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Selection of Patients for Admission to the Respiratory Intermediate Care Unit

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ABSTRACT

The respiratory intermediate care units (RICU) usually admit patients with intermediate severity between those managed in a pulmonary ward and those admitted to the intensive care units (ICUs). There are two different assistant circuits, with different purposes: the step-up circuit, whose main aim is to avoid the worsening of acute respiratory failure (ARF), leading eventually to endotracheal intubation, and the step-down, that includes patients with variable degrees of dependence of the mechanical ventilation. The adequacy of admission criteria for individual patients is a key point for the optimal functioning of the RICU.

Finally, many patients admitted to the RICU have prior do-not-intubate (DNI) orders, being non-invasive respiratory support (NIRS) their ceiling of therapy. In this setting, it is of utmost importance to have the design of a care planning before admission to the RICU, including how the team should proceed in case of NIRS failure.

Keywords: Acute respiratory failure. High flow nasal cannula. Non-invasive ventilation.

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INTRODUCTION

From a generic point of view, a respiratory intermediate care unit (RICU) is defined as a space dedicated to the management of non-intubated patients with acute or acute-on-chronic respiratory failure[1]. The two main therapies of non-invasive respiratory support (NIRS) used in the RICU are non-invasive mechanical ventilation (NIV) and high-flow nasal cannula (HFNC). There are also some patients with continuous monitoring needs (heart rate, oxygen saturation [SpO_2]), without NIRS indication who are also candidates for admission to the RICU (life-threatening haemoptysis, for example). All these procedures do not specifically require admission to intensive care units (ICUs), but at the same time cannot be performed safely in a conventional hospital ward.

The opening of RICUs in reference hospitals has represented an improvement in the prognosis for patients who otherwise would have been managed mostly in the ward or in the Emergency Department. A study carried out in Italy[2] described the creation of an RICU, and demonstrated lower mortality, hospital stay and need for admission to critical care areas in patients with pneumonia, exacerbated chronic obstructive pulmonary disease (COPD) or acute respiratory failure (ARF) who were managed in the RICU, compared to those who were treated on the ward or in the emergency services. The proportion of patients requiring admission to the ICUs was always less than 10% among individuals admitted to the RICU. This percentage may give an idea of the approximate rate of NIRS failure in patients with ARF. In the same way, some quality timing indicators (blood gases, start of antibiotics, respiratory physiotherapy) were significantly earlier in the RICU. Finally, there are studies that demonstrated its cost-effectiveness, mainly through saving ICU stays[3].

PHYSICAL STRUCTURE AND ASSISTANCE CIRCUITS IN THE RICU

Both ICUs and RICUs can be designed in different architecture distributions: the so-called open units (multibed units), where patients are managed in an open space, without individualized rooms, and the closed units (single-bed units) that manage patients in individualized spaces separated by walls or similar. This latter model is the preferred choice for most of the attending physicians. However, this design presents also some limitations: for example, in the RICU, since there are mostly conscious patients, isolation can be an adverse factor in the case of uncooperative or agitated patients[4]. Likewise, the patient's mobilization needs (sitting, walking) seem to be carried out more frequently in open spaces, as has been shown in neurological patients[5]. On the contrary, in case of admission of patients infected by transmissible microorganisms (multi-resistant bacteria, SARS-CoV-2, etc), it seems more prudent to have some specific isolation spaces for their care[6].

Essentially, patients can be admitted to an RICU for two main purposes: to prevent the progression of ARF requiring orotracheal intubation, or to restore respiratory autonomy after an episode of long-term respiratory failure, usually after prolonged invasive mechanical ventilation. Both clinical pathways are known respectively as *step-up* and *step-down*, although some authors differentiate two subgroups within the *step-up* category, depending on whether the patients come from the emergency services (direct admission) or from other hospital services[7]. The *step-up/down* models also seem to reflect two types of patients with different needs and outcomes. In a cohort of 326 patients admitted to an RICU, the admission from a ward or emergency department (*step-up*) presented up to four times higher mortality in the multivariate analysis compared to the *step-down* model (admission from the ICU)[7]. Similar results were observed during the COVID pandemic[8]. The *step-down* model (mainly difficult weaning) will be covered in another chapter of this monograph, so we will refer essentially to the *step-up*.

Finally, and concerning mainly care circuits, cooperation with the departments of admission and discharge of these patients is especially important. Figure 1 reflects the interrelation pathways between RICU and admission and referral departments.

GENERIC ADMISSION CRITERIA

The admission criteria for the *step-up* model would include the following groups of patients

– Patients requiring NIRS, either NIV or HFNC. It is especially important to detect before admission the subset of patients in whom a short-term need for orotracheal intubation is anticipated due to a high risk of failure (for example, patients with severe ARF and a ratio of arterial oxygen partial pressure to fractional inspired oxygen [PaO_2/FiO_2] of less than 100, or with clinical criteria of imminent respiratory failure). These patients should be admitted directly to the intensive care units. The use of validated scales for critical care patients (APACHE III, SOFA score…) would be also helpful here. There are even experiences of detecting high-risk patients and subsequent reduction in mortality using artificial intelligence[9]. Obviously, this exclusion does not affect patients with do-no-intubate (DNI) orders, in whom admission to the RICU and NIRS is their ceiling of therapy.

– Patients with severe respiratory failure requiring monitoring, even in the absence of NIRS. Although there are no objective data around this kind of patients, it seems prudent to continuously monitor patients with a need for FiO_2 higher than 0.4, as they may be candidates for NIRS in a short period of time, as suggested in the COVID consensus document published during the first wave of the pandemic[10].

– Patients with life-threatening hemoptysis, in whom hemodynamic and respiratory function monitoring is necessary (in addition to the therapeutic procedure to be indicated). Eventually, these patients may require an emergency endoscopic examination[11].Non-intubated patients in the immediate postoperative period of major thoracic surgery (for example, pulmonary resections).

Generic non-admission criteria

In addition to the above-mentioned indications, some conditions might influence the decision of not admitting the patient to the RICU. Two different criteria should be mentioned

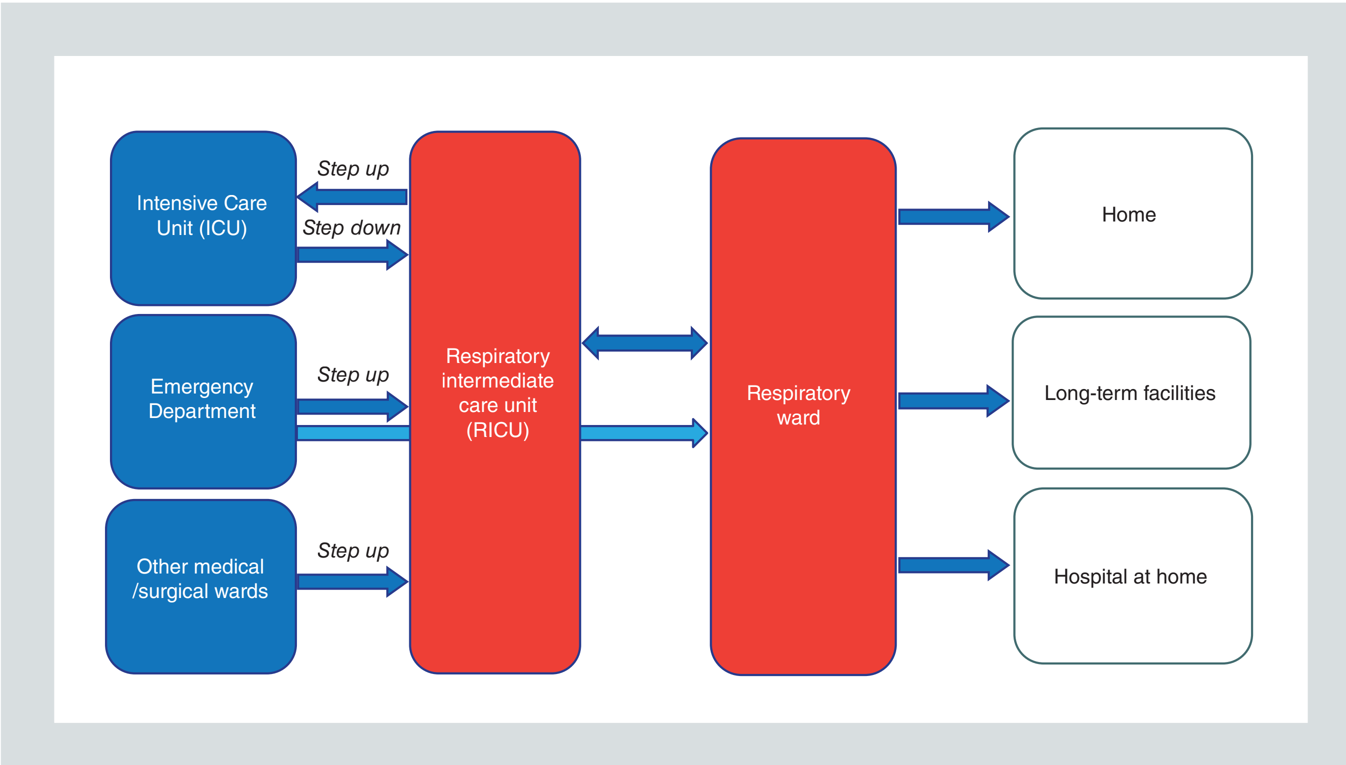

FIGURE 1. Generic flowchart of relationship between the RICU and the other services involved in admission and discharge (model of a conventional hospital).

here: patients without DNI orders and with high severity of illness and patients with very deteriorated baseline condition.

High severity of illness

Patients without DNI orders and presenting a high-risk situation for NIRS failure at admission, should mainly be admitted to intensive care units. In this regard, the Spanish consensus on non-invasive respiratory support stratified patients with ARF into two categories. The high-risk category included patients with NIRS (either NIV or HFNC) failure, acute respiratory distress, pneumonia with ARF in patients without cardio-respiratory comorbidity, and severe chest trauma[12]. It should also be noted that the above-mentioned document was prepared prior to the COVID pandemic, during which many patients with hypoxemic ARF and bilateral pneumonia have been successfully managed in the RICU. Some stratification criteria dedicated exclusively to COVID patients have been developed. One of them, based on the experience in Switzerland, proposed increased work of breathing and hypoxemia as stratification criteria. Thus, patients coming from the ward with FiO_2 needs > 0.5 to maintain SpO_2 of 90% and increased work of breathing would be candidates for admission to the ICU. For patients admitted to intermediate units, the criteria would be FiO_2 > 0.8 under HFNC and increased work of breathing. It might be that the experience acquired in the RICU during the COVID pandemic contributes to modifying the previous criteria, including parameters such as PaO_2/FiO_2 and work of breathing as stratification tools for hypoxemic ARF de novo patients[13].

Deteriorated baseline condition

One of the decisions that should be carefully evaluated is the non-admission to the RICU of a patient considering his/her frailty, comorbidity, and low survival expectations even under NIRS. The main risk of admitting a very elderly or frail patient is to prolong unnecessarily the dying process. Moreover, many times this situation is also perceived by the medical or nursing staff as "inappropriate treatment". From the other point of view, an opportunity to reverse an acute situation with a less invasive and time-limited treatment can be offered to the patient. Both points should be carefully balanced.

The criteria for setting therapeutic effort limitation and non-admission to the RICU must consider not only factors related to frailty and baseline comorbidities, but also others related to the probability of success of NIRS. Clearly, in this regard, patients with COPD, neuromuscular pathology or acute cardiogenic pulmonary oedema have higher survival rates than patients with hypoxemic respiratory failure[14,15]. In a study that included more than 1,900 patients over 10 years, hypoxemia, along with metabolic acidosis and other minor analytical parameters, were predictors of NIRS failure[9].

But also, the patient's perspective and opinion are of importance: a study that included 43 patients in their end-stage pulmonary disease, with DNI orders and admitted to the hospital with respiratory acidosis (50% of the patients were in hypercapnic coma) showed an overall mortality of 28%, without any differences based on the severity of acidosis. After the acute episode was treated, up to 85% of the survivors expressed their wish to receive NIV treatment again in the event of a new episode of hypercapnia. Failure rates of less than 15% were also detected in a multicenter study that included 969 patients with respiratory acidosis (many of them with pH < 7.25) in seven RICU in Spain, suggesting that patients with respiratory acidosis (even severe) may be successfully managed in an RICU, with a high success rate[16].

The stratification of patients with a high probability of dying and in whom admission to the RICU may be associated with therapeutic futility can be carried out using scales of frailty, chronicity, and baseline quality of life. One of the most used criteria for ICU non-admission is life expectancy based on comorbidities. Patients with life expectancy of less than 6 months should not be admitted at these units. Probably, the same criterion would be valid for the RICU[17]. However, it is sometimes difficult to estimate this probability. Due to its simplicity, one of the most applied frailty scales in critically ill patients is the Clinical Frailty Scale (CFS)[18] which classifies the baseline status of patients in nine grades, from the patient with optimal health (better than expected for the age, group 1) to the dying terminal patient (group 9). In a study with more than 240,000 patients, the CFS score was an independent predictor of mortality, improving the predictive value of the APACHE III scale[19]. From a general point of view, patients with a CFS higher than 6 should not be admitted to the RICU.

Advanced neoplasia is also usually qualified as an exclusion criterion: in a very recent study that included 140 patients with advanced-stage lung cancer (III/IV), with ARF and DNI orders, mortality at 28 and 90 days was 66 and 86% respectively. Patients who survived showed a higher PaO_2/FiO_2 ratio at admission and a lower APACHE II scale score than non-survivors[20]. In a multicenter study that included 54 ICUs in France and Belgium, the mortality of patients with orders not to intubate was 44%, but the survivors showed a quality of life similar to their baseline state once they got over the acute episode and without show significant differences with patients without therapeutic limitation[15].

Finally, there are a group of patients, in which the indication for NIRS is directed towards a better comfort of the frail patients (especially HFNC). These patients should not be admitted to the RICU, being the conventional ward or the palliative care units the appropriate point of care. Table 1 summarizes the generic criteria for admission and non-admission to the RICU.

SPECIFIC INDICATIONS

Acute exacerbation of chronic obstructive pulmonary disease (AE-COPD)

AE-COPD is the clinical condition in which there is a greater experience and where NIRS has shown greater efficacy. In AE-COPD, there is typically an increase in respiratory work due to increased resistance to airflow and the development of dynamic hyperinflation, which frequently lead to respiratory acidosis. NIV has been shown to reduce respiratory work, increasing alveolar ventilation, with a decrease in respiratory rate and an improvement in air trapping.

The use of NIV in patients with hypercapnic exacerbation of COPD became widespread in the 1990s after the publication of the first controlled studies[21], showing that the NIV therapy was associated with a reduction in the intubation rate and mortality compared to conventional medical treatment. A meta-analysis[22] reinforced the evidence in the reduction in intubation rate (relative risk 0.42), mortality (relative risk 0.41), hospital stay (-3.4 days) when NIV therapy was added to the usual care. At the same time, increases in pH, decreases in partial pressure of carbon dioxide ($PaCO_2$) and decreases in respiratory rate were also demonstrated. Another study demonstrated that, even in situations of increased severity, such as decreased level of consciousness due to hypercapnic encephalopathy, its use is considered feasible, because NIV failure has not been associated with a worse prognosis compared to conventional medical treatment[23].

On the other side, NIV is not recommended in AE-COPD patients without respiratory acidosis. In this group of patients, the approach should be aimed at considering long-term home ventilation[24]. This clinical picture (home NIV start) does not seem enough reason to indicate admission to the RICU.

In recent years, HFNC has emerged as an alternative to NIV in patients with AE-COPD. A randomized study in 80 patients showed noninferiority of HFNC versus NIV in patients with mild-to-moderate AE-COPD, but the truth is that a good number of patients

Table 1. Generic criteria for patient admission and non-admission to the RICU

Generic criteria for admission	Non-admission criteria (high NIRS failure probability)	Non-admission criteria (frail patients)
– Patients with ARF (or acute-on-chronic RF) candidates to NIRS. – Patients with ARF without NIRS indication, but with $FiO_2 > 0.4$ and continuous monitoring needs. – Patients with life-threatening haemoptysis without immediate intubation criteria. – High risk patients with ARF and DNI orders.	– Patients with acute respiratory distress syndrome without DNI orders. – Patients without respiratory and cardiac comorbidities with pneumonia and ARF, with FiO_2 needs > 0.8 or increased work of breathing, even with lower FiO_2 needs. – Severe blunt chest trauma. – NIRS failure without DNI orders.	– Deteriorated baseline status (CFS > 6). – Patients with life expectancy lower than six months, especially in presence of criteria for NIRS failure (PaO2/FiO_2 < 150, increased work-of breathing, non-hypercapnic respiratory failure).

ARF: acute respiratory failure; CFS: clinical frailty scale; DNI: do-not-intubate; FiO2: fractional inspired oxygen; NIRS: non-invasive respiratory support; PaO_2: arterial oxygen partial pressure; RICU: respiratory intermediate care unit.

who received high nasal flow required rescue therapy with NIV during their hospital stay. Looking into the future, HFNC may represent an alternative for patients who are intolerant to NIV, or it may replace conventional oxygen therapy during NIV breaks, using combined treatment in the same way as has been done during the COVID pandemic[25,26].

Acute cardiogenic pulmonary oedema (CPE)

Management of acute CPE may induce some misunderstandings, mainly related to the clinical skills needed (can be managed by cardiologists, pulmonologists, emergency department physicians…). In fact, despite being an entity of non-pulmonary aetiology, often requires treatment with positive pressure devices, that provide beneficial hemodynamic and respiratory effects. The main hemodynamic effects are the decreases in the right ventricle preload and left ventricle afterload, leading to an increase in cardiac output and myocardial contractility. Concerning the respiratory effects, the main ones are the alveolar recruitment, the reduction in the pulmonary shunt, the increase in pulmonary distensibility and, finally, the decrease in the work-of-breathing. All these effects can lead to an improvement in dyspnoea, oxygenation and a decrease in respiratory rate early after its onset[27].

In acute CPE, the comparative therapy for the positive-pressure devices has traditionally been conventional oxygen therapy. There is evidence in the literature that continuous airway pressure (CPAP) and NIV are superior to conventional oxygen therapy, mainly reducing the proportion of intubations. It demonstrated also a faster initial clinical improvement than in the conventional treatment arm. Similar results were obtained (superiority of positive pressure above conventional therapy), but without any differences between CPAP and NIV in the outcome, even in patients with respiratory acidosis[28,29]. The conclusion of these studies is that early treatment with positive pressure devices should be part of the treatment of patients with hypertensive acute CPE. The organization of each hospital must ultimately decide which is the responsible specialist and department (RICU, coronary unit, ICU) for the care of these patients.

Hypoxemic de novo acute respiratory failure

It is a huge and heterogeneous group, since hypoxemic de novo ARF can be present in several clinical entities, such as pneumonia in immunocompromised patients, pneumonia in patients without immunocompromise, and acute respiratory distress syndrome (ARDS).

The main problem with the use of NIV in previously healthy patients with severe community-acquired pneumonia was its high failure rate. At the same time, the delay in the decision of intubation and invasive ventilation was associated to increased mortality[30]. The only exception would be patients with community-acquired pneumonia and cardio-respiratory comorbidity, where the use of NIV improved outcome[31].

Immunocompromised patients with pneumonia and hypoxemic ARF had been considered candidates for NIV[32]. However, post hoc analysis of a large HFNC study showed that the best strategy in immunosuppressed patients with pneumonia was HFNC instead of NIV[33].

Regarding ARDS, different studies and meta-analyses have shown a negative impact of the use of NIV in patients with ARDS in the context of the failure of other organs. On the contrary, since the appearance of the High-flow oxygen through nasal cannula in acute hypoxemic respiratory failure (FLORALI) study, the use of HFNC is nowadays considered as the best strategy for these patients in order to try to avoid endotracheal intubation[34]. One alternative option for ARDS patients supported by the results in a single-center study is the use of NIV with the helmet-type interface[35]. Clearly, more prospective studies are needed.

The decision of admission to the RICU may be controversial. The Spanish consensus proposed that patients with hypoxemic ARF de novo should be managed in the ICU[12], but the experience acquired during the COVID pandemic[36] requires a deep reflection on the stratification of these patients, perhaps reserving for admission to the ICU those patients with the highest NIRS failure rate based on clinical/oximetric criteria, as proposed in table 1.

NIV in patients with DNI orders

In patients with DNI orders, the use of NIRS is recommended in situations in which its efficacy has been documented. A recent meta-analysis with 27 studies and 2020 patients with DNI orders showed a survival to hospital discharge of 56% per year in the NIV arm and 32% in the conventional treatment arm, with no differences in the quality of life for survivors[37]. In other words, these patients can benefit from specialized management in intensive or intermediate units, even in presence of DNI orders[16].

Patients with obesity hypoventilation syndrome (OHS)

Patients with OHS often have exacerbations leading to hypercapnia and respiratory acidosis. The use of NIV, in the same way as in AE-COPD, was associated with clinical and arterial blood gases improvement in one of the few studies in this kind of patients[38]. In another observational study, the NIV failure rate was 17%, being the presence of pneumonia and a high value on the simplified acute physiologic score II (SAPSII) and sequential organ failure assessment (SOFA) severity scales at admission the only independent predictors of NIV failure. It should be noted that many patients (up to 50%) presented a delayed response in the correction of acidosis (> 6 h). In contrast, idiopathic exacerbation of OHS showed lower NIV failure rates[39].

Patients with decompensated neuromuscular diseases

In previously healthy patients with acute neuromuscular illness (myasthenic crisis, Guillain-Barré syndrome), NIRS (mainly NIV) should be used with caution and closed monitoring to detect signs of ARF requiring invasive ventilation, especially when bulbar involvement is present[40]. ICU admission should be considered early in case of non-response to NIRS.

Contrarywise, in case of decompensated underlying chronic neuromuscular illness (amyotrophic lateral sclerosis [ALS], myotonic dystrophy), the use of NIV to prevent or treat respiratory acidosis should be considered. Most patients of this second group are treated with chronic home NIV and can be adequately managed in an RICU.

Therapeutic effort limitation and withdrawal of supportive therapy in the RICU

The advanced decision planning is of utmost importance, especially in patients admitted to the RICU and with baseline comorbidities, in whom usually NIRS is considered as a ceiling of therapy. Ideally, this advanced decision planning should be established in a consensual way with the family (and the patient if possible) at the time of admission to the RICU.

In a study including 404 patients admitted to a medical-surgical intermediate unit, 19% (79 patients) had therapeutic effort limitations orders. In 70% of cases, this limitation was established at the time of admission[41], while in the remaining 30%, the decision was made during the stay. Hypercapnic respiratory failure was the main condition associated with therapeutic effort limitation. Finally, hospital mortality in patients with limited therapeutic effort was 53%, with hypoxemic ARF (but interestingly not hypercapnic) being one of the most prevalent diagnoses in limited patients who died.

Another important decision in advanced care planning is how to proceed in case of treatment (usually NIRS) failure, or simply lack of improvement after the indication. This can lead to non-desired situations of NIV/NIRS dependence, often in patients with little expectation of recovery. In the previously mentioned study[41], in 20% of the patients where the limitation was established, essential supportive measures were withdrawn (NIV, vasoactive drugs, etc). The decision to withdraw non-invasive support measures is a procedure that must be carefully planned, but at the same time is carried out in a relatively short period of time. It must be considered that during this time interval, patients who are withdrawn from life support may experience a series of symptoms that must be treated (dyspnea, anxiety, pain, etc.). Direct relatives and the patients themselves (whenever possible) should participate in the decision, together with the multidisciplinary team that takes care of the patient.

Concerning the management of symptoms after supportive therapy is withdrawn, the most prevalent is dyspnea, usually accompanied by agitation. It is recommended that standardized scales be used for symptoms (Ramsay scale for agitation, or respiratory distress observation scale [RDOS] for dyspnea) searching for a correct titration of the therapy to be administered, which consists mainly of opioids or sedative drugs (mainly benzodiazepines), both separately or in association[42].

Finally, once it has been decided to withdraw life support measures, it is recommended that all other treatment (antibiotics, serum therapy, transfusions, etc.) be withdrawn and that the patient and their relatives be provided with an environment that facilitates intimacy throughout the process.

CONCLUSIONS

The selection of patients to be admitted to the RICU should avoid the admission of patients at high risk of therapeutic failure and in whom early intubation would be indicated. At the same time, admission of excessively frail patients with poor baseline quality of life and poor chances of survival should be avoided. In chronic patients, the baseline status of the patient must be carefully evaluated using objective scales, together with an evaluation of the expected benefits of the therapy to be applied. The design of a therapeutic plan agreed upon with the patient and their family is recommended, considering the different options in the event of NIRS failure, including both therapeutic escalation and withdrawal of life support measures under appropriate conditions.

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