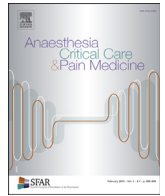




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## Letter to the Editor

### In-ICU COVID-19 patients' characteristics for an estimation in post-ICU rehabilitation care requirement



#### ARTICLE INFO

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Due to the emergence of a virus outbreak in Mulhouse, a city located 100 km south of Strasbourg, Alsace was one of the first regions in France to be affected by SARS-CoV-2 and people developed a new coronavirus disease (COVID-19). Strasbourg University Hospital increased more than twice its intensive care bed capacity (+140%). At the time of writing this article, six weeks after the start of the epidemic, 998 hospital deaths were counted in the region, i.e., an intrahospital mortality rate linked to COVID-19 of 0.53 deaths per 100,000 inhabitants (<https://dashboard.covid19.data.gouv.fr/>). Currently, a large number of patients with severe COVID-19 remain hospitalised in our intensive care unit (ICU). Many of these patients have severe damages to one or more organs, suggesting that certain patients will need higher post-resuscitation care in active post-resuscitation care (APRC) unit or more classic rehabilitation care in a follow-care and rehabilitation service. The purpose of this letter is to succinctly estimate the need for post COVID-19 resuscitation rehabilitation care before conduct wider study to definitively assess post COVID-19 rehabilitation care requirements.

Between February 24<sup>th</sup> and April 15<sup>th</sup>, 2020, all ICU hospitalisations for COVID-19 in our teaching hospital were recorded. All patients had a chest CT scan compatible with COVID-19 and an RT PCR SARS-CoV-2 positive, either on a nasopharyngeal smear or on bronchoalveolar lavage.

We arbitrarily estimated that patients with tracheotomy and still under mechanical ventilation will need a post-ICU hospitalisation in an APRC and patients with dependency, defined with an activities daily life score (ADL) < 4, will need a post-ICU hospitalisation in a follow-up unit. All patients hospitalised in APRC will also need a hospitalisation in a follow-up unit.

Among the patients hospitalised in our ICU, we recorded the number of deaths, health transfers, patients discharged alive to a conventional unit and patients still in our ICU on April 15<sup>th</sup>, 2020. Demographic characteristics (age, sex, weight, height), simplified acute physiology score (SAPS) II at admission, length of hospitalisation and ICU length of stay were recorded. Dependence was assessed by the ADL score [1]. The number of ICU COVID-19 patients admitted in Alsace until April 15<sup>th</sup> was also

recorded, based on local administrative survey. The study protocol was approved by the ethical committee, reference CE-2020-89, and patients informed consent was obtained.

Variables are described as median and interquartile range for continuous variables, and frequency and percentage for categorical criteria.

Presented here are the results of the demographic characteristics of current 51 ICU patients. Patients were mainly males ( $n = 37$ , 72.5%), with a median age of 66 years old [IQR (45; 85)]. The baseline median SAPS II was 50 [IQR (23;82)], and the median minimal PaO<sub>2</sub>/FiO<sub>2</sub> was 84 [IQR (31;142)]. Five patients (10%) had non-invasive ventilation during their hospital stay, and four patients (8%) had high-flow oxygen therapy. All 51 patients (100%) required orotracheal intubation. The median duration of mechanical ventilation was 17 days [IQR (1; 31)].

Nine patients (18%) were tracheotomised after a median duration of 16 days [IQR (6–26)]. Forty-nine patients (96%) required use of neuromuscular blockade agents for a median duration of seven days [IQR (0–19)]. Eighteen patients (35%) needed continuous renal replacement therapy. The median length of stay in ICU was 15 days [IQR (2;30)].

The results of current clinical status are presented in Table 1.

These previous indicators were used to approximate that, among the 51 remaining COVID-19 patients in our ICU, 5 (11%) patients will die within the ICU. If the 46 remaining patients should be weaned from ICU life support, and regarding their extreme fragility and dependency, it was estimated that five patients will need APRC and 45 follow-up cares. From the hospital perspective, it was estimated that 14 patients will need APRC and 205 a follow-up care. From a population-based perspective, it was estimated that the need for APRC and follow-up care were respectively four and 40 per 100,000 inhabitants.

It is expected that this altered state of health will result in a post-intensive care syndrome with intensive care unit-acquired weakness (ICUAW) and difficulties to wean the patient from mechanical ventilation [2]. Rhamel et al. recently showed that the highest survival rates in septic patients were observed in patients transferred to rehabilitation facilities [3].

The aim of this study is to provide an immediate feedback on a specialised ICU, allowing us to increase our knowledge and understanding of follow-up care requirements. As there is actually no published data on such estimate, we had to choose arbitrarily the way of counting ICU COVID-19 patients who will need APRC and follow-up. A recent systematic “living” review on rehabilitation needs due to COVID-19 [5] stated that early rehabilitation should be granted to inpatients with COVID-19 and telerehabilitation may represent the first option for people at home. But these main messages were based on previous literature and not on the current COVID-19 pandemic. Moreover, there is no precise tool to assess how long will be the length of stay in APRC. Apostokalis and al. showed that ICU-WA required on average six [IQR (4–12)]

**Table 1**

Current clinical status.

Characteristics of ICU COVID-19 patients	N = 51
Currently sedated–n (%)	23 (45%)
Currently under neuromuscular blockade–n (%)	16 (31%)
Orotracheal intubation–n (%)	39 (76%)
Tracheotomy–n (%)	9 (18%)
Spontaneous ventilation–n (%)	3 (6%)
ECMO–n (%)	5 (10%)
CRRT–n (%)	16 (31%)
Neurologic disorders–n (%)	13 (26%)
Total dependency–n (%)	48 (94%)
Estimation of the number of patients needing a long respiratory weaning process	5 (9%)
Estimation of the number of patients with ICU AW	45 (88%)

CRRT: continuous renal replacement therapy; ECMO: extracorporeal membrane oxygenation; ICU AW: intensive care unit acquired weakness.

weeks in APRC [4]. These considerations help us estimate the burden that ICU COVID-19 patients represent and anticipate the sizing of COVID-19 APRC and follow-up care.

This study provides immediate patients' characteristics and a first rough estimation of requirements for COVID-19 post-resuscitation care. More patients and further studies are required to definitively assess COVID-19-related rehabilitation cares.

#### Disclosure of interest

The authors declare that they have no competing interest.

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#### References

- [1] Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The index of adl: a standardized measure of biological and psychosocial function. *JAMA* 1963;185:914–9.
- [2] Ali NA, O'Brien Jr JM, Hoffmann SP, Phillips G, Garland A, Finley JC, et al. Acquired weakness, handgrip strength, and mortality in critically ill patients. *Am J Respir Crit Care Med* 2008;178(3):261–8.
- [3] Rahmel T, Schmitz S, Nowak H, Schepanek K, Bergmann L, Halberstadt P, et al. Long-term mortality and outcome in hospital survivors of septic shock, sepsis, and severe infections: the importance of aftercare. *PLoS One* 2020;15(2):e0228952.
- [4] Apostolakis E, Papakonstantinou NA, Baikoussis NG, Papadopoulos G. Intensive care unit-related generalized neuromuscular weakness due to critical illness polyneuropathy/myopathy in critically ill patients. *J Anesth* 2015;29(1):112–21.
- [5] Ceravolo MG. Systematic rapid living review on rehabilitation needs to COVID-19: update to March 31st 2020. *Eur J Phys Rehabil Med* 2020.

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