Intensive Care Management of Coronavirus Disease

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7.1 Structural and Functional Features of COVID-19 ICU

7.1.1 Structural Characteristics

Given the severe morbidity and mortality of the disease, the COVID-19 outbreak represents a major public health problem not only for clinical physician but also for those who had to set up a healthcare strategy aiming to optimize patient’s assistance [1]. The sudden and unpredicted spreading of COVID-19 prevented to organize an adequate response system to face on the overcrowding of patients in emergency departments (ED) and ICU [2]. An exceptional number of patients accessed healthcare facilities, imposing unprecedented intra-hospital organizational efforts, in the context of a dynamic and ever-evolving situation.

COVID-19 surge led to a rapid increase ICU beds capability; this has been pursued reallocating spaces in previously existing medical and/or surgical ICUs (including the reconversion of operating rooms, coronary care units, stroke units, recovery areas into critical care units) and with new dedicated facilities [3, 4]. In order to limit the in-hospital spreading of the infection it is necessary—when possible—to use negative pressure airborne isolation rooms in dedicated ICUs [3]. However, during the pandemic surge, available spaces with these characteristics have been rapidly saturated [3]. Structural partition of ICUs spaces should include “clean” and “contaminated” areas, to be kept separated by a double filter zone [4, 5]. For ICU admission of suspected COVID-19 patients, it has also been described the use of isolated positions as “buffer zone” while waiting for swab results [5]. “Clean areas” should be dedicated to activities that don’t imply a direct contact with
patients, such as briefings and clinical discussions, planning of ordinary activities at the beginning of the turn-shift, resting of personnel while rotating, fulfilling of bureaucratic tasks, etc. [4] Clean areas should also include appropriate “filter zone” for personal protection equipment (PPE) donning before entering the contaminated areas [5]. Efficient communication between the clean and contaminated areas is fundamental and might also be facilitated by the use of intercom and new technologies such as smartphones [4, 5]. Access to contaminated areas should be selectively limited to patient’s care at the bedside [4–6].

7.1.2 Equipment (Ventilators/Monitors/Devices)

Separation of “clean” and “contaminated” areas along with the increase of ICU beds imposes a comparable expansion of equipment availability: ventilators, monitors, and a growing supply of disposable devices [3–6]. In setting up a system of diversified routes and increasing resources, the placement of resources follows two different needs: machinery for each patient and machinery for common use in the contaminated space. In the first case, in order to meet the unprecedented demand for mechanical ventilators, the use of anesthesia machines in critical care settings has become a frequently adopted solution [6]. In this scenario, in March of 2020, the US Food and Drug Administration allowed the off-label use of anesthesia machines for ICU purposes; furthermore, the Anesthesia Patient Safety Foundation and the American Society of Anesthesiologists released dedicated guidelines. Furthermore, several other alternatives were used as emergency transport ventilators, magnetic resonance imaging compatible ventilators, and a last option alternative technique (as prolonged manual ventilation, NIV for invasive ventilation, veterinary ventilators).

In order to warrant a common equipment for all COVID-19 patients, the ultrasound machine and other necessary devices, including fiberbronchoscopes, videolaryngoscopes, point-of-care arterial blood gas and coagulation analyses, as well as transport ventilator and emergency cart with defibrillator, should be included in the contaminated area [5].

In order to limit the access of healthcare providers to the “contaminated” area, it has been suggested to use a centralized monitoring system in the clean zone [4, 5].

7.1.3 Human Resources

Structural hospital’s changes have been accompanied by reallocation of internal human resources (intensivists, anesthesiologists, emergency doctors, pneumologists, infection diseases specialists, nurses, and other healthcare providers) and by hiring new healthcare personnel [3, 6]. In most of the cases, when routine hospital activities were reduced or suspended, anesthesiologist, pulmonologists, and non-critical care nurses were employed to fill ICU rotation [3, 6]. Recommendations were released in order to reduce the risk for personnel exposure [3, 4, 6]. It is
important that staff undergo proper training in donning and doffing of PPE; the use of visual aids, checklists, and trained observers to assist in safely doffing PPE is also suggested [6]. Moreover, it is recommended to minimize the permanence of staff personnel in the “contaminated area” [4–6].

| ICU organization | Reorganizing spaces in previously existing medical and/or surgical ICUs; building new facilities |
|------------------|--------------------------------------------------------------------------------------------------|
|                   | Reconversion of operating rooms, coronary care units, stroke units, recovery areas               |
|                   | In case of lack of mechanical ventilators, the use of anesthesia machines in critical care settings is suggested; the use of different alternatives was also suggested |
|                   | The use of a single ventilator to support multiple patients is not recommended                   |

| Staff management | In case of expected surge, suspend, or reduce regular activity                                     |
|------------------|--------------------------------------------------------------------------------------------------|
|                   | Recruit and educate staff from other wards                                                       |

| Reducing in-hospital spreading of the infection | If available, the use of isolation ICUs, with negative pressure airborne infectious isolation rooms, is recommended |
|------------------------------------------------|--------------------------------------------------------------------------------------------------|
|                                                | The creation of cohort ICUs for COVID-19 patients can maximize the containment                    |
|                                                | ICU units should be divided into clean and contaminated isolated areas, separated by a double filter zone |
|                                                | The use of a “buffer zone” for suspected COVID-19 patients is described                           |
|                                                | Programme infected waste disposal                                                                |

| Reducing the risk for personnel exposure | The staff must undergo a proper training in donning and doffing of PPE |
|----------------------------------------|-----------------------------------------------------------------------|
|                                        | The use of visual aids, checklists, and trained observers to assist in safely doffing PPE is suggested |
|                                        | Minimize staff permanence in contaminated areas by reducing the number of personnel and ensuring rotation of the staff |

### 7.2 Criteria for COVID-19 ICU Admission

Out of the infected COVID-19 patients, about 5% develop critical illness, including severe pneumonia, respiratory failure and acute respiratory distress syndrome (ARDS), septic shock, coagulopathy, rhabdomyolysis, and multiorgan—cardiac, kidney, and liver—dysfunction or failure; the majority of them require invasive mechanical ventilation and advanced ventilatory support including prone position, curarization, or extracorporeal membrane oxygenation (ECMO) [7–9]. According to the most recent interpretation, the possible underlying mechanism can be attributed to altered immune system response that leads to a cytokine release syndrome and subsequent multiorgan failure [7, 10, 11].

Several characteristics have been associated to a higher rate of developing COVID-19-related critical illness and death: advanced age, comorbidities
(including cardiovascular and cerebrovascular diseases, diabetes, kidney disease, obesity), higher Sequential Organ Failure Assessment (SOFA) score, severity of present symptoms (dyspnea, anorexia), plasmatic levels of d-dimer, troponin I, lactate dehydrogenase (LDH), lymphocytes, platelets, inflammation-related marker levels (high sensitivity C-reactive protein, erythrocyte sedimentation rate, and ferritin), cytokine (i.e., IL-2R, IL-6, IL-10, and TNF-α) [12–14]. Reported mortality in mechanically ventilated patients ranges between 12 and 97% depending on severity of ICU admission criteria and on the reported phase of the pandemic [13, 15–19].

Early recognition of COVID-19 patients who require intensive care is of utmost importance especially considering the surge during pandemic that run critical care management capabilities to an edge [20]. To standardize the criteria for ICU admission, several severity scores have been used. In some cases previously developed and purposely modified indicators were adopted; some centers tested new and dedicated scores. Among the used available scores are quick-SOFA (qSOFA); confusion, rate of respiration, and blood pressure (CRB) score; confusion, urea nitrogen, rate of respiration, blood pressure (CURB-65) score; CRB-65 score; National Early Warning Score (NEWS); Adjusted National Early Warning Score (ANEWS); VitalPAC-Early Warning Score (ViEWS). The COVID-GRAM is a newly developed clinical risk score. The qSOFA score that ranges from 0 to 3 was developed in 2016 as a bedside tool that identifies patients at greater risk for a poor outcome outside the ICU, and it is based on three clinical variables: altered mental status—evaluated with Glasgow coma scale—the respiratory rate, and blood pressure values. The CRB score is based on the same variables of the qSOFA (with “confusion assessment” to evaluate the altered mental status), and it turns to be a simplified version of the CURB-65 score that was firstly introduced in 2003 in order to stratify patients with community-acquired pneumonia, and, in addition to the variables that are evaluated by the CRB score, it considers urea nitrogen values and also age when ≥65. The CRB-65 does not evaluate urea nitrogen levels. The CRB score ranges from 0 to 3, the CURB-65 score ranges from 0 to 5, and the CRB-65 ranges from 0 to 4. Predictive value in identifying patients who require intensive respiratory or vasopressor support was retrospectively tested in this setting by evaluating a cohort of 116 cases and suggesting an higher performance for CRB-65 and CURB-65 scores. The CRB-65 score, when a cut-off value of 2 is applied, had a sensitivity of 64% and specificity of 93.4%; the CURB-65 score, when a cut-off value of 2 is applied, had a sensitivity of 80% and specificity of 87.9%; the CRB score, when a cut-off value of 1 is applied, had a sensitivity of 72% and specificity of 79.1%; the qSOFA score, when a cut-off value of 1 is applied, had a sensitivity of 80% and specificity of 47.3% [21]. The NEWS was originally developed in 2012 and further implemented in 2017 (i.e., NEWS2) in order to improve the detection of patients in with acute illness at risk for clinical deterioration and includes several parameters: respiration rate, oxygen saturation, systolic blood pressure, pulse rate, level of consciousness and new confusion, and temperature, plus a weighting score for supplemental oxygen. A maximum score of 3 is associated to each of the parameters, and four trigger levels, that should determine the urgency of the clinical response, are recommended: low score (1–4), nurse assessment, a single red score (a score of 3 in any one parameter), urgent review by a
ward doctor; medium score (5 or 6), urgent review by a ward doctor; and high score (≥7), emergency assessment by a critical care team. The Royal College of Physicians (RCP), United Kingdom, recommends the use of NEWS2 when managing patients with COVID-19. The predictive value of NEWS2 for ICU admission in COVID-19 patients was retrospectively tested in a cohort of 71 patients: a NEWS2 ≥ 5 showed sensitivity of 89%, specificity of 66%, and accuracy of 75%; a NEWS2 ≥ 7 showed sensitivity of 63%, specificity of 98%, and accuracy of 84%; the AUROC curve was 0.90 [22]. The Adjusted National Early Warning Score (ANEWS) is a modified version of the NEWS2 that includes also age and comorbidities and has been proposed as a tool for early recognition and escalation of treatment in hospitalized COVID-19 patients. The ANEWS ranges from 0 to 24: a score ≥ 5 is related to a medium clinical risk and is considered a key threshold for urgent response [20]. The VitalPAC-Early Warning Score (ViEWS) was described in 2010 and is very similar to the NEWS2, including the same variables with a slightly different scoring system and ranging from 0 to 21. Some authors propose the use of a modified version of the ViEWS (that did not include a central nervous system evaluation) for the early identification of COVID-19 patients requiring ICU admission. A modified-ViEWS ≥7 showed sensitivity of 87–94% and specificity of 78–93%; the AUROC curve was 0.88–0.98 [23].

The COVID-GRAM is a score designed to predict the course of hospitalized COVID-19 patients, based on a development cohort of 1590 patients and a validation cohort of 710 patients [24]. It includes ten variables: chest X-rays abnormality, age, hemoptysis, dyspnea, unconsciousness, number of comorbidities, cancer history, neutrophil-to-lymphocyte ratio, lactate dehydrogenase, and direct bilirubin. The selected comorbidities include chronic obstructive pulmonary disease, hypertension, diabetes, coronary heart disease, chronic kidney disease, cancer, cerebral vascular disease, hepatitis B, and immunodeficiency. This score can be achieved by an online calculation tool that predicts the probability for critical-ill events (including invasive ventilation, ICU admission, and death), identifying three risk groups: low-risk group (0.7%); medium-risk group (7.3%); and high-risk group (59.3%). Accuracy of this risk score is 0.88, based on AUCs in both the development and validation cohorts.

| Test  | Clinical variables                                                                 | Performance                  |
|-------|------------------------------------------------------------------------------------|------------------------------|
| qSOFA | – Altered mental status (GCS < 15)                                                | – Cut-off value of 1: Sensitivity = 80%, specificity = 47.3% |
|       | – Respiratory rate > 22                                                            |                              |
|       | – Systolic BP ≤ 100                                                                |                              |
| CRB   | – Altered mental status (confusion)                                               | – Cut-off value of 1: Sensitivity = 72%, specificity = 79.1% |
|       | – Respiratory rate ≥ 30                                                             |                              |
|       | – Systolic BP < 90 mmHg or diastolic BP ≥ 60 mmHg                                 |                              |
| CRB-65| – Altered mental status (confusion)                                               | – Cut-off value of 2: Sensitivity = 64%, specificity = 93.4% |
|       | – Respiratory rate ≥ 30                                                             |                              |
|       | – Systolic BP < 90 mmHg or diastolic BP ≤ 60 mmHg                                 |                              |
|       | – Age ≥ 65 years                                                                   |                              |

(continued)
| Test          | Clinical variables                                                                 | Performance                                                                 |
|--------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| CURB-65      | - Altered mental status (confusion)                                               | - Cut-off value of 2: Sensitivity = 80%, specificity = 87.9%                |
|              | - BUN >19 mg/dL (＞7 mmol/L)                                                        |                                                                            |
|              | - Respiratory rate ≥ 30                                                             |                                                                            |
|              | - Systolic BP < 90 mmHg or diastolic BP ≤ 60 mmHg                                  |                                                                            |
|              | - Age ≥ 65 years                                                                   |                                                                            |
| NEWS2        | - Respiratory rate                                                                  | - Cut-off ≥5: Sensitivity = 89%, specificity = 66%, accuracy = 75%         |
|              | - Hypercapnic respiratory failure                                                   | - Cut-off ≥7: Sensitivity = 63%, specificity = 98%, accuracy = 84%         |
|              | - Room air or supplemental O₂                                                      |                                                                            |
|              | - Temperature                                                                      |                                                                            |
|              | - Systolic BP                                                                       |                                                                            |
|              | - Pulse                                                                            |                                                                            |
|              | - Consciousness (AVPU)                                                             |                                                                            |
| ANEWS        | - Age ≥ 65 years                                                                    | - Not tested in COVID-19 patients                                         |
|              | - Comorbidities (DM, HTN, COPD, CKD, malignant tumors)                              |                                                                            |
|              | - Respiratory rate                                                                  |                                                                            |
|              | - Oxygen saturation                                                                 |                                                                            |
|              | - Room air or supplemental O₂                                                      |                                                                            |
|              | - Temperature                                                                      |                                                                            |
|              | - Systolic BP                                                                       |                                                                            |
|              | - Pulse                                                                            |                                                                            |
|              | - Consciousness (AVPU)                                                             |                                                                            |
| Modified-ViEWS | - Pulse                                                                          | - Cut-off value ≥7: Sensitivity from 87 to 94%, specificity from 78 to 93% |
|              | - Respiratory rate                                                                  |                                                                            |
|              | - Systolic BP                                                                       |                                                                            |
|              | - Temperature                                                                      |                                                                            |
|              | - Oxygen saturation                                                                 |                                                                            |
|              | - Room air or supplemental O₂                                                      |                                                                            |
| COVID-Gram   | - Chest X-ray abnormality                                                           | - Accuracy = 88%                                                          |
|              | - Age                                                                              |                                                                            |
|              | - Hemoptysis                                                                       |                                                                            |
|              | - Dyspnea                                                                          |                                                                            |
|              | - Unconsciousness                                                                   |                                                                            |
|              | - Number of comorbidities\(^a\)                                                    |                                                                            |
|              | - Cancer history                                                                    |                                                                            |
|              | - Neutrophil-to-lymphocyte ratio                                                   |                                                                            |
|              | - Lactate dehydrogenase                                                             |                                                                            |
|              | - Direct bilirubin                                                                  |                                                                            |

\(^{qSOFA}\) quick Sequential [sepsis-related] Organ Failure Assessment, \(^{GCS}\) Glasgow Coma Scale, \(^{BP}\) blood pressure, \(^{BUN}\) blood urea nitrogen, \(^{NEWS}\) National Early Warning Score, \(^{AVPU}\) alert, voice, pain, unresponsive, \(^{ANEWS}\) Adjusted National Early Warning Score, \(^{DM}\) diabetes mellitus, \(^{HTN}\) hypertension, \(^{COPD}\) chronic obstructive pulmonary disease, \(^{CKD}\) chronic kidney disease, \(^{ViEWS}\) VitalPAC-Early Warning Score

\(^{a}\)Chronic obstructive pulmonary disease, hypertension, diabetes, coronary heart disease, chronic kidney disease, cancer, cerebral vascular disease, hepatitis B, and immunodeficiency
7.3 Respiratory Support

The respiratory system is commonly involved in COVID-19 patients, and the spectrum of disease expression can variously range from asymptomatic hypoxemia to severe acute respiratory distress syndrome (ARDS) [7, 19]. The optimal noninvasive respiratory support as well as intubation timing and settings is debated. To date, few data are available on the efficacy of noninvasive and invasive respiratory support in COVID-19 patients [25]. The reported available evidence and related recommendations are mostly based on patients affected by different types of acute respiratory failure (ARF) and on different pandemic contexts such as severe acute respiratory syndrome (SARS), influenza A H1N1, and Middle East respiratory syndrome (MERS) [25, 26].

7.3.1 Noninvasive Respiratory Support

The high-flow through nasal cannula (HFNC) allows to deliver up to 100% of inspiratory fraction of oxygen (FiO₂), a flow up to 60 L/min, a positive end-expiratory pressure (PEEP) up to 8 cmH₂O and CO₂ wash out from the upper airways dead space. Compared with other noninvasive strategies such as NIV, the HFNC is more acceptable for patients and associates with higher compliance; moreover, the effect of heat and humidified oxygen minimizes mucosal injury, improves secretion clearance, and reduces transpulmonary driving pressure [26]. The use of HFNC has been proposed also with the adding prone positioning and in combination with NIV in sequential application [26].

Avoiding of hyperoxemia is a recommended priority [27, 28]. Guidelines released in March, 2020, by the Surviving Sepsis Campaign (SSC) COVID-19 subcommittee, suggest to start conventional oxygen therapy when peripheral oxygen saturation (SpO₂) drops <92% and recommended it for SpO₂ < 90% [27]. According to the SSC panel, when treating acute hypoxemic respiratory failure not responding to oxygen therapy, HFNC should be preferred over NIV because of lower mortality and reduced need for subsequent endotracheal intubation, as reported in some subsets of non-COVID-19 patients [27]. Furthermore, HFNC should be preferred because of the possible reduced risk for nosocomial infection spreading to healthcare providers [27]. On the other hand, the NHS guidelines advise against the use of HFNC in COVID-19 patients because of concerns on potential of aerosolization related to this treatment [28, 29]. This concern is disproportionate considering the evidence of comparable viral aerosols and droplet dispersion of HFNC and standard oxygen masks [29]. Data on the efficacy of HFNC on improving oxygenation and reducing respiratory rate in hypoxemic COVID-19 patients are increasing but are mainly derived from small clusters of patients in observational studies. HFNC failure was seen in 61% of patients with PaO₂/FiO₂ ratio < 200 mmHg, and NIV was
used as rescue therapy. HFNC use has been also reported in series of patients from the USA, Italy, and other countries [13, 14, 16–18, 26, 30, 31]. Interestingly, in a cohort of 84 patients in Italy, it has been reported that the use of HFNC in a regular ward, together with other measures aimed to rise the intensity of care, reduced the need for ICU admission [30].

The use of mechanical ventilators together with dedicated interfaces (including facial masks and helmets) allows the application of continuous positive airway pressure (CPAP) and eventually of a pressure support (PS) at patient’s bedside through a noninvasive approach (i.e., NIV). Alternatively, some devices can administrate CPAP, but not PS, with specific flow drivers connected to an oxygen source. The use of NIV has been proposed also with the adding of prone positioning [26]. In patients under NIV, there is the risk that high inspiratory efforts could lead to large tidal volumes ($V_t$) that are independently associated with NIV failure [26].

According to the SSC panel, a trial of NIV is suggested if HFNC is not available, and there is no urgent indication for endotracheal intubation, but the application of CPAP is not mentioned; on the contrary, others (e.g., NHS guidelines) stated that, for some patients, CPAP or NIV could represent the “appropriate ceiling of treatment” [27, 28]. Also the use of CPAP and NIV has been considered at high risk for aerosolization and transmission among healthcare personnel [27]. Considering the higher potential of facial masks, the application of a CPAP or NIV through the helmet would be a safer option [26].

The use of CPAP and NIV in COVID-19 patients has been reported in studies from China and other countries [13, 14, 16–18, 26, 31, 32]. A management strategy proposal, based on the experience with >70 COVID-19 patients, suggests to start with helmet-CPAP support when $\text{PaO}_2/\text{FiO}_2$ ratio < 250 mmHg or respiratory rate $\geq$ 30/min and to consider the use of NIV with PS in case of presence of hypercapnia [32]. In a retrospective study on 52 patients in China, 56% of patients were treated with NIV with a high rate of noninvasive support failure and need for intubation [13, 25].

In a study of 15 COVID-19 patients receiving NIV and prone position (PP), all patients had improvement in SpO$_2$ and PaO$_2$/FiO$_2$ during pronation and in 12 (80%) the improvement was maintained after [33].

### 7.3.2 Invasive Mechanical Ventilation

Whenever noninvasive support is not enough and the patient shows symptoms and signs of respiratory fatigue along with impairment of gas exchanges, endotracheal intubation and invasive mechanical ventilation are mandatory. Acute refractory hypoxemia and bilateral infiltrates at the chest imaging, not completely explained by cardiac failure, are clinical features comparable with ARDS despite high respiratory compliance, and plateau pressures ($P_{\text{plat}}$) < 30 mmHg are not consistent in all cases; however pulmonary microembolism, the intrapulmonary shunt, lung
perfusion dysregulation, and hypoxic vasoconstriction mechanism play an important role in the pathogenesis of respiratory failure in COVID-19. Some authors hypothesized two different phenotypes to describe the respiratory mechanic of COVID-19: the Type L is a low-elastance, low ventilation-to-perfusion (VA/Q) ratio, low lung weight, and low lung recruitability, while the Type H is a high elastance due to increased edema, high right to left shunt, and high lung weight associated with a high lung recruitability [34]. However, these could be two different stage of severity more than two real phenotypes, and respiratory treatment should be titrated to the different recruitability and respiratory system compliance.

The Type L patients can be ventilated with volumes greater than 6 mL/kg (up to 8–9 mL/kg), as the high compliance results in tolerable strain without the risk of ventilator induced lung injury (VILI). The PEEP should be reduced to 8–10 cmH₂O, given that the recruitability is low and the risk of hemodynamic failure increases at higher levels. Type H patients should be treated as severe ARDS; low tidal volume ventilation (4–8 mL/kg of predicted body weight) is strongly recommended and preferred over higher tidal volumes. Plateau pressure (P_{Plat}) has to be limited to 30 cmH₂O. Oxygenation has to guarantee a SpO₂ > 92–95% optimizing FiO₂ and PEEP. The “best PEEP” is the value that allow the lower driving pressure and consequently the best compliance, but in a condition of well-preserved lung mechanics, the target should be the optimal oxygenation and the best pulmonary perfusion, so it has to be considered the hemodynamic impairment due to high level of PEEP. In COVID-19 patients undergoing MV, there is no advantage attributed to different MV modes, and pressure modes are comparable to the volume modes.

### 7.3.3 Prone Position

Based on the evidence on PP usefulness as adjunct to invasive ventilation support in moderate-severe ARDS patients with PaO₂/FiO₂ < 150 mmHg, it has been introduced in the treatment of COVID-19 patients [35]. In ARDS, 12–16 h of MV in prone position improves several parameters: dorsal lung recruitment, end-expiratory lung volume, and chest wall elastance increase, alveolar shunt decreases, and tidal volume along with ventilation/perfusion mismatch (V/Q) [35]. In COVID-19 patients, that present Type H pattern of respiratory mechanic and predominant basilar consolidation to include PP is especially effective [34]. Considering the context of limited human resources availability that characterizes the workload of ICU healthcare professionals in COVID-19 surge, long-term clinical benefits of this strategy have been questioned (five guidelines). Further concerns have been raised in consideration of the specific training necessary to appropriately deliver PP and prevent associated complications (i.e., pressure sores, vascular line and endotracheal tube displacement, facial edema, corneal abrasions, brachial plexus injury, etc.) [36].
7.3.4 Extracorporeal Membrane Oxygenation (ECMO)

Extracorporeal membrane oxygenation (ECMO) should be considered for COVID-19 patients with refractory hypoxemia when all other rescue therapy failed in improving oxygenation. The ECMO should can be considered in presence of one of the following criteria: (1) \( \text{PaO}_2/\text{FiO}_2 < 50 \text{ mmHg for >3 h} \); (2) \( \text{PaO}_2/\text{FiO}_2 < 80 \text{ mmHg for >6 h} \); and (3) \( \text{pH} < 7.25 \text{ with PaCO}_2 > 60 \text{ mmHg for >6 h} \) with a respiratory rate up to 35 breaths per minute, adjusted for plateau pressure > 30 cmH\(_2\)O [37]. The complexity of ECMO requires a well-qualified ICU team to deliver care to these critically ill patients, and therefore the use of ECMO should be limited to expert and high-volume centers. ECMO mortality rates vary widely across ECMO centers, and experience in COVID-19 outbreak is still limited.

7.3.5 Tracheostomy

The weaning process from MV in COVID-19 patients remains poorly described, and the latest guidelines did not provide any specific recommendation. Several studies showed the relationship between the timing of tracheostomy and the prognosis of patients, comparing early tracheostomy with late tracheostomy or prolonged intubation and assessing the influence of timing of tracheostomy on mortality, duration of MV, ICU stay, and other clinical outcomes. Although there are no evidence-based guidelines on the timing to perform a tracheostomy in MV patients, early tracheostomy (within 10 days from translaryngeal intubation) should be preferred to late tracheostomy when MV is expected to last >21 days [38]. To accomplish early tracheostomy associates with several advantages, including shortening duration of sedation and vasopressor infusion, increased patient comfort, oral feeding, interactive communication, and nursing care [38]. Furthermore, early tracheostomy might decrease the incidence of ventilator-associated pneumonia (VAP), duration of MV, and length of ICU stay. In COVID-19 patients, some authors suggest an “earlier than usual” tracheostomy along with weaning with NIV in order to improve patient-ventilator interaction, early weaning from MV, and ICU discharge [39]. This could also contribute to optimize ventilators availability in a context of limited resources.

7.3.6 Lung Ultrasound

Bedside lung ultrasonography is gaining popularity in the ICU and permits timely assessment of pleural and lung conditions, such as consolidation, effusions, and prompt detection of pneumothorax. In COVID-19 pneumonia and ARDS patients, most of the lesions are distributed peripherally in the lung, which facilitates detection by lung ultrasound [40]. The most common findings in patients with severe respiratory involvement have recently been reported by some authors: separated or confluent B-lines (100%), consolidation (64%), and pleural line abnormalities
Bilateral involvement was always observed with predominant distribution in the posterior part of the lungs. Composition B-lines and areas of consolidation showed parallel changes with the clinical severity with a peak at the second week.

Respiratory support

| Noninvasive respiratory support | Avoiding of hyperoxemia is recommended |
|---------------------------------|----------------------------------------|
|                                 | Starting conventional oxygen therapy is suggested when peripheral oxygen saturation drops <92% and recommended for SpO₂ < 90% |
|                                 | The SSC panel suggests to prefer HFNC over NIV when treating acute hypoxemic respiratory failure not responding to oxygen therapy |
|                                 | NHS guidelines advise against the use of HFNC in COVID19 patients |
|                                 | The SSC panel suggests a trial of NIV if HFNC is not available and there is no urgent indication for endotracheal intubation |
|                                 | NHS guidelines: For some patients, CPAP or NIV could represent the “appropriate ceiling of treatment” |

| Invasive mechanical ventilation | Endotracheal intubation and invasive mechanical ventilation is mandatory if noninvasive support is not enough and the patient shows symptoms and signs of respiratory fatigue along with impairment of gas exchanges |
|                                | The type L patients can be ventilated with volumes greater than 6 mL/kg (up to 8–9 mL/kg); the PEEP should be reduced to 8–10 cmH₂O |
|                                | Type H patients should be treated as severe ARDS |
|                                | There is no advantage attributed to different MV modes |

| Prone position                  | Prone position can be useful especially in type H pattern of respiratory mechanic |
|---------------------------------|---------------------------------|
| ECMO                            | Should be considered for COVID19 patients with refractory hypoxemia despite all other rescue therapy took in place to improve oxygenation |
| Tracheostomy                    | Early tracheostomy should be preferred to late tracheostomy |

SSC surviving sepsis campaign, HFNC high-flow nasal cannula, NIV noninvasive ventilation, NHS National Health Service, ARDS acute respiratory distress syndrome

### 7.4 Management of Hemodynamic Failure

#### 7.4.1 Shock

Prevalence of hemodynamic failure in COVID-19 patients is extremely variable in both hospitalized and in ICU patients, ranging from 1 to 35% [9, 12–15, 17, 18, 27, 31]. In these patients, the pathophysiology of shock and organs hypoperfusion is multifactorial: patients often present at hospital admission with severe dehydration and hypovolemia, after several days of hyperthermia and gastrointestinal symptoms, including severe diarrhea [41, 42]. Distributive shock is probably the main mechanism for acute circulatory failure, and the magnitude of the “cytokine storm” is directly involved in the severity of the clinical presentation [10]. Nevertheless, growing evidence highlights that acute myocardial injury, cardiomyopathy, and
venous and pulmonary embolism also contribute to worsen hemodynamic stability [8, 43]. Therefore, in COVID-19 patients, a combination of hypovolemic, distributive, cardiogenic, and obstructive shock mechanisms are variously involved in different phases of the disease.

### 7.4.2 Fluid Therapy and Vasopressors

Fluid therapy is a key point in restoring perfusion in patients with hypovolemic shock along with fluid resuscitation strategy. In COVID-19 patients, fluid infusion should aim to maintain organ perfusion to avoid fluid overload (“keeping lungs dry”) [42]. Recommendations from SSC COVID-19 panel, based on the evidence available for general management of fluid therapy in sepsis and septic shock, suggest initial conservative approach with buffered/balanced crystalloids and advise against the use of colloids (i.e., hydroxyethyl starch, gelatins, dextrans) [27]. In advanced phase of management, when patients present a reliable restored hemodynamic stability, optimal fluid management include de-escalation strategy associated with active fluid removal through the renal replacement therapy aim to pursue daily negative fluid balance [41].

Rapid variability of fluid volume status of these patients, ranging from hypovolemia to severe fluid overload, imposes a reliable monitoring [44]. According to SSC COVID-19 panel, monitoring recommends to include preferentially dynamic rather than static parameters and clinical measurements (including skin temperature, capillary refilling time, and/or serum lactate) to assess fluid responsiveness and guide fluid resuscitation [27]. Dynamic parameters include stroke volume variation (SVV), pulse pressure variation (PPV), passive leg raise test, and fluid challenge. Static parameters include central venous pressure (CVP) and mean arterial pressure (MAP). Dynamic parameters can be easily obtained by minimally invasive technologies that use arterial waveform variation analysis and transpulmonary thermodilution to estimate cardiac output, volumetric parameters, and fluid responsiveness.

Point-of-care ultrasound (POCUS) is useful tool to guide fluid management since integrates information from scanning different organs as proposed by “Tri-POCUS” approach that combines the use of lung ultrasound (LUS), focused cardiac ultrasound (FoCUS), and venous Doppler ultrasound [44].

The use of pulmonary artery catheter (PAC) in COVID-19 critically ill patients provides valuable information on hemodynamic status, especially in those affected by pulmonary hypertension associated with right-heart dysfunction, but no firm evidence prove benefits with this approach [45].

Norepinephrine infusion is the first-choice vasopressor to treat hypotension and achieve target mean arterial pressure (MAP) of 60–65 mmHg; vasopressin is suggested as adjunct, in order to reduce the dose of norepinephrine [27]. Dobutamine should be preferred in patients with cardiac dysfunction and persistent hypoperfusion. In case of refractory shock, low-dose corticosteroid therapy (“shock-reversal”) is suggested.
7.4.3 Basic and Advanced Life Support in COVID-19 Adult Patients

The American Heart Association (AHA) released specific guidelines for basic and advanced life support in patients with suspected or confirmed COVID-19 [46]. The unique perspective of these guidelines is the attention to reduce the exposure of healthcare providers that include ventilation strategies associated lower aerosolization and to consider appropriateness of beginning and continuing resuscitation maneuvers. Despite evidence on aerosolization and virus spreading during chest compressions and defibrillation is very limited, the World Health Organization listed cardiopulmonary resuscitation (CPR) as an aerosol-generating procedure. The strategies proposed to reduce providers’ exposure include PPE donning by all providers of the team before entering the scene; limiting the personnel in the room; considering the use of mechanical CPR devices to replace manual chest compressions; and communicating COVID-19 status to any new provider [46]. A more rapid switching of the rescuers (e.g., 1 min) is suggested to cope with the damage or the loss of PPE such as mask slipping and to limit the fatigue caused by the CPR wearing PPE [47]. Other measures to minimize aerosolization include using high-efficiency particulate filter (HEPA) adjunct to any ventilation circuit; rapid intubation and increase of a first-pass success likelihood expertise of the provider, device such as video laryngoscopy if available and pausing chest compressions for intubation); using a bag-mask device with HEPA filter and tight seal before intubation or considering passive oxygenation with non-rebreathing face mask, covered by surgical mask; if intubation is delayed, considering the use of manual ventilation with supraglottic airway or bag-mask device with HEPA filter covered by surgical mask; and minimizing disconnection of the “close-circuit” [46]. Considering the poor survival rates of COVID-19 patients, who require intubation and invasive ventilation, the appropriateness of beginning resuscitation maneuvers should include to share with the patient or next of kin the expected results after CPR and to implement specific policies for CPR discontinuation [13, 17, 46].

7.4.4 Acute Kidney Injury (AKI) and Continuous Renal Replacement Therapy (CRRT)

While in mild-moderate COVID-19 infection, acute kidney injury (AKI) is relatively infrequent (5%), but proteinuria and hematuria are frequently detected (44%, 27%). Changes in serum creatinine (SCr) and/or blood urea nitrogen (BUN) occur in up to 13% of patient’s [48, 49]. In these patients, AKI is associated to an higher risk of in-hospital death. In severe COVID-19 patients, AKI complicates about 37% and is the first extrapulmonary complication (29%), and 14–25% of patients leads to temporary CRRT. In this case, mortality raise up to 80%: Kdigo stage 1 was in 47% of patients, Kdigo stage 2 in 22% of patients, and Kdigo stage 3 in 31% [13].
In ICU, several predisposing factors such as older age, diabetes mellitus, cardiovascular disease, black race, chronic arterial hypertension, and need for ventilation and vasopressor medications increase the risk to develop AKI in COVID-19 critical patients. Right ventricular dysfunction or left ventricular failure get worsen the renal function. The SARS-Cov2 directly induces mitochondrial dysfunction, acute tubular necrosis, glomerulopathy, and protein leakage in Bowman’s capsule through angiotensin-converting enzyme (ACE)-2-depending pathway. A dysregulation of the immune host response, lymphopenia, and cytokine storm contributes to endothelium damage. Other contributing factors for AKI in COVID-19 patients are rhabdomyolyses, macrophage activation syndrome, and microemboli and microthrombi caused by hypercoagulopathy.

There are no specific treatments for AKI in ICU, and current clinical management of COVID-19 patients affected by renal impairment follows general indications of the KDIGO guidelines: to avoid nephrotoxins, regular monitoring of serum creatinine and urine output, and hemodynamic monitoring. Several evidence demonstrate the kidney protective effect of a reduction in tidal volume up to 6 mL/kg of PBW. Fluid balance has to be maintained according to volume responsiveness and tolerance assessment, in order to restore normal volume status and to avoid fluid overload, right ventricular overload, pulmonary edema, congestion, and subsequent AKI. When oliguria persists or fluid overload impairs renal function, despite all conservative treatments, patients should undergo CRRT.

| Hemodynamic management          |
|---------------------------------|
| Avoid fluid overload           |
| Initial conservative approach with buffered/balanced crystalloids is suggested |
| Recommendation against using hydroxyethyl starch, gelatins, dextrans and the routine use of albumin |
| Consider the use of a deresuscitation or de-escalation strategy, also with active fluid removal through the use of renal replacement therapy |
| Hemodynamic monitoring         |
| Use dynamic parameters together with clinical measurements for fluid responsiveness assessment and to guide fluid resuscitation |
| Point-of-care ultrasound assessment has been proposed |
| Both the use of minimally invasive technologies and pulmonary artery catheter are options |
| Vasopressors use               |
| Target a medium artery pressure of 60–65 mmHg |
| Norepinephrine is first-line vasoactive agent; vasopressin or epinephrine are second-line agents |
| Combined strategy with norepinephrine and vasopressin is suggested in order to reduce the dose of norepinephrine |
| Dobutamine is the inotrope of choice in case of cardiac dysfunction and persistent hypoperfusion |
| Low-dose corticosteroid (“shock-reversal”) is suggested in case of refractory shock |
### Basic and advanced life support

| Reduce providers exposure | All providers should don personal protective equipment before entering the scene |
|---------------------------|--------------------------------------------------------------------------------|
|                           | Limit the personnel in the room                                               |
|                           | Consider the use of mechanical CPR devices                                    |
|                           | Communicate COVID-19 status to any new provider                               |
|                           | A rapid switching of the rescuers (e.g., 1 min) is suggested to limit fatigue, damage to PPE, and slipping of the face mask |

| Lower aerosolization risk | Use high-efficiency particulate (HEPA) filter                                  |
|---------------------------|-------------------------------------------------------------------------------|
|                           | Early intubation and maximization of likelihood of a first-pass success        |
|                           | Use a bag-mask device with HEPA filter and tight seal before intubation or consider passive oxygenation with non-rebreathing face mask, covered by surgical mask |
|                           | Consider the use of manual ventilation with supraglottic airway or bag-mask device with HEPA filter covered by surgical mask |

| Consider the appropriateness of resuscitation | Address goals of care with COVID-19 patients or proxy in anticipation |
|------------------------------------------------|---------------------------------------------------------------------|
|                                                | Implementation of policies to guide front-line providers              |

| Out-of-hospital cardiac arrest | Consider bystanders CPR with a face mask covering the mouth and nose of the rescuer and/or victim |
| In-hospital cardiac arrest     | Consider the use of an automated external defibrillator               |
| AKI and CRRT                   | Preearrest management should include a close monitoring for signs and symptoms of clinical deterioration |
|                                | Patients at risk for cardiac arrest should be moved into negative pressure room/unit or at least door must be closed |
|                                | Intubated patients at the time of cardiac arrest should be maintained on a mechanical ventilator |
| AKI and CRRT                   | AKI is common in severe COVID-19 patients                              |
|                                | Predisposing factors in ICU are older age, diabetes mellitus, cardiovascular disease, black race, hypertension, need for ventilation and vasopressor medications, right ventricular dysfunction, or left ventricular failure |
|                                | The current clinical management follows the general indications of the KDIGO guidelines |
|                                | Early treatment seems to improve outcomes                              |

_AKI_ acute kidney injury, _CRRT_ continuous renal replacement therapy

### 7.5 Adjuvant Therapies

#### 7.5.1 Coagulation

The relevance of COVID-19 coagulopathy has been suggested by the presence of a hypercoagulable state that, along with immobilization and vascular damage, increases the risk of thromboembolic complications and death. Critical COVID-19
patients are characterized by high concentrations of proinflammatory cytokines (i.e., TNF-α, IL1, and IL-6) and chemokines, which subsequently initiates coagulation activation and thrombin generation, while SARS-Cov2 infection is also associated with the activation of fibrinolytic system. The increase in d-dimer, platelet count, and prolongation of the prothrombin time is the most typical finding in coagulopathy of COVID-19 patients that result in higher death rate.

Post-mortem findings from COVID-19 patients show typical microvascular platelet-rich thrombotic depositions in small vessels of the lungs and other organs; however, there are no signs of hemolysis or schistocytes in the blood film [50]. In critical COVID-19 patients, the rate of thromboembolic complications ranges between 5 and 15%, and pulmonary embolism is often involved. Tests to monitor critical COVID-19 patients should include prothrombin time, fibrinogen, platelet count, and d-dimers. The use of viscoelastic tests is still debated. In these patients, despite the use of standard thromboprophylaxis with low molecular-weight heparin (LMWH) or unfractionated heparin (UFH), prevalence of thrombotic events is unusually high: hence “aggressive” pharmacological thromboprophylaxis should be considered when multiple risk factors for thromboembolism are present.

7.5.2 Co-Infections and Antibiotics Use in COVID-19 ICU Patients

Co-infections in COVID-19 patients can be caused by bacteria, viruses, and fungus and predispose to higher mortality [51–53]. Among hospitalized COVID-19 patients, antibiotics’ use ranges from 71 to 100% of patients; the co-infection rate in non-survivors ranges between 4.8 and 50% [51, 52]. Incidence of bacterial co-infection in ICU patients is higher than in non COVID-19 with bloodstream detected in 25% after 15 days and 50% after 30 days [53, 54]. Overall, most frequent reported bacteria are *Mycoplasma pneumonia, Pseudomonas aeruginosa*, and *Haemophilus influenzae* [52, 53]. Other reported bacteria include *Streptococcus pneumoniae, Staphylococcus aureus, Klebsiella pneumoniae, Chlamydia pneumonia, Legionella pneumophila, Acinetobacter baumannii*, and *Clostridiodides difficile* [52, 53]. Respiratory syncytial virus and influenza A are the most common viral co-infections, along with other coronaviruses, rhinovirus/enterovirus, parainfluenza, metapneumovirus, influenza B virus, and human immunodeficiency virus [52, 53]. Several risk factors associated with severe COVID-19—including ICU admission, corticosteroid therapy, intubation and MV, underlying respiratory disease, cytokine storm—are related to an increase of invasive fungal infections [51]. Up to date, different pulmonary fungal co-infections have been reported in COVID-19 patients, including *Aspergillus flavus* and *A. fumigatus* and *Candida glabrata* and *C. albicans*, but data are scarce, considering the difficulty of the diagnosis [51]. Of note, high rates of candidemia (6, 9%) have been reported in a subset of COVID-19 patients treated with tocilizumab [51].
Unfortunately, routine laboratory findings or imaging studies alone cannot discriminate bacterial co-infection from COVID-19 [52]. Respiratory symptoms as well as sepsis and septic shock are common and are virtually present in all severe cases [18]. A strict clinical and laboratory monitoring is mandatory for an early diagnosis of co-infections in order to promptly start appropriate therapy [27, 54]. SARS-CoV-2 has been recently incorporated into preexisting syndromic multiplex panels; therefore the risk to under-diagnose co-infections in COVID-19 patients could be effectively reduced [52].

Prophylactic interventions released by national authorities must be taken into account in order to lower the incidence of co-infections, particularly for VAP: appropriate sterile insertion of vascular catheters, with daily reminder to remove catheter if no longer needed; oral intubation is preferable to nasal intubation in adolescents and adults; keep patient in semi-recumbent position (head of bed elevation 30–45°); use a closed suctioning system; periodically drain and discard condensate in circuit tubing; use of a new ventilator circuit for each patient; once patient is mechanically ventilated, change circuit if it is soiled or damaged, however, not routinely; and change heat moisture exchanger when it malfunctions, soiled, or every 5–7 days [27, 52]. Optimal antimicrobials stewardship in the COVID-19 pandemic is debated; a ratio between the risk of patients’ clinical deterioration and the concern about antimicrobial resistance must be considered [52, 53]. Several antibiotics showed a synergic effect on virus clearance: teicoplanin was found to effectively prevent the entry of Ebola virus, MERS, and SARS-CoV1 and is a promising agent for the prophylaxis and treatment of SARS-CoV2 infection [42, 52, 55]. Azithromycin showed in vitro activity against different viruses and has been found useful in preventing severe respiratory tract infections [42]. Fluoroquinolones have been proposed as an adjunct treatment in COVID-19 patients because of their in vitro antiviral activity and immunomodulatory properties, favorable pharmacokinetics, and safety profile [56].

7.5.3 Steroids

Although the use of systemic corticosteroids is controversial in patients with ARDS and beside the potential effect as a “shock reversal” therapy, their use has been suggested in critical COVID-19 patients in order to attenuate the hyper-inflammatory response and the “cytokine storm” [11]. Nevertheless, the potential adverse effects include the risk of delaying virus clearance, secondary bacterial infections, and osteonecrosis of the femoral head [11]. Preliminary findings of the RECOVERY trial released that the use of dexamethasone reduced deaths by one-third in ventilated patients and by one-fifth in other patients receiving only oxygen. There was no benefit among those patients who did not require respiratory support [57].
Coagulation
Associated therapy
A more aggressive thromboprophylaxis using LMWH or UFH could be considered on an individual basis

Co-infections and antibiotics use
Prophylactic interventions must be taken in order to lower the incidence of co-infections.
Empiric treatment of co-infections in COVID-19 patients should be started as soon as they are suspected, and appropriate de-escalation should be performed on the basis of microbiologic results and clinical judgment.

Steroids
Potential adverse effects
According to preliminary results of the RECOVERY trial, dexamethasone reduced deaths by one-third in ventilated patients and by one-fifth in other patients receiving oxygen only.

**LMWH** low-molecular-weight heparin, **UFH** unfractionated heparin

### 7.6 Communication Strategies in the ICU at the Time of COVID-19 Pandemic

The surge of COVID-19 pandemic has posed unique challenge in communication management, in particular in ICU setting. The need for social distancing and access limitations to hospital delivered according to public health policy have induced several forms of psychological discomfort in patients, relatives, and healthcare providers. Furthermore, there were other important factors that affected communication: uncommon clinical scenario, increased workload, and need for PPE [58, 59]. Effective communication is a cornerstone of high-quality medical care and humanization of hospitalization process is part of the treatment [60].

There is no consistent literature on ICU communication issues at the time of complete isolation, and most of the guidelines available refer to other settings, still providing inspiring principles to be carefully adapted to this challenging and evolving situation.

#### 7.6.1 Basic Principles: Honesty, Punctuality, Accountability, Trust

First contact (phone call) with patient’s relatives should take place at the time of admission in the ICU consistently delivered at least once a day and more frequently should clinical conditions worsen. Communication should be punctual, informative, and honest. It is of the utmost importance to identify clearly both who is responsible for the call (a doctor who knows the patient directly) and who will receive clinical information (a selected family member): the same doctor—whenever possible—should be involved, to ensure continuity, avoid repetition, and build trust. Patient dignity, autonomy, and ethical principles are pivotal in a pandemic as in any other
condition. Transparency about available resources, criteria for ICU access, and allocation policy should be carefully discussed with both patient and relatives, and when patient is not suitable for intensive care treatment, it is important to clarify alternative goals of care.

7.6.2 Content of the Communication

Clinical content of the communication should be clear, simple, and tailored to the level of comprehension of the person. An effective communication may also help collecting previous medical history and reconstruct values of the patient and treatment directives, when present. The communicator should cover all aspects involved in patient care: actual clinical condition, therapeutic options, and goals. Information should be given gradually (i.e., “small packets”). The communicator can select the amount of information to be given in a step-by-step manner to ensure full understanding, but omitting is not recommended. Medical staff should also encourage questions and give time for listening. When asked for prognostic evaluation of the case (“how long will it last?”, “when will this happen?”) it is important to be transparent also about uncertainty and possible clinical scenarios of an almost unknown disease.

7.6.3 Checklist for Communication

Healthcare workers are used to follow checklists for a lot of standard procedures (e.g., airway management, surgery, transfusions), yet they are not confident with checking themselves for effective communication. Structured communication strategies (maps, checklists) can effectively guide healthcare providers throughout the process.

7.6.4 Videocalls and Other Communication Strategies

There are several communication tools available: phone and videocalls with medical staff, videocalls with patient, emails and text messages. It is important to choose the most suitable tool for patients and relatives. Videocalls can promote closeness by visual contact and reduce anxiety and stress in the awake patient and should be encouraged by doctors and nurses. When planning for a videocall adequate preparation of patient and family is desirable, especially in the presence of tracheostomy, swelling, tubes, and monitors. Video calling is not recommended for patients who are conscious but uncooperative. Family conferences with doctors have also been widely used.
7.6.5 Communication at the End of Life and Grief

Should patient’s condition deteriorates, prompt, close communication with family must be established. To prepare families for the loss at the time of complete isolation is very hard. Physical nearness and end-of-life rituals are essential for grief elaboration in normal conditions, yet often they are not feasible because of sanitary reasons during a pandemic. There is no receipt, but a combination of significant interventions may help: allowing for direct calls on the ward, leaving an email address, and keeping yourself accountable as a team around the patient. Family must receive reassurance about pain and distress relief, sedation, and continuous presence of healthcare staff around their loved one even when withholding/withdrawal of disproportioned treatment. After communication of death, psychological and religious/spiritual support should be offered.

Due to the dramatic nature of pandemic and the huge workloads, healthcare providers must take into serious account the importance of their own emotional and psychological well-being, improve communication between members of the team, share their emotions, and learn to seek for help and consultation to prevent moral distress and burnout.

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Communication strategies

| Basic principles | Honesty, punctuality, accountability, trust |
|------------------|-------------------------------------------|
| **Content**      | Clear, simple, free of technicism and adjusted to the level of comprehension of the person. It is important to be transparent also about uncertainty and possible clinical scenarios of an almost unknown disease |
| **Checklist**    | Can guide healthcare workers throughout the process of communication |
| **Alternative communication tools** | Phone and videocalls with medical staff, videocalls with patient, emails and text messages |
| **Communication at the end of life and grief** | Allowing for direct calls on the ward, leaving an email address and keeping yourself accountable as a team around the patient |
|                  | Reassure about pain and distress relief, sedation, and continuous presence of healthcare staff |
| **Basic principles** | Honesty, punctuality, accountability, trust |
| **Content**      | Clear, simple, free of technicism, and adjusted to the level of comprehension of the person. It is important to be transparent also about uncertainty and possible clinical scenarios of an almost unknown disease |
| **Checklist**    | Can guide healthcare workers throughout the process of communication |
| **Alternative communication tools** | Phone and videocalls with medical staff, videocalls with patient, emails and text messages |
| **Communication at the end of life and grief** | Allowing for direct calls on the ward, leaving an email address and keeping yourself accountable as a team around the patient |
|                  | Reassure about pain and distress relief, sedation and continuous presence of healthcare staff |
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