Pediatric intensive care resources in Ibero-Latin America: SPREAD PED Ibero–Latin America, a multinational, multicentre, cross-sectional study

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Summary

Background **Pediatric intensive care units (PICUs) are a cornerstone of child survival, yet their structure, staffing, and adherence to evidence-based protocols vary widely across regions. Comprehensive and contemporary data from Ibero-Latin America are lacking. We aimed to characterize the organization, human resources, and implementation of standardized care practices in PICUs across this region.**

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Methods We conducted an international, multicentre, cross-sectional study including all PICUs admitting patients during a five-day period (Sept 2024) across 21 countries in Latin America, Spain, and Portugal. Unit-level data were obtained through a standardized electronic survey describing hospital characteristics, workforce distribution, monitoring capabilities, and clinical protocols. The primary objective was to characterize the distribution of structural and organizational features of participating PICUs across the región; secondary outcomes examined multidisciplinary coverage and adherence to standardized care practices.

Findings Among 339 PICUs (70.6% public; 61.4% university-affiliated), nearly half had fewer than ten beds. Median physician-to-patient ratio was 1:5–6 by day and 1:8–10 overnight. Nursing ratios varied widely, most favourable in the Iberian region (≈1:1–2) and least in the Andean block (≈1:3–4), underscoring inequities in bedside care capacity. Only 68% of units had dedicated physiotherapists, with far lower coverage from nutritionists, psychologists, or pharmacists. Basic monitoring and ventilation were nearly universal (>95%), yet advanced technologies—cardiac output, near-infrared spectroscopy, renal replacement therapy—were available in fewer than 40% of centers. Structured protocols for sepsis, mechanical ventilation, sedation, or antimicrobial stewardship were reported in only 56% of PICUs, with adherence highest in the Iberian and lowest in the Andean and Caribbean regions.

Interpretation This multinational, multicentre assessment provides the first comprehensive and contemporary map of pediatric critical care capacity across Ibero-Latin America, revealing major disparities in infrastructure, human resources, and protocol implementation. Strengthening human capital, multidisciplinary training, and regionally adapted strategies is essential to achieve equitable, high-quality critical care for children across the region.

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Keywords: Pediatric intensive care; Workforce; Health inequities; Quality of care; Latin America

Research in context

Evidence before this study

We searched PubMed and Embase from Jan 1, 1990, to June 30, 2024, using the terms "pediatric intensive care", "infrastructure", "resources", and "Latin America" without language restrictions. We also reviewed reference lists from key articles. Available studies were limited, fragmented, and mostly country-specific, including early descriptive reports from Argentina, Brazil, and selected countries in the Andean and Caribbean regions. The most comprehensive previous regional overview was published in 2012, documenting substantial heterogeneity in pediatric intensive care unit (PICU) availability, staffing, and outcomes across Latin America. However, no multicentre study had systematically evaluated PICU infrastructure across Ibero-Latin America, including Spain and Portugal, using standardized definitions and methodology.

Added value of this study

To our knowledge, this is the largest multicentre investigation of PICU resources ever conducted in Ibero-Latin America. By capturing data from 339 units across 21 countries, the SPREAD PED LATAM Iberia study provides the first contemporary baseline of structural capacity, workforce distribution, monitoring technologies, and essential treatments in the region. Beyond documenting inequities, it highlights areas of resilience—such as widespread access to basic monitoring and essential antibiotics—while exposing critical gaps in allied health professionals, advanced monitoring, and standardized clinical protocols. This comprehensive mapping offers a platform for benchmarking and regional comparison.

Implications of all the available evidence

Taken together with previous fragmented reports, our findings demonstrate both the progress and the ongoing inequities in pediatric intensive care provision across Ibero-Latin America. These results have direct implications for health policy and workforce planning, underscoring the need for targeted investment in PICU infrastructure, equitable distribution of staff and technology, and the strengthening of regional networks for collaborative research and training. Establishing systematic registries and monitoring frameworks will be essential to track progress and evaluate the impact of interventions aimed at improving outcomes for critically ill children.

Introduction

Pediatric intensive care saves lives but demands systems built on equity and resilience. Intensive care represents a cornerstone of pediatric practice dedicated to stabilizing children facing life-threatening acute derangements, whether caused by illness, trauma, surgery, or the administration of high-risk treatments. Its effectiveness depends on the integration of trained human resources with adequate physical and technological infrastructure, ensuring the minimum conditions required to deliver safe, multidisciplinary, and high-quality care.[1–4] However, across many regions of the world—including Ibero-Latin America—the burden of critical conditions in children collides with fragile health systems, unevenly distributed specialized services, and limited capacity for timely referral.[5] These challenges underscore the need for sufficient, properly designed Pediatric Intensive Care Units (PICUs) that can respond to the demands of critically ill children while reducing disparities in access and outcomes.

Unfortunately, the development of PICUs has not been equitable across all regions of the world. In Latin America, their availability has expanded steadily over recent decades, but PICUs remain disproportionately concentrated in large metropolitan areas. This uneven distribution reflects the combined impact of geographical barriers, financial constraints, and the necessity of regionalization to optimize scarce health resources. Although centralization can enhance expertise and consolidate the quality of services delivered, it also deepens disparities in access for children living in rural and underserved areas, a challenge repeatedly highlighted in the literature from the region.[2,5]

The pediatric intensive care units exhibit substantial heterogeneity across structural, physical, and resource domains.[2,4,6] Variability exists in spatial design, bed capacity, and environmental conditions, as well as in the availability of critical equipment, medications, and diagnostic capacity, alongside differences in staffing, training, and care organization.[2] These dimensions reflect the concept of facility readiness, whereby infrastructure, human resources, and care processes jointly determine the ability of health systems to deliver timely and effective critical care. Prior studies from low- and middle-income settings have documented significant variability in PICU resources and capacity; however, these data remain limited, heterogeneous, and in many cases outdated, highlighting a critical gap in the contemporary characterization of intensive care resources across regions such as Ibero-Latin America.[6]

Despite advances, comprehensive data describing the structural, physical, and resource characteristics of PICUs across Ibero-Latin America remain scarce. Available evidence is fragmented—frequently restricted to single-country analyses or specific subspecialties—and does not adequately reflect the marked heterogeneity in capacity across this large and diverse region.[6–8] Understanding the availability of beds, human resources, monitoring technologies, and organizational models is essential to inform regional planning, promote equitable allocation of resources, and strengthen health-system resilience in the face of high-burden conditions such as sepsis.[9,10] Against this background, the SPREAD PED IBERO-LATAM study (**S**epsis **PRE**valence **A**ssessment **D**atabase in **PED**iatric population in Latin America and Iberia) offered a unique opportunity to capture contemporary baseline data. Here, we present a characterization of participating PICUs, providing updated evidence on structure and resource availability in the region—an essential foundation for guiding health policy, research agendas, and targeted improvements in pediatric intensive care.

Methods

Study design and oversight

We conducted an international, multicentre, cross-sectional study aimed at characterizing the organizational and structural resources of pediatric intensive care units (PICUs) across Latin America, Spain, and Portugal. The initiative was coordinated by the University of São Paulo, Brazil, and supported by the Latin American Sepsis Institute (ILAS), with the endorsement and active participation of the Latin American Society of Pediatric Intensive Care (SLACIP). A steering committee oversaw study design, survey development, and analysis. The study is reported in accordance with the STROBE guidelines.

Study setting and participants

PICUs from 21 countries were invited to participate through national pediatric intensive care societies, professional networks, and direct institutional contacts. Eligible units were defined as hospital-based facilities providing 24/7 multidisciplinary critical care to children aged 1 month to 18 years, with at least four dedicated beds for pediatric intensive care. Neonatal-only units were excluded. All units admitting patients during the census week were (September 2024) eligible, irrespective of hospital size, ownership, or teaching status.

Recruitment strategy

The study employed an open invitation strategy through SLACIP and affiliated societies, with additional outreach via institutional registries and professional networks. Participation was voluntary, and no financial incentives were provided. No formal sample size calculation was performed, as all eligible participants reached during the study period were invited to participate. To minimize selection bias, the study emphasized inclusion of both public and private institutions, as well as university-affiliated and non-academic hospitals. Potential sources of bias included voluntary participation and regional variability in

response rates. Although 339 units across 21 countries participated, representing the largest Ibero-Latin American PICU survey to date, not all existing PICUs in each country were included. Findings should therefore be interpreted as representative of participating units rather than as a complete census.

Data collection procedures

Data were collected through a standardized electronic case report form (CRF) designed by the coordinating centre. The questionnaire was developed by the study steering committee on the basis of a prespecified conceptual framework aimed at characterising PICU structural and organisational capacity across participating sites. Item generation was organised to cover core domains considered essential to institutional readiness in pediatric critical care, including hospital characteristics, PICU structure, staffing, supportive services, laboratory and imaging access, monitoring resources, essential medications, advanced support devices, and standardised clinical protocols. Draft items were developed iteratively by the coordinating centre and study investigators, with attention to relevance, clarity, and cross-country applicability, and were structured using predefined response categories and operational definitions to minimise interpretative variability. The CRF was then piloted in five institutions before study launch to assess clarity and feasibility, and minor refinements were made before final implementation. Because the instrument was intended as a descriptive unit-level resource survey rather than a psychometric scale, formal psychometric validation was not undertaken; instead, content and face validity were supported through expert review, piloting, standardised definitions, and subsequent REDCap-based consistency checks.

Variables collected

The survey captured detailed information on: (1) hospital characteristics (ownership, university affiliation, certification status, bed capacity); (2) PICU structure (number of beds, type of unit, admissions per month); (3) staffing and patient-to-staff ratios (physicians, nurses, nursing technicians, allied professionals); (4) availability of supportive services (physiotherapy, nutrition, psychology, pharmacy); (5) access to laboratory tests and imaging; (6) monitoring resources (basic, invasive, point-of-care ultrasound, cardiac output monitoring); (7) essential medications for sepsis management; (8) devices and advanced support therapies (ventilation, renal replacement, extracorporeal support); and (9) presence and use of standardized clinical protocols. Hospitals were grouped into four regional blocks: Southern Cone, with 166 units (Brazil, Argentina, Chile, Uruguay, and Paraguay); Andean Region, with 86 units (Colombia, Peru, Bolivia, Ecuador, and Venezuela); North and Central America and the Caribbean, with 67 units (Mexico, Guatemala, Cuba, Honduras, Panama, Costa Rica, El Salvador, Nicaragua, and the Dominican Republic); and Iberian Region, with 20 units (Spain and Portugal). Urban centers were further classified according to population size as large urban centers (≥500,000 inhabitants) or smaller urban centers (<500,000 inhabitants), based on the population of the corresponding city or metropolitan area, as applicable.

Key terms were defined a priori. "*Always or almost always available*" resources referred to those accessible more than 75% of the time in daily practice. Patient-to-staff ratios were calculated separately for daytime and nighttime shifts. PICU "university hospital" status was restricted to units formally affiliated with medical schools offering undergraduate programs. These standardized definitions sought to reduce variability in interpretation across participating countries.

Data quality and monitoring

All data were submitted electronically to the coordinating centre and entered into a REDCap database specifically designed for the SPREAD PED IBERO-LATAM study. Automated consistency checks flagged implausible or incomplete entries, which were subsequently clarified through direct queries to local investigators. Central monitoring ensured adherence to predefined definitions and reduced the risk of reporting bias. No individual patient-level data were collected, as the study focused exclusively on unit-level variables.

Outcomes

The primary outcome was to describe the distribution of structural and organizational characteristics of PICUs across four predefined regional blocks: Southern Cone, Andean Region, North and Central America with the Caribbean, and Iberian Region. Secondary outcomes included quantifying differences in resource availability, staffing patterns, and protocol use across regions and hospital types.

Statistical analysis

Categorical variables were summarized as counts and percentages. Continuous variables were expressed as medians with interquartile ranges, given the non-parametric distribution of most variables. Group comparisons were performed using chi-square tests for categorical variables and the Kruskal–Wallis Htest for continuous variables. No imputation was performed for missing data; analyses were based on available cases. Statistical analyses were performed using R (version 4.4.1; R Foundation for Statistical Computing, Vienna, Austria). A two-sided α of 0.05 was considered statistically significant.

Ethical considerations

The study complied with the principles of the Declaration of Helsinki and Good Clinical Practice

guidelines. Ethical approval was obtained by the coordinating centre from the Brazilian National Research Ethics Commission (CONEP), and each participating institution secured local approval as required by national regulations. Given the exclusive focus on unit-level aggregate data, individual informed consent was waived in most jurisdictions.

Role of the funding source
The funding institutions had no involvement in the design of the study, the collection, analysis, or interpretation of data, or in the writing of the manuscript.

Results

General characteristics
A total of 339 PICUs from 21 countries (19 in Latin America, plus Spain and Portugal) participated in this study (Table 1 and Appendix material, Tables S1 and S2). The geographic distribution and characteristics of participating pediatric intensive care units in Ibero-Latin America is shown in Fig. 1 (1A, 1B and 1C). Response rates varied substantially across countries, ranging from 4.8% in the Dominican Republic to 100% in Costa Rica. Higher participation was observed in smaller networks, whereas larger countries with higher absolute PICU numbers, such as Brazil, showed lower proportional response rates (17.2%) (Appendix material, Table S2). Overall, 76.6% of health systems were reported as public; however, regional differences were observed: Iberian region (100% public), North and Central America with the Caribbean (94% public), Southern Cone (73.3% public), and Andean region (63.5% public) (Fig. 1B).

Hospitals hosting PICUs were classified as public in 70.6%, private non-philanthropic in 19%, and private philanthropic in 10.4%. Again, important regional variations were noted: Iberian region (100% public), North and Central America with the Caribbean (95.5% public, 3% private non-philanthropic, 1.5% philanthropic), Southern Cone (64% public, 22% private non-philanthropic, 14% philanthropic), and Andean region (57% public, 30.2% private non-philanthropic, 12.8% philanthropic).

Overall, 61.4% of institutions were university hospitals (100% in the Iberian region; 74.6% in North and Central America with the Caribbean; 64.7% in the Andean region; and 49.7% in the Southern Cone). Certification status also varied: 61.4% had national accreditation, 12% international certification, and 26.6% had none.

Most PICUs (88.1%) were exclusively pediatric, whereas 11.9% were mixed units. Distribution was similar across regions: North and Central America with the Caribbean, 91% pediatric and 9% mixed; Southern Cone, 90.2% pediatric and 9.8% mixed; Iberian region, 85% pediatric and 15% mixed; and Andean region, 82.6% pediatric and 17.4% mixed. Table 1 and shows the relationship between PICU type and the number of hospital and ICU beds.

Bed capacity category	Total	Iberian Europe	North America, Central America, and the Caribbean	Andean region	Southern cone
Total hospital beds[a]	324	15	66	83	160
<100	46 (14.2)	0 (0.0)	14 (21.2)	15 (18.1)	17 (10.6)
100–299	134 (41.4)	2 (13.3)	29 (43.9)	28 (33.7)	75 (46.9)
>299	144 (44.4)	13 (86.7)	23 (34.8)	40 (48.2)	68 (42.5)
Total pediatric ICU beds[a]	339	20	67	86	166
<10	165 (48.6)	10 (50.)	39 (58.2)	53 (61.6)	63 (38.0)
10–20	136 (40.1)	9 (45.0)	22 (32.8)	23 (26.7)	82 (49.4)
>20	38 (11.2)	1 (5.0)	6 (9.0)	10 (11.6)	21 (12.7)
Total neonatal ICU beds[a]	326	18	63	85	160
<10	144 (44.2)	4 (22.2)	33 (52.4)	36 (42.4)	71 (44.4)
10–20	139 (42.6)	11 (61.1)	21 (33.3)	36 (42.4)	71 (44.4)
>20	43 (13.2)	3 (16.7)	9 (14.3)	13 (15.3)	18 (11.3)

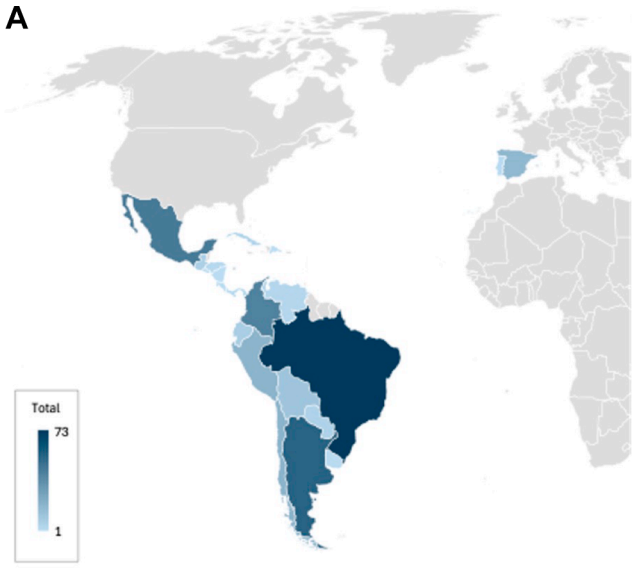
Data are presented as n (%). ICU = intensive care unit. PICU = pediatric intensive care unit. Hospital and ICU bed counts refer to institutions hosting each participating PICU; totals may differ from the overall number of participating units (n = 339) owing to missing data or hospitals containing multiple PICUs. Regional blocks are defined as follows: Southern Cone (Argentina, Brazil, Chile, Paraguay, Uruguay); Andean Region (Bolivia, Colombia, Ecuador, Peru, Venezuela); North and Central America and the Caribbean (Costa Rica, Cuba, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama); and Iberian Europe (Portugal, Spain). [a]n (%).

Table 1: **Distribution of hospital, ICU, pediatric ICU, and neonatal ICU beds by region.**

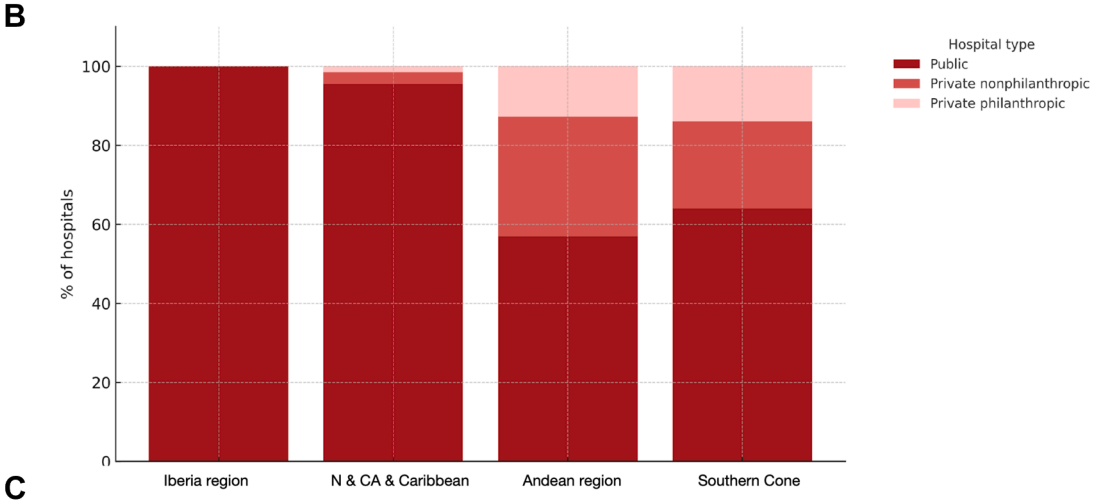
Regarding the availability of supportive professionals, 67.9% of PICUs reported access to physiotherapy, 38.4% to a nutritionist, 31.0% to a psychologist, and 24.2% to a pharmacist. Fig. 1C shows the distribution by region. In addition, 98.5% of units reported access to basic laboratory services (93.5% also with microbiology), 97.1% to an operating room, 95.6% to an emergency department, and 85.3% to a blood bank.

Monitoring equipment
With regard to monitoring resources, most units reported that basic monitoring was "*always*" or "*almost always*" available: non-invasive blood pressure measurement (99.1%), oxygen saturation monitoring (99.1%), serum lactate measurement (95.3%), invasive arterial pressure (88.8%), central venous pressure (88.4%), and point-of-care ultrasound (POCUS, 85.0%) (Fig. 2A).

Availability of laboratory tests
Regarding laboratory resources, several tests were reported as "always" or "almost always" available in most units: complete blood count (99.4%), platelet count (99.4%), creatinine (99.4%), prothrombin time (99.2%), urine culture (99.1%), blood cultures (98.8%), blood gas measurement within the first hour (98.5%), C-reactive protein (97.6%), and serum lactate measurement within the first hour (95.3%). Other tests were less



Country	Total (%)
Brazil	73 (21.5)
Argentina	55 (16.2)
Mexico	45 (13.3)
Colombia	42 (12.4)
Chile	20 (5.9)
Peru	20 (5.9)
Spain	18 (5.3)
Bolivia	12 (3.5)
Uruguay	12 (3.5)
Ecuador	8 (2.4)
Guatemala	7 (2.1)
Paraguay	6 (1.8)
Cuba	5 (1.5)
Venezuela	4 (1.2)
Honduras	3 (0.9)
Panama	3 (0.9)
Portugal	2 (0.6)
Costa Rica	1 (0.3)
El Salvador	1 (0.3)
Nicaragua	1 (0.3)
Dominican Republic	1 (0.3)



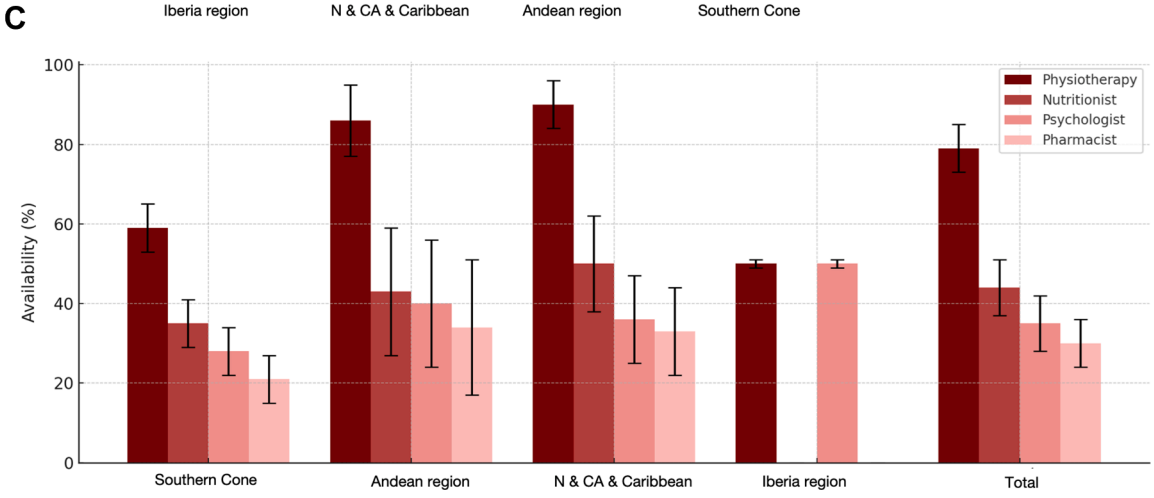


***Fig. 1:* Geographic distribution and characteristics of participating pediatric intensive care units in Ibero-Latin America**. A. Geographic distribution of pediatric intensive care units (PICUs) in Latin America, Spain, and Portugal. Choropleth world map showing the number of PICUs per country. Darker shades indicate a greater number of units, with labels included for the five countries with the highest counts (Brazil,

frequently available: fibrinogen (90.3%), quantitative respiratory cultures (87.7%), D-dimer (86.1%), ferritin (82.8%), and procalcitonin (72.5%).

Availability of antibiotics and other essential medications

With regard to antibiotic availability, most units reported "always" or "almost always" having access to carbapenems (99.1%), third-generation cephalosporins (98.8%), glycopeptides (98.8%), piperacillin–tazobactam (94.7%), fourth-generation cephalosporins (89.2%), macrolides (86.3%), linezolid (84.2%), and echinocandins (74.2%). For other commonly used medications in sepsis management, high availability ("*always*" or "*almost always*") was also reported for adrenaline (100%), noradrenaline (99.7%), oxygen (99.7%), hydrocortisone (99.7%), crystalloids (99.4%), midazolam (98.8%), neuromuscular blocking agents (98.5%), dobutamine (97.9%), albumin (95.9%), fentanyl (95.9%), propofol (94.7%), heparin (96.5%), dopamine (94.2%), dexmedetomidine (86.1%), and milrinone (84.6%). In contrast, vasopressin (78.1%) and levosimendan (59.3%) were less frequently available. Blood transfusions within the first 6 h were reported as "*always*" or "*almost always*" available in 99.4% of units.

Availability of support devices and guidelines

The availability of devices required for routine supportive care was reported as consistently high, particularly for oxygen delivery, intravascular infusion of fluids and medications, and mechanical respiratory support. In contrast, access was lower for therapies such as haemodialysis and for portable imaging modalities (Fig. 2B). The presence of management protocols is summarized in Fig. 3 A–D. Sepsis management protocols were reported as "*always*" or "*almost always*" available in 53.1% of units.

Staffing ratios

Fig. 4 A–D summarizes patient-to-staff ratios for physicians, nurses, and nursing technicians across regions, showing substantial variability both between regions and between day and night shifts.

Discussion

Our study provides the most comprehensive contemporary characterization of pediatric intensive care unit (PICU) capacity across Ibero–Latin America. We identified substantial heterogeneity in the distribution of resources, with persistent gaps in workforce capacity, access to multidisciplinary support, and availability of essential monitoring and therapeutic resources, despite notable expansion of PICU infrastructure over recent decades. These findings underscore the coexistence of progress and structural inequities, highlighting both the resilience and the fragility of pediatric critical care systems in the region. In settings where infectious diseases and sepsis continue to impose a substantial burden, the capacity of health systems to deliver timely, high-quality critical care remains constrained by structural, economic, and geographic barriers. Consequently, our findings establish a contemporary baseline to inform health policy, workforce development, and regional planning efforts aimed at strengthening pediatric critical care systems.

From an analytical perspective, these results can be interpreted across two interrelated domains: institutional resources—including governance, workforce, and protocol implementation—and physical resources, encompassing infrastructure, bed capacity, and availability of monitoring technologies and essential equipment. Framing the findings within these domains provides a structured lens to identify both strengths and actionable gaps in PICU systems across the region.

One of the earliest reports addressing pediatric critical care capacity in the region was published in 2012 by Campos-Miño and colleagues, 6 documenting marked disparities in the number of PICUs across countries (e.g., Argentina with 125 units and Mexico with 85, compared with Ecuador and El Salvador with only four each, and Honduras with two). That study further highlighted variability in the availability of pediatric-only hospitals, the pediatric intensivist workforce, and PICU mortality, with rates reaching 13.3% in Latin American units compared with 5% in European settings. These findings underscore that structural inequities in pediatric critical care have been longstanding across the region. Our results extend this evidence by providing contemporary data and a more granular characterization of these disparities across two interrelated domains. From an institutional perspective, important gaps persist in workforce composition, access to multidisciplinary teams, and the implementation of standardized clinical protocols. The limited availability of allied health professionals and the

Argentina, Mexico, Colombia, and Chile). PICU = Pediatric intensive care unit. B. Distribution of hospital type by region in pediatric intensive care units (PICUs). Stacked bar chart showing the proportion of PICUs located in public, private non-philanthropic, and private philanthropic hospitals across the Southern Cone, Andean Region, North and Central America with the Caribbean, and Iberian Region. PICU = pediatric intensive care unit. C. Availability of professional support by region in pediatric intensive care units (PICUs). Grouped bar charts showing the proportion of PICUs reporting availability of physiotherapy, nutritionists, psychologists, and pharmacists across Southern Cone, Andean, North and Central America with the Caribbean, and Iberian regions. PICU = pediatric intensive care unit. Error bars represent standard errors (SE) of proportions, calculated assuming a binomial distribution. Results for the Iberian region should be interpreted with caution given the small number of participating units, which may influence the apparent availability of specific multidisciplinary resources.

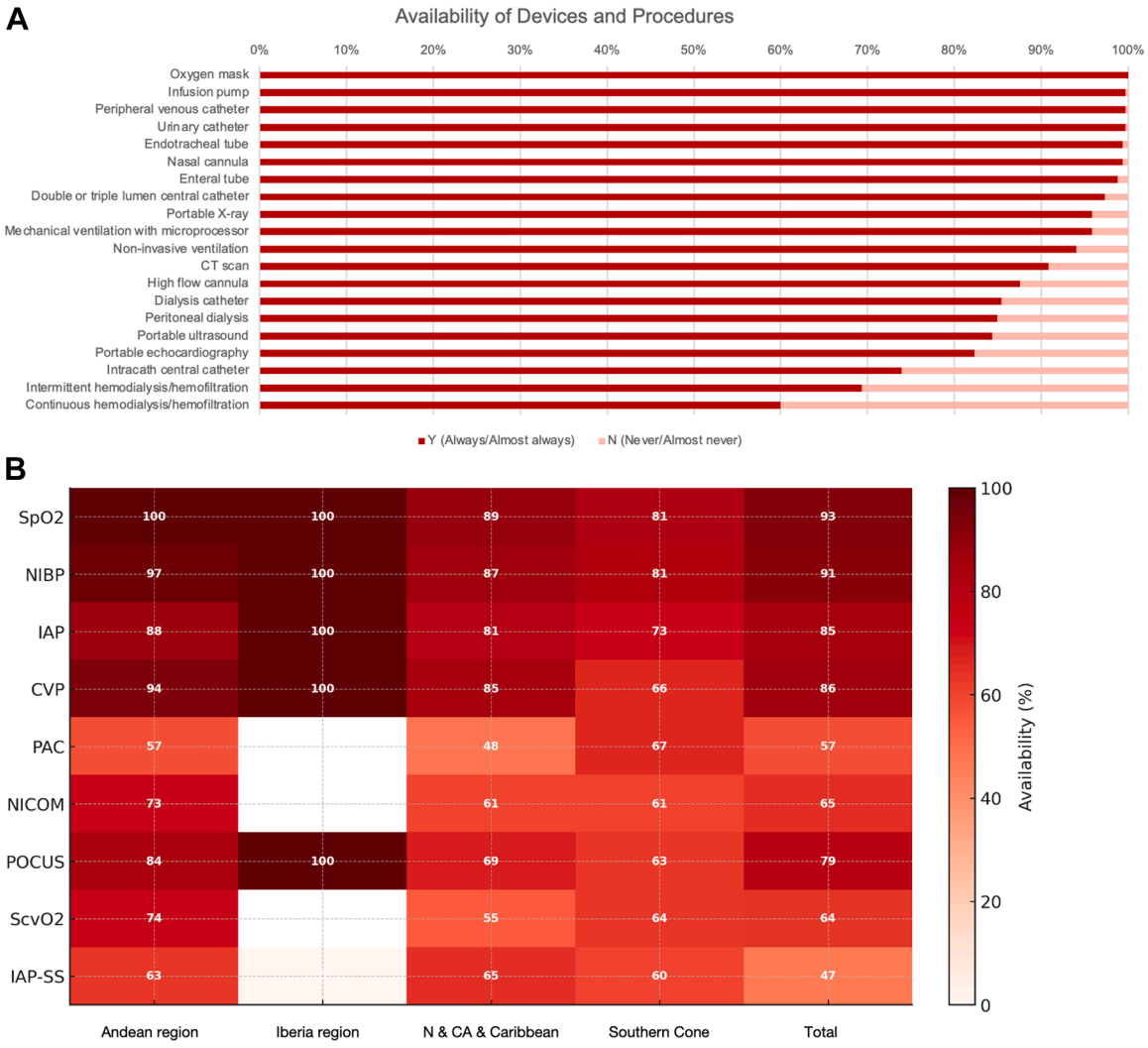


***Fig. 2:* Availability of monitoring technologies, devices, and procedures across regions**. A. Haemodynamic monitoring tools. Regional availability of basic and advanced monitoring modalities in pediatric intensive care units (PICUs). Non-invasive measures such as pulse oximetry (SpO_2) and non-invasive blood pressure (NIBP) were almost universal, whereas invasive arterial pressure (IAP), central venous pressure (CVP), and point-of-care ultrasound (POCUS) showed variable coverage. Advanced hemodynamic technologies—including pulmonary artery catheter (PAC), non-invasive cardiac output monitoring (NICOM), and mixed/central venous oxygen saturation ($ScvO_2$)—were markedly less available, with higher access in Iberian and Andean regions and lower in Southern Cone and Caribbean blocks. B. Devices and procedures. Availability of essential equipment and procedures across all PICUs. Core devices for respiratory and vascular access (oxygen mask, endotracheal tube, infusion pump, urinary catheter, and mechanical ventilation) were nearly universal (>95%), while access to high-complexity procedures such as continuous renal replacement therapy, haemodialysis, and advanced imaging (echocardiography, CT scan) remained limited to fewer than 50% of units, highlighting the technological gap between high- and middle-income settings.

inconsistent use of protocols point to weaknesses in care organization and governance that may directly affect quality and outcomes. From a physical resources perspective, disparities in bed capacity, infrastructure, and access to essential monitoring and therapeutic resources reflect uneven health system investment and planning across countries, reinforcing the persistence of structural inequities in PICU capacity across Ibero–Latin America. It is concerning that all the units participating in our study are located in large urban centers, which can certainly impose a first barrier to access to care in PICUs. This could be due to the administrative dynamics of centralizing technical and human resources in larger cities.

A striking difference across regions in our study was the proportion of public versus private institutions housing PICUs, with 100% of units in the Iberian region being public compared with only 57% in the

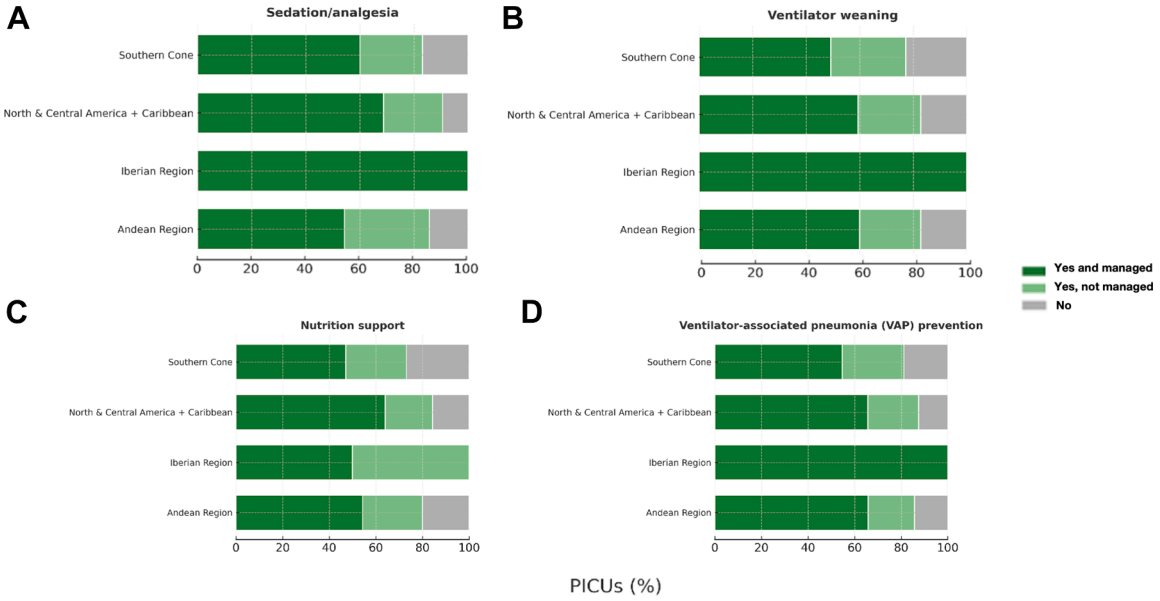


***Fig. 3:* Implementation of standardised clinical protocols across regions**. Proportion of pediatric intensive care units (PICUs) reporting the presence and management of key clinical protocols. Adherence to sedation–analgesia (A) and ventilator weaning protocols (B) exceeded two-thirds overall but remained inconsistent outside the Iberian region. Nutrition support (C) and ventilator-associated pneumonia prevention (D) protocols were less frequently applied, particularly in Andean and Caribbean PICUs, underscoring wide regional variability in structured care practices.

Andean region. This finding reflects the level of state involvement and the heterogeneous dynamics of health systems, which in turn are linked to broader indicators of underdevelopment. Similar disparities have been described outside the region: for example, a study from Nepal in 2016 that surveyed 16 of the country's 18

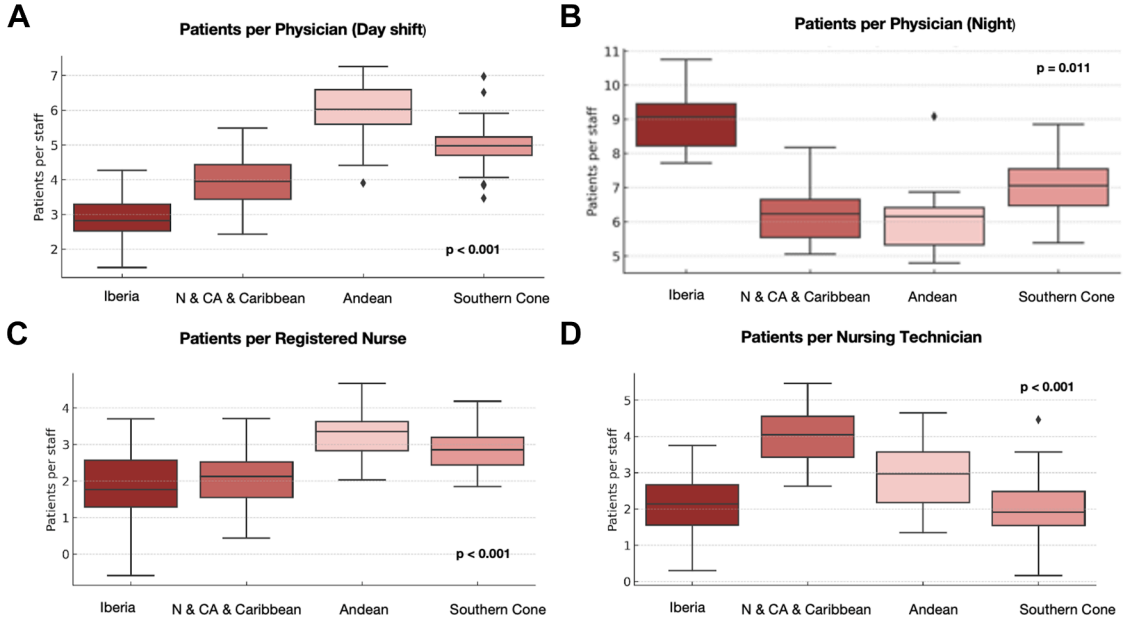


***Fig. 4:* Regional variation in physician and nursing workload in pediatric intensive care units**. Boxplots show the distribution of patient-to-staff ratios across regions. A. Patients per physician during the day shift. B. Patients per physician during the night shift. C. Patients per registered nurse. D. Patients per nursing technician. Workload was lowest in the Iberian region and highest in the Andean and Southern Cone blocks, reflecting significant inter-regional disparities in bedside staffing capacity.

PICUs found that 75% were private and only 25% were public.[9]

Of concern is the low availability of allied health professionals essential for delivering comprehensive, multidisciplinary intensive care, as advocated in modern PICUs. Only two-thirds of units reported access to physiotherapy, one-third to psychology, and one-quarter to pharmacy services. These limitations could adversely affect the quality of care, which should aim for holistic recovery in critically ill children.[10]

Beyond our regional findings, international literature provides important context for understanding the challenges and opportunities in strengthening sepsis care within PICUs.[11–17] Reports from resource-limited settings show that fewer than 80% of units consistently secure the essential bundle of sepsis care —blood cultures, first-line antimicrobials, oxygen therapy, crystalloids, and vasoactive agents— underscoring structural barriers that parallel those observed in our investigation.[12,13] Evidence from high-income countries highlights that limitations are not exclusive to low-resource environments: in the USA, for example, a national survey revealed that only one-third of PICUs met recommended physical design standards, including room size and access to advanced support modalities.[14] Furthermore, disparities in pediatric critical care outcomes have been consistently linked to socioeconomic status, race, and ethnicity, as demonstrated in a recent scoping review documenting inequities in PICU admission, readmission, and mortality. Collectively, these data reinforce that improving sepsis outcomes in Ibero-Latin America requires not only the expansion of physical infrastructure but also a deliberate effort to address inequities in access to diagnostics, therapeutics, and multidisciplinary support.

Slightly more than half of participating PICUs reported having and consistently using basic clinical protocols, including those for mechanical ventilation, sedation, nutritional support, and ventilator weaning. However, important gaps remain: approximately one-quarter of units reported having protocols that were not routinely implemented, and nearly one-fifth reported lacking them altogether. These findings point to a critical deficit in the institutional domain, particularly in the standardization and operationalization of care processes. This gap is further underscored by discrepancies with national reports; for example, although a recent study of pediatric emergency departments in Argentina reported that 82% had sepsis management protocols, in our study nearly 30% of PICUs reported that such protocols were unavailable or only minimally available.[15]

These results have important implications for health policy and resource allocation. Addressing the identified gaps will require a dual, system-level strategy: strengthening physical capacity—through expansion of PICU beds, infrastructure, and access to essential technologies—while concurrently enhancing institutional capacity, including workforce development, multidisciplinary integration, and the effective implementation of standardized clinical protocols. Regional collaborative frameworks and data-driven initiatives, such as SPREAD PED, offer a unique platform to guide equitable resource allocation and improve system resilience. Future policies should explicitly target geographic and socioeconomic inequities, ensuring that access to high-quality pediatric critical care is not determined by place of residence or health system fragmentation.

This study has several limitations. First, not all existing PICUs in each country were included, and the proportion of units participating varied widely between countries. Although the SPREAD PED LATAM Iberia invitation was broadly disseminated, the voluntary nature of participation introduces the risk of selection bias, as units with stronger academic engagement or better resources might have been more likely to respond. In addition, although the questionnaire was developed using expert consensus, standardised definitions, and pilot testing, it did not undergo formal psychometric validation, which should be considered when interpreting the consistency of unit-level reporting across diverse health systems. Second, data were self-reported by local staff through a single survey administered at one point in time. This approach limited our ability to validate responses externally and may have been affected by recall bias or variability in how definitions were interpreted across countries. Third, given the dynamic economic and political conditions in the region, some variables —particularly those related to staffing, medication availability, or advanced monitoring— are likely to fluctuate rapidly, reducing the temporal stability of our estimates. Fourth, although the survey captured a wide range of structural and organizational variables, it did not evaluate patient-level outcomes, which limits the ability to link resource availability directly with quality of care or mortality. Fifth, despite efforts to standardize definitions and implement consistency checks, differences in terminology and health system organization across 21 countries may have introduced heterogeneity in reporting. The survey did not capture data on access to emergency surgical services or the availability of on-call specialty support, which are important components of comprehensive critical care and may influence the capacity of PICUs to manage life-threatening conditions. Finally, this study focused on participating PICUs, and results should therefore be interpreted as representative of those units rather than as a complete census of all PICUs in Ibero-Latin America.

Conclusion

This large, multicentre investigation provides the most comprehensive contemporary assessment of the

structural and organizational capacity of PICUs across Ibero-Latin America. Our findings document meaningful progress in the consolidation of pediatric intensive care, but also reveal persistent inequities in workforce distribution, infrastructure, and access to essential technologies and multidisciplinary support. These gaps, deeply rooted in the sociopolitical and economic heterogeneity of the region, expose both the fragility and resilience of existing systems. By establishing a robust baseline, the SPREAD PED LATAM Iberia investigation creates a platform for regional benchmarking, policy dialogue, and collaborative research. Strengthening PICU infrastructure, investing in human resources, and ensuring equitable distribution of critical care must become urgent priorities to improve outcomes for critically ill children.

Contributors

RJ, CFO, JCJB, JFS, DCS, NSP, and VSL conceptualised the study. RJ, CFO, JCJB, JFS, DCS, NSP, and VSL developed the study protocol with contributions from the SPREAD PED LATAM Iberia steering committee. RJ, CFO, JFS, LNSP, DSO designed the statistical analysis plan. Data collection and verification were coordinated by RJ, CFO, JCJB, JFS, DCS, LNSP, VSL, JDB, DSO, FJB, PZC, GG, FD, MM, REK, MSB, AM, NM, AAM, PT, ASAD, AYC, LMM, PBP and FRM with support from national leads and local investigators across all participating countries. RJ, CFO, JCJB, JFS, DCS, VS, JDB, performed the analyses with oversight from, who had access to the raw data and verified their integrity. RJ, CFO, JCJB, JFS drafted the first version of the manuscript. All authors had full access to all the data in the study, contributed to data interpretation, reviewed and approved the final version of the manuscript, and accepted responsibility for submission.

Data sharing statement

De-identified unit-level data collected for this investigation will be securely stored at the coordinating centre (Federal University of São Paulo, Brazil). Data will be made available upon reasonable request to the corresponding author, accompanied by a methodologically sound proposal and approval from an appropriate research ethics committee. Data access will require a formal, written agreement.

Editor note

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Declaration of interests

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lana.2026.101675.

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