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Trabajo Original

Paciente crítico

Healthcare resource utilization among critically-ill COVID-19 survivors – Results from the NUTRICOVID study

Uso de recursos sanitarios en pacientes críticos supervivientes de la COVID-19: resultados del estudio NUTRICOVID

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Abstract

Background: critically ill patients admitted to the intensive care unit (ICU) are often associated with malnutrition and nutrition therapy is recommended. Previous studies on COVID-19 focused on the recovery of critically ill patients after hospital discharge; however, there are limited data on healthcare resource utilization (HRU) after discharge.

Aims: to describe and analyze the HRU and nutritional status of COVID-19 patients during hospitalization and one year after discharge.

Methods: during hospitalization and 12-month follow-up after discharge, we collected data on hospital and ICU length of stay, ventilatory support therapies, medical nutrition therapy, and outpatient visits. Factors contributing to outpatient visits and readmissions during the follow-up period were also analyzed.

Results: a total of 199 patients were included, with a median hospital and ICU length of stay of 53.0 and 23.5 days, respectively. During hospitalization, 86.4 % of the patients needed invasive ventilation and 51.5 % non-invasive ventilation; 50.3 % of the patients required parenteral nutrition, while 84.3 % required enteral nutrition and 66.0 % oral nutritional supplements. After discharge a mean number of visits per patient to general practitioner, specialized care, and emergency department of 4.5, 14.7, and 0.8, respectively, were registered, most of them directly or possibly related to COVID-19. Additionally, a better health-related quality of life (HRQoL) at discharge and lower weight loss during hospitalization were associated with lower HRU during follow-up.

Conclusions: our study shows a high HRU among patients with COVID-19 admitted to ICU in the year following discharge and highlights the importance of the nutrition status during admission and its relation to HRU.

Keywords:

Coronavirus disease (COVID-19). Intensive care. Nutritional therapy. Malnutrition. Healthcare resource utilization.

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Resumen

Introducción: los pacientes críticos ingresados en la unidad de cuidados intensivos (UCI) suelen presentar desnutrición, siendo recomendable la terapia nutricional. Estudios previos sobre la COVID-19 se centraron en la recuperación de los pacientes críticos tras el alta hospitalaria; sin embargo, existen pocos datos sobre el uso de recursos sanitarios (URS) tras el alta.

Objetivos: describir y analizar el URS y el estado nutricional de pacientes con COVID-19 durante la hospitalización y un año después del alta.

Métodos: durante la hospitalización y el seguimiento de 12 meses se recogieron la duración de la estancia hospitalaria y, en la UCI, las terapias de soporte ventilatorio, la terapia médica nutricional y las visitas ambulatorias. Se analizaron los factores que contribuyeron a las visitas ambulatorias y a los reingresos durante el período de seguimiento.

Resultados: se incluyeron 199 pacientes, con una mediana de estancia hospitalaria y en UCI de 53,0 y 23,5 días, respectivamente. Durante la hospitalización, el 86,4 % de los pacientes necesitó ventilación invasiva y el 51,5 % ventilación no invasiva; el 50,3 % precisó nutrición parenteral, mientras que el 84,3 % nutrición enteral y el 66,0 % suplementos nutricionales orales. Tras el alta se registró una media de visitas por paciente al médico general, la atención especializada y urgencias de 4,5, 14,7 y 0,8, respectivamente, la mayoría relacionadas directa o posiblemente con la COVID-19. Una mejor calidad de vida relacionada con la salud (CVRS) en el momento del alta y una menor pérdida de peso durante la hospitalización se asociaron a menor URS durante el seguimiento.

Conclusiones: nuestro estudio muestra un elevado URS entre los pacientes con COVID-19 ingresados en UCI en el año siguiente al alta y destaca la importancia del estado nutricional durante el ingreso y su relación con el URS.

Palabras clave:

Enfermedad por coronavirus (COVID-19). Cuidados intensivos. Terapia nutricional. Desnutrición. Uso de recursos sanitarios.

INTRODUCTION

The coronavirus disease-19 (COVID-19) was caused by the emergence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus (1). March 2020 represents a hallmark as the World Health Organization declared the outbreak as a pandemic (1,2). At that time, SARS-CoV-2 spread rapidly and, together with the lack of knowledge about the incipient disease, specific treatments and vaccines, led to a large number of patients admitted to the hospital or the intensive care unit (ICU) (3), which overloaded the healthcare system.

Patients with critical illness are often admitted to the ICU and associated with malnutrition (4). In fact, the prevalence of malnutrition in the ICU can be up to 78 % (5). In these patients, loss of muscle mass, a known indicator of malnutrition, is frequently observed (4). In this context, the guidelines recommend implementing a nutritional intervention within 24-48 hours of ICU admission in critically ill COVID-19 patients (6-8), as previous studies have shown that the prevalence of malnutrition in critically ill COVID-19 patients admitted to an ICU was 18-60 % (9,10), and that approximately 40 % of them had reduced muscle mass (11).

Additionally, during ICU stay patients often require mechanical ventilation; throughout the duration of mechanical ventilation, patients may receive inadequate protein and energy levels and some still present malnutrition to some extent after ICU discharge (4).

Previous studies have reported a median length of stay in the ICU of 8-12 days (12-14). Such values might lead to a rapid reduction of ICU capacity and resources (12), and are associated with increased medical costs (15). In this context, studies on other pathologies revealed that malnutrition is associated with longer hospital lengths of stay and increased risk of readmission and costs (16,17).

Most of the studies on COVID-19 focus on patient recovery after hospital discharge and describe persistent symptoms (18). However, data on healthcare resource utilization (HRU) after hospital discharge and on factors that may increase HRU are scarce.

The aim of this work was to describe HRU, including nutritional treatment, in the NUTRICOVID study cohort during hospitalization and at one year after hospital discharge, and to analyze the sociodemographic and clinical factors that may lead to high HRU.

METHODS

STUDY DESIGN AND PATIENTS

Details of the NUTRICOVID study design and population have been published previously (19). Briefly, this multicentric, observational, ambispective cohort study was carried out in adult (≥ 18 years old) patients with confirmed COVID-19 and admitted to an ICU from March 1st to June 30th, 2020. Patients were followed up for 12 months after hospital discharge.

The study protocol was approved by the Ethics Committee of Hospital Clínico San Carlos (Madrid, Spain), and was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines. A written informed consent was obtained from all patients.

DATA COLLECTION

Eligible patients were invited to participate voluntarily in the study after discharge from hospital. Sociodemographic characteristics, patient nutritional status, patient use of healthcare resources, medical nutrition therapy (MNT) received, duration of MNT, functional status, and health-related quality of life (HRQoL) were collected. Full details have been previously published (19).

Healthcare resource utilization

Data on HRU during hospitalization and for a 12-month period post-discharge were retrospectively collected from electronic medical records.

The following variables were collected: hospital and ICU length of stay, ventilatory support therapies (including invasive or non-invasive ventilation) and tracheostomy, MNT during hospitalization (use of oral nutritional supplements [ONS], enteral or parenteral nutrition [EN or PN]) and MNT prescribed after discharge and in readmissions, number of outpatient

(visit date, service [general practitioner (GP), specialist]) and emergency department (ED) visits, and number and length of readmissions were recorded. The researchers consulted the patients' health records to establish the motive for each consultation and determined whether it was directly or possibly related to COVID-19, or the motive was not determined. Mean number of visits per patient and visit frequency according to each motive were estimated.

STATISTICAL ANALYSIS

Measures of centrality and dispersion (mean, standard deviation [SD], interquartile range [IQR], minimum, and maximum) for quantitative variables, and absolute and relative frequencies for qualitative variables were estimated for the study outcomes.

A regression was performed using a generalized linear model in order to assess the factors that contributed to the number of outpatient visits during the follow-up period. The following, previously published (20) characteristics of the patients at hospital discharge were used as explanatory variables (factors): age, sex, risk of malnutrition, risk of sarcopenia, level of dependency, EQ-VAS score (EuroQoL-Visual Analogue Scale), EuroQoL-5D dimensions (mobility issues, personal care, daily activities, discomfort/pain, anxiety/depression), utility value, and weight loss during hospitalization. To determine factors that contributed to readmissions a logistic regression was performed using the same variables. In both models a multivariate analysis using the stepwise method (21) was carried out.

All statistical analyses were performed using the software STATA v.14 (Stata Corp. College Station, TX, USA). The level of statistical significance was set at $p = 0.05$.

RESULTS

HOSPITALIZATION AND VENTILATORY SUPPORT THERAPIES

A total of 199 patients were included in the study. Of these, 188 (94.5 %) patients were followed-up throughout the study. Of the remaining eleven patients, six were lost to follow-up after three months and did not complete the study, and in five cases the patients had to be withdrawn from the study because they had not complied with any of the established procedures. Mean (SD) age of the patients completed was 60.7 (10.1) and most of them were men ($n = 140$, 70.4 %).

The median (IQR) hospital length of stay was 53.0 (27.0-85.0) days, while the median (IQR) ICU length of stay was 23.5 (11.0-43.0) days.

During hospitalization, 172 (86.4 %) patients needed invasive ventilation, while 101 (51.5 %) needed non-invasive ventilation. In addition, 106 (53.5 %) patients underwent a tracheostomy (Table I).

Table I. Support therapies requirement for the included patients during hospitalization

Support therapies	Hospitalization
Invasive ventilation, n (%)	
Yes	172 (86.4)
No	16 (8.0)
Unknown	11 (5.5)
Missing data	0
Non-invasive ventilation, n (%)	
Yes	101 (51.5)
No	82 (41.8)
Unknown	13 (6.6)
Missing data	3 (1.5)
Tracheostomy, n (%)	
Yes	106 (53.5)
No	87 (43.9)
Unknown	5 (2.5)
Missing data	1 (0.5)

NUTRITIONAL SUPPORT

Most of the patients required some kind of MNT during hospitalization ($n = 177$; 94.1 %). A total of 100 (50.3 %) patients required PN, with a mean (SD) duration of 15.8 (14.0) days, with values ranging from 1.0 to 97.0 days. In addition, 166 (84.3 %) patients required EN during a mean (SD) of 25.6 (23.9) days (ranging from 1.0 to 123.0 days), while 130 (66.0 %) patients needed ONS during a mean (SD) of 22.0 (21.4) days (ranging from 2.0 to 118.0 days) (Table II).

At hospital discharge, only two patients (1.0 %) required EN (Table II). The mean (SD) duration of EN after discharge was 62.5 (38.9) days, ranging from 35.0 to 90.0 days. As of the 3-month visit, no patient required EN.

Additionally, 69 patients (34.7 %) still required ONS after discharge, with a mean (SD) duration of 85.6 (41.1) days and values ranging from 6.0 to 180.0 days. The number of patients requiring ONS decreased with follow-up time. In fact, at the 12-month visit only 12 patients (6.4 %) still continued treatment with ONS.

CONSULTATION VISITS AFTER DISCHARGE

Data regarding resource utilization from 198 patients was collected during the following 12 months after hospital discharge.

General practitioner visits

A total of 889 visits to GP during the 12-month period after discharge were registered. Of these, 529 (59.5 %) were related to COVID-19, 107 (12.0 %) were not directly related, and for 253 (28.5 %) the relation to COVID-19 was unknown.

Table II. Medical nutrition therapy requirement by the included patients during hospitalization and after discharge

Medical nutrition therapy	Hospitalization	After discharge
Parenteral nutrition, n (%)		
Yes	100 (50.3)	0
No	94 (47.2)	199 (100)
Unknown	5 (2.5)	0
Missing data	0	0
Enteral nutrition, n (%)		
Yes	166 (84.3)	2 (1.0)
No	28 (14.2)	197 (99.0)
Unknown	3 (1.5)	0
Missing data	0	0
Oral nutritional supplements, n (%)		
Yes	130 (66.0)	69 (34.7)
No	61 (31.0)	127 (63.8)
Unknown	6 (3.0)	3 (1.5)
Missing data	2 (1.0)	0

The mean (SD) number of total visits to GP per patient was 4.5 (4.7), with values ranging from 0 to 24 visits. Of these, a mean (SD) of 2.7 (3.7) visits were directly or possibly related to COVID-19.

Specialized care visits

Of the total 2906 visits to specialized care registered during the follow-up period, 2312 (79.6 %) were related to COVID-19, while 414 (14.0 %) were not related. Only 180 (6.2 %) of these visits were of unknown relation to the disease. Data on medical specialties could only be registered for 945 visits. Of these, most of the visits were in Pneumology (n = 142, 15.0 %), Physical Medicine and Rehabilitation (n = 109, 11.5 %) and Endocrinology and Nutrition (n = 80, 8.5 %) departments (Fig. 1).

The mean (SD) number of total visits to specialized departments per patient was 14.7 (13.0), with values ranging from 0 to 81 visits. A mean (SD) of 11.6 (11.7) visits were directly related to COVID-19.

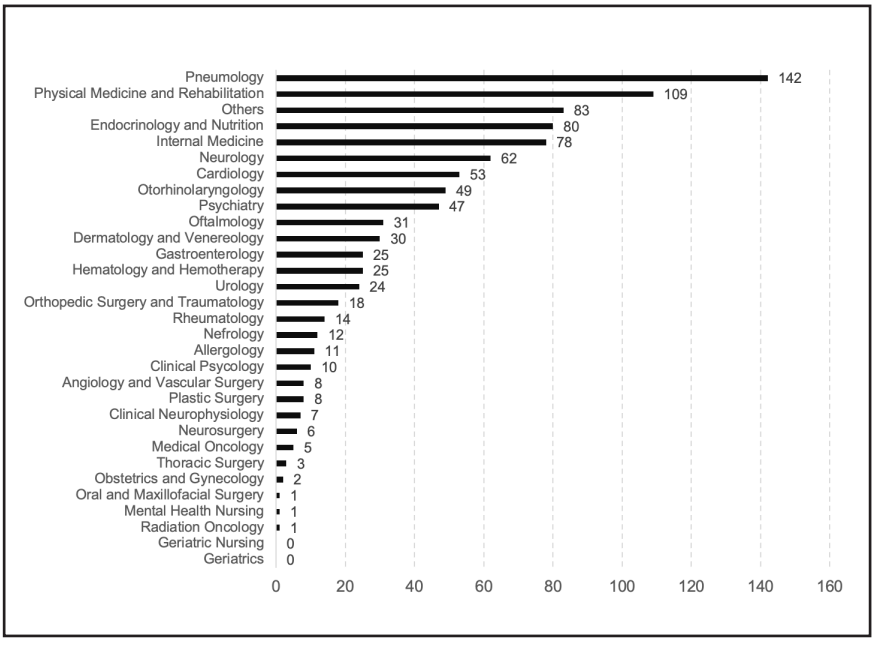

Figure 1.

Number of visits registered to the different departments of specialized care (n = 945 visits).

Emergency department visits

One hundred and fifty visits to ED were registered. Approximately half of those (n = 79, 52.7 %) were related to COVID-19, while 15 (10.0 %) were not related to the disease. A high number of visits (n = 56, 37.3 %) did not provide information regarding their relation to COVID-19. Of the total visits to ED, only 19 (12.7 %) required further hospitalization.

The mean (SD) number of total visits to ED per patient was 0.8 (1.3), with values ranging from 0 to 8 visits. Of these, a mean (SD) of 0.4 (0.9) visits were related to the disease.

HOSPITAL READMISSIONS

A mean (SD) of 0.2 (0.5) hospital readmission per patient was registered, with readmission values ranging from 0 to 2.

During the 12-month follow-up period 33 (16.7 %) patients were readmitted corresponding to a total of 38 registered readmissions. Of these, invasive and non-invasive ventilation was required in one (2.6 %) and two occasions (5.3 %), respectively. Moreover, ONS was required in eight (21.1 %) readmissions, while parenteral nutrition was required in only one (2.6 %) occasion.

FACTORS ASSOCIATED WITH CONSULTATIONS

Finally, we evaluated which factors (20) could be involved in more frequent consultations during the 12-month follow-up period after discharge. The analysis revealed that patients with self-care issues, anxiety, and problems with daily activities according to EuroQoL-5D questionnaire at discharge were significantly associated with a higher number of total visits (GP, specialized care, and ED) during 12 months after discharge compared with those patients with no reported issues in neither of these domains (Table III). In addition, a better HRQoL (higher score in the EQ-VAS) and a lower weight loss during hospitalization were significantly associated with a lower number of total visits during follow-up (Table III).

Regarding hospital readmission, the analysis showed that neither of these factors was significantly associated with a higher probability of readmission.

DISCUSSION

Our study evaluated the use of nutritional treatment and HRU in COVID-19 patients admitted to the ICU during the first wave of the pandemic and in the 12-month period after hospital discharge.

Patients included in the study were hospitalized for a median of 53.0 days. For those who were admitted to the ICU, a median length of stay of 23.5 days was registered.

The length of hospitalization observed in the NUTRICOVID cohort, although high, was similar to that reported previously. However, the length of ICU stay observed in our cohort was higher than those reported during the first wave in other populations. A systematic review of studies (most of them carried out in China) reporting COVID-19 length of hospital stay showed a median of hospital and ICU stay ranging from 4 to 53 days and 5 to 19 days, respectively (14). In a cohort of patients admitted to ICU in a region of Italy the reported median ICU length of stay ranged from 5 to 13 days (13), while the estimated mean of ICU stay in England reported by Shryane and colleagues was over 16 days (12). These observed differences could be explained as during the first wave Madrid was severely hit by the SARS-CoV-2, being the most affected city in Spain. Indeed, it was reported to have one of the highest COVID-19 mortality in Europe (22).

During hospitalization, 172 (86.4 %) patients needed invasive ventilation, while 101 (51.5 %) needed non-invasive ventilation. In addition, 106 (53.5 %) patients underwent a tracheostomy. Grasselli and colleagues reported similar data regarding patients requiring invasive ventilation (88 %) (13). However, the percentage of patients requiring invasive ventilation in our cohort and Graselli's was higher than that reported in ICU populations from the United States and China (30 %-71 %) (23-26). Data on the use of non-invasive ventilation is heterogeneous; the NUTRICOVID cohort showed a higher proportion of patients who required non-invasive ventilation compared with some of these populations (11 %-42 %) (13,23,24), while it was lower than in others (56 % and 62 %) (25,26).

Previous studies have reported that nutritional risk is highly prevalent in patients with COVID-19 (27). Moreover, a worse nutritional status of patients admitted to the ICU leads to an elevated weight loss and longer stays (27,28), which results in higher HRU. Additionally, at discharge, these patients report malnutrition,

Table III. Factors significantly associated with the number of visits

Factors	Coefficient	SD	*p*-value
Self-care issues	2.19	0.82	< 0.01
Anxiety/Depression	1.88	0.73	0.01
Daily activities	2.9	0.90	< 0.01
EQ-VAS score	-0.06	0.02	< 0.01
Weight loss during hospitalization	-0.09	0.04	0.023

EQ-VAS: EuroQoL Visual Analogue Scale; SD: standard deviation.

loss of functionality for daily activities and show a poor HRQoL (20). Thus, clinicians should consider the risks of malnutrition in patients in the ICU, with focus on those with a longer stay (28,29). Given the importance of ICU occupancy, attention should be paid the nutrition therapy as a proper nutritional status could reduce length of stay. Furthermore, this would impact positively on patient's HRQoL and HRU after hospital discharge.

A further analysis revealed that some factors were significantly associated with the number of visits, and therefore, with HRU. In this regard, we have published that almost all patients had lost weight at discharge compared with their weight at hospital admission (20). However, patients showing a lower weight loss and a better HRQoL during hospitalization were less likely to need further consultations during the 12-months period after discharge. This highlights the importance of the nutritional status during ICU stay and at discharge and its relation to HRU.

One year after discharge, HRU associated to COVID-19 was still high; of the total registered visits to GP, specialized care, and ED, 59.5 %, 79.6 % and 53.7 %, respectively, were directly related to the disease, and 16.7 % of the patients were readmitted.

Our data on readmission were similar to those previously published on COVID survivors one year after discharge (30). This population showed the same proportion of patients readmitted after two years of follow-up (31).

Even though in our cohort most of the patients required nutritional support during hospitalization, including PN, EN, and ONS, the proportion of patients requiring MNT drastically reduced after discharge. In this regard, our results are consistent with those previously observed in patients with COVID-19 (29) and in populations with other conditions admitted to the ICU (32). In addition, it has been reported that patients who required intubation during ICU stay showed lower appetite and swallowing difficulties (4), which could explain the need for MNT after discharge.

Our study has several strengths and limitations. The main strength was the period of follow-up after discharge, which is long enough to draw conclusions and is higher than length showed in other studies. Even though our study sample is smaller compared with other studies, 16 different hospitals participated in study. Thereby, we believe our cohort is representative of the most populated city in the country. However, the study has some limitations. Due to the pandemic situation and the consequent healthcare system saturation, a prospective follow-up could not be carried out and part of the data were retrospectively collected through electronic medical records. Nevertheless, information was precisely registered and there was little loss of data for the main variables. Finally, some data regarding visits to specialized care could not be collected and the relation of the visit to COVID-19 was established based on doctor's appreciation, not following specific diagnostic tools due to overload and saturation of the different departments caused by the pandemic.

CONCLUSION

In conclusion, HRU is high among patients with COVID-19 admitted to ICU even one year after discharge. Special attention should be paid to patients' nutritional status as it directly affects HRU after discharge.

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Supplementary Table I. List of participating centers and researchers

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