PPE.
Hospital area maintenance	Intensive training for the seven crew members of the onboard maintenance staff (the only crews authorized to enter the hospital area). Maintenance operations were performed in the absence of patients whenever possible. Donning and doffing PPE were performed under the direct supervision and assistance of healthcare staff.
Ship safety rules as per SOLAS for emergencies such as fire onboard, man overboard, abandon ship	Revision of the muster list. Emergency instructions to healthcare staff. New training for crew in charge of safety in the hospital area.
Epidemiological surveillance	Self-assessment of the crew's temperature and COVID-19 symptoms two times a day. In case of symptoms or temperature > 37.5 °C, the crew immediately isolated in the cabin and used a PCR swab test. Swab and pre-triage stations were located on the pier ashore

#### 4. Discussion and Conclusions

To the best of our knowledge, this is the only example in the world in which a passenger ship was transformed into a hospital ship for COVID-19 patients in such a short space of time and with such excellent clinical results.

The infection risk procedures ashore need to be adapted and implemented when a hospital is set up in the context of a ship with specific maritime safety rules and the working presence of both health staff and ship crew.

It is also important to underline that the complete separation between crew and healthcare staff was not possible (maintenance staff and crew in charge of safety tasks, according to the muster list, had to enter the hospital area if necessary).

The crew members' experience of health protection—gained in the field and in this project—which is unique in the world, underlines the importance of a multidisciplinary approach and should be a benchmark in other, future, similar hospital ship transformations worldwide.

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**Conflicts of Interest:** The authors declare no conflict of interest. The content represents the views of the author only and is their sole responsibility; it cannot be considered to reflect the views of Italian Ministry of Health or any other body of Italian Government.

## Appendix A. Plan of Deck 7—Hospital Area

**MIN SPLENDID - 7 ATLANTIC DECK**

