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Characteristics and Reported Practices of ICUs Participating in the Sedation, Analgesia and Delirium Management International Study: Variability in Site-Level Management of Mechanically Ventilated Patients

OBJECTIVE: To describe site-level ICU organizational policies and implementation of pain, agitation, and delirium (PAD) best practices before the COVID-19 pandemic, and perceived changes during the pandemic.

DESIGN: International site-level questionnaire study.

SETTING: Participating sites completed a standardized electronic Case Report Form between January 5, 2022 and March 31, 2023.

PATIENTS/CENTERS: Ninety-three ICUs caring for adult patients from 79 hospitals across 27 countries in North America, South America, and Europe.

INTERVENTIONS: Each ICU submitted data on site characteristics, staffing, implementation of PAD protocols and assessment tools prepandemic, and perceived changes during the COVID-19 pandemic. Descriptive statistics and multivariable logistic regressions were performed using R.

MEASUREMENTS AND MAIN RESULTS: Of 93 ICUs, 63% were university-affiliated, and 59% reported a closed physician staffing model. Most managed mixed patient populations (78%), with a nurse-to-patient ratio for ventilated patients of 1:2 (45%) or 1:1 (39%). Physiotherapists and pharmacists were available in 83% and 68% of ICUs, respectively. Over 75% reported routine use of validated PAD scales, most commonly Richmond Agitation Sedation Scale (86%), Confusion Assessment Method for ICU (59%), and Numeric Rating Scale (44%). Protocols were most available for spontaneous breathing trials (60%) and sedation (58%), followed by delirium (53%), mobilization (47%), and pain (46%). University affiliation and 1:1 nurse staffing was associated with reported use of delirium or mobilization protocols. The presence of a weaning protocol was associated with higher odds of daily sedation interruption (adjusted odds ratio [aOR] 3.80; 95% CI, 1.43–10.89; $p = 0.009$), and use of sedation protocols (aOR 5.95; 95% CI, 2.29–16.86; $p < 0.001$). Nearly one-half of ICUs reported drug shortages during the pandemic, and 62% prohibited any visitation.

CONCLUSIONS: ICU organizational structures and reported PAD practices vary widely worldwide. Despite international guidelines, many ICUs lack consistent implementation of evidence-based sedation, analgesia, and delirium management strategies.

KEYWORDS: analgesia; COVID-19; delirium; intensive care unit; mobility; sedation

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KEY POINTS

Question: How did site-level ICU organizational policies and implementation of pain, agitation, and delirium (PAD) best practices vary internationally before the COVID-19 pandemic?

Findings: Over 75% of 93 ICUs reported routine use of validated PAD scales, most commonly Richmond Agitation-Sedation Scale (86%), Confusion Assessment Method for ICU (59%), and Numeric Rating Scale (44%). Protocols were most available for spontaneous breathing trials (60%) and sedation (58%), followed by delirium (53%), mobilization (47%), and pain (46%). University affiliation and 1:1 nurse staffing was associated with reported use of delirium or mobilization protocols.

Meaning: ICU organizational structures and reported PAD practices vary widely worldwide, with inconsistent implementation of evidence-based practices.

Critically ill patients admitted to the ICU should ideally be awake and free of pain, anxiety, and distress. Achieving this goal requires a nuanced balance between adequate analgesia and appropriate sedation; international practice guidelines have progressively shifted toward promoting lighter levels of sedation and prioritizing pain management. Multiple guidelines, including those issued by the Society of Critical Care Medicine (1–3), advocate for an analgesia-first approach in which pain is treated before initiating sedatives. They also recommend routine use of validated scales for pain, agitation, and delirium (PAD), implementation of structured protocols, early and progressive mobilization, minimization of physical restraints, and flexible visitation policies (1–3).

Despite evidence-based recommendations, consistent implementation remains a challenge. Numerous international surveys and audits have documented wide variability in PAD management across different ICU settings and geographic regions (4–6). Reported barriers to guideline adherence include lack of staff training, institutional inertia, concerns about patient safety, limited interprofessional collaboration, and personnel or resource constraints. Furthermore, the availability and integration of standardized PAD protocols are inconsistent, particularly in nonacademic or resource-limited environments.

The COVID-19 pandemic introduced additional complexities that further disrupted optimal PAD management. The overwhelming surge of critically ill patients, staffing shortages, reallocation of resources, and elevated patient acuity all contributed to a departure from best practices. In many institutions, shortages of sedatives and analgesics prompted changes in drug selection and dosing strategies. The heightened use of deep sedation to facilitate proning, paralysis, and ventilator synchrony was perceived as necessary in COVID-19 patients yet may have exacerbated delirium. Furthermore, infection control policies led to widespread visitor restrictions, removing a key element of patient orientation and psychological support.

To date, large-scale international data examining real-world adherence to PAD guidelines, especially in the context of COVID-19, remain sparse. There is a pressing need to understand how ICU characteristics, such as staffing models, availability of protocols, and institutional affiliation, may influence PAD practices and the degree to which guideline-recommended strategies are implemented.

To address this gap, we conducted the SAnDMAN (Sedation, Analgesia and Delirium MANagement) study, an international, retrospective, observational investigation that explored PAD practices in more than 3000 mechanically ventilated, critically ill adults. Participating centers included those treating medical, surgical, trauma, neurologic, and COVID-19 patients. In this article, we present site-level data from 93 ICUs. Specifically, we describe 1) prepandemic ICU characteristics, 2) self-reported site-level implementation of evidence-based and guideline-directed PAD practices, and 3) perceived practice changes during the COVID-19 pandemic. These findings offer a global snapshot of site-reported organizational policies and processes that shape bedside care for critically ill patients.

METHODS

Study Design

The Sedation, Analgesia, and Delirium Management study is a retrospective international observational study. The study was conducted according to Strengthening the Reporting of Observational Studies in Epidemiology guidelines (**eTable 1**, https://links.lww.com/CCX/B683) (7). In 2019, an invitation to participate was distributed through the European

Society of Intensive Care Medicine (ESICM) and the American Thoracic Society Critical Care Assembly. Eligible centers included ICUs treating patients 18 years or older; multiple ICUs from the same hospital could participate.

The primary study cohort included patients admitted between October 1 and December 31, 2019; the COVID-19 sub-study included patients admitted from January 1, 2020 (or the date of the first pandemic wave in each country) to January 1, 2021. In total, 754 centers expressed interest, and 122 signed data collaboration agreements. National Coordinators were appointed to assist with site recruitment and serve as points of contact and support. Ethical approval was obtained locally at each site (**Supplemental Digital Content**, https://links.lww.com/CCX/B683), informed consent was waived given the retrospective design, and the study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2024 (8). The study is registered on ClinicalTrials.gov (NCT05027217).

Data Collection

The study sponsor is the University of Oxford. Study documents and contact details were available via the ESICM website (https://www.esicm.org/sandman/) in English and Spanish. Data collection occurred between January 5, 2022 and March 31, 2023. Participating sites submitted data using an electronic Case Report Form (eCRF) hosted on a secure General Data Protection Regulation-compliant platform provided by Clinfile (MultiHealth Group, Vélizy-Villacoublay, France). A manual of operations with detailed instructions on data entry was sent to all sites. Data entry was supported by real-time validation rules to minimize missing or implausible values, and the eCRF could only be submitted once all required fields were completed and forms validated. The research team remained available to answer eCRF-specific queries during the duration of data collection; errors or missing validations were checked regularly by one investigator (S.B.) and resolved within one month.

Each ICU contributed prepandemic site-level data, including hospital and ICU characteristics (e.g., size, academic affiliation, model of care), staffing, and availability of dedicated team members (e.g., physiotherapists, pharmacists, respiratory therapists). Data were also collected on the local availability of standardized PAD protocols (i.e., sedation, analgesia, delirium, ventilator weaning, physical restraint, and mobilization), validated PAD assessment scales, and analgo-sedation pharmacologic strategies. Finally, ICUs reported site-level changes to practice during the COVID-19 pandemic, including staffing, PAD drug shortages, perceived sedation requirements, and visitor policies. The site questionnaire is available in the Supplemental Digital Content (https://links.lww.com/CCX/B683).

Statistical Analysis

Data analysis was prespecified and conducted in R, Version 4.4.1 (Ripley) (R Foundation for Statistical Computing, Vienna, Austria). Analyses were restricted to centers with complete paired data for both prepandemic and pandemic-period responses for each variable. Categorical variables are summarized as frequencies and percentages, and continuous variables as mean (SD) or median (interquartile range), depending on distribution. Comparisons between prepandemic and pandemic ICU-level data were conducted using paired statistical methods. For categorical variables with mutually exclusive response options (e.g., staffing ratios and visitor policies), Bowker test of symmetry was used to assess changes in distribution over time. For variables allowing multiple responses (e.g., ICU staff composition and physician specialties), each response category was analyzed as a paired binary variable using McNemar exact test. Two-tailed p values of less than 0.05 were considered statistically significant. Where any expected cell frequency was less than 5, Fisher exact test was used instead. Two-tailed p values of less than 0.05 were considered statistically significant. Given the exploratory nature of this study, raw p values are presented without adjustment for multiple comparisons.

The unit of analysis for the site survey was the individual ICU. Multiple ICUs from the same hospital were analyzed as separate units because they represented distinct clinical services with different organizational structures and clinical practices. Formal multilevel modeling by hospital or country was not undertaken because relatively few hospitals contributed multiple ICUs and the survey was primarily descriptive.

To identify factors associated with the availability of specific PAD-related protocols and practices, we conducted exploratory multivariable logistic regression

models (analgesia-first; analgesia-first or pain protocol in place; sedation interruption; sedation protocol; sedation protocol or interruption; mobilization protocols; and delirium protocols), as determined a priori. Covariates included hospital size, academic affiliation, ICU model (open vs. closed), and nurse-to-patient ratio. Results are presented as adjusted odds ratios (aORs) with 95% CIs; *p* values of less than 0.05 were considered statistically significant. Given the modest sample size (*n* = 93 ICUs), multivariable logistic regression was used cautiously and primarily for exploratory purposes. To reduce the risk of overfitting, only a limited number of covariates were included in each model based on clinical relevance. Multicollinearity was evaluated using variance inflation factors.

RESULTS

Hospital and ICU Characteristics

A total of 93 ICUs from 79 hospitals across 27 countries in North America, South America, Europe, and Asia completed the site questionnaire and contributed data (**eFigs. 1** and **2**, https://links.lww.com/CCX/B683). **Table 1** shows prepandemic site characteristics. Most ICUs (63%, *n* = 59) were university-affiliated, and 32% (*n* = 30) were community hospitals (teaching or non-teaching). One-half of the sites reported 500–1000 hospital beds, and 90% had at least 11 invasive mechanical ventilators. The most commonly reported ICU size was 11–19 beds (40%), and 61% of ICUs had single-patient rooms.

Most ICUs operated under a closed model of care (59%), with care delivered by a dedicated team of intensivists. A mixed patient population (medical, surgical, trauma, etc) was managed in 78% of the ICUs. ICUs reported a range of dedicated staffing: 83% physiotherapists, 68% pharmacists, 50% respiratory therapists, 30% mobility teams, and a minority reported pet (18%) or music therapy (12%).

Prepandemic Site-Level PAD Practices and Protocol Availability

Although PAD practices and protocol implementation varied, more than 75% of ICUs reported routine use of validated PAD assessment scales (**Fig. 1**; **eFig. 3**, https://links.lww.com/CCX/B683). The most frequently reported tools were the Richmond Agitation-Sedation Scale (86%), the Confusion Assessment Method for ICU (59%), and the Numeric Rating Scale (NRS, 44%) for pain. Patients were assessed for delirium primarily by nurses (81%) and ICU attending physicians (68%).

The reported availability of local protocols varied: ventilator weaning/spontaneous breathing trial (SBT) protocols were available in 59%, followed by protocols for sedation (59%), delirium (57%), mobilization (49%), pain (46%), and physical restraint (43%; **Fig. 1*A***). Reported routine practices included daily sedation or analgesia interruption (69%), physical restraint application (66%), gradual weaning of opioids to prevent iatrogenic withdrawal (62%), daily SBTs (56%), and analgesia-first approach (49%; **Fig. 1*B***). Notably, 6% of ICUs reported having no standardized protocols at all.

Association Between ICU Characteristics and Prepandemic PAD Strategies

Logistic regression analyses identified several institutional characteristics associated with the reported implementation of PAD practices (**eFig. 4**; **eTables 2–5**, https://links.lww.com/CCX/B683). University-affiliated centers were more likely to report using an analgesia-first approach (aOR 4.56; 95% CI, 1.56–14.9; $p = 0.008$), and mobilization and delirium protocols. A 1:1 nurse-to-patient ratio was associated with lower analgesia-first management (aOR 0.09; 95% CI, 0.03–0.26; $p < 0.001$), and was independently associated with the availability of delirium protocols (aOR 3.88; 95% CI, 1.41–11.82; $p = 0.012$). The presence of a ventilator weaning/SBT protocol was strongly associated with other reported best practices, including daily sedation interruption (aOR 3.80; 95% CI: 1.43–10.89; $p = 0.009$) and sedation protocols (aOR 5.95; 95% CI, 2.29–16.86; $p < 0.001$).

Medication Availability and Changes During the COVID-19 Pandemic

Over 80% of ICUs reported having the following medications available for use: fentanyl, morphine, paracetamol, propofol, midazolam, dexmedetomidine, and ketamine (**Fig. 2**; **eTable 6**, https://links.lww.com/CCX/B683). During the pandemic, 48% of ICUs reported drug shortages (Fig. 2), and 50.6% of those affected reported changes in sedation practices. Respondents perceived a need for higher doses

TABLE 1.
Sedation, Analgesia and Delirium Management Participating Site Characteristics (*N* = 93)

Characteristic	Response	*N* (%)
Hospital type	University-affiliated	59 (63.4)
	Community–teaching	24 (25.8)
	Community–non-teaching	6 (6.5)
	Other	4 (4.3)
Number of hospital beds	≤ 250	13 (14.0)
	251–499	29 (20.4)
	500–1000	47 (50.5)
	> 1000	14 (15.1)
Type of ICU	Mixed	73 (78.5)
	Neurologic/ neurosurgical	8 (8.6)
	Medical	5 (5.4)
	Surgical	3 (3.2)
	Trauma, burns, cardiac, other[a]	4 (4.4)
ICU admissions per year, *N*	< 300	13 (14.0)
	301–500	18 (19.4)
	501–1000	34 (36.6)
	Unknown	28 (30.1)
ICU model of care	Closed	55 (59.1)
	Semi-closed	26 (28.0)
	Open	9 (9.7)
	Other	3 (3.2)
Number of staffed ICU beds	≤ 10	22 (23.7)
	11–19	37 (39.8)
	20–29	18 (19.4)
	≥ 30	16 (17.2)
Number of ventilators for invasive ventilation	1–5	4 (4.3)
	6–10	15 (16.1)
	11–20	38 (40.9)
	≥ 21	36 (38.7)
Dedicated ICU staff	Physiotherapist	77 (82.8)
	Pharmacist	63 (67.6)
	Respiratory therapist	46 (49.5)
	Mobility team	28 (30.1)
	Pet therapy/pet visits	17 (18.3)
	Music therapist	11 (11.8)
ICU patient rooms[b]	Single-patient room	57 (61.3)
	Open plan	44 (47.3)
	Two patients per room	14 (15.1)
	More than two patients per room	14 (15.1)

[a]One each for trauma, burns, cardiac, other = 4.
[b]It was permitted to select more than one response.
Prepandemic site characteristics. Data are shown as *N* (%). ICU model of care: closed = patients cared for by one team of intensivists, and only intensivists have admitting privileges; open = any physician can admit patients to ICU, and intensivists are available for consultation at the discretion of the responsible physician; semi-closed = the ICU team provides direct patient care, in collaboration with other physicians who are also allowed to enter patient orders.

of sedatives, analgesics, and neuromuscular blockade in COVID-19 patients, along with a perception of an increased incidence of delirium.

Staffing and Visitor Policies Before and During the COVID-19 Pandemic

Prepandemic, the most common nurse-to-patient ratio for mechanically ventilated patients was 1:2 (45%) or 1:1 (39%). Sites reported a significant shift in nurse-to-patient ratios for mechanically ventilated patients during the pandemic, reflecting a trend toward lower staffing ratios (**Table 2**). Nurse-to-patient ratios for non-mechanically ventilated patients also changed significantly during the pandemic, with a shift toward higher patient loads. Intensivist-to-patient staffing typically ranged from 1:5 to 1:10, with no significant change. ICU team composition was largely stable overall, although there were changes in specific roles, including an increase in the presence of senior physicians during nighttime coverage, and a reduction in the proportion of centers staffed by critical care specialists during the pandemic (Table 2; **eTable 7,** https://links.lww.com/CCX/B683).

The pandemic led to a marked change in visitor policies, with 61.5% of ICUs reporting they prohibited all visitation ($p < 0.001$; Table 2).

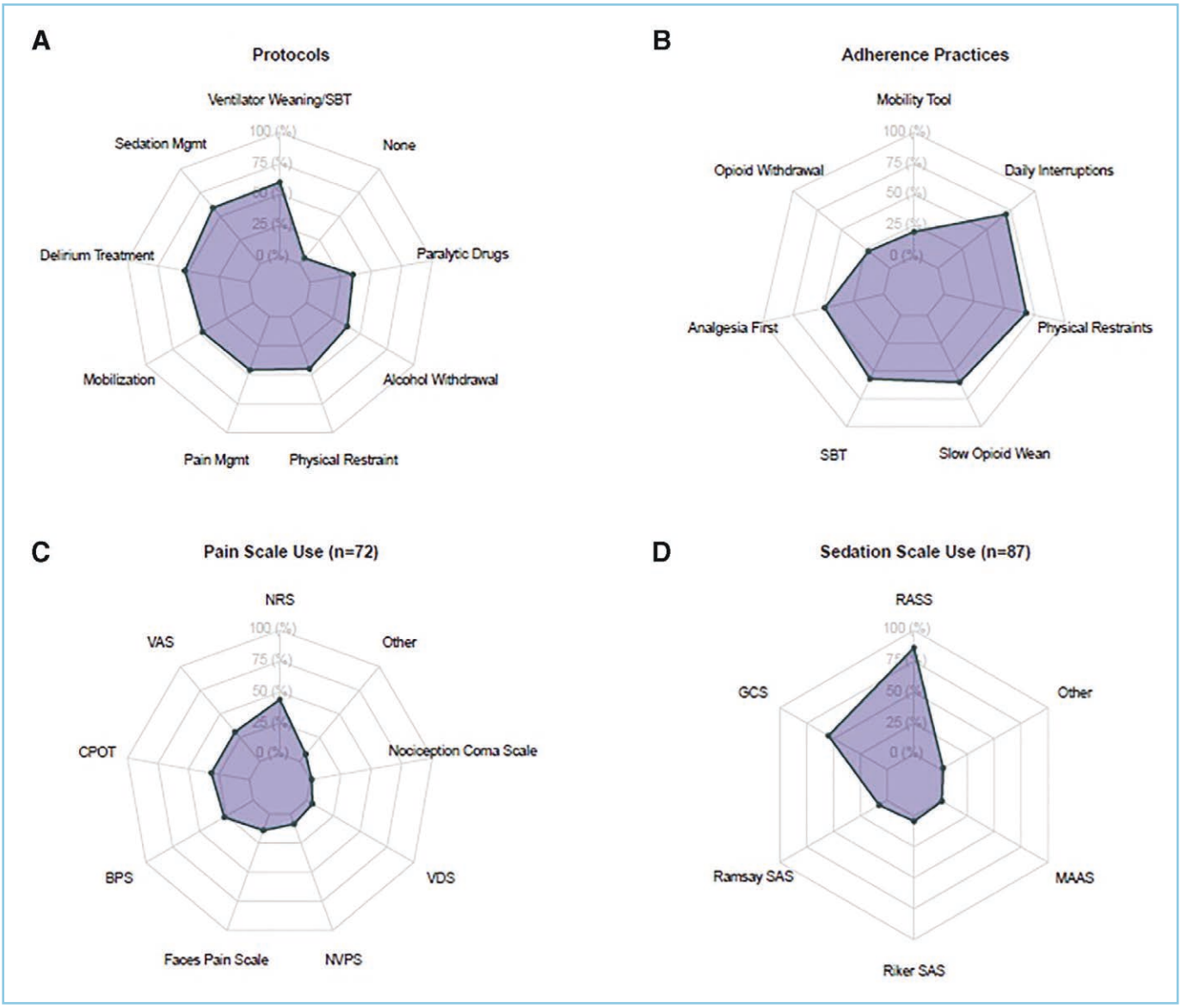

Figure 1. Reported availability of protocols, strategies, and tools in participating ICUs (*N* = 93). **A**, Local use of standardized protocols; **B**, Local adherence to strategies and tools; **C**, Pain scale use; **D,** Sedation scale use. BPS = Behavioral Pain Scale, CPOT = critical-care pain observation tool, GCS = Glasgow Coma Scale, MASS = Motor Activity Assessment Scale, NRS = Numeric Rating Scale, NVPS = Nonverbal Pain Scale, RASS = Richmond Agitation Sedation Scale, SAS = Sedation Agitation Scale, SBT = spontaneous breathing trial, VAS = Visual Analog Scale, VDS = Verbal Descriptor Scale.

DISCUSSION

In this article, we present initial findings from the SAnDMAN study, relating to detailed information on organizational characteristics, staffing, protocols, and reported guideline adherence from 93 ICUs across 27 countries and 4 continents. The ICUs that participated in SAnDMAN represent a broad range of settings, including university-affiliated and community hospitals, with diverse resource levels, staffing models, and sedation practices. SAnDMAN captures variability in resources, protocols, and PAD practices for mechanically ventilated patients across geographic and institutional contexts, reflecting real-world practice in diverse settings. A future article will report PAD management for more than 3000 patients.

Our findings demonstrate persistent variability in the reported implementation of guideline-recommended practices, including protocolized pain management, sedation and delirium assessment, sedation interruption, and SBTs. Despite evidence supporting these interventions, translation into clinical

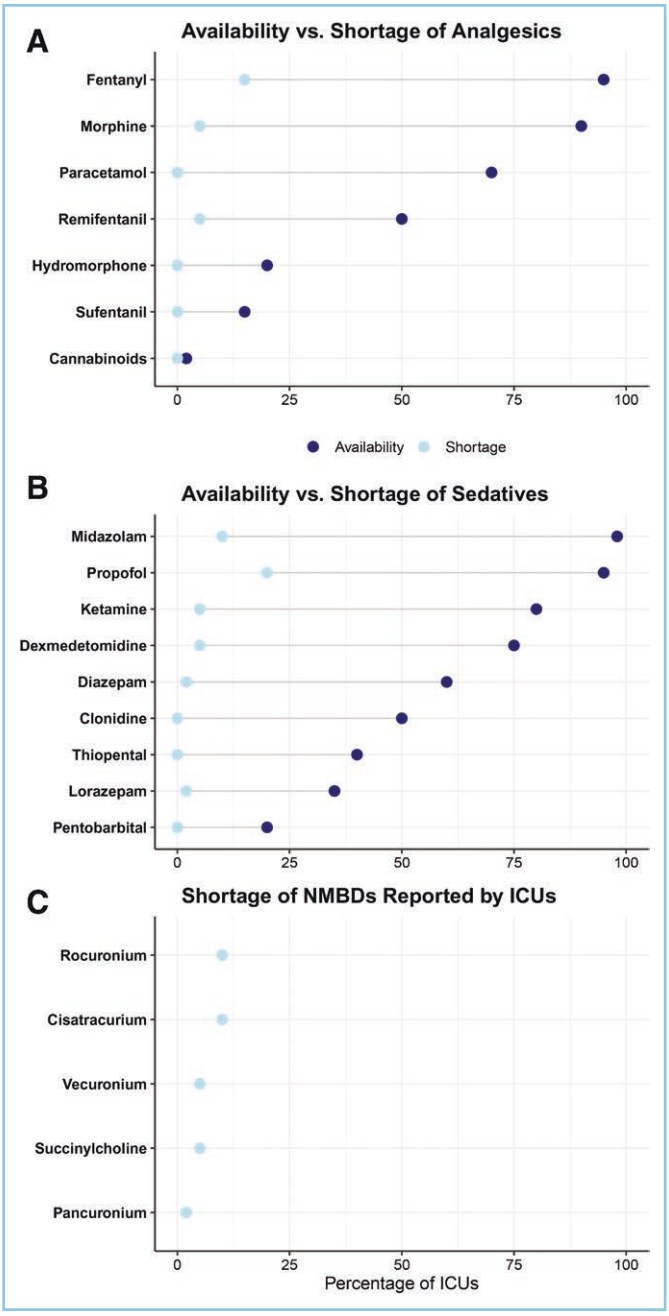

Figure 2. Dumbbell plot showing the availability and shortage of analgesics and sedatives, and the shortage of NeuroMuscular Blocking Drugs (NMBDs) during the pandemic, across all participating ICUs. **A**, Availability vs. shortage of analgesics; **B**, Available vs. shortage of sedatives; **C,** Shortage of NMBDs reported by ICUs.

practice remains inconsistent. Although the majority of ICUs report a nurse-to-patient ratio of 1:1 or 1:2 for mechanically ventilated patients, lower ratios were also reported, which may limit the feasibility of implementing labor-intensive protocols such as restraint minimization, early mobilization, and delirium prevention.

The composition of the ICU multidisciplinary team also varied substantially, with physiotherapists present in 83% of sites, pharmacists in 68%, and respiratory therapists in only 50%. Given that these allied health practitioners promote early mobility, spontaneous awakening trials, and SBTs, respectively, these differences may influence protocol adherence and patient outcomes. Single-patient rooms, associated with improved infection control and family communication, were common but not universal. Prepandemic, family presence was restricted in most ICUs, with only 27% reporting unrestricted 24/7 access—a finding especially relevant in light of the emphasis on family engagement in the A2F bundle and ICU Liberation movement (9).

Clinical Practice Guidelines for the Management of PAD (1, 10) have laid the groundwork for evidence-based management. The ICU Liberation A2F bundle (assess, prevent, and manage pain; both spontaneous awakening and breathing trials; choice of analgesia and sedation; delirium assessment; early mobility; and family engagement) operationalized these recommendations into a unified framework. Multicenter observational studies show that compliance with more bundle components is associated with improved patient outcomes (9, 10) and highlight the adverse events associated with sedation (11). Nevertheless, achieving consistent adherence to the A2F bundle in real-world settings remains a challenge, and international (4–6) and national audits (12, 13) highlight the implementation gap. In a 2017 international survey of A2F bundle use, intensivists reported high use of validated pain (83%) and sedation (89%) scales in their ICUs, but only 42% of respondents reported routine delirium assessments (**eTable 8**, https://links.lww.com/CCX/B683) (14). Daily spontaneous awakening and breathing trials were reported by 66% and 67%, respectively, with substantial geographical variation.

Although other large-scale ICU observational efforts—such as the Intensive Care Over Nations study (15) and the COVID-ICU study (16)—documented ICU structure and outcomes globally, they lack granular data on PAD management practices. The SAnDMAN study complements these by offering high-resolution data on ICU staffing models, protocols, and sedative strategies, and targets actionable quality improvement areas that directly affect patient experience and recovery.

TABLE 2.
ICU Staffing and Visitor Policy Before and During the COVID-19 Pandemic

Characteristic	Response	Before Pandemic	During Pandemic	*p*
Nurse:patient ratio for mechanically ventilated patients[a]	1:1	36 (38.7)	20 (22.2)	0.15
	1:2	42 (45.2)	46 (51.1)	
	1:3	7 (7.5)	13 (14.4)	
	1:4	3 (3.2)	5 (5.6)	
	Other	5 (5.4)	6 (6.7)	
Nurse:patient ratio for non-mechanically ventilated patients[a]	1:1	14 (15.1)	12 (13.3)	0.24
	1:2	52 (55.9)	39 (43.3)	
	1:3	15 (16.1)	18 (20.0)	
	1:4	6 (6.5)	13 (14.4)	
	Other	6 (6.5)	8 (8.9)	
Intensivist:patient ratio[a]	1:5	27 (29.0)	28 (31.1)	0.63
	1:6–10	38 (40.9)	33 (36.7)	
	1:11–15	10 (10.8)	15 (16.7)	
	1:16–20	8 (8.6)	7 (7.8)	
	Other	10 (10.8)	7 (7.8)	
ICU staff present during daytime[b]	Trainee Physician (non-ICU trainee)	59 (63.4)	62 (66.7)	0.97
	ICU/anesthesia trainee	85 (91.4)	82 (88.2)	
	Advanced nurse practitioner	37 (39.8)	34 (36.6)	
	Specialist critical care nurse	73 (78.5)	69 (74.2)	
	Senior physician (attending/ consultant)	85 (91.4)	77 (82.8)	
ICU staff present during nighttime[b]	Trainee physician (non-ICU trainee)	39 (41.9)	42 (45.2)	0.95
	ICU/anesthesia trainee	75 (80.6)	75 (80.6)	
	Advanced nurse practitioner	28 (30.1)	26 (28.0)	
	Specialist critical care nurse	57 (61.3)	59 (63.4)	
	Senior physician (attending/ consultant)	58 (62.4)	64 (68.8)	
	None of the above	1 (1.1)	1 (1.1)	
	Other	5 (5.4)	5 (5.4)	
	Unknown/not available	1 (1.1)	0 (0.0)	
ICU visitor policy[a]	Limited to specific times of the day	68 (73.1)	23 (25.3)	< 0.001[b]
	Open access 24 hr/d	25 (26.9)	8 (8.8)	
	No visitors permitted at any time	0 (0.0)	56 (61.5)	
	Other	0 (0.0)	4 (4.4)	

[a]During pandemic $N = 91$.
[b]Significant finding ($p < 0.05$).
Data are shown as N (%). Total $N = 93$, unless specified otherwise.

SAnDMAN builds on prior surveys by linking institutional characteristics (e.g., university affiliation, staffing ratios, presence of protocols) to specific reported practices. For instance, ICUs affiliated with universities were significantly more likely to report analgesia-first approaches and pain or mobilization protocols. A 1:1 nurse-to-patient ratio was associated with higher use of delirium protocols, indicating the central role of nursing staffing capacity in facilitating evidence-based care. Unexpectedly, a 1:1 nursing ratio was associated with lower use of analgesia-first sedation; we are unable to evaluate possible explanations within this study. These associations underscore the interplay between geographic, structural, and cultural factors in translating guidelines into practice.

SAnDMAN further contributes to existing literature by capturing clinicians' perceived practice and staffing practice changes during the COVID-19 pandemic. Many respondents perceived that COVID-19 patients required higher doses of sedatives and analgesics – a perception supported by published literature (17–19). In SAMDS-ICU, a multinational questionnaire study before and during the pandemic, intensivists reported a similar perception that COVID-19 patients received sedation more frequently (eTable 8, https://links.lww.com/CCX/B683) (17). In a single-center German study, nearly half of mechanically ventilated COVID-19 patients required at least two sedative agents, often in combination with sufentanil (18). This may be a reflection of increased sedation requirements in patients with severe respiratory failure, or alternatively may reflect the use of alternative sedative agents due to drug shortages. A propensity-matched study found that COVID-19 patients with acute respiratory distress syndrome (ARDS) received higher doses of hypnotics and experienced longer durations of coma and higher mortality compared with non-COVID-19 ARDS patients (19). The perception of increased sedation needs during COVID-19—driven by patient acuity, proning, and infection control—may have compounded existing barriers to implementing daily sedation interruption or early mobilization. Analyses of SAnDMAN patient-level data will confirm or refute the perception of increased sedation needs; this will be reported in a subsequent article.

Our findings may reflect underlying logistical, linguistic, and economic barriers to guideline implementation before and during the pandemic, such as limited access to validated assessment tools in local languages, staffing constraints, and medication shortages. These issues have been noted in Eastern Europe and low- and middle-income countries and may have been exacerbated during the COVID-19 pandemic (12).

The strengths of SAnDMAN include its global reach, inclusion of diverse ICU settings, and detailed reporting of structure, staffing, and protocol use. We deliberately collected both objective institutional data and subjective perceptions (e.g., impact of COVID-19 on sedative use), enabling triangulation of findings. Unlike prior surveys reliant on individual clinician responses, we solicited site-level responses to better reflect institutional policies (eTable 8, https://links.lww.com/CCX/B683 presents a comparison of SAnDMAN to other surveys). The study has limitations. Availability of a local protocol does not mean it is routinely used; thus, our data may overestimate adherence to best practices, especially if responses reflect idealized or policy-based answers rather than actual clinical behaviors (6, 20, 21). Participation was biased toward high-income countries, and underrepresentation from low-resource settings limits generalizability. Sites participating in SAnDMAN may have had a greater interest in quality improvement or research and thus may not represent average or under-resourced ICUs. Furthermore, many sites that initially expressed interest were ultimately unable to participate owing to the administrative burden, lack of contracts or legal infrastructure, inadequate research personnel, or challenges inpatient data access. The pandemic further disrupted data collection, leading to site withdrawals and delays. In addition, because the site survey analyzed ICUs as the unit of observation, we did not account for potential correlation between multiple ICUs from the same hospital. However, these units generally represented distinct specialty ICUs with different organizational characteristics and clinical practices, reducing the expected degree of within-hospital similarity. The paired nature of prepandemic and during-pandemic comparisons required the use of methods that account for within-center correlation; however, analyses of multiple-response variables were conducted at the level of individual categories and should be interpreted cautiously given the potential for multiplicity. Given the limited sample size, the regression analyses should be interpreted with caution and may have limited precision hindering the generalizability of the findings. Accordingly, the results should be

considered hypothesis-generating rather than confirmatory or causational. Finally, as a survey-based study, the results presented are subject to response bias, particularly in areas where institutional policies diverge from routine bedside practice.

Nevertheless, these results set the stage for the second phase of SAnDMAN reporting, which will link reported ICU-level practices to individual patient data. This will allow us to examine the association between sedation practices, staffing models, and clinical outcomes such as duration of mechanical ventilation, early ICU delirium, and mortality. By combining institutional and patient-level data, we hope to develop predictive models and targeted recommendations to support the implementation of best practices in real-world settings.

CONCLUSIONS

The SAnDMAN study provides insight into international variability of ICU structures, staffing, and site-level reported implementation of evidence-based PAD strategies. Despite decades of research and guideline development, substantial heterogeneity persists in the reported adoption of protocols, assessment tools, and A2F bundle components. University affiliation and higher nurse-to-patient ratio were associated with more consistent implementation of some evidence-based strategies. The COVID-19 pandemic further challenged best practice adherence, both due to perceived increased sedation needs and systemic disruptions. SAnDMAN highlights areas where ICU efforts to implement the A2F bundle may need greater support and customization. Future analyses linking site-level characteristics to patient-level outcomes will be instrumental in shaping quality improvement initiatives in sedation and delirium management worldwide.

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