



OPEN Incidence of post-intensive care syndrome among patients admitted to post-ICU multidisciplinary consultations: the retrospective observational PICS-MIR study

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To determine the prevalence of functional, respiratory and renal impairments and of post-intensive-care-syndrome (PICS) among patients who had attended a post-ICU multidisciplinary consultation (post-ICU-MC) around 3 months after ICU discharge, we performed a retrospective, monocentric observational study, at Clermont Ferrand University hospital, France. We included patients who had attended a post-ICU-MC. Their characteristics during ICU stay and at the post-ICU-MC were collected. Functional status was assessed by the 6-min-walking test, handgrip test and peak inspiratory pressure, respiratory function by exploratory functional outcomes, mental status by SF-36 score, and quality of life by SF-36 score and European Quality of Life 5 Dimensions questionnaire. Overall, we enrolled 67 patients, of whom 70%, 74%, and 68% had functional, respiratory, and renal impairments, respectively, at the post-ICU-MC. Additionally, 40%, 28%, 19%, and 2.5% had three, two, one, and none of these impairments, respectively. All patients experienced mental disorders and a decline in quality of life. Functional impairment correlated with frailty score and sex, and respiratory function with age. To conclude, the prevalence of PICS in our cohort was high, as was that of functional, respiratory and renal failure.

Keywords Long term outcomes, Multidisciplinary consultations, Intensive care

Abbreviations

6mWT	6-metre walking test
ADL	Activity daily living
BMI	Body mass index
DLCO	The diffusion coefficient of CO
EuroQoL-5D	The European Quality of Life 5 Dimensions survey
FEV	The full expiratory volume per second
FVC	The forced vital capacity
GFR	The glomerular filtration rate
HAD	The Hospital Anxiety and Depression scale

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HGT	Hand grip test
HRQoL	Health care related quality of life
IALD	Instrumental ADL scores
ICU	Intensive care unit
IMV	Invasive mechanical ventilation
IQR	Interquartile range
IRB	Institutional review board
LOS	Length of stay
MCS	The mental component summary scales
MoCA	The Montreal Cognitive Assessment test
PCL-5	The Posttraumatic Stress Disorder Checklist for DSM-5
PCS	The physical component summary scales
PICS	Post intensive care syndrome
PIP	Peak inspiratory pressure
Post-ICU-MC	Post ICU multidisciplinary consultations
PTSS-10	The Posttraumatic Stress Syndrome questionnaire
RFT	Respiratory function tests
RRT	Renal replacement therapy
SAPS II	The Simplified Acute Physiology Score II
SF-36	Study Short Form 36

Mortality after an ICU stay is tending to decrease owing to advances in critical care medicine despite patients getting older and having more comorbidities and less autonomy¹. One of the unfortunate consequences of this better survival rate is an increased number of sequelae among survivors, such as cognitive disorders (impaired memory, executive function, language skills, and spatial and visual attention), physical disorders (muscle weakness, chronic pain) and psychological disorders (depression, anxiety and post-traumatic stress symptoms)². These post-ICU sequelae collectively constitute what is called the post-intensive care syndrome or PICS. Several tests, scores, scales and questionnaires can be used to explore all the component of the PICS (Table S1). The term PICS was coined in 2010 by the Society of Critical Care Medicine, whose aims were to raise awareness among clinicians, patients and the general population of the various impairments that occur during ICU stay and after discharge, increase evaluation of the syndrome and create a new field of research³. Since 2010, several studies have reported data on the prevalence of PICS (Table S2). For instance, in the study of Weidman et al.⁴, involving a cohort of COVID-19 patients discharged alive from the ICU, the prevalence of PICS reached 90%. The authors defined PICS by the percentage of patients with at least one impairment. Cognition was assessed by the Montreal Cognitive Assessment (MoCA) test, and the psychological status of patients by the Hospital Anxiety and Depression (HAD) scale, the Posttraumatic Stress Syndrome (PTSS-10) questionnaire, or the Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5). In another study⁵ involving 60 patients, the prevalence of PICS was 80%: 47% of the patients were impaired in at least two domains and 20% in all three domains of the PICS spectrum. In this study cognition was assessed by the MoCA test, and the psychological components of PICS by the HAD scale and the Impact of Event Scale-6. Physical function was assessed by the European Quality of Life 5 Dimensions (EuroQoL-5D) survey. Several studies have also shown that PICS is associated with increased risk of death as, for instance, in that of Yanagi et al.⁶, who found a significant association up to 1 year after ICU discharge.

Since 2018, the Medical Intensive Care Unit of the Clermont-Ferrand University Hospital, France, has referred eligible patients for post-ICU multidisciplinary follow-up consultations (post-ICU-MC) that all took place in a day hospital around 3 months after ICU discharge. Patients had several consultations with different specialists including nephrologists, pulmonologists, nutritionists and intensivists. Different components of PICS were then assessed such as motricity, mental impairment, and health care-related quality of life (HRQoL).

Against this background, the main aim of our study, called the PICS-MIR study, was to assess the prevalence of long-term alteration of the functional status among patients who had attended a post-ICU-MC. We also documented the prevalence of respiratory and renal impairment, deterioration of HRQoL, and PICS in the cohort.

Material and method

Type of study

This study was a monocentric, retrospective, observational study, involving patients who had attended a post-ICU-MC of Clermont-Ferrand University Hospital, from April 2018 to January 2024.

Population

The criteria to propose attendance at a post-ICU-MC were an ICU length of stay (LOS) of at least 4 days, and one of the following criteria: body mass index (BMI) < 19 or > 35 kg/m² on admission, and/or administration for at least 48 h of a vasopressor, and/or invasive mechanical ventilation (IMV), and/or renal replacement therapy (RRT), and/or age over 80 years, or an ICU LOS of at least 7 days. Only patients who attended the post-ICU-MC were eligible. Patients who refused use of their data were excluded.

Ethical considerations

The PICS-MIR study was approved by the local ethics committee (IRB13412, CHU de Clermont Ferrand IRB #1, IRB number 2023-CF229). Each participant was informed of the possible use of anonymized data for research. The families were given a written informed consent form on ICU admission, and the same written information

was displayed in the waiting room of the ward. None of the participants were opposed to use of their data. All procedures were conducted in accordance with the ethical standards of the responsible committee on human experimentation, whether institutional or regional, and in agreement with the Helsinki Declaration of 1975.

Description of the post-ICU-MC

More details of the post-ICU-MC are given in the supplemental file. Briefly, the post-ICU -MC included nephrology, pneumology, nutrition, physiotherapy and intensivists consultations. Health status was assessed by the Knaus score, the activity daily living (ADL) and instrumental ADL (IADL) scores, and the Medical Outcomes Study Short Form 36 (SF-36). CT-scans, respiratory function tests (RFT), hand grip test (HGT) and 6-minute walking test (6mWT) were performed.

Data collection

We collected data on ICU admission, during ICU stay, and between ICU stay and attendance at the post-ICU-MC. Data were (1) on ICU admission: age, BMI, main comorbidities, autonomy as assessed by the Knaus score, clinical frailty score and place of residence before ICU admission, and baseline severity measured by the Simplified Acute Physiology Score II (SAPS II); (2) during ICU stay, requirement for and duration of oxygen therapy, IMV, vasopressors and RRT, occurrence of nosocomial infections, and ICU LOS; and (3) during the post-ICU-MC, autonomy, health care-related quality of life (HRQoL) evaluated by SF-36 and EuroQoL-5D questionnaires, conclusions of the consultations, and results of the explorations. All the data were extracted from current ICU and hospital patient electronic files.

Outcome measures and definitions

The primary outcome of the study was deterioration of motor function as assessed during the post-ICU-MC by the distance covered during the 6mWT. Age- and sex-normative values were obtained from the reference equations of Enright et al.⁷, and the distance was defined as low if less than 80% of the expected distance⁸.

Secondary outcomes were impairment of functional status, respiratory, renal, and mental functions, autonomy, and HRQoL^{9,10}.

Impairment of functional status was defined by a low HGT and/or 6mWT score, and/or a peak inspiratory pressure (PIP) of less than 80% of the theoretical value. A Jamar hydraulic hand dynamometer was used to perform the HGT. The three measurements were made at 30-s intervals between contractions. The best performance was considered for analysis. HGT was considered pathological if < 25 kg in men aged ≤ 60 years and < 23 kg in men between 61 and 79 years, and < 14 kg in women aged ≤ 60 years and < 13 kg in women between 61 and 79 years¹¹.

The SF-36 explored eight items of physical and mental disorders. The physical component summary (PCS) and mental component summary (MCS) scales combine information from all eight domains of SF-36^{9,10}. An MCS < 50, a PCS < 50, and any of the subcomponents of the SF-36 - physical functioning (PF), role-physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE), and mental health (MH) - < 50 were considered as pathological. The EQ-5D-5 L was pathological if an item achieved a score of more than or equal to 2.

Impairment of mental function was defined by an MCS score of the SF36 < 50.

Impairment of respiratory function was defined by a decrease in one of the indices obtained by respiratory functional tests (< 80% theoretical value), including full expiratory volume (FEV) per second, and/or forced vital capacity (FVC), and/or diffusion coefficient of CO (DLCO).

Impairment of renal function was defined by a glomerular filtration rate (GFR) < 45 mL/min/1.73m² and/or GFR decline > 5 mL/min/1.73m².

Patients had PICS if they presented mental and/or functional impairments.

Nutritional status was assessed by BMI measurement, and weight loss between ICU admission and post-ICU-MC.

Statistical analysis

Patient characteristics were expressed in numbers (percentage) for categorical variables and median (interquartile range [IQR]) for continuous variables. Comparisons were made with exact Fisher tests for categorical variables and Wilcoxon tests for continuous variables.

To identify factors associated with HGT, distance and PIP, these variables were first dichotomized using a median. Correlations between measurements and these outcomes were then assessed by Spearman correlation coefficient. For every test, a two-sided α of 0.05 was considered as significant. Missing variables were handled by the median. All statistical analyses were performed with SAS software, Version 9.4 (SAS Institute, Cary, NC) and R (version 3.6.3).

Results

Characteristics of the cohort during hospitalization

Between April 2018 and December 2023, 67 patients were enrolled in the PICS-MIR study (Fig. 1). Most of the patients hospitalized in the ICU came either directly from home without (42 patients) or with assistance (3 patients), or from a short-stay facility (13 patients) (Fig. 2). The characteristics of the patients are given in Table 1. Their median age was 64 years [55.3; 71.8], and 62.7% were male. The median BMI was 27.4 kg/m² [22.6–34.6]. Their main comorbidities were chronic cardiovascular disease (38.8%) and diabetes (23.9%). Their median SAPS II was 40 [30–57]. Overall, 42 patients (62.7%) were mechanically ventilated, and 43 (64.2%) and 21 (31.3%), respectively, required vasopressors and RRT. The median ICU LOS was 12 days [7–25].

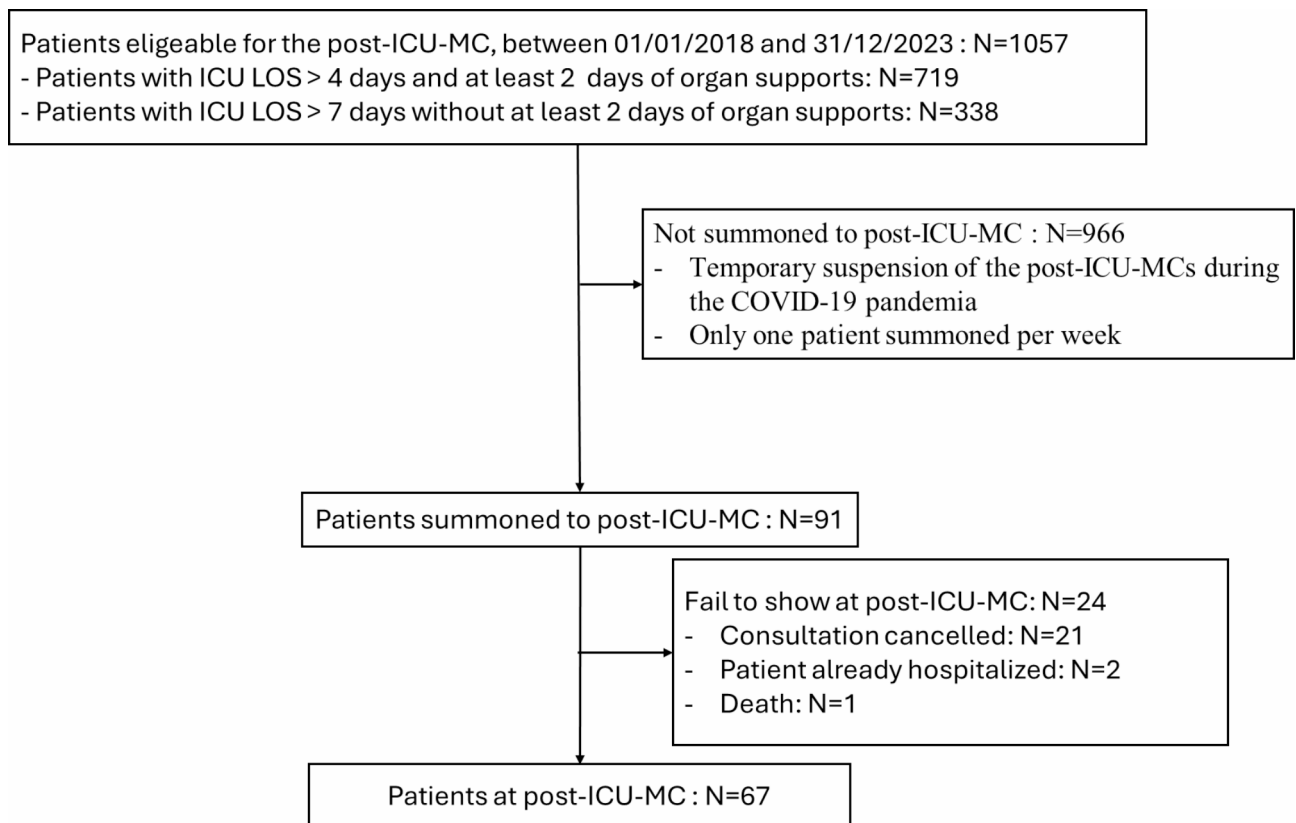


Fig. 1. Flow chart. Post ICU MC: post intensive care multidisciplinary consultations; ICU LOS: intensive care unit length of stay.

Characteristics of the cohort at the post-ICU-MC

The median time from ICU discharge to post-ICU-MC was 164 days [117–235] (Table 2). At post-ICU-MC, only two patients had no functional, no respiratory and no renal impairments (Fig. 3).

Nephrological assessment

Most of the 58 patients (86.6%) who had a nephrological evaluation experienced a decline in their GFR $> 5\text{ mL}/\text{min}/1.73\text{ m}^2$ (73.7%), and 12 of the 58 (21.1%) had a GFR $< 45\text{ mL}/\text{min}/1.73\text{ m}^2$, including 2 dependent on RRT.

Respiratory assessment

Three patients were still being treated with long-term oxygen therapy and four with non-invasive mechanical ventilation. Most of the patients presented a decrease in their DLCO 47/55 (85%), and half of the patients had a decreased FEV (28/62 (45)) (Table 2).

Nutritional assessment

From ICU admission to post-ICU-MC, 25 patients (37.3%) lost more than 5% of their body weight. The median BMI was about $27.1\text{ kg}/\text{m}^2$. Albumin, pre-albumin and CRP dosages were abnormal for, respectively, 2/62 (3.2%), 8/57 (14%) and 7/59 (11.9%) patients.

Functional assessment and autonomy

The HGT, 6mWT and PIP were low in 7/61 (11.5%), 31/56 (55.4%) and 31/62 (50%) patients, respectively. At the time of post-ICU-MC, more patients were dependent on home care assistance than at the time of ICU admission, and the functional status of most of the patients decreased from ICU admission to the time of the post-ICU-MC. However, the proportion of patients living with severe frailty was unchanged (Fig. 2).

Health-related quality of life

The SF-36 questionnaire was completed by 39 patients (58.21%). The PCS was 25.47 [24.75–26.49] and MCS was 23.69 [22.8–24.24]. After ICU stay the main issues were physical limitations (100% under a score of 50) and mental limitations (92.31% under a score of 50). The main outcomes were a lack of physical activity, a loss of vitality, a change in health status, and physical pain (Table 2).

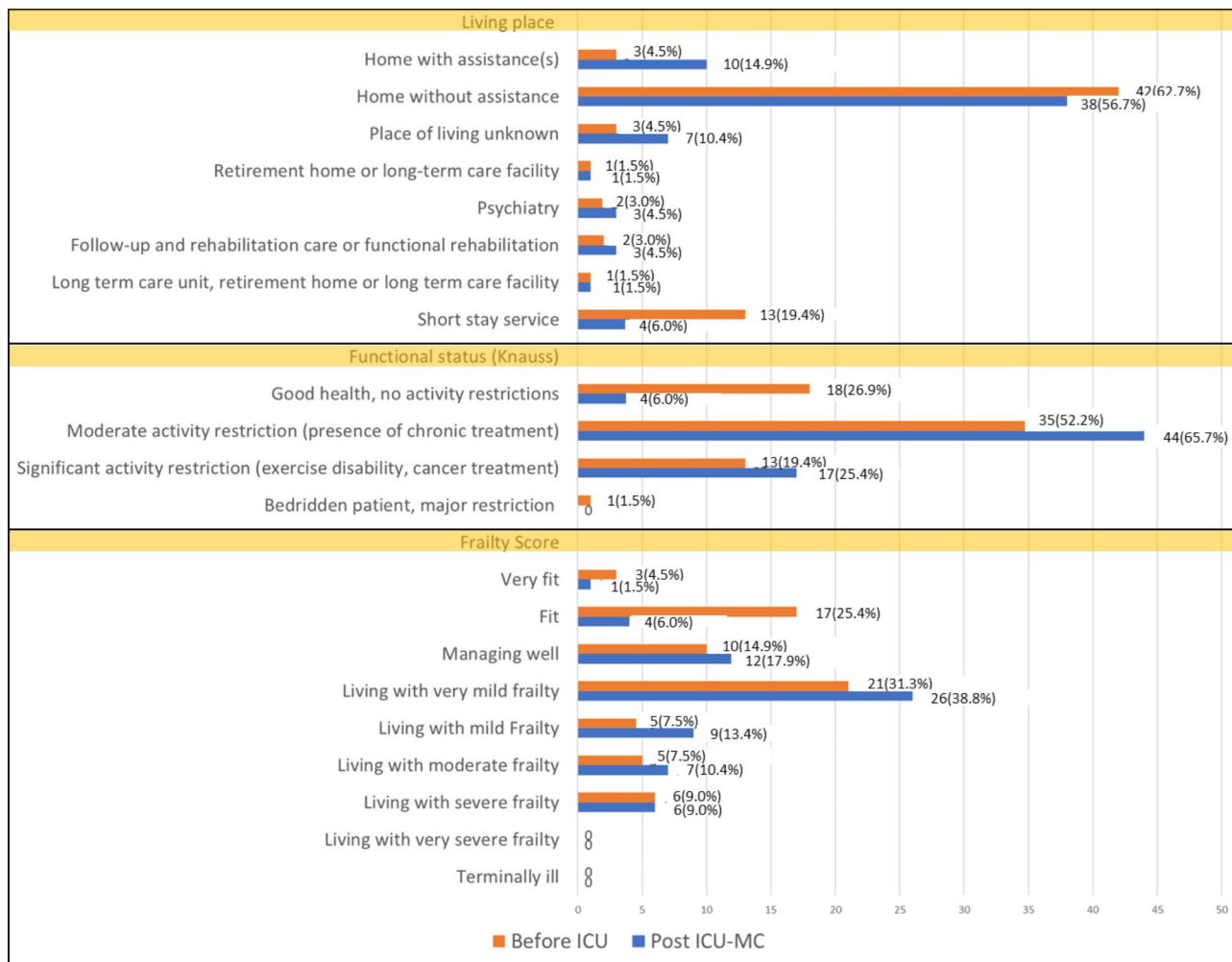


Fig. 2. Distribution of the patients depending on their place of residence, functional status and frailty score before ICU and at the post-ICU multidisciplinary consultations. ICU: Intensive care unit; Post-ICU-MC: post intensive care multidisciplinary consultations.

Correlations between parameters

Age was significantly associated with 6mWT (-0.5), PCS (-0.4), PIP (-0.34) and GFR (-0.4) assessed during post-ICU-MC. At the post-ICU-MC, the variables assessing patient functionality (PIP, 6mWT and HGT) were significantly correlated. GFR was also correlated with 6mWT (0.37) (Fig. 4).

Comparisons depending on the distance at the 6mWT (Table S3)

The patients who covered a short distance were more often diabetic (35.5% vs. 8%, $p=0.02$), more often under IMV, and had a longer ICU and hospital LOS. At the time of post-ICU-MC, these patients had lower DLCO.

Comparisons depending on physical impairment (Table S3)

Women were more likely to have physical impairment than men, and frailty score on ICU admission was higher for patients with a functional impairment. At the post-ICU-MC, DLCO was lower for patients with physical impairment.

Comparisons depending on respiratory impairment (Table S4)

Older patients had a higher risk of respiratory impairment.

Comparisons depending on renal impairment (Table S4)

The SAPS II of patients with renal impairment was lower. The psychological components of SF-36 (General Health, Mental Health, Psychological Summary Score) were significantly associated with renal impairment. These patients also had a higher bodily pain score as assessed by SF-36.

Variables	N (%) or median (IQR)
Number of patients	67
Characteristics on admission	
Age	63.91 [55.3; 71.8]
Gender (male)	42 (62.7)
BMI (kg/m ²)	27.38 [22.6; 34.6]
Main comorbidities	
Chronic Cardiovascular Disease	26 (38.8)
Chronic Respiratory Failure	6 (9.0)
Long-term oxygen therapy	3/6 (50)
NIV or CPAP	3/6 (50)
Chronic Kidney Disease	7 (10.5)
Hemodialysis	3/7 (42.9)
Chronic Liver Failure	1 (1.5)
Immunosuppression	5 (7.5)
Diabetes	16 (23.9)
Characteristics of ICU stay	
Medical motif of admission	64 (95.5)
SAPS II score	40 [30; 57]
IMV	42 (62.7)
Duration of IMV (days)	3 [0; 16]
Oxygen administration	67(100)
Duration of oxygen administration (days)	10 [5; 18]
Administration of blocking agent	24 (35.8)
RRT	21 (31.3)
Duration of RRT	9 [3; 17]
Vasopressors	43 (64.2)
Duration of vasopressors	6 [3; 12]
Steroids	34 (50.8)
Duration of steroids (days)	7 [5; 14]
Nosocomial infections	15 (22.4)
Surgery	6 (9.0)
Limitation of care	9 (13.4)
ICU LOS (days)	12 [7; 25]
Hospital LOS (days)	27 [12; 43]
Main motif of inclusion	
ICU LOS ≥ 4 days and	
BMI < 19 or > 35 (kg/m ²) or	24 (35.8)
Vasopressors ≥ 2 days or	36 (53.7)
IMV for ≥ 2 days	39 (58.2)
RRT ≥ 2 days	16 (23.9)
ICU LOS ≥ 7 days	15 (22.4)
ICU LOS > 2 days and age > 80 years	1 (1.5)

Table 1. Patients' demographics and characteristics at ICU admission and characteristics of their ICU stay. BMI = body mass index; NIV = Non-invasive ventilation; CPAP = Continuous Positive Airway Pressure ; ICU = intensive care unit ; SAPS II: IMV = invasive mechanical ventilation; RRT = Renal replacement therapy; LOS = Length of stay.

Comparisons depending on ICU LOS and SAPS II score on ICU admission (Table S5)

No significant differences were observed at post-ICU-MC in relation to ICU LOS. Patients who were more severely affected on ICU admission, i.e. those with a higher SAPS II score, lost more weight and had several impairments in components of the SF-36. No other differences were observed.

Discussion

We finally enrolled 67 patients, of whom 70%, 74%, and 68% exhibited functional, respiratory, and renal impairments, respectively, at the time of the post-ICU-MCs. Additionally, 40%, 28%, 19%, and 2.5% had three, two, one, and none of these impairments, respectively. All patients experienced mental disorders and a decline in

Variables	N (%) or median [IQR]
Time from ICU discharge to post-ICU-MC (days)	164 [117; 235]
Time from hospital discharge to post-ICU-MC (days)	146 [90; 210]
Nephrological assessment	58 (86.6)
Renal replacement therapy	2/58 (3.5)
Indication for nephrology consultation	
GFR < 45 mL/min/1.73m ²	12/57 (21.1)
GFR decline > 5 mL/min/1.73m ²	42/57 (73.7)
Respiratory assessment	53 (79.1)
Long-term oxygen therapy	3/53 (5.7)
NIV or CPAP	4/53 (6.0)
Respiratory Functional Investigation (Raw value - value < 80% th)	62 (92.5)
Th FEV1 (%)	83 [72; 100] – 28/62 (45.2)
Th FVC (%)	98 [82; 113] – 12/62 (19.4)
Th TLC (%)	106.5 [92; 114] – 7/60 (11.7)
Th DLCO (%) (missing data = 3)	63 [47; 74] – 47/55 (85.5)
Th KCO (%) (missing data = 3)	80 [65; 91] – 27/55 (49.1)
Th PIP (%)	80.2 [57.6; 87.8] – 31/62 (50)
Obstructive syndrome (FEV/CPT < 80%)	6/62 (9.7)
Desaturation during the 6-MWT	17/56 (30.4)
Nutritional assessment	
Weight loss (%) - > 5%	1.47 [-3.3; 6.1] – 25 (37.3)
BMI (kg/m ²)	27.1 [23.0; 31.1]
Albumin (g/L) - Albumin < (30 g/L) (missing data = 3)	40 [37.4; 43] – 2/62 (3.2)
Pre-albumin (g/L) - < 0.2 (g/L) (missing data = 7)	0.26 [0.22; 0.32] – 8/57 (14.0)
CRP (mg/L) - > 15 (mg/L) (missing data = 7)	3.1 [1.7; 8.4] – 7/59 (11.9)
Functional assessment	
Handgrip score (kg) (missing data = 5)	24.5 [20.3; 31.4]
Low hand grip test* (missing data = 5)	7/61 (11.5)
Distance at the 6mWT (m) (missing data = 6)	398.5 [268.3; 494.5]
Th distance at the 6mWT (%) - < 80% th (missing data = 6)	78.15 [55.9; 93.7] – 31/56 (55.4)
Short Form 36 (Raw value - Value < 50)	36 (53.7)
PF	30 [15; 45] – 32/36 (82.1)
RP	0 [0; 25] – 29/36 (80.6)
BP	32 [22; 54] – 21/36 (58.3)
GH	52 [40; 62] – 13/36 (36.1)
VT	52 [40; 62] – 28/36 (77.8)
SF	75 [37.5; 100] – 9/36 (25)
RE	0 [0; 33.33] – 33/36(91.7)
MH	64 [56; 72] – 6/36(16.7)
HT	25 [0; 50] – 24/36 (66.7)
PCS	26.02 [25.4; 26.7] – 36/36 (100)
MCS	23.47 [22.7; 24.0] – 36/36 (100)
EQ-5D-5 L	26 (38.8)
Impairment of mobility	18/26 (69.2)
Impairment of autonomy	11/26 (42.3)
Impairment of daily activity	19/26 (73.1)
Pain discomfort	23/26 (88.5)
Anxiety depression	19/26 (73.1)

Table 2. Characteristics of the patients at the post-ICU-multidisciplinary consultations. GFR = Glomerular Filtration Rate; CKD-Epi = Chronic Kidney Disease-Epidemiology; NIV = non-invasive ventilation; CPAP: Continuous Positive Airway Pressure; Th = Theoretical; FEV1 = Full Expiratory Volume per Second; TLC = Total Lung Capacity; FVC = Forced Vital Capacity; DLCO = Diffusion Capacity of Carbon Monoxide, KCO = diffusion coefficient of CO; PIP = Peak Inspiratory Pressure; BMI = Body Mass Index; CRP = C-Reactive Protein; PF = Physical Functioning; RP = role-Physical; BP = Bodily Pain; GH = General Health; VT = Vitality; SF = Social Functioning; RE = role-Emotional; MH = Mental Health; HT = Health change; PCS = Physical Component Summary; MCS = Mental Component Summary. * HGT was considered pathological if < 25 kg in men aged ≤ 60 years and < 23 kg in men between 61 and 79 years, and < 14 kg in women aged ≤ 60 years and < 13 kg in women between 61 and 79 years.

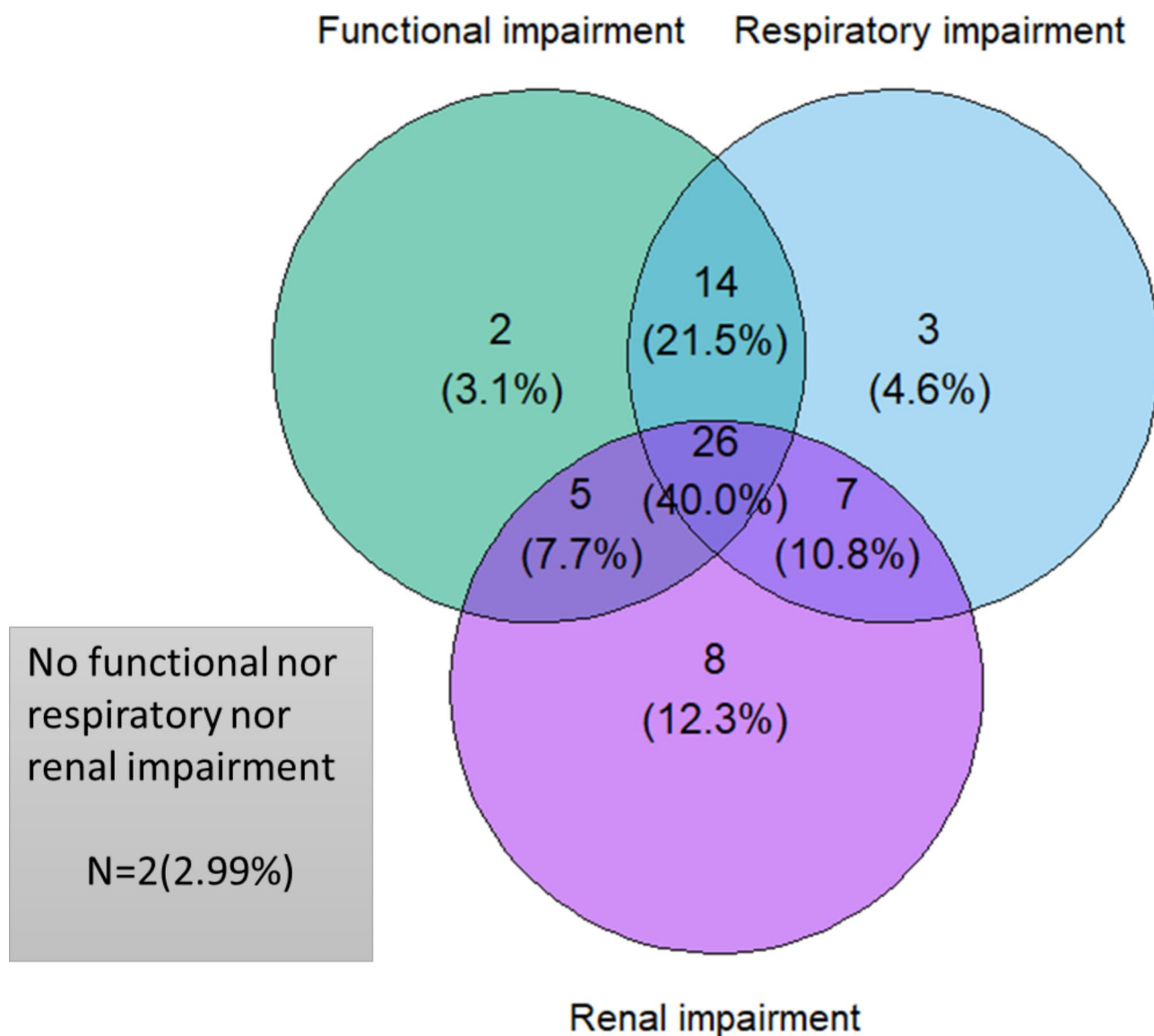


Fig. 3. Venn diagram of the population according to functional, respiratory and renal impairment.

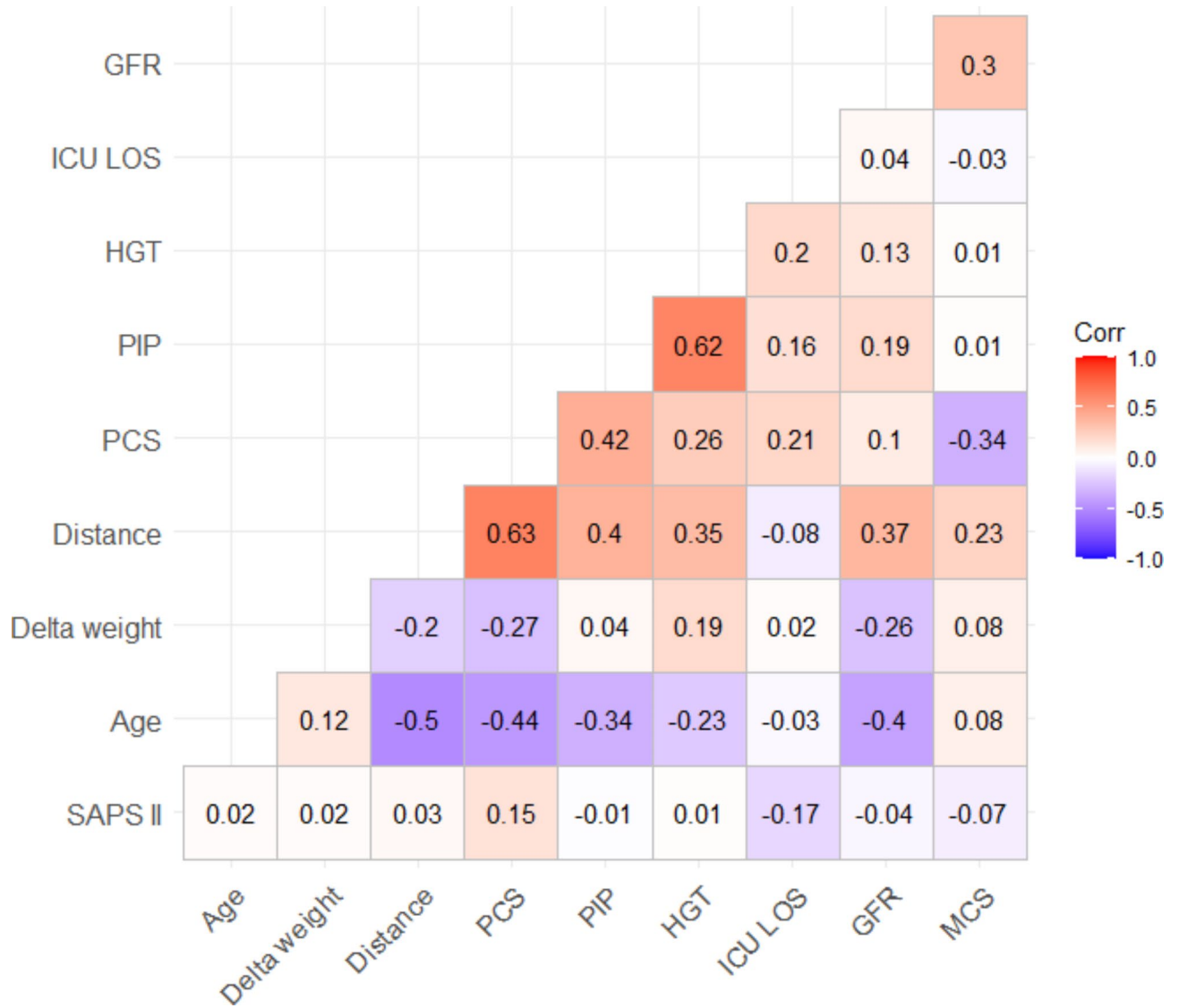


Fig. 4. Correlation between parameters during ICU stay and during post-ICU-Multidisciplinary consultations. PCS=Physical summary score of the Short Form 36; PIP=Peak inspiratory pressure; HGT=handgrip test; ICU=intensive care unit; LOS=length of stay; GFR=glomerular filtration rate; MCS=Psychological summary score of the Short Form 36; SAPS II=Simplified acute physiology score.

quality of life, which together warrant consideration for a diagnosis of PICS. Functional impairment correlated with frailty score and sex, while respiratory function correlated with age.

These findings prompt several observations

First, we reported that in our cohort, all the patients had a decrease in their MCS score < 50, and their mental health seemed more severely affected than usual. In the literature, mental health problems occur in about 10–40% of ICU survivors 3–12 months after critical illness^{12–14}. For instance, Estrup et al. reported an MCS of 55 in patients who survived an ICU stay of more than 24 h [43–63]. However, in their cohort, only 50% of the patients were ventilated, and their median LOS in the ICU was 4 [2; 7] days¹⁵. Some of these patients could have had post-traumatic stress disorder (PTSD), which like anxiety and depression is considered as a mental health problem, but we were unable to identify them. In PICS, the prevalence of PTSD is generally less frequent than that of anxiety and depression¹⁶. Our results underline the need to assess PTSD during our multidisciplinary post-ICU-MC and for patients to consult with a psychologist particularly since multidisciplinary consultations have promising results for mental outcomes^{17,18}. However, published data in this field are still scarce and sometimes conflicting, with two randomized controlled trials (RCT) showing no beneficial effect on selected outcomes of the mode of follow-up tested^{19,20}. Additionally, in the latest published RCT, involving 547 patients, post-ICU-MCs were associated with a worse outcome at 12 months as defined by death or severe-to-extreme impairment of at least one EuroQoL-5D-5 L dimension²¹.

The functional outcomes of our patients were assessed by different tests, i.e.: the 6mWT, the HGT and the PIP. The 6mWT and HGT are widely used and now recommended for the assessment of the functional components of PICS^{22,23} unlike the PIP, which requires respiratory functional exploration. PIP can, however, be used to assess functional status because it reflects the functionality and strength of respiratory muscles²⁴. Prolonged physical impairments occur in about 30% of ICU survivors 3–6 months after critical illness^{12,13} and often lead to persistent disabilities in activities of daily living (ADL). In one study, for instance, 33% of patients had partial dependence in at least one aspect of ADL 12 months after critical illness²⁵. A reduction in HGT and 6mWT scores can indicate the persistence of ICU-acquired weakness²⁶, and is also related to increased risk of long-term mortality²⁷.

We observed that frailty score was correlated with long-term functional outcome, which clearly suggests that frailty should be used more often to select patients who would benefit the most from assessment at the post-ICU-MC. Evidence shows that in today's aging society, frailty is one of the important risk factors for PICS²⁸.

In our post-ICU-MCs, most of the patients underwent respiratory functional tests. Such evaluations have been widely performed for survivors of the COVID-19 pandemic. For instance, Laveneziana et al. assessed 485 survivors of COVID-19 3 months after their ICU discharge, and reported that 34%, 70% and 56% of the participants, respectively, had a restrictive lung defect, impaired DLCO, and significant radiological sequelae. They also reported that some of these patients improved their pulmonary function and also their radiological abnormalities, but the most severely affected still had significant lung sequelae and residual symptoms justifying prolonged follow-up²⁹. Patients surviving ARDS underwent similar explorations [23, 29]. Complete assessment of respiratory function is not systematically mentioned in documented reports of PICS³⁰. However, Dusart et al.³¹ recently described assessment of post-ICU pulmonary function.

We also assessed renal function during the post-ICU-MC. Other studies also document long-term renal function after ICU stay³². Acute kidney injury (AKI) affects about half of patients admitted to the ICU. Certain cases of AKI last more than 7 days and can also persist after 3 months to become chronic kidney disease. Some studies also reported that persistent AKI can modify long-term quality of life and that more deficits in physical than mental health domains are found in survivors of AKI in critical care³³.

Contrary to other studies such as that of Lakenman et al.³⁴, patients in our cohort had a non-significant variation in weight. In addition, their nutritional status was generally good at the post-ICU-MC.

Finally, we observed a prevalence of PICS of 100% in our preselected cohort of patients. The criteria used in our hospital to offer a post-ICU-MC seemed therefore appropriate. The prevalence of PICS varies widely from one study to another. For example, individual PICS symptoms have been reported to develop in 50–70% of critically ill patients, and their co-occurrence has been evidenced in about 20% of patients^{12,13}. In addition, patient quality of life decreases with the onset of PICS, and around two-thirds, two-fifths, and one-third of previously employed ICU survivors are jobless up to 3, 12, and 60 months, respectively, after hospital discharge^{35,36}.

Although PICS is recognized as a public health issue³⁷ and post-ICU-MCs are routinely recommended^{23,38}, the modalities of the consultations, which are not clearly established, require further investigation, and evidence of their effectiveness is lacking³⁹.

The study of Sharshar et al.²¹, involving a very large panel of ICU survivors, showed no positive effect of the post-ICU-MCs. It is a good reminder that the criteria for selecting patients, monitoring frequency, and determining the tests to perform and the measures to adopt in case of impairments must be improved to render post-ICU-MCs useful.

The finding that all our patients, enrolled on the basis of preselected criteria, had PICS, is interesting as it shows that the criteria used in our hospital to refer patients for post-ICU-MC were appropriate. The other modalities of our post-ICU-MCs, i.e.: the caregivers involved, the screening tools used, the frequency of follow-up, the measures adopted in case of deterioration, the coordination of the follow-up or interface of the consultations and the trajectory of the patients in the health care system could however be improved.

This study has both strengths and limitations. Its main strength was to report our own experience of post-ICU-MCs, to determine the incidence of PICS in our cohort, and to provide a full evaluation of the patients, showing the respiratory, renal and nutritional impairments.

The study has certain limitations. It was a monocentric retrospective study based on a quite small sample size, which limits the external value of the results. The sample size could be in part explained by the temporary suspension of the post-ICU-MCs during the COVID-19 pandemic and by the initial limited time dedicated to the consultations, which allowed only a few patients to be assessed per week. Consequently, we acknowledge our population is in part self-selected. There were also considerable differences in follow-up time, ranging from 3 months to 7 months. These discrepancies can be explained by the way we organized the post-ICU-MCs. All the patients were initially invited to attend a consultation 3 months after ICU discharge but, owing to the limited time dedicated per week for post-ICU-MCs and because of the availability of patients, some of the consultations had to be postponed and were not performed until 7 months after ICU discharge. We did not account for these discrepancies in the analyses. Not all components of PICS were explored, notably cognition. In the light of recent reports indicating cognitive alterations in around 40% of patients after prolonged ICU stays, this limitation warrants attention^{4,5,11,30,40,41}. With regard to their mental function, not all of our patients completed the SF-36^{15,42,43} and/or the EuroQoL-5D [4, 5, 43, 44] questionnaires. There are now fewer missing assessments since, if the questionnaires are not fully completed before the post-ICU-MC, the intensivist fills them out in the presence of the patient. PTSD was not assessed^{4,40,44}, and nor were scores of widely used questionnaires such as the HAD scale [37, 39, 40, 44–47]. In addition, the SF-36 did not seem to be the best measure to assess mental disorder and recent guidelines propose other assessment tools for the mental components of PICS. For instance, Nakanishi et al.⁴⁵, in their study based on a Delphi method, recommended 20 PICS assessment instruments for mental health including the HAD scale, the IES-R (impact of event scale), and the PHQ-9 (Patient Health Questionnaire). Of note, SF-36 and EQ-5D-5 L, 3 L were not recommended for the assessment of mental health but rather for

the assessment of the quality of life. In France, the HAS recommends using PHQ-8, GAD-7 (general anxiety disorder), and PCL-5 to assess psychological symptoms, the MoCA for cognition, and EuroQol-5D-5 L for quality of life. Finally, we only assessed a part of the ICU survivors. However, the patients who attended a post-ICU-MC were selected on the basis of criteria that are now recommended in France²³.

Conclusion

Although our study did not assess all components of PICS, it nevertheless showed that almost all our selected patients experienced the syndrome and that more than half of them had respiratory, functional and/or renal impairments. Our criteria for offering patients a post-ICU-MC seemed to be appropriate and attendance at the consultation was useful to diagnose persistent organ failures. Finally, a clinical review of the patient's status after an ICU stay should be recommended to optimize the trajectory of survivors. An intensivist would probably be best-suited to supervise and summarize the results of all the consultations and explorations. Our results suggest that systematic prescription of physiotherapy and psychological follow-up for patients should be considered after an ICU stay.

Data availability

Data are available under request at the correspondent author.

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Author contributions

“Conceptualization, CD, BS; methodology, BS, CD.; software, CD.; validation, BS., CD, RB; LC formal analysis, CD; investigation, LM, SB, CD; resources, BS.; data curation, CD, writing—original draft preparation, CD.; LM, SB writing—review and editing, RB, NF, LM, SB, CP, GL, LC, FC, BS, CD; supervision, BS, CD.; project administration, BS. All authors have read and agreed to the published version of the manuscript.”

Declarations

Ethics approval and consent to participate

The PICS-MIR study was approved by the local ethics committee (IRB13412, CHU de Clermont Ferrand IRB #1, IRB number 2023-CF229). Each participant was informed of the possible use of anonymized data for research: The families were given a written consent form on ICU admission and the same written information was displayed in the waiting room of the ward. None of the participants were opposed to use of their data.

Competing interests

The authors declare no competing interests.

Additional information

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