Analysis of Nursing Staff Management for a Semi-intensive Pulmonology Unit During the COVID-19 Pandemic Using the Nursing Activities Score

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Objectives: During the COVID-19 pandemic, a shortage of intensive care unit beds was encountered across Europe. Opening a semi-intensive pulmonary ward freed up intensive care unit beds. This study aimed to determine the appropriate nurse staffing level for a semi-intensive pulmonology unit (SIPU) for patients with COVID-19 and to identify factors associated with an increase in nursing workload in this type of unit.

Methods: This was a retrospective study of the SIPU of the Erasme university clinics in Belgium. Nursing staff was determined with the Nursing Activities Score (NAS) during the second wave of COVID-19 in Belgium.

Results: During the study period, 59 patients were admitted to the SIPU, and a total of 416 NAS scores were encoded. The mean (±SD) NAS was 70.3% (±16.6%). Total NAS varied significantly depending on the reason for admission: respiratory distress (mean [SD] NAS, 71.6% [±13.9%]) or critical illness–related weakness (65.1% ± 10.9%). The items encoded were significantly different depending on the reason for admission. In multivariate analysis, body mass index > 30 (odds ratio [OR], 1.77; 95% confidence interval [CI], 1.07-3.30) and higher Simplified Acute Physiology Score II score (OR, 1.05; 95 CI, 1.02-1.11) were associated with higher NAS. Patients admitted via the emergency department (OR, 2.45; 95% CI, 1.15-5.22) had higher NAS. Patients on noninvasive ventilation (OR, 13.65; 95% CI, 3.76-49.5) and oxygen therapy (OR, 4.29; 95% CI, 1.27-14.48) had higher NAS. High peripheral venous oxygen saturation (OR, 0.86; 95% CI, 0.78-0.94) was a predictor of lower workload.

Conclusion: A ratio of 2 nurses to 3 patients is necessary for SIPU care of patients with COVID-19. Factors associated with higher workload were high Simplified Acute Physiology Score II score, body mass index > 30, admission via emergency room, patients on oxygen, and noninvasive ventilation.

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On March 11, 2020, the World Health Organization declared the outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) to be a pandemic.[1] In Belgium, the first peak in hospitalizations linked to the epidemic occurred on April 10, 2020, and the second occurred on November 4, 2020.[2]

Many patients with SARS-CoV-2 infection (ie, COVID-19 disease) require significant respiratory support, including mechanical ventilation, and approximately 5% of patients with the disease will need to be admitted to intensive care.[3-5] Early in the pandemic, problems related to bed availability were reported in Europe.[6] Belgium has one of the highest ratios of intensive care beds per 100 000 inhabitants in Europe with 17.4 intensive care beds per 100 000 inhabitants.[7,8] Despite this large number of intensive care beds, the bed occupancy rate in Belgian intensive care units (ICUs) is very high, between 75% and 90%,[8-11] and the lack of availability of ICU beds was quickly felt during the COVID-19 crisis. The number of patients per nurse in Belgian acute hospitals is among the highest in Europe, leading to difficulties in increasing the number of ICU beds.[12]

The use of semi-ICU (SICU) services frees up ICU beds. It has been shown, internationally, that in hospitals with SICUs, mortality is reduced in patients admitted to the ICU compared with hospitals without SICUs.[13] The presence of a SICU also decreases the length of stay in the ICU.[14]

During the H1N1 influenza pandemic, hospitals with SICUs refused fewer intensive care patients.[15] Managing these patients with noninvasive respiratory support in an intermediate respiratory care unit reduces the need for intubation and, therefore, reduces complications, ICU admissions, and mortality.[15] Studies published during the first wave of COVID-19 showed that hospitals with SICUs admitted fewer patients to the ICU, freeing up resources and ICU beds.[6,16,17]

In Belgium, in contrast to many other countries, there is no legislation regarding SICU services. Because this type of unit is not provided for by legislation, there is no framework standard. In Belgium, the current standards in force require a minimum nurse-to-patient (N:P) ratio of 1:3 in the ICU and 1:30 in inpatient units.[18,19] The standards set for the coronary unit and the stroke unit are comparable with what is needed for the SICU, with proposed N:P ratios ranging from 1:4 to 1:5.[20,21] In addition, there is no international consensus on the use and operation of these SICU beds.[22-24] Indeed, there is significant heterogeneity regarding the use of SICUs in different countries and with regard to recommended N:P ratios, which range from 1:1 to 1:11.[24] This important difference in N:P ratio can be explained by the fact that there is currently no international definition of SICU.[14,23,25] The World Federation of Societies of Intensive and Critical Care Medicine has defined 3 levels of intensive care. The levels are defined according to the intensity of the support. Level 1 is capable of providing oxygen, noninvasive monitoring, and more intensive nursing care. This definition is close to the SICU definition of the authors mentioned previously. For this level of critical care, the World Federation of Societies of Intensive and Critical Care Medicine recommends an N:P ratio of 1: 3 to 1: 4.[26]

Obtaining an adequate N:P ratio for the SICU is important. Indeed, an inadequate N:P ratio in the SICU can lead to admission to the ICU due to overburdensome nursing care patient caseloads.[27] In addition, other studies have demonstrated the association between inadequate N:P ratios and in-hospital mortality.[28,29]

The objectives of this study were to determine the appropriate nursing staffing needed for a semi-intensive pulmonology unit (SIPU) for patients with COVID-19 and to analyze the factors associated with an increase in the nursing workload in this type of unit.

METHODS

Study Design and Population

Erasme Hospital has an ICU consisting of 30 medico-surgical beds. To compensate for the lack of ICU beds during the second wave of COVID-19, Erasme Hospital temporarily created a 14-bed SICU in the form of a SIPU. This unit was created in an inpatient department; the rooms were fitted out to have oxygen and continuous monitoring of rhythm and heart rate, peripheral venous saturation, and arterial pressure in a noninvasive manner. Depending on the saturation of the ICU beds and the need for SIPU beds, the number of open beds varied from 6 to 14 beds. The unit was manned by pulmonologists, and the nursing staff consisted mainly of pulmonology and gastroenterology nurses, with the activity of these services

having fallen sharply. These nurses received rapid training in the management of acute respiratory distress as well as the various means of ventilation. Different media were used to train and educate nurses, such as seminars, demonstrations, real-life coaching, and debriefing, and we also developed video supports. A physiotherapist was present continuously in the SIPU during the day, and 2 physiotherapists were available for the entire hospital at night. In Belgium, there are no personnel standards for this type of service. Throughout the time this unit was open, an important collaboration developed between the ICU and the SIPU. Twice a day, the doctors in charge of the SIPU and ICU were in contact to discuss the condition of the patients. Similarly, every morning, the head nurses reviewed the availability of space in these units and potential transfers.

This was a retrospective study carried out in the semi-intensive pulmonology department of Erasme Hospital during the second wave of the COVID-19 pandemic from October 28, 2020, to December 13, 2020.

All patients admitted to the unit during the study period were included. All patients admitted to this unit during the study period had COVID-19. The diagnosis of COVID-19 was made after a nasopharyngeal polymerase chain reaction test and/or by computed tomographic scan.

Nursing Activities Score

The Nursing Activities Score (NAS) is an intensive care workload-specific score. This scale is made up of 23 items corresponding to 23 nursing activities. It provides a score in percentage (from 0% to 177%). A score of 100% means that a patient consumed 100% of a nurse's time. Eighteen items are dichotomous, and 5 are multiple choice, depending on the intensity of the item. The NAS scale accounts for 81% of nursing activity and is independent of disease severity.[30] The NAS was translated and published into French,[9] and guidelines for correctly calculating the NAS were published in 2015.[31] The score is encoded once every 24 hours. The NAS was manually encoded every day by the head nurse and the investigators at 4 PM.

Data Collected and Results

Demographic data as well as history, reason for admission, and recognized risk factors for COVID-19 (high blood pressure, diabetes, and obesity) were collected. Obesity was defined by a body mass index (BMI) greater than 30. Severity scores, including the Sepsis-related Organ Failure Assessment[32] and the Simplified Acute Physiology Score II (SAPS II),[33] were calculated at admission. Length of stay, origin, and destination of patients were also encoded. Do not resuscitate or no ICU status was given to the patient according to a prognosis score table (Appendix 1). Regarding destinations, rehability relates to patients transferred to hospital internal or external rehabilitation centers. Other transfers to traditional hospitalization services are listed under the term "ward."

The NAS was recorded every day at 2 PM by the research team. The research team had mastered the NAS and encoded it for several years in intensive care.

Oxygen was administered via nasal cannula or via an artificial nose for tracheostomies providing a flow rate of 0.5 to 6 L/min. The term *noninvasive ventilation* (NIV) refers to the application of ventilation without any conduit access to the airways.[34] Noninvasive positive-pressure ventilation using a mask (or interface) that conducts gas from a positive-pressure ventilator into the airways has become the predominant means of administering NIV.[35] Continuous positive airway pressure was administered, via a simple continuous positive airway pressure foot or via a Boussignac system with a positive end-expiratory pressure ranging from 5 to 15 cm H_2O and an FiO_2 varying from 21% to 100%. The continuous positive airway pressure interface was a simple mask or a full-face helmet depending on patient compliance. We also used high-flow oxygenation via Fisher and Paykel Healthcare's AIRVO 2 with nasal cannula with settings ranging from 21% to 100% FiO_2 and a flow rate of 40 to 60 L/min. Bilevel noninvasive positive-pressure ventilation was not used in this unit.

We admitted 2 main types of patients to the unit, patients admitted for respiratory distress and patients admitted for critical illness–related weakness. The patients admitted for critical illness–related weakness were patients with post-ICU polyneuropathy, requiring too much care for a conventional hospitalization service.

Statistical Analyses

Means (±SDs) were used to describe symmetric quantitative variables. Medians and 25th and 75th percentiles were used to describe skewed quantitative variables. For symmetric variables, Student *t* test was used for comparisons of means.

Multiple logistic regression analyses were performed to determine which independent variables predicted longer nursing time in intensive care. The factors chosen to perform the multivariate analysis were derived from data already analyzed in previous studies.[31,36] We dichotomized (high or low values) the continuous variable NAS scores by referring to the median (eg, NAS > 70.3%). Odds ratios (ORs) and 95% confidence intervals (CIs) were used to describe the results. For multiple comparisons, an analysis of variance was used for symmetric variables and the Kruskal-Wallis rank test was used for nonsymmetric variables.

All analyses were performed with Software for Statistics and Data Science (14.0). Data with a *P* value less than <.05 were considered statistically significant.

Ethical Considerations

An anonymous number was assigned to each patient. Being a retrospective observational study, informed consent from patients was not requested. The study was approved by the ethics committee of Erasme University Clinics (P2021/262/B4062021000139).

RESULTS

During the study period, 59 patients were admitted to the SIPU and a total of 416 NAS were recorded.

Patient Sociodemographic Characteristics

The mean (SD) age was 63.3 (±11.2) years; 81.4% of admitted patients were male. On admission, the mean (SD) Sepsis-related Organ Failure Assessment score was 3.7 (±1.6), the mean (SD) SAPS II scorer was 30.3 (±9), and the median (P25-P75) PaO_2-to-FiO_2 ratio was 122 (102-153). More than half of the patients were admitted to the SIPU from an in-hospital unit room, 33.9% from the ICU and 15.2% from the emergency room. There was no statistically significant difference between severity factors between the different origins of admitted patients (Appendix 2). Twelve patients were eventually transferred from the SIPU to the ICU; 9 of these 12 patients died in the ICU. The most common comorbidities were high blood pressure (54.2%), diabetes (33.9%), and obesity (BMI > 30, 27.1%). The median length of stay in the unit was 5 (4-8) days, and the median length of stay in the hospital was 17 (10-34) days. All patients were medical-type patients; all patients admitted during the study period tested positive for SARS-CoV-2. During their stay, 74.6% of patients received NIV, and the median (P25-P75) duration of NIV was 4 (1-5). As the intensive care beds were full, the criteria for admission to the ICU were strict, based on the patient's clinical condition and history. Of the patients included in the study, 14 patients (23.7%) had received a do not resuscitate status and no admission to the ICU. A total of 48 patients were admitted for respiratory distress, 10 patients for critical illness–related weakness, and 1 for nonsymptomatic COVID-positive cardiac decompensation. On discharge from the hospital, 52.5% of the patients returned home, 13.6% were transferred for rehabilitation, and 33.9% of the patients had died (Table 1).

Distribution of NAS

The mean (SD) NAS was 70.3% (±16.6%). The total NAS varied significantly ($t = 3.9$, $P < .0001$) depending on the reason for admission. The total NAS for patients admitted for respiratory distress was 71.6% (±13.9%), and NAS was 65.1% (±10.9%) for patients admitted for critical illness–related weakness. The items encoded were significantly different depending on the reason for admission. Patients admitted for respiratory distress consumed more nursing time in "monitoring and titration," "administrative tasks," and "support for respiratory function." Patients admitted for critical illness–related weakness consumed more time for hygienic procedures and mobilizations.

Most of the total NASs were between 51% and 75%. The total NAS exceeded a score of 100% only in patients admitted for respiratory distress (Table 2).

Factors Associated With a High Nursing Workload

In multivariate analysis, obesity (OR, 1.77; 95% CI, 1.07-3.30) and a high SAPS II score (OR, 1.05; 95 CI, 1.02-1.11) were associated with higher NAS. Conversely, higher peripheral venous oxygen saturation (OR, 0.86; 95% CI, 0.78-0.94) was associated with a lower workload.

Patients admitted via the emergency department (OR, 2.45; 95% CI, 1.15-5.22) were associated with higher NAS. Patients on NIV (OR, 13.65; 95% CI, 3.76-49.5) and on oxygen therapy (OR, 4.29; 95% CI, 1.27-14.48) were associated with higher NAS than patients breathing ambient air (Table 3).

Total NAS and Nursing Workforce

When the unit opened, the theoretical efficacy provided by the NAS was much higher than the actual efficacy. The unit's daily total NAS score had a coefficient of variability of 33%. The theoretical staff required to take care of the patients present in the SIPU provided by the NAS varied between 3 and 11 nurses depending on the number of beds open in the unit and the time consumed in nursing care by each patient (Figure).

DISCUSSION

In this study, 59 patients were included. The patients admitted to this unit were patients with severe COVID-19, most with respiratory failure. The sociodemographic characteristics of these patients are similar to those of COVID-19 patients in the ICU in terms of sex (81.4% male) and age (63.3 ± 11.2 years).[36,37] The patients presented with COVID-19 risk factors in the same proportion as the COVID-19 patients admitted to the ICU including an average BMI of 27.9 ± 5.9, 54.2% of patients had high blood pressure, and 33.9% of patients had diabetes.[37] More than 70% of admitted patients underwent NIV. In Belgium, we have no national admission criteria for the ICU, we have outdated staffing standards for wards dating from 1964, and outside the COVID-19 period, NIV is normally reserved for the ICU.[19]

The use of the SICU is essential in order not to deny care to certain patients,[38] as in our experience. These services are also useful before and after intensive care.[39] However, we are not aware of any other reports of

TABLE 1 Sociodemographic Data

Characteristics	
Age, mean (SD), y	63.3 (11.2)
Men, n (%)	48 (81.4)
SOFA, mean (SD)	3.7 (1.6)
SAPS II, mean (SD)	30.3 (9.0)
D1 P/F ratio, Mdn (P25-P75), mm Hg	122 (102-153)
Length of stay, Mdn (P25-P75), mm Hg	5 (4-8)
Length of stay in hospitals, Mdn (P25-P75), mm Hg	17 (10-34)
DNR status, n (%)	14 (23.7)
Dialysis	0 (0)
NIV duration, Mdn (P25-P75), d	4 (1-5)
Tracheostomy, n (%)	3 (5.1)
ICU readmission after SIPU	5 (8.5)
Unit characteristics	
Bed occupancy, mean (SD)	85.8 (16.0)
Nurse-to-patient ratio, mean (SD)	0.5 (0.1)
No. beds open daily, mean (SD)	10.2 (1.7)
Oxygenation interface	
Helmet, n (%)	5 (8.5)
CPAP, n (%)	39 (66.1)
HFNC, n (%)	5 (8.5)
Origin	
Emergency, n (%)	9 (15.2)
Non-COVID ward, n (%)	3 (5.1)
Ward, n (%)	27 (45.8)
ICU, n (%)	20 (33.9)
Destination	
Death, n (%)	11 (18.6)
ICU, n (%)	12 (20.3)
Ward, n (%)	34 (57.7)
Rehabilitation, n (%)	2 (3.4)
Hospital discharge	
Death, n (%)	20 (33.9)
Home, n (%)	31 (52.5)
Rehabilitation, n (%)	8 (13.6)
Reasons for admission	
Respiratory failure, n (%)	48 (81.4)
Critical illness–related weakness, n (%)	10 (16.9)
Cardiac decompensation, nonsymptomatic COVID, n (%)	1 (1.7)
COVID risk factor	
Arterial hypertension, n (%)	32 (54.2)
Diabetes, n (%)	20 (33.9)
Obesity (BMI > 30), n (%)	16 (27.1)
BMI, mean (SD)	27.9 (5.9)
History	
Hypercholesterolemia, n (%)	10 (16.9)
Chronic renal failure, n (%)	9 (15.2)
Atrial fibrillation, n (%)	9 (15.2)
Asthma, n (%)	6 (10.2)
COPD, n (%)	3 (5.1)
Obstructive sleep apnea syndrome, n (%)	7 (11.9)
Heart failure, n (%)	6 (10.2)
Transplant, n (%)	4 (6.8)

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease; CPAP, continuous positive airway pressure; D1, day 1; DNR, do not resuscitate; HFNC, High Flow Nasal Cannula; ICU, intensive care unit; Mdn, median; NIV, noninvasive ventilation; P/F, PaO_2/FiO_2; SAPS II, Simplified Acute Physiology Score II; SOFA, Sepsis-related Organ Failure Assessment.

semi-intensive care service experiences in Belgium. Compared with other semi-intensive pulmonary units created during the crisis,[16,17] the mortality of SIPU patients (33.9%) was higher but admitted patients were also more severe.[5] Indeed, in our study, the median PaO_2-to-FiO_2 ratio at admission was 122 (102-153); in an Italian SIPU, the average PaO_2-to-FiO_2 ratio was 272.7 ± 90.5.[17] Despite the median PaO_2-to-FiO_2 ratio at admission was 122, Sepsis-related Organ Failure Assessment and SAPS II scores are not very high. This can be explained by the fact that our patients were mainly single-disease patients with COVID-19. In addition, 23.7% of patients admitted to the Belgian SIPU unit had therapeutic limitations, which also increased the mortality rate. In the literature, the mortality of COVID-19 patients who require admission to the ICU is highly variable depending on the country, their health care organization, and the different waves of the epidemic, with a mortality rate ranging from 16% to 78%.[3-5,36,40] Mortality in our SIPU was slightly lower than that of patients admitted to Belgian ICUs (36.1%) during the first wave of COVID-19.[37]

In a large Spanish experience, the authors found that these units are an alternative for patients whose ICU admission has been initially turned down.[39] During our study period, 14 patients were admitted with a do not resuscitate status and no ICU because of lack of ICU beds. Without SIPU, these patients would not have been able to benefit from NIV. Five of these patients (35.7%) were finally able to return home.

The NAS, used and cited in the literature internationally,[31,41] was chosen to assess nursing time. A major advantage of the NAS is its fast encoding.[9] The NAS is a tool that is specifically designed for intensive care but is also validated for semi-intensive care services.[42] In addition, outside a pandemic situation, patients who were admitted

TABLE 2 NAS Items According to Reason for Admission

NAS Items	Respiratory Failure (n = 334)	Critical Illness Related Weakness (n = 82)	Test Values	*P*	All Patients (N = 416)
NAS total, mean (SD), %	71.6 (13.9)	65.15 (10.9)	$t = 3.9$	<.0001	70.3 (13.6)
NAS < 50%, n (%)	11 (3.2)	8 (9.8)			19 (4.6)
NAS of 51%-75%, n (%)	206 (61.8)	64 (78)			270 (64.9)
NAS of 76%-100%, n (%)	104 (31.1)	10 (12.2)			114 (27.4)
NAS > 100%, n (%)	13 (3.9)	0 (0)			13 (3.1)
Monitoring and titration, mean (SD), %	10.5 (5.1)	5.9 (3.5)	$z = 7.568$	<.0001	9.6 (5.1)
Hygiene procedures, mean (SD), %	16.5 (0.3)	17 (1.2)	$z = -6.307$	<.0001	16.6 (0.6)
Mobilization and positioning, mean (SD), %	8.2 (3.4)	10.5 (3.1)	$z = -5.306$	<.0001	8.6 (3.5)
Administrative and managerial tasks, mean (SD), %	10.5 (8.9)	7.9 (7.6)	$z = 2.376$	.0175	9.9 (8.7)
Supports respiratory function, mean (SD), %	4.7 (2.0)	3.6 (3.1)	$z = 2.215$	.0268	4.5 (2.3)

Abbreviation: NAS, Nursing Activities Score.

Supports respiratory function includes items 7, 8, and 9 of the original NAS scale.

to the SIPU during the study would have been admitted to the ICU.

The mean (SD) NAS of the patients was 70.3% (±13.6%), which means that 2 nurses are needed to take care of 3 patients (N:P of 2:3). This ratio is higher than that proposed by the World Federation of Societies of Intensive and Critical Care Medicine (N:P of 1:3) for a level 1 ICU.[26] The average NAS for SIPU patients was higher than the average NAS for Belgian ICUs outside the COVID-19 pandemic period (68.6%).[10] This can be explained by the fact that the patients admitted to this unit were seriously ill and would end up, outside the pandemic, in ICU beds.

TABLE 3 Factors Related to High Nursing Workload (NAS Cutoff, 70.3)

Multivariable Logistic Regression	OR (95% CI)	*P*
Age (ref: <63 y with mean)	0.82 (0.47-1.44)	.502
Sex (ref: female)	0.68 (0.34-1.36)	.281
BMI (ref: <30 kg/m^2, threshold for obesity)	1.77 (1.07-3.30)	**.034**
SOFA score	0.96 (0.78-1.19)	.774
SAPS II	1.05 (1.02-1.11)	**.027**
Pulsed oxygen saturation	0.86 (0.78-0.94)	**<.0001**
Origin (ref: ward)	—	—
ICU	1.11 (0.64-1.93)	.691
Emergency	2.45 (1.15-5.22)	**.020**
Destination (ref: ward)	—	—
Death	2.05 (0.73-5.75)	.169
ICU	1.25 (0.61-2.55)	.543
Rehabilitation	1.25 (0.61-11.84)	.873
Oxygenation interface (ref: no oxygen)	—	—
Noninvasive ventilation	13.65 (3.76-49.5)	**<.0001**
Oxygen	4.29 (1.27-14.48)	**<.0001**
Reason for admission (ref: critical illness–related weakness)	—	—
Respiratory failure	0.92 (0.43-1.93)	.819

Data in bold indicate statistically significant results.

Abbreviations: BMI, body mass index; CI, confidence interval; ICU, intensive care unit; NAS, Nursing Activities Score; OR, odds ratio; SAPS II, Simplified Acute Physiology Score II; SOFA, Sepsis-related Organ Failure Assessment; ref, reference.

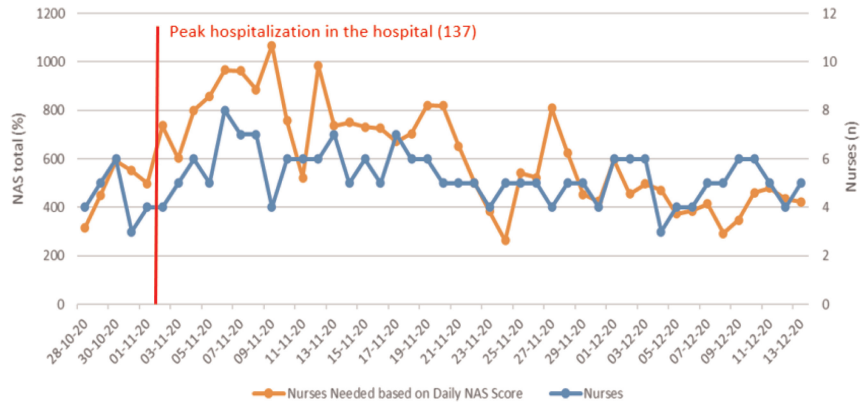

Figure. Total Nursing Activities Score (NAS) and nursing workforce.

However, if we compare the NAS of the COVID-19 patients in the SIPU, this score is lower than the average NAS of Belgian COVID-19 patients in the ICU (90%).[36]

Patients admitted to the SIPU had 2 types of reasons for admission: respiratory failure and post-ICU critical illness–related weakness. Depending on the reason for admission, the encoded NAS activities were different. The patients admitted for respiratory failure required more time for "monitoring and titration," for "administrative tasks," and for "respiratory support," requiring significant nursing experience. Patients admitted for critical illness–related weakness required more time for hygienic procedures and mobilizations. For this second category of patients, a nurse/nursing assistant could, therefore, be possible. However, as has been proposed by some authors,[43] we did not use the prone position in patients with NIV. This could have increased the resources needed for mobilization and positioning and monitoring.

According to this study, an N:P ratio of 2:3 is necessary in this type of SICU. However, in Belgium, there are no supervisory standards for this type of unit. According to Belgian legislation, the N:P ratio in intensive care is 1:3, but these standards for nursing staff for intensive care are obsolete[10] and have already proven insufficient for the SIPU during a COVID-19 pandemic outbreak period, presenting a risk for the quality of care.[44] Nursing staffing for the SIPU is, therefore, important, but in view of the precise profile of the patients, nurses not specialized in intensive care who receive rapid training on the management of acute respiratory failure and NIV have been able to take care of these patients. This ratio remains below that required for COVID ICU patients of 1:1.[36] This service, therefore, requires a large number of caregivers, which is not always achievable in times of pandemic where nursing staff are a precious resource.

It has been shown that when the theoretical nursing number given by the NAS was lower than the actual number present, there was an increase in patient mortality.[44] However, the day-to-day management of this unit was not easy, especially in terms of finding the right ratio without additional staff available during the peak of hospitalizations. The number of beds in this unit varied, according to need, between 6 and 14 beds. The unit's daily total NAS coefficient of variability was large, 33%. On February 11, 2020, during the peak of hospitalizations at Erasme Hospital (137 COVID-19 patients hospitalized), the difference between the theoretical necessary staff provided by the scale and the actual staff needed was significant. At that time, there were no more staff available in the hospital because of the number of hospitalized patients and the high absenteeism rate of nursing staff.

This study has certain limitations. First, we had a limited number of COVID-19 patients (59 patients). It would be interesting to repeat this study with more patients and more SIPUs to improve representation and statistical power. An important limitation of this study is that it was carried out in a single Belgian university center, so it is difficult to extend the results of this study outside the organization of health care in Belgium. Indeed, in Belgium, there are currently no intensive care levels; we only have intensive beds and conventional hospitalization. The authors' recommendations in relation to this study are to set up this type of unit to refuse fewer patients to the ICU during a pandemic. The creation of a SIPU to delay ICU admissions and free up beds is feasible and seems to be a suitable option to reduce the pressure on the ICU. This type of project makes it possible to retrain nurses in a new department with a specific patient profile after targeted training. To do this, the Belgian government should legislate adequate staffing standards and adequate funding for this type of unit requiring significant staffing given the profile of patients admitted to these units. To extend our recommendation outside pandemic periods, it would also be interesting to test this type of unit during a time when there is no pandemic; this would perhaps reduce the occupancy rate of intensive care beds in

Belgium[9-12] despite a large number of intensive care beds per 100 000 inhabitants.[7,12] The shortage of ICU nurses has been reported across the world.[45] Creating an SIPU designed to treat a well-defined type of single-disease patients with COVID-19 makes it possible to quickly train personnel who are not experienced in the ICU in ICU skills limited to the care of these patients. An insufficient N:P is a major cause of burnout among ICU nurses.[46] The daily encoding of the NAS not only could be an asset in day-to-day management to adapt the workforce to changing care needs but also would avoid wasting precious nursing resources during a pandemic.

CONCLUSION

This study showed that a ratio of 2 nurses to 3 patients was needed in a SICU. The patients admitted to this unit were severe COVID-19 patients mainly with respiratory failure, and 70% were administered NIV. Factors associated with a higher workload are a high SAPS II score, BMI > 30, admission via emergency room, patients on oxygen, and NIV. This unit also gave a chance to patients with therapeutic limitations, who, because of a lack of beds, could not be admitted to the ICU.

IMPLICATIONS FOR CLINICAL PRACTICE

- This SIPU received severe COVID-19 patients with a PaO_2-to-FiO_2 ratio (median [P25-P75]) at admission of 122 (102-153) and provided a place for semi-intensive management of patients with therapeutic limitations that could not be admitted to the ICU because of lack of beds. Of the 59 patients included in the study, 74.6% received NIV in this unit.
- The mean (SD) NAS for patients admitted to this unit was 70.3% (±13.6%). The nurse staffing level needed for a SIPU during the COVID-19 period was 2 nurses for every 3 patients.
- Factors associated with higher workload were high SAPS II score, BMI > 30, admission via emergency room, patients on oxygen, and NIV.

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