

RESEARCH ARTICLE

Contextual Variability in Nurses' Discourses on Environmental Sustainability Across Intensive Care Settings: An Exploratory Lexical Analysis

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ABSTRACT

Background: Intensive care units (ICUs) are among the most resource-intensive hospital settings, generating substantial greenhouse gas emissions and waste. While ICU nurses play a central role in advancing sustainability, how clinical context shapes their understanding and enactment of sustainable practices remains unclear.

Aim: To explore how nurses frame and integrate environmental sustainability across different intensive care settings.

Study Design: A qualitative exploratory design was adopted using semi-structured interviews with ICU nurses from Trauma, General, Cardiac and General Surgery ICUs in Italy. Textual data were analysed through Automatic Analysis of Textual Data within the framework of Exploratory Multidimensional Data Analysis. Correspondence analysis identified lexical associations and latent semantic dimensions differentiating sustainability discourses across settings.

Findings: A total of 29 ICU nurses participated in the study. Discourses varied markedly by clinical context. Trauma ICUs emphasised cultural awareness and collective responsibility. General ICUs reflected institutional coordination and procedural integration. Cardiac ICUs described systemic barriers and operational strain, while Surgical ICUs highlighted pragmatic alignment with infection prevention. Two latent dimensions, cultural promotion versus institutional coordination and integration versus operational strain, captured how sustainability transitions from value-driven awareness to structured policy practice.

Conclusions: Environmental sustainability in intensive care is not a universal construct, but a negotiated, context-dependent practice shaped by cultural, organisational and material factors.

Relevance to Clinical Practice: Promoting sustainability in critical care requires setting-specific strategies that align ecological principles with clinical priorities. Nursing education and leadership should foster both bottom-up engagement and top-down institutional support to embed sustainability into the culture and operations of intensive care.

Impact Statement

- What Is Known About the Topic
 - Intensive care units (ICUs) are among the most resource- and energy-intensive hospital settings, producing high volumes of waste and carbon emissions.
 - Nurses play a crucial role in promoting and implementing environmentally sustainable practices in critical care.
 - Most existing studies focus on individual behaviours or waste management, with limited understanding of how contextual and organisational factors shape sustainability in ICUs.
- What This Paper Adds
 - Reveals that nurses' discourses on environmental sustainability differ across ICU contexts, reflecting distinct cultural and organisational configurations.
 - Identifies four discursive profiles: collective ecological responsibility, institutional coordination, operational strain and pragmatic waste reduction, each tied to specific ICU dynamics.
 - Demonstrates how sustainability in critical care evolves from individual awareness to structured institutional integration, highlighting the need for context-sensitive educational and policy interventions

1 | Introduction

The healthcare sector is responsible for almost 5% of global greenhouse gas (GHG) emissions, a share that would rank it among the top five emitting nations worldwide [1, 2]. Intensive care units (ICUs) are among the most resource-intensive departments in hospitals due to their high levels of energy use, resource consumption and medical waste [3]. Indeed, ICUs have been shown to generate 1.3 times more waste and 3.1 times more GHG emissions than conventional hospital wards [3]. Evidence highlights the considerable environmental toll of ICUs but also points to opportunities for improvement. Variability across countries and clinical practices [4] suggests that targeted institutional or provider-level changes could help reduce healthcare-related GHG emissions [5].

ICU nurses comprise a large proportion of the ICU workforce; therefore, nurse involvement is crucial to reducing the environmental footprint of ICUs [6]. Their close proximity to patients and integral role in healthcare operations positions them uniquely to advocate for and implement eco-friendly practices, embedding sustainability into the very fabric of healthcare [7]. For instance, effective waste management and energy-efficient practices not only mitigate environmental harm but also have the potential to reduce hospital-acquired infections and lower healthcare costs, illustrating the dual benefits of eco-conscious nursing [8].

The variability across ICUs highlights the need to consider clinical context as a central factor, rather than a simple backdrop, in understanding how nurses interpret and integrate sustainability into practice. These differences suggest that the conceptualisation and

enactment of sustainable practices may be mediated by the specific clinical setting, influencing whether such practices are adopted, adapted or resisted [9, 10]. Although comparative data remain limited, existing research on material flows and team dynamics suggests that local procedural norms and perceived clinical risks are key determinants in the uptake of sustainability initiatives [11, 12]. However, given the variability in ICU clinical priorities and workflows, it remains unclear whether and how nurses' conceptualisations of sustainability differ across settings, representing a critical knowledge gap [13]. Understanding these differences is essential to designing sustainability initiatives that are contextually feasible, culturally aligned and more likely to be adopted at the bedside [14].

Bartoli et al. [15] conducted a qualitative content analysis exploring how ICU nurses conceive and enact sustainability. Their findings highlight that sustainability in critical care cannot be advanced solely through institutional directives but requires active interpretation and engagement by nurses within their clinical context. They underscore the need to foster team-wide awareness of environmentally sustainable behaviours so that such practices become an integral part of intensive care rather than the initiative of only a few environmentally conscious individuals. Aligning nurses' sustainability values with existing ICU structures thus emerges as a prerequisite for translating institutional objectives into everyday practice.

To address this gap, we applied automatic analysis of textual data (AATD), a novel approach that combines qualitative depth with quantitative rigour. Unlike traditional manual analysis, AATD can reveal linguistic patterns, thematic clusters and conceptual relationships that might otherwise remain hidden [16]. This method has been increasingly adopted in nursing research [17–21] and offers particular advantages for comparing how attitudes and behaviours differ across diverse ICU settings.

The aim of this study is to examine whether intensive care nurses' reported experiences of sustainable clinical practices are influenced by the specific care setting in which they are employed, by leveraging AATD to cluster and compare interview data statistically. By quantifying textual themes and grouping related expressions, AATD enhances rigour and overcomes variability in human interpretation, and here it will support more objective and reproducible insights into how context shapes sustainability attitudes in critical care.

2 | Aim and Objectives of the Study

2.1 | Aim

To explore how intensive care nurses frame, understand and integrate environmental sustainability within their clinical practice across different ICU settings.

2.2 | Objectives

1. To identify the main discursive profiles of environmental sustainability emerging from nurses' accounts across Trauma, General, Cardiac and Surgical ICUs.

2. To examine how contextual, organisational and operational factors shape nurses' representations and practices of sustainability.
3. To uncover the latent semantic dimensions that differentiate sustainability discourses across intensive care contexts.

3 | Design and Methods

The study was reported following the Standards for Reporting Qualitative Research (SRQR) [22] to ensure methodological transparency and completeness.

This study adopted a qualitative exploratory design to investigate how intensive care nurses conceptualise and experience environmental sustainability in their daily clinical practice. Data were collected through semi-structured face-to-face interviews, allowing for an in-depth understanding of individual perceptions and professional interpretations. The study was grounded in a constructivist–interpretivist paradigm consistent with the hermeneutic principles guiding meaning reconstruction. This philosophical orientation recognises that meanings are co-constructed through interaction between participants and researchers, aligning with the study's focus on how contextual and cultural factors shape nurses' understanding of sustainability [23].

The textual corpus was analysed using Automatic Analysis of Textual Data (AATD) [24] according to the methodological framework of Exploratory Multidimensional Data Analysis (EMDA) [25]. EMDA is a hybrid analytical approach that combines the interpretative richness of qualitative research with the mathematical modelling typical of multivariate statistics [26]. It enables the identification of deep semantic patterns and discursive regularities within large textual corpora, allowing for a multidimensional exploration of how meanings are socially constructed. Within this paradigm, correspondence analysis (CA) plays a key role in uncovering latent semantic dimensions, moving beyond surface-level statistics to reveal the underlying discursive logics through which complex constructs are represented and negotiated [16]. The study followed the Consolidated Criteria for Reporting Qualitative Research (COREQ) to ensure methodological rigour, transparency and completeness throughout the research process [27].

4 | Setting and Sample

Participants were recruited from three Italian hospitals located in northern and southern Rome and in Salerno, encompassing Trauma Intensive Care Unit (TICU), General Intensive Care Unit (ICU), Cardiac Intensive Care Unit (CICU) and General Surgery Intensive Care Unit (GSICU). A purposive sampling strategy was employed to ensure a representative cohort of ICU nurses. The selection followed the logic of information-rich cases [28], recruiting participants capable of providing in-depth reflections on environmental sustainability within their professional context, while also incorporating a maximum variation approach to capture discursive differences across diverse ICU types (Trauma, General, Cardiac and Surgical). Recruitment was conducted over 2 months (May–June 2024) and continued until data saturation was reached, defined as

the absence of new categories or insights in subsequent interviews. Eligible participants were ICU nurses with a minimum of 1 year of experience. Participation was voluntary, and all critical care nurses who completed the full enrolment process were included in the study.

5 | Data Collection Tools and Methods

Nurses were asked to reflect freely on the meaning of environmental sustainability in their everyday practice, using an open-ended question to encourage in-depth narrative responses ('What does environmental sustainability mean for you as an intensive care nurse?'). The interview guide was developed based on existing literature and reviewed by two qualitative research experts to ensure content relevance and methodological consistency. All interviews were video recorded and lasted between 17 and 45 min. They were conducted via online platforms (WhatsApp or Google Meet), according to participants' preferences and time availability. All interviews and written reflections were conducted in Italian, the participants' native language, to ensure clarity, emotional accessibility and cultural congruence [29] and subsequently translated into English by a professional native speaker with expertise in medical translation, who was blinded to the original version. The use of the mother tongue, combined with an empathetic and non-directive facilitation style, fostered a psychologically safe environment in which participants felt heard and respected [30].

Data collection continued until data saturation was reached, defined as the point at which no new semantic categories or discursive patterns emerged from the interview material [31]. In addition to the narrative data, a short questionnaire was administered to collect sociodemographic and professional characteristics.

6 | Data Analysis

The textual data were analysed using Correspondence Analysis (CA), a multivariate statistical method within the framework of Exploratory Multidimensional Data Analysis (EMDA). CA is designed to explore associations between categorical variables and lexical patterns, enabling researchers to visualise how discourse varies across distinct social or institutional groups. In this study, the analysis aimed to identify how representations of environmental sustainability differed among nurses working in four distinct clinical settings: Trauma Intensive Care Unit (TICU), General Intensive Care Unit (ICU), Cardiac Intensive Care Unit (CICU) and General Surgery Intensive Care Unit (GSICU). The analysis followed Fraire's seven-step model for AATD, combining the interpretative logic of qualitative research with the statistical robustness of textual data modelling.

First, interviews were translated into English, verified for accuracy and organised into segments (where each segment corresponds to a single interview) and tagged with metadata indicating the clinical setting of the speaker (e.g., *SETTING = ICU*), allowing the comparison of discursive features across groups ([Supporting Information](#)). The corpus was

then processed using IRaMuTeQ (version 0.7 alpha 2). A contingency matrix was generated by crossing active lexical forms (nouns, adjectives, verbs and adverbs) with the metadata variable 'SETTING'. Lexical richness and internal consistency of the corpus were evaluated according to established thresholds: a sufficiently large number of words (over 25 000), a balanced variety of vocabulary (type-token ratio < 20%), and limited use of extremely rare words (hapax rate < 50). These checks confirmed that the data were suitable for robust statistical analysis.

A chi-squared test was applied to detect significant associations between lexical items and specific clinical settings. The results were plotted on a factorial map, which positioned both words and groups within a shared two-dimensional semantic space. The relative proximity of terms to clinical units indicates the degree of association between specific lexical patterns and work environments. A distinctive strength of CA within the EMDA paradigm is its capacity to extract latent semantic dimensions (the factorial axes) which reveal the underlying structure of discourse. These axes are not predefined but empirically derived from the data, emerging from patterns of co-occurrence between lexical items and categorical variables. In line with the hermeneutic foundations of qualitative research, each axis represents a latent semantic dimension that reflects how participants construct meaning around sustainability. Rather than imposing categories a priori, the factorial structure arises inductively from the discourse itself, allowing researchers to interpret the deep narrative logics that differentiate professional perspectives across settings. Final outputs included graphical visualisations of the factorial space, chi-squared contributions and variance statistics, providing a comprehensive picture of how sustainability is constructed differently across ICU work environments.

7 | Rigour

To ensure the trustworthiness of the findings, this study followed Lincoln and Guba's framework for qualitative rigour, addressing credibility, dependability, transferability and confirmability [32].

Credibility was reinforced through member checking [28], triangulation [33] and methodological transparency [27]. Member checking was conducted with selected participants, who reviewed key thematic interpretations to verify their resonance with lived experience. Investigator triangulation involved multiple researchers independently reviewing and discussing the coding process and interpretative decisions, enhancing analytical reflexivity and minimising bias. Bracketing was conducted prior to data collection, allowing researchers to reflect on and suspend their preconceptions about environmental sustainability, thus minimising interpretive bias during the interviews and preserving the authenticity of participants' perspectives [34]. The research team included a male intensive care nurse who was also a PhD student during data collection and had hands-on ICU experience. This dual role as practitioner and researcher enabled a nuanced comprehension of ICU dynamics and offered an academic perspective to explore sustainability in clinical practice, enriching the interpretation of participants' accounts. Although there was no prior professional relationship with the participants, they were informed about the researcher's background, the study objectives and his interest in

understanding how nurses integrate environmental sustainability into their daily practice. This professional background supported informed interpretation of the data while also requiring conscious reflexivity to prevent assumptions based on prior knowledge. Throughout the analytic process, researchers maintained reflective memos and engaged in regular debriefing sessions to critically examine how their professional perspectives might shape data interpretation and theme development.

Although only one core statistical technique (CA) was applied, its integration within the Exploratory Multidimensional Data Analysis (EMDA) framework enabled a multi-perspective reconstruction of meaning grounded in both lexical frequency and spatial association.

Dependability was ensured through a transparent and replicable analytical process based on Fraire's seven-step model for AATD and implemented using IRaMuTeQ (version 0.7 alpha 2). Corpus reliability was validated against key statistical thresholds (word count > 25 000, type-token ratio < 20%, hapax rate < 50%), ensuring the robustness of results. Moreover, the use of dedicated software and multidimensional statistical techniques supported the reduction of researcher-induced bias by automating lexical clustering and association detection. However, interpretation remained a central phase of the analysis: the extraction of latent dimensions required theoretical sensitivity and epistemological positioning [23]. This dual structure (statistical modelling coupled with human interpretation) preserves the foundational tenets of qualitative inquiry, wherein the researcher acts not as a neutral processor but as a meaning-maker engaged in the construction of situated knowledge. Confirmability was achieved by anchoring all interpretive claims in the statistical evidence produced through CA. Term contributions, association strengths and spatial proximities within the factorial space were used to support the formulation of semantic dimensions. Transferability was addressed by detailed reporting of corpus structure, metadata configuration and discursive variations across clinical settings, allowing readers to assess relevance to their professional contexts.

8 | Ethical and Institutional Approvals

The study protocol was approved by the local Ethics Committee "Campania Sud" (protocol n. 124_r.p.s.o.), 31 May 2023 and conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants. Confidentiality and anonymity were strictly maintained, with data managed in compliance with current data protection regulations and good clinical practice standards. To protect privacy, all data were anonymised and assigned alphanumeric codes. Participants consented to the use of their data exclusively for research purposes.

9 | Findings

9.1 | Sample Characteristics

The study sample consisted of 29 intensive care nurses employed in hospitals across Central and Southern Italy. The mean age was 36.9 years, with a slight predominance of male participants (51.7%). The mean total length of professional service

was 12.6 years (SD=8.18), of which an average of 8.38 years (SD=7.20) was spent working in ICUs. Participants were distributed across Trauma Intensive Care Unit (TICU) ($n=8$), General Intensive Care Unit (ICU) ($n=8$), Cardiac Intensive Care Unit (CICU) ($n=6$) and General Surgery Intensive Care Unit (GSICU) ($n=7$). Additional demographic and professional characteristics are presented in Table 1.

9.2 | Corpus Description

To assess the suitability of the textual corpus for multivariate analysis, a lexical profiling was conducted. The corpus consists of 29 texts, yielding a total of 25 550 word occurrences, which refer to the total number of tokens (i.e., all words appearing in the corpus, including repetitions). A total of 2171 unique forms (i.e., distinct word types) were identified. Of these, 852 are hapax legomena, meaning they occur only once in the entire corpus. This corresponds to 33.3% of the total occurrences and 39.24% of all unique forms. While a high number of hapax legomena is typical in natural language corpora, it is essential to verify lexical saturation to ensure the robustness of statistical modelling. The type-token ratio (TTR), calculated as the number of unique forms divided by the total number of occurrences (2171/25 550), is 0.085. This value indicates a lexical density appropriate for correspondence analysis, as TTR values between 0.08 and 0.20 are generally considered optimal in AATD, reflecting both semantic richness and internal redundancy [24]. These metrics confirm that the corpus is lexically balanced and statistically adequate for CA, providing a reliable basis for the extraction of latent semantic dimensions and discursive differentiation across clinical settings (Table 2).

10 | Correspondence Analysis

The correspondence analysis (CA) conducted on the textual corpus revealed distinct discursive orientations among intensive care nurses from different clinical units regarding the meaning and implementation of environmental sustainability. The factorial maps (Figures 1 and 2) illustrate how lexical forms were distributed across four units: Trauma Intensive Care Unit (TICU—purple), General Intensive Care Unit (ICU—light blue), Cardiac Intensive Care Unit (CICU—red) and General Surgery Intensive Care Unit (GSICU—green). Table S1 further reports the lexical profiles of participants in relation to the categorical variable of clinical unit, highlighting the discursive specificities associated with each setting.

10.1 | Trauma Intensive Care Unit (TICU—Purple): “Resource-conscious care & collective design”

TICU professionals emphasise vocabulary related to waste management and sustainable practices, such as *disposable*, *reuse*, *separate*, *package*, *collective*, *individual*, *design*, *equipment*, *water* and *recently*. This lexicon reflects a dual orientation: the urgency of hygiene and safety (as conveyed by *disposable*) is tempered by an emerging ecological awareness (*reuse*, *separate*). The simultaneous presence of collective and individual

points to a shared responsibility paradigm: sustainability is enacted both through coordinated group efforts and personal accountability. Mentions of *water* and *recently* suggest a transitional phase, where ecological awareness is still consolidating but already generating procedural shifts. The group's location in the upper-right quadrant reveals a combination of promotional engagement and sustainable technical practices, highlighting a proactive but still evolving environmental discourse.

10.2 | Intensive Care Unit (ICU—Light Blue): ‘Structured sustainability and institutional engagement’

In the general ICU, the discourse is marked by system-oriented terms including *segregation*, *workplace*, *include*, *system*, *practice*, *sustainable*, *resource*, *initiative*, *encourage*, *waste*, *manage*, *management* and *colleague*. These words reflect the need for structured integration of sustainability into organisational routines. The presence of *initiative* and *encourage* indicates the need for both top-down and bottom-up efforts, suggesting that environmental sustainability is no longer aspirational but integrated into the workflow. The focus is on formalised waste management, staff engagement and strategic resource allocation. Positioned in the upper-left quadrant, this group illustrates a technically mature and institutionally embedded vision of sustainability, where environmental practices are no longer peripheral but normalised.

10.3 | Cardiac Intensive Care Unit (CICU—Red): ‘Environmental stressors and operational gaps’

CICU discourse is defined by terms such as *operator*, *company*, *well-being*, *bottle*, *sound*, *alarm*, *problem*, *drug*, *attention*, *noise*, *lack*, *pollution*, *safety*, *device*, *turn*, *topic* and *awareness*. The lexicon reflects a highly technologised and stressful environment where sustainability is perceived but difficult to enact. Frequent references to *noise*, *alarm* and *pollution* point to environmental burdens, while terms like *lack* and *problem* highlight systemic and procedural barriers. Despite the presence of *awareness* and *topic*, the implementation of sustainable practices remains fragmented. This cluster's lower-left placement corresponds to operational overload and limited institutional support for ecological change.

10.4 | General Surgery Intensive Care Unit (GSICU—Green): Pragmatic Sustainability and Waste Optimisation

The GSICU's discourse centres on practical sustainability strategies, marked by terms like *station*, *improve*, *temperature*, *risk*, *promote*, *container*, *plastic*, *room*, *environmental*, *reduce*, *sort*, *throw*, *impact*, *infection*, *opinion* and *recycle*. The emphasis is on tangible behaviours, such as sorting waste, optimising temperature control and reducing plastic consumption, all integrated with infection prevention protocols. Terms like *opinion* and *promote* suggest staff engagement and attitude shaping. Located in the lower-right quadrant, this group combines behavioural pragmatism with operational efficiency, indicating that sustainability is translated into daily clinical routines.

TABLE 1 | Socio-demographic characteristics of participants ($n = 29$).

ID	Age	Gender	Professional position	Length of service	Length of service in ICU	Clinical setting	Hospital
X1	33	M	RN	10	6	ICU	University Hospital in North of Rome
X2	27	M	RN	4	2	GSICU	Hospital in South of Rome
X3	32	M	RN	8	7	CICU	Hospital in South of Rome
X4	45	M	RN	23	8	TICU	Hospital in South of Rome
X5	30	F	RN	7	5	TICU	Hospital in South of Rome
X6	33	M	RN	9	4	CICU	Hospital in South of Rome
X7	29	F	RN	8	3	ICU	Hospital in South of Rome
X8	39	M	RN	5	3	ICU	University Hospital in North of Rome
X9	29	F	RN	3, 5	3,5	CICU	Hospital in South of Rome
X10	38	F	RN	15	15	CICU	University Hospital in Salerno
X11	38	F	RN	17	7, 5	CICU	Hospital in South of Rome
X12	43	M	RN	20	20	ICU	Hospital in South of Rome
X13	39	M	RN	14	7	TICU	Hospital in South of Rome
X14	50	M	RN	29	25	ICU	Hospital in South of Rome
X15	35	F	RN	8	4	ICU	Hospital in South of Rome
X16	32	M	RN	8	4	TICU	Hospital in South of Rome
X17	47	F	RN	20	6	GSICU	University Hospital in North of Rome
X18	51	M	RN	27	21	TICU	Hospital in South of Rome
X19	53	F	WM	31	24	TICU	Hospital in South of Rome
X20	38	F	RN	16	6	GSICU	University Hospital in North of Rome
X21	29	F	RN	5	4	ICU	Hospital in South of Rome
X22	43	M	RN	17	17	GSICU	University Hospital in North of Rome
X23	32	F	RN	7	2	GSICU	University Hospital in North of Rome
X24	47	F	RN	23	19	GSICU	University Hospital in North of Rome
X25	29	F	RN	5	1	ICU	Hospital in South of Rome
X26	27	F	RN	5	3	GSICU	University Hospital in North of Rome
X27	32	M	RN	9	9	TICU	Hospital in South of Rome
X28	33	M	RN	9	5	TICU	Hospital in South of Rome
X29	38	M	RN	3	2	CICU	University Hospital in Salerno

Note: This table presents participants' age, gender, professional position and years of service both overall and within intensive care, categorised by clinical setting and hospital type.

Abbreviations: CICU, cardiac intensive care unit; F, female; GSICU, general surgery intensive care unit; ICU, intensive care unit; M, male; RN, registered nurse; TICU, trauma intensive care unit; WM, ward manager.

The main lexical clusters identified through correspondence analysis are summarised in Table 3.

10.5 | Latent Dimensions

Beyond the identification of thematic clusters, the factorial space revealed two latent dimensions that structure the underlying discursive patterns.

TABLE 2 | Corpus description.

Number of texts	29
Number of occurrences	25 550
Number of forms	2171
Number of hapax	852 (33.3% of occurrences–39.24 of forms)
Mean of occurrences per text	881.30

Note: Lexical composition of the textual corpus analysed through Automatic Analysis of Textual Data (AATD), including total word occurrences, unique forms, hapax legomena and lexical richness indices confirming the adequacy of the corpus for multivariate analysis.

10.6 | Factor 1: From Cultural Promotion to Institutional Coordination

The first axis (horizontal, 40.8% of variance) contrasts a promotional and cultural engagement approach (left semiaxis), centred on individual and collective awareness and procedural adaptation, with an efficient managerial model (right semiaxis), grounded in operational systems, resource optimisation and institutional integration. This dimension reflects a continuum from behavioural and motivational discourse to structural and organisational sustainability practices. On the left semiaxis, represented by the Trauma Intensive Care Unit (TICU), the vocabulary emphasises the emergence of sustainability as a shared cultural value. Terms such as collective, individual, design, reuse and recently reflect a participatory and reflexive engagement with sustainability, often driven by personal initiative and team awareness. This lexicon suggests a culturally negotiated approach to ecological practices, where environmental concerns are integrated into care through collaborative effort and evolving habits. On the right end, mainly covered by General ICU (ICU) and the General Surgery ICU (GSICU), the lexicon becomes more system-oriented, featuring terms like system, practice, initiative, management, resource, recycle and equipment. Here, sustainability is embedded in institutional structures and operational

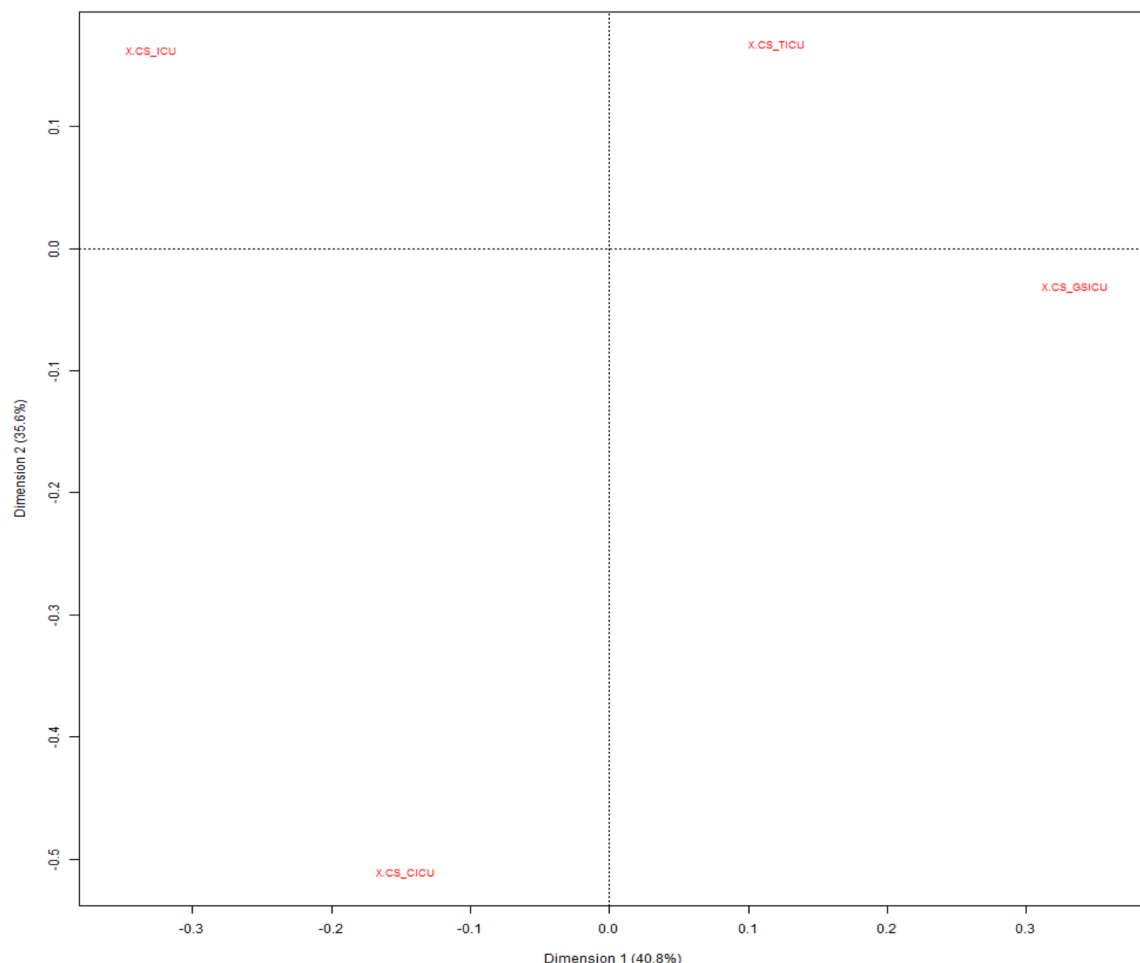


FIGURE 1 | Correspondence Analysis factorial map of clinical settings. The plot displays the spatial distribution of intensive care settings along the first two latent dimensions of the Correspondence Analysis. Each point represents a specific clinical setting (ICU, CICU, TICU, GSICU); distances between points indicate differences in their associated lexical profiles.

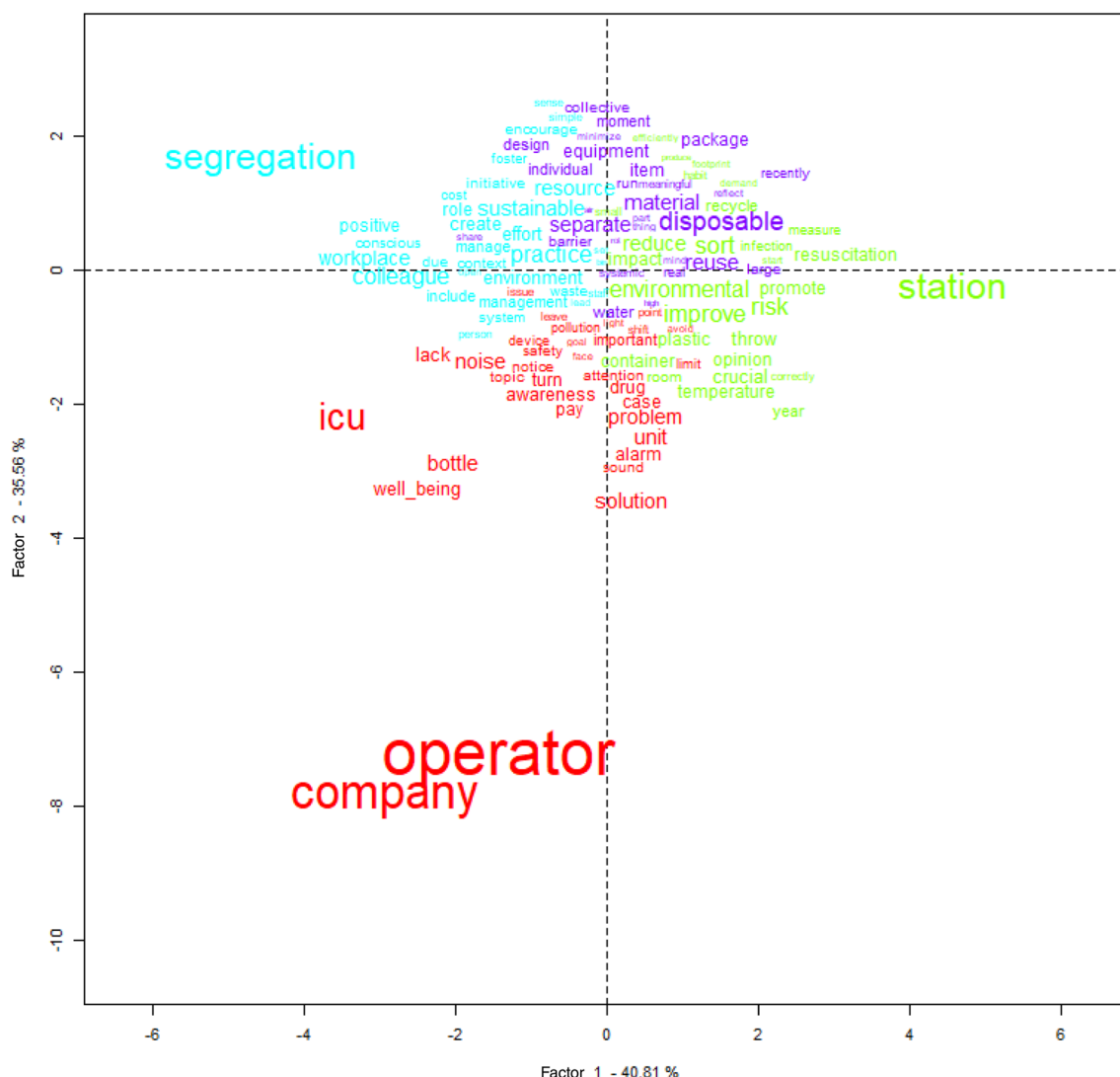


FIGURE 2 | Correspondence Analysis factorial map of environmental sustainability discourses across intensive care units. The factorial map displays the distribution of lexical forms associated with environmental sustainability across four intensive care settings: Trauma Intensive Care Unit (TICU, purple), General Intensive Care Unit (ICU, light blue), Cardiac Intensive Care Unit (CICU, red), and General Surgery Intensive Care Unit (GSICU, green). Factor 1 (horizontal axis, 40.8% of variance) represents a continuum from cultural promotion and awareness-driven engagement with sustainability (left side), based on collective responsibility and emerging practices, to institutional coordination and managerial integration (right side), characterized by structured systems, resource optimization, and formalized procedures. Factor 2 (vertical axis, 35.6% of variance) contrasts technical integration and proactive implementation of sustainable practices (upper side) with operational strain and fragmented enactment (lower side), where environmental awareness is constrained by workload, technological burden, and organizational barriers. Word proximity and size reflect the strength of association with each factorial dimension and clinical context.

frameworks. It is no longer an emergent practice but a regulated process supported by standard operating procedures and organised resource management systems. This polarity reflects a shift from cultural emergence to procedural codification of sustainability efforts. This dimension thus captures the transition from a promotional, awareness-driven phase to one of operational maturity and structured integration within hospital units.

10.7 | Factor 2: From Technical Integration to Operational Strain

The second axis (vertical, 35.6% of variance) distinguishes between a complete technical engagement (upper semi-axis), characterised

by proactive implementation of eco-sustainable procedures and conscious staff participation, and an incomplete or fragmented operational technicality (lower semi-axis), where environmental awareness exists but is hindered by systemic stressors, lack of protocols and procedural overload. The upper section of the factorial space includes the TICU and ICU, where sustainability is linguistically connected to notions of efficiency, environmental control and procedural inclusion. Terms such as equipment, water, segregation, initiative and sustainable suggest a level of technical alignment, where sustainability measures are embedded in daily routines and supported by both resources and staff engagement. Conversely, the lower section, predominantly occupied by the Cardiac Intensive Care Unit (CICU), reflects a more fragmented and challenged representation of sustainability. Here, the

TABLE 3 | Discursive profiles of environmental sustainability across clinical units.

Clinical unit	Cluster theme	Key words	Representation of sustainability
TICU (purple)	Resource-conscious care and collective design	<i>Disposable, reuse, separate, package, equipment, collective, design, water, individual</i>	Sustainability as a developing practice shaped by shared responsibility, ecological awareness and hygiene concerns
ICU (light blue)	Structured sustainability and Institutional Engagement	<i>Segregation, system, initiative, encourage, management, practice, resource, colleague</i>	Sustainability as an integrated component of organisational routines, supported by institutional policies and team dynamics
CICU (red)	Environmental stressors and operational gaps	<i>Operator, company, alarm, noise, pollution, problem, lack, device, safety, awareness</i>	Sustainability hindered by clinical overload, environmental strain and lack of structured procedures
GSICU (green)	Pragmatic sustainability and waste optimisation	<i>Plastic, container, room, recycle, reduce, impact, infection, station, opinion, promote</i>	Sustainability as a set of practical, visible actions tied to safety, waste management and behavioural routines

Note: Lexical clusters and thematic representations of sustainability identified through correspondence analysis (CA), showing how sustainability discourses vary across Trauma, General, Cardiac and General Surgery ICUs. This table summarizes the main discursive profiles of environmental sustainability emerging from the Correspondence Analysis across different intensive care settings. Colors identify the clinical units consistently represented throughout the study: purple = Trauma Intensive Care Unit (TICU); light blue = General Intensive Care Unit (ICU); red = Cardiac Intensive Care Unit (CICU); green = General Surgery Intensive Care Unit (GSICU). For each setting, the table reports the dominant cluster theme, the most characteristic lexical items, and the corresponding interpretative representation of sustainability.

vocabulary includes noise, alarm, problem, lack, pollution, safety and device, indicating a context of operational burden and heightened environmental stress. These terms highlight issues such as excessive auditory stimuli, inadequate waste protocols and the difficulty of implementing sustainable behaviours in high-pressure clinical environments. Although awareness and attention are present, they are often dissociated from consistent practice, suggesting a disconnect between intention and implementation.

These latent axes not only structure the factorial space statistically but also represent interpretative dimensions that reflect how sustainability is imagined, operationalised or hindered across different intensive care settings. Their emergence through Correspondence Analysis allows for a multidimensional reconstruction of meaning that aligns with the hermeneutic premises of the EMDA framework: meaning is not only derived from lexical frequency but from the relational positions and oppositions that define a discursive field. In this sense, each clinical setting is situated not just spatially, but epistemologically, reflecting how sustainability is embedded (or not) within its organisational culture, professional routines and systemic structures.

The two latent dimensions identified through correspondence analysis are summarised in Table 4.

11 | Discussion

This study contributes to advancing the debate on environmental sustainability in intensive care by demonstrating that nurses' discourses are not uniform across settings but reflect the organisational structures, cultural orientations and clinical priorities specific to each unit. At the same time, these discourses may also be shaped by individual nurses' personal views and interpretations of sustainable practice, adding an additional layer of

subjective meaning to their accounts. While most prior work has considered sustainability in healthcare as a relatively universal concept, our findings reveal that its conceptualisation and enactment in practice are deeply contextual. This insight challenges the notion that top-down sustainability policies can be equally effective across different ICUs and instead suggests that context-sensitive strategies are essential [12, 35].

Nurses in these units described sustainability primarily in terms of responsibility, team engagement and awareness of resource use, but without consistent reference to formalised routines. This discourse raises the issue of whether cultural commitment is sufficient to sustain long-term ecological practices. The literature on organisational change suggests that awareness and motivation are necessary but not sufficient; without institutional reinforcement and managerial support, there is a high risk of reversion to established routines [11, 36]. The challenge, therefore, lies in transforming emerging cultural values into structured practices that can survive beyond individual enthusiasm or isolated initiatives.

By contrast, General ICUs revealed a more institutionalised conceptualisation of sustainability. Nurses framed ecological practices as embedded within existing governance systems, audits and organisational procedures. This discourse suggests that sustainability is not perceived as an add-on but as part of the formal structure of care, aligned with broader objectives of safety and efficiency. In addition to these organisational influences, nurses' engagement with sustainable practices may also be shaped by their prior educational preparation, which can affect both their awareness and their perceived competence in integrating ecological behaviours into daily care [37, 38]. This finding underscores how sustainability can become embedded within everyday professional routines when reinforced by institutional frameworks and a supportive organisational

TABLE 4 | Latent semantic dimensions.

Factor	Interpretation	Semantic poles
Factor 1 (40.8)	Cultural promotion vs. institutional coordination	Left pole: Sustainability is understood as a shared cultural value, driven by individual and team awareness, informal reflection and voluntary behaviours. Right pole: Sustainability is embedded within organisational structures, supported by protocols, managerial strategies and formal resource optimisation systems.
Factor 2	Technical integration vs. operational strain	Upper pole: sustainability is operationalised through proactive eco-compatible practices and supported by staff engagement, technical alignment and efficient routines. Lower pole: although environmental awareness exists, implementation is hindered by systemic stressors, lack of protocols and procedural overload.

Note: Interpretation of the two main factorial dimensions derived from correspondence analysis, representing the transition from cultural promotion to institutional coordination and from technical integration to operational strain.

culture [14, 39]. However, the extent to which these actions can be operationalised depends on organisational managers' readiness to engage with the literature and guidance provided. Current evidence indicates that this engagement remains in its early stages and is vulnerable to fluctuations in organisational capacity. Periods of heightened workload, staffing shortages or systemic strain may reduce managers' ability to prioritise environmental sustainability initiatives, thereby limiting the translation of recommended practices into daily operations [35, 39, 40]. At the same time, this institutionalisation risks turning sustainability into a compliance-oriented process rather than a value-driven endeavour [40]. A critical question is whether formalisation enhances or stifles innovation: while protocols provide stability, they may also narrow opportunities for frontline creativity [8].

The discourse of Cardiac ICUs, however, illuminates a more problematic scenario. Nurses expressed strong awareness of

sustainability but highlighted systemic barriers that make enactment difficult, including technological dependency, alarm overload and high-intensity workflows. This tension is significant because it underscores that sustainability cannot be reduced to individual behaviour or professional values; instead, it must be understood as a systemic issue shaped by material infrastructures and workflow design [41]. The paradox here is that the very technological sophistication that defines Cardiac ICUs generates the ecological burden that undermines sustainability. Without redesigning processes, such as noise reduction strategies, smarter alarm management or device optimisation, sustainability risks become a moral burden imposed on nurses who have little control over structural conditions [5, 42]. This finding resonates with critiques of 'green individualism' in health care, which argue that ecological responsibility should not be shouldered by professionals alone but must be addressed through systemic interventions [43].

General Surgery ICUs demonstrated yet another approach, where sustainability was pragmatically integrated with infection prevention practices and waste reduction protocols. This linkage reflects a strategic coupling between ecological and safety imperatives. The advantage of such coupling is that it anchors sustainability in already recognised clinical priorities, thereby increasing feasibility and acceptance among staff [44]. Yet this pragmatic framing also poses risks: if sustainability is seen exclusively through the lens of infection prevention, broader ecological issues such as energy consumption, procurement practices or circular economy strategies may be marginalised [14]. Thus, while the pragmatic orientation of Surgical ICUs demonstrates the potential for rapid implementation, it also raises the question of whether sustainability is being reduced to narrow operational tasks rather than being embraced as a systemic value [13].

The two latent semantic dimensions identified through correspondence analysis, cultural promotion versus institutional coordination and integration versus operational strain, serve as interpretive axes through which the complexity of these findings can be understood. The first axis demonstrates that sustainability evolves from an emergent, value-driven phenomenon to a coordinated, policy-driven practice. This suggests that cultural awareness can serve as a catalyst, but institutionalisation is necessary for long-term sustainability [35]. The second axis, however, reveals that even where sustainability is formally embedded, it may still falter under conditions of operational strain. This tension between aspiration and feasibility is a key contribution of this study: it demonstrates that sustainability is not simply about awareness or governance, but about the degree to which ecological values are aligned with the lived realities of clinical work [16].

From a theoretical perspective, these findings support the idea that sustainability in healthcare is best understood as a 'negotiated practice' [23], where professional values, organisational constraints and material infrastructures intersect. This challenges simplistic narratives that frame sustainability as either a matter of individual responsibility or a matter of institutional policy [45]. Instead, it emerges as a relational construct, contingent on the interplay between bottom-up engagement and top-down structures [35]. This relational view aligns with broader critiques in nursing research that emphasise the need

to contextualise ecological responsibility within the socio-technical systems of health care [36].

Taken together, the findings call for a rethinking of how sustainability is promoted in intensive care. They suggest that success does not depend solely on awareness campaigns or institutional directives but on the capacity to design context-sensitive interventions that align ecological principles with the realities of each setting. The study demonstrates that sustainability can neither be imposed as a uniform standard nor left to individual goodwill: it requires a systemic, differentiated and negotiated approach that recognises the distinctive challenges and opportunities of each ICU type.

12 | Strengths and Limitations

This study presents several strengths. It offers an original framework for understanding how environmental sustainability is conceptualised in intensive care by explicitly situating it within the clinical context. While previous research often treated sustainability as a uniform construct, our findings show that professional discourses and practices differ systematically across ICU types, thus enhancing the contextual relevance of sustainability initiatives [14]. The methodological integration of Automatic Analysis of Textual Data (AATD) with correspondence analysis ensured transparency, reproducibility and interpretive depth [16]. This innovative approach generated empirically grounded insights and a conceptual map that can guide managers and educators in designing targeted sustainability strategies aligned with the organisational and cultural features of each ICU [35].

Nonetheless, some limitations should be acknowledged. Given the qualitative nature of this study, the findings are not generalisable beyond the specific sample investigated. The small size and uneven distribution of participants across ICU types may have influenced lexical associations. Furthermore, while the AATD approach minimises researcher bias, the interpretation of latent dimensions still involves subjective judgement. Future studies with larger and more diverse samples could enhance transferability and confirm the robustness of these findings.

13 | Implications for Practice and Further Research

This study contributes to clinical practice by identifying specific ecological nursing needs within intensive care. The findings indicate that nurses' ecological attitudes and behaviours are influenced by their clinical context, such as general, cardiac, trauma or surgical ICUs, showing that sustainability in critical care cannot be addressed through uniform strategies but requires setting-tailored approaches [14, 35]. These results underscore the need to design educational programmes that strengthen ecological awareness and promote behaviours consistent with the technical and cultural characteristics of each ICU [6, 36]. Future research should explore nurses' individual attitudes, knowledge and awareness to develop targeted educational interventions capable of fostering sustainable clinical behaviours and improving

ecological responsibility in patient and family care across diverse intensive care settings [10, 45].

14 | Conclusion

This study reveals that environmental sustainability in intensive care is not a single, universal construct but a multifaceted practice shaped by the cultural, organisational and technical realities of each ICU setting. Trauma units framed sustainability as a collective cultural value in progress; general ICUs embedded it in institutional systems; cardiac ICUs exposed the gap between awareness and feasibility; and surgical ICUs translated it into pragmatic, infection-focused actions.

By capturing these contextual nuances, the study underscores that ecological nursing must evolve through strategies tailored to each intensive care specialty rather than through uniform institutional policies. This contextual understanding defines new 'ecological nursing needs' within critical care and provides a foundation for developing education and leadership programs that integrate sustainability into the professional identity of nurses.

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Ethics Statement

This study was approved by the local Ethics Committee 'Campania Sud' (protocol no. 124_r.p.s.o.), 31 May 2023. All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are not publicly available due to privacy and ethical restrictions but are available from the corresponding author upon reasonable request.

References

1. M. J. Eckelman, K. Huang, R. Lagasse, E. Senay, R. Dubrow, and J. D. Sherman, "Health Care Pollution and Public Health Damage in the United States: An Update," *Health Affairs (Project Hope)* 39, no. 12 (2020): 2071–2079, <https://doi.org/10.1377/hlthaff.2020.01247>.
2. M. Lenzen, A. Malik, M. Li, et al., "The Environmental Footprint of Health Care: A Global Assessment," *Lancet. Planetary Health* 4, no. 7 (2020): e271–e279, [https://doi.org/10.1016/S2542-5196\(20\)30121-2](https://doi.org/10.1016/S2542-5196(20)30121-2).
3. P. A. Prasad, D. Joshi, J. Lighter, et al., "Environmental Footprint of Regular and Intensive Inpatient Care in a Large US Hospital,"

- International Journal of Life Cycle Assessment* 27, no. 1 (2022): 38–49, <https://doi.org/10.1007/s11367-021-01998-8>.
4. J. Nicolet, Y. Mueller, P. Paruta, J. Boucher, and N. Senn, “What Is the Carbon Footprint of Primary Care Practices? A Retrospective Life-Cycle Analysis in Switzerland,” *Environmental Health: A Global Access Science Source* 21, no. 1 (2022): 3, <https://doi.org/10.1186/s12940-021-00814-y>.
 5. A. S. Rabin, P. S. Lai, S. I. Maximous, and H. M. Shankar, “Reducing the Climate Impact of Critical Care,” *CHEST Critical Care* 2, no. 1 (2023): 100037, <https://doi.org/10.1016/j.chstcc.2023.100037>.
 6. E. Smale, H. Baid, M. Balan, et al., “The Green ICU: How to Interpret Green? A Multiple Perspective Approach,” *Critical Care* 29, no. 1 (2025): 80, <https://doi.org/10.1186/s13054-025-05316-8>.
 7. J. Kleber, “Environmental Stewardship: The Nurse’s Role in Sustainability,” *Clinical Journal of Oncology Nursing* 22, no. 3 (2018): 354–356, <https://doi.org/10.1188/18.CJON.354-356>.
 8. S. M. Lee and D. Lee, “Effective Medical Waste Management for Sustainable Green Healthcare,” *International Journal of Environmental Research and Public Health* 19, no. 1 (2022): 460, <https://doi.org/10.3390/ijerph19010460>.
 9. A. Anåker and M. Elf, “Sustainability in Nursing: A Concept Analysis,” *Scandinavian Journal of Caring Sciences* 28, no. 2 (2014): 381–389, <https://doi.org/10.1111/scs.12121>.
 10. J. P. Cruz, E. M. Balay-Odao, J. U. Almazan, et al., “Perspectives of Healthcare Practitioners on Environmental Sustainability in Healthcare: A Qualitative Study,” *Journal of Advanced Nursing* 81 (2024): 8300–8315, <https://doi.org/10.1111/jan.16327>.
 11. J. N. Ervin, J. M. Kahn, T. R. Cohen, and L. R. Weingart, “Teamwork in the Intensive Care Unit,” *American Psychologist* 73, no. 4 (2018): 468–477, <https://doi.org/10.1037/amp0000247>.
 12. N. Hunfeld, J. C. Diehl, M. Timmermann, et al., “Circular Material Flow in the Intensive Care Unit-Environmental Effects and Identification of Hotspots,” *Intensive Care Medicine* 49, no. 1 (2023): 65–74, <https://doi.org/10.1007/s00134-022-06940-6>.
 13. F. N. Masud, F. Sasangohar, I. Ratnani, et al., “Past, Present, and Future of Sustainable Intensive Care: Narrative Review and a Large Hospital System Experience,” *Critical Care (London, England)* 28, no. 1 (2024): 154, <https://doi.org/10.1186/s13054-024-04937-9>.
 14. H. Baid, J. Richardson, J. Scholes, and C. Hebron, “Sustainability in Critical Care Practice: A Grounded Theory Study,” *Nursing in Critical Care* 26, no. 1 (2021): 20–27, <https://doi.org/10.1111/nicc.12493>.
 15. D. Bartoli, F. Petrosino, L. Midolo, G. Pucciarelli, and F. Trotta, “Critical Care Nurses’ Experiences on Environmental Sustainability: A Qualitative Content Analysis,” *Intensive & Critical Care Nursing* 87 (2025): 103847, <https://doi.org/10.1016/j.iccn.2024.103847>.
 16. M. Figura, M. Fraire, A. Durante, et al., “New Frontiers for Qualitative Textual Data Analysis: A Multimethod Statistical Approach,” *European Journal of Cardiovascular Nursing* 22, no. 5 (2023): 547–551, <https://doi.org/10.1093/eurjcn/zvad021>.
 17. M. Figura, P. Arcadi, E. Vellone, et al., “Living in a Multicultural Context: Health and Integration From the Perspective of Undocumented Mediterranean Migrants, Residents, and Stakeholders in Italy. A Qualitative-Multimethod Study,” *Journal of Advanced Nursing* 80, no. 8 (2024): 3382–3394, <https://doi.org/10.1111/jan.16036>.
 18. R. Grout, R. Gupta, R. Bryant, et al., “Predicting Disease Onset From Electronic Health Records for Population Health Management: A Scalable and Explainable Deep Learning Approach,” *Frontiers in Artificial Intelligence* 6 (2024): 1287541, <https://doi.org/10.3389/frai.2023.1287541>.
 19. L. Piervisani, A. Palombo, B. Albanesi, et al., “The Nurse in the Mirror: Image of the Female Nurse During the Italian Fascist Period,” *Journal of Advanced Nursing* 77, no. 2 (2021): 957–972, <https://doi.org/10.1111/jan.14679>.
 20. C. Rivas, D. Tkacz, L. Antao, et al., “Automated Analysis of Free-Text Comments and Dashboard Representations in Patient Experience Surveys: a Multimethod Co-Design Study,” *NIHR Journals Library* (2019).
 21. M. M. van Buchem, O. M. Neve, I. M. J. Kant, E. W. Steyerberg, H. Boosman, and E. F. Hensen, “Analyzing Patient Experiences Using Natural Language Processing: Development and Validation of the Artificial Intelligence Patient Reported Experience Measure (AI-PREM),” *BMC Medical Informatics and Decision Making* 22, no. 1 (2022): 183, <https://doi.org/10.1186/s12911-022-01923-5>.
 22. B. C. O’Brien, I. B. Harris, T. J. Beckman, D. A. Reed, and D. A. Cook, “Standards for Reporting Qualitative Research: A Synthesis of Recommendations,” *Academic Medicine: Journal of the Association of American Medical Colleges* 89, no. 9 (2014): 1245–1251, <https://doi.org/10.1097/ACM.0000000000000388>.
 23. H. Gadamer, “Classical and Philosophical Hermeneutics,” *Theory, Culture and Society* 23, no. 1 (2006): 29–56, <https://doi.org/10.1177/0263276406063228>.
 24. S. Bolasco, *L’analisi automatica dei testi. Fare ricerca con il Text Mining* (Carocci Editore, 2013).
 25. M. Fraire, “Statistical Methods for Exploratory Multidimensional Data Analysis on Time Use,” *Statistica* 69, no. 4 (2009): 317–341, <https://doi.org/10.6092/issn.1973-2201/3573>.
 26. M. Fraire, S. Spagnuolo, and S. Stasi, “L’Utilizzo dei Big Social Data per la Ricerca Sociale: Il Caso della Cittadinanza Attiva in Difesa del Territorio,” 2016, <http://digital.casalini.it/3145629>.
 27. A. Tong, P. Sainsbury, and J. Craig, “Consolidated Criteria for Reporting Qualitative Research (COREQ): A 32-Item Checklist for Interviews and Focus Groups,” *International Journal for Quality in Health Care* 19, no. 6 (2007): 349–357, <https://doi.org/10.1093/intqhc/mzm042>.
 28. M. Patton, *Qualitative Research and Evaluation Methods*, 4th ed. (Sage Publications, 2015).
 29. A. Cuoco, P. Arcadi, M. C. Figura, et al., “Designing and Conducting Qualitative Research Across Countries and Cultures: Challenges for Inclusiveness and Rigour,” *European Journal of Cardiovascular Nursing* 21, no. 8 (2022): 873–879, <https://doi.org/10.1093/eurjcn/zvac067>.
 30. M. Råheim, L. H. Magnussen, R. J. T. Sekse, Å. Lunde, T. Jacobsen, and A. Blystad, “Researcher–Researched Relationship in Qualitative Research: Shifts in Positions and Researcher Vulnerability,” *International Journal of Qualitative Studies on Health and Well-Being* 11, no. 1 (2016): 30996, <https://doi.org/10.3402/qhw.v11.30996>.
 31. G. Guest, E. Namey, and M. Chen, “A Simple Method to Assess and Report Thematic Saturation in Qualitative Research,” *PLoS One* 15, no. 5 (2020): e0232076, <https://doi.org/10.1371/journal.pone.0232076>.
 32. Y. S. Lincoln and E. G. Guba, “But Is It Rigorous? Trustworthiness and Authenticity in Naturalistic Evaluation,” *New Directions for Program Evaluation* 1986, no. 30 (1986): 73–84, <https://doi.org/10.1002/ev.1427>.
 33. N. Carter, D. Bryant-Lukosius, A. DiCenso, J. Blythe, and A. J. Neville, “The Use of Triangulation in Qualitative Research,” *Oncology Nursing Forum* 41, no. 5 (2014): 545–547, <https://doi.org/10.1188/14.Onf.545-547>.
 34. L. Tufford and P. Newman, “Bracketing in Qualitative Research,” *Qualitative Social Work* 11, no. 1 (2012): 80–96, <https://doi.org/10.1177/1473325010368316>.
 35. J. J. De Waele, N. Hunfeld, H. Baid, et al., “Environmental Sustainability in Intensive Care: The Path Forward. An ESICM Green Paper,” *Intensive Care Medicine* 50, no. 11 (2024): 1729–1739, <https://doi.org/10.1007/s00134-024-07662-7>.
 36. F. Mortimer, J. Isherwood, M. Pearce, C. Kenward, and E. Vaux, “Sustainability in Quality Improvement: Measuring Impact,” *Future*

Healthcare Journal 5, no. 2 (2018): 94–97, <https://doi.org/10.7861/futurehosp.5-2-94>.

37. J. Aronsson, M. Elf, P. Warwick, R. LoMartire, and A. Anåker, “The Relevance of Climate Change and Sustainability in Nursing Education: A Cross-Sectional Study of Students’ Perspectives,” *BMC Nursing* 24, no. 1 (2025): 834, <https://doi.org/10.1186/s12912-025-03285-5>.

38. D. S. Boakye, A. A. Kwashie, S. Adjorlolo, and K. A. Korsah, “Nursing Education for Sustainable Development: A Concept Analysis,” *Nursing Open* 11, no. 10 (2024): e70058, <https://doi.org/10.1002/nop2.70058>.

39. M. Bobini and A. Cicchetti, “Chasing Environmental Sustainability in Healthcare Organizations: Insights From the Italian Experience,” *BMC Health Services Research* 25, no. 1 (2025): 978, <https://doi.org/10.1186/s12913-025-13158-x>.

40. Y. Zuryski, K. Ludlow, L. Testa, et al., “Built to Last? Barriers and Facilitators of Healthcare Program Sustainability: A Systematic Integrative Review,” *Implementation Science* 18, no. 1 (2023): 62, <https://doi.org/10.1186/s13012-023-01315-x>.

41. P. Verdonck and I. Verniers, “Environmental Sustainability in Healthcare: Managerial Concerns and Solutions,” *Best Practice & Research. Clinical Anaesthesiology* 38, no. 4 (2024): 379–385, <https://doi.org/10.1016/j.bpa.2025.03.006>.

42. F. McGain, J. Muret, C. Lawson, and J. D. Sherman, “Environmental Sustainability in Anaesthesia and Critical Care,” *British Journal of Anaesthesia* 125, no. 5 (2020): 680–692, <https://doi.org/10.1016/j.bja.2020.06.055>.

43. S. G. Kuitert, A. Herrmann, M. Mertz, C. Quitmann, and S. Salloch, “Should Healthcare Professionals Include Aspects of Environmental Sustainability in Clinical Decision-Making? A Systematic Review of Reasons,” *BMC Medical Ethics* 26, no. 1 (2025): 78, <https://doi.org/10.1186/s12910-025-01230-4>.

44. J. D. Sherman, C. Thiel, A. MacNeill, et al., “The Green Print: Advancement of Environmental Sustainability in Healthcare,” *Resources Conservation and Recycling* 161 (2020): 104882, <https://doi.org/10.1016/j.resconrec.2020.104882>.

45. M. M. Shaban, M. A. Alanazi, H. H. Mohammed, et al., “Advancing Sustainable Healthcare: A Concept Analysis of Eco-Conscious Nursing Practices,” *BMC Nursing* 23, no. 1 (2024): 660, <https://doi.org/10.1186/s12912-024-02197-0>.

Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Lexical correspondence matrix showing standardised coordinates of active lemmas across four ICU settings (CICU, Cardiac Intensive Care Unit; GSICU, General Surgery Intensive Care Unit; ICU, General Intensive Care Unit; TICU, Trauma Intensive Care Unit). Positive and negative values indicate the relative strength and direction of association between lexical items and clinical contexts, as identified through Correspondence Analysis (CA) within the Exploratory Multidimensional Data Analysis (EMDA) framework. Higher absolute values denote stronger lexical contributions to the factorial dimensions illustrated in Figures 1 and 2.