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Original Article

Technostress among nursong staff in Intensive Care Units in three hospitals of the southern area of Madrid (Spain)

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ABSTRACT

Introduction. Intensive Care Units expose nursing staff to psychosocial risks derived from the intensive use of Information and Communication Technologies. Talking about this topic, technostress has been identified as an emerging issue. The objective was to assess the level of technostress experienced by nursing staff in the Intensive Care Units of three hospitals in the southern region of the Community of Madrid.

Methodos. A multicentre, observational, descriptive, and cross-sectional study was conducted during 2024-2025. The RED-Technostress questionnaire was used to measure NOT anxiety fatigue, scepticism, inefficacy, and addiction related to the use of Information and Communication Technologies.

Results. A total of 20,47% of the surveyed staff exhibited technostress, while 37,79% showed signs of techno-addiction. Differences were observed in the affective dimension based on gender, whereas age influenced both technostress and techno-addiction. Factors such as work experience, shift schedule, contract type, and working hours showed no significant association with technostress. Although prior training did not significantly impact overall technostress levels, it was associated with a reduction in fatigue.

Conclusions. The homogeneity of technostress levels across hospitals suggests that it is a common challenge within the healthcare sector, regardless of the specific characteristics of each institution.

Keywords: Information and Communication Technology; Intensive Care Unit; Nursing; Technostress.

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Introduction

Digital competence in the healthcare sector has gained increasing relevance with the integration of technologies such as telemedicine, electronic health records, and mobile health applications. While these advancements offer clear benefits, they also generate growing concerns among healthcare workers regarding their impact on day-to-day clinical practice (1–3).

Within this framework of digital transformation, the integration of Information and Communication Technologies (ICT) into healthcare workplaces has introduced new psychosocial risks, including technostress (1).

The European Agency for Safety and Health at Work (EU-OSHA) (4) identifies technostress as an emerging risk linked to ICT usage. This risk is exacerbated by tools such as corporate email, work-related WhatsApp groups, and the expectation of constant availability—especially in rotating shifts or temporary contracts. These factors contribute to a perceived obligation to remain continuously connected, negatively affecting worker well-being by blurring the boundaries between work and personal life (5).

Consequently, work-related stress has become a common occupational hazard that is now receiving more attention. This highlights the need for further research to properly identify and address the contributing factors of ICT-induced stress (6–7).

The Spanish Society of Health Informatics (SEIS), together with the Ministry of Health, emphasizes the importance of integrating ICT to enhance healthcare services and has committed to increasing training for all professionals within the National Health System (8). Based on their proposal, healthcare professionals must continually update their technical knowledge while coping with the demands of sophisticated digital systems (7).

American psychologist Craig Brod coined the term “technostress” in his 1984 book *Technostress: The Human Cost of the Computer Revolution*, defining it as “a modern disease of adaptation caused by an inability to cope healthily with new computer technologies” (9, p.16). He anticipated that this would especially affect workers whose jobs depend heavily on technology (10). Today, this health issue has intensified due to intergenerational coexistence in the workplace—between Generation X (who transitioned

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into the digital age in adulthood) and Millennials or Generation Y (digital natives) (11). In the healthcare field, this digital gap does not necessarily manifest in differences between junior and senior nurses, as the clinical environment can be equally challenging for professionals of all ages regardless of their familiarity with digital tools (12).

Recent studies have explored technostress in healthcare, revealing that health professionals are particularly vulnerable due to the constant interaction with ICT systems required for tasks such as using electronic medical records, monitors, telephones, ventilators, infusion pumps, and automated drug dispensers (3,13).

The use of these technologies to monitor, assess, and treat patients contributes to emotional exhaustion, stress, insomnia, and reduced job satisfaction. It also increases workload, a sense of insecurity, and difficulty unwinding after shifts—factors that can lead to absenteeism (1,5,14–18).

Among hospital departments, Intensive Care Units (ICUs) are considered one of the most stressful environments. This is due to their heavy use of advanced technology, exposure to critical situations, provision of specialized care, and daily interaction with distressed patients and families (19). ICUs often incorporate advanced alert systems, and nurses play a vital role in identifying and responding to these alerts. However, acoustic alarms—reaching up to 80 dB—can cause sensory overload and increase professional fatigue. As a coping strategy, some staff engage in risky behaviors such as raising alarm thresholds, temporarily silencing devices, or assuming alerts don't concern their assigned patient (20).

Technostress in ICUs poses a significant challenge for nurses, who often experience moderate levels of this phenomenon with implications for both performance and well-being (5,21). Reproted physical effects include headaches, sweating, muscular and gastrointestinal issues. Psychological symptoms range from anxiety and distress to depression and resistance to learning new technologies. Cases of depersonalization have also been documented (9,22). These impacts affect not only staff well-being but also job performance and healthcare delivery (22).

Mobile phone use in clinical environments deserves special attention due to its similar negative effects to other technologies. Frequent interactions with digital devices

can reduce focus and efficiency among healthcare professionals (23).

Several instruments have been developed to measure technostress, mostly in the U.S. These include the Computer Anxiety Rating Scale (CARS-C) (24), the Computer Thoughts Survey (CTS-C) (25), and the General Attitudes Toward Computer Scale (GATCS-C) (26), which respectively assess anxiety, thoughts, and attitudes related to technology (22). In Spain, the RED-Tecnoestrés questionnaire—developed by Llorens et al. at Jaume I University—has been validated and recommended by the National Institute for Occupational Safety and Health (INSHT) (22,27). This tool comprises 137 items across five domains, with a core section of 22 items designed to assess technostress experiences (Annex II).

The RED-Tecnoestrés questionnaire evaluates three core dimensions (28):

Affective dimension:

- *Anxiety:* Feelings of tension, fear, or insecurity when using workplace technology.
- *Fatigue:* Mental and physical exhaustion from prolonged ICT use.

Attitudinal dimension:

- *Skepticism: Negative attitudes or disinterest toward technology due to* perceived uselessness or burden.

Cognitive dimension:

- *Inefficacy: A sense of personal inadequacy in effectively managing technology.*

The authors also chose to measure *technology addiction* to deepen understanding of the phenomenon (Annex I).

Current legislation acknowledges the importance of aligning occupational risk training and assessments with technological advances. Spain's Law 31/1995 on Occupational Risk Prevention mandates specific training related to the risks arising from new technologies (29). Similarly, Royal Decree 39/1997 highlights the need to reevaluate occupational hazards when new technology is introduced (30).

Technological progress has improved efficiency in healthcare, enhancing diagnostics, time management, and clinical data handling (31). However, inadequate training, digital

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information overload, and pressure to keep up with constant changes contribute to psychological strain, potentially jeopardizing patient safety and care quality (5,12–13).

To mitigate these effects, experts recommend intuitive technologies with improved design and comprehensive training to reduce key sources of technostress: technoload (information overload), technoinvasion (always being connected), technouncertainty (rapid technological change), technocomplexity (perceived difficulty), and technoinsecurity (fear of job loss due to technology) (5).

On the other hand, strengthening "technostress inhibitors" such as organizational support, involvement in technology implementation, and effective communication, can foster better adaptation among nursing staff (12,22,27).

Research also indicates that individual personality traits significantly influence how technostress is experienced (22,27). This suggests the need for personalized strategies in technostress management.

Preventing psychosocial risks associated with digital demands in ICUs is essential. To address this challenge, it is vital to quantify technostress levels and implement preventive strategies that promote occupational well-being. Despite growing interest, technostress remains under-researched in the field of occupational health and safety (32).

In this context, occupational health nurses play a key role in fostering healthy work environments that ease the transition to new technologies. Their contributions include advocating for regular breaks, specific training in ICT use, peer support groups, and digital disconnection strategies. They also promote ergonomic practices and conduct ongoing monitoring of technostress levels to identify specific needs and support adaptation in the workplace (22).

Objectives

General Objective

To evaluate the level of technostress among nursing staff working in the Intensive Care Units of three hospitals in the southern area of the Community of Madrid, and its association with sociodemographic and work-related factors.

Specific Objectives

- To analyze differences in technostress based on sex.
- To analyze the presence of technostress in relation to age.
- To investigate the relationship between ICU work experience and technostress.
- To determine whether work shift is associated with the presence of technostress.
- To assess whether the type of employment contract influences the occurrence of technostress.
- To explore differences in technostress among workers with full-time or part-time schedules.
- To examine whether previous training conditions the presence of technostress.
- To determine whether there are differences in the level of technostress among the three hospitals.

Methods

Study design. Population.

Multicenter, observational, descriptive, and cross-sectional study. Conducted in three hospitals of the Community of Madrid between May 2024 and April 2025: University Hospital 12 de Octubre (H.U.12O), University Hospital of Getafe (H.U.G), and University Hospital of Móstoles (H.U.M).

Eligibility Criteria

Inclusion criteria. The study population consisted of nursing staff with a bachelor's or diploma degree working in the Intensive Care Units (ICUs) of the participating hospitals (Table 1).

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Table 1: Distribution of nursing staff by hospital

Work center	Number of workers
University Hospital 12 de octubre	**Module B:** 69 nurses
	Module C: 65 nurses
	Module D y UCITE: 68 nurses
University Hospital of Getafe	75 nurses
University Hospital of Móstoles	52 nurses

*UCITE: Trauma and Emergency Intensive Care Unit.

All members of the target population, comprising 329 nursing professionals, were invited to participate in the study. As this was a descriptive study and the entire accessible population was included, no prior sample size calculation was performed.

Exclusion criteria. Staff from the pediatric and neonatal ICU at H.U.12O were excluded based on the recommendation of the Occupational Health Service, due to work overload in a context of multiple ongoing changes.

Variables and measurements

Sociodemographic variables: Age was collected and transformed into a dichotomous variable with a cut-off point at 44 years (born before 1980), considering the potential influence of the digital divide (11), and sex (male/female).

Work-related variables: Unit, type of employment contract, length of time working in the ICU, work shift, working hours, previous training in ICT, and hospital (Table 2).

Outcome variable: Level of technostress.

Data collection was carried out between December 11, 2024, and January 15, 2025. REDCap (Research Electronic Data Capture), a secure web-based software platform hosted at H.U.12O, was used for data collection. This tool facilitated the effective dissemination of the questionnaire, ensured reliable data collection, and enabled subsequent analysis while preserving data confidentiality.

Table 2: Sociolaboral variables

Service			
General ICU	Polytrauma ICU	Coronary ICU	Burn ICU
Type of contract			
Permanent	Temporary		Interim
Time worked in the ICU			
<1 year	1-5 years	5-10 years	>10 years
Work shift			
Morning/Night	Afternoon/Night	Rotating	Other
Type or working day			
Full time		Part time	
Training on the technologies used in their worplace			
Yes		No	
Hospital			
University Hospital 12 de Octubre	University Hospital of Getafe		H. de Getafe

The self-administered RED-Tecnoestrés questionnaire, validated in Spain, was employed. This instrument has demonstrated high internal consistency, as measured by Cronbach's alpha coefficient (33).

Participants were required to complete all 22 items using a 7-point Likert-type frequency scale ranging from "0" (not at all/never) to "6" (always/every day).

The sum of these items was designed to assess the dimensions of technostress: affective (anxiety and fatigue), attitudinal (skepticism), cognitive (ineffectiveness), and addiction to technology.

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To assess the level of technostress, the scores assigned by each participant to the items corresponding to each dimension were summed and then divided by the number of items in that subscale, yielding a mean score for each dimension.

Each score obtained by the participants was categorized into previously defined intervals described by the authors, to classify technostress levels from lower to higher.

For the diagnosis of technostress, high scores were required in all four dimensions (anxiety, fatigue, ineffectiveness, and skepticism) according to the Technostress Intervention Guide (27). High scores in isolated dimensions were not considered indicative of technostress.

Finally, a high or very high score was considered necessary for the diagnosis of technoaddiction.

Before distributing the questionnaire, a pilot test was conducted with a sample of eight nurses from the Pediatric Intensive Care Unit at H.U.12O to identify and correct potential issues.

Mid-level managers were contacted to explain the purpose of the study and to request their collaboration in disseminating the questionnaire via corporate email.
Finally, in-person visits were conducted to clarify doubts and encourage participation.

Ethical Considerations

Nursing staff accessed the survey through a digital link after providing informed consent. Anonymity and confidentiality of data were ensured in accordance with ethical guidelines and data protection regulations (Organic Law 3/2018).
Data were processed collectively, and only the research team had access to them through a coded system. The study adhered to ethical standards and was approved by the Ethics Committees of the participating hospitals.

- University Hospital of Móstoles: CEI 2024/042
- University Hospital of Getafe: CV 24/69
- University Hospital 12 de Octubre: CEI 24/595

All participants signed informed consent forms in accordance with the principles of the Declaration of Helsinki.

The authors declare no conflict of interest.

Statistical Analysis

A descriptive analysis was carried out for sociodemographic, occupational, and technostress level variables. Quantitative variables were summarized using the median and interquartile range (IQR), as the assumption of normality was not met. Qualitative variables were described using absolute and relative frequencies.

For bivariate analysis, non-parametric tests were applied, considering technostress level (global and by dimension) as the dependent variable, and sociodemographic and occupational characteristics as independent variables. The Chi-square test was used to assess associations between categorical variables, the Mann–Whitney U test for comparisons between two groups, and the Kruskal–Wallis test for comparisons across more than two groups.

A p-value of <0.05 was considered statistically significant. The statistical analysis was conducted using R software, version 4.4.2.

Results

A total of 156 healthcare professionals accessed the questionnaire, of whom 127 completed it in full, representing an overall response rate of 38.6%.bThe age range of participants was between 20 and 61 years, with a mean age of 37.69 ± 10.31 years.

The distribution of respondents by hospital was as follows: University Hospital 12 de Octubre (H.U.12O): 62 participants from a population of 202 professionals (response rate: 30.69%). University Hospital of Getafe (H.U.G): 43 participants from 75 professionals (response rate: 57.33%). University Hospital of Móstoles (H.U.M): 22 participants from 52

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professionals (response rate: 42.31%).bIn relative terms, overall participation by hospital was 48.8% at H.U. 12 de Octubre, 33.9% at H.U. de Getafe, and 17.3% at H.U. de Móstoles.bThe distribution of demographic and occupational characteristics of the participating nursing staff is presented in Table 3.

Table 3: Demographic and Occupational Characteristics of Nursing Staff

		TOTAL	H.U.12O	H.U.G	H.U.M
Number of workers		127	62	43	22
Age		37,69(10,31)	36,40(9,89)	39,00(10,30)	38,73(11,45)
Sex	**Male**	37 (29,1%)	17 (27,4%)	11 (25,6%)	9 (40,9%)
	Female	90 (70,9%)	45 (72,6%)	32 (74,4%)	13 (59,1%)
ICU Unit	**Coronary ICU**	17 (13,4%)	17 (27,4%)	0 (0%)	0 (0%)
	General ICU	78 (61,4%)	28 (45,2%)	28 (65,1%)	22 (100%)
	Polytrauma ICU	17 (13,4%)	17 (27,4%)	0 (0%)	0 (0%)
	Burn ICU	15 (11,8%)	0 (0%)	15 (34,9%)	0 (0%)
Contract Type	**Permanent**	56 (44,1%)	24 (38,7%)	22 (51,2%)	10 (45,5%)
	Temporary	33 (26%)	13 (21%)	13 (30,2%)	7 (31,8%)
	Interim	38 (29,9%)	25 (40,3%)	8 (18,6 %)	5 (22,7%)
Time working In ICU	**<1 year**	17 (13,4%)	7 (11,3%)	6 (14%)	4 (18,2%)
	1-5 years	43 (33,9%)	19 (30,6%)	20 (46,5%)	4 (18,2%)
	5-10 years	31 (24,4%)	18 (29%)	6 (14%)	7 (31,8%)
	>10 years	36 (28,3%)	18 (29%)	11 (25,6%)	7 (31,8%)
Shift Type	**Morning/Night**	64 (50,4%)	32 (51,6%)	24 (55,8%)	8 (36,4%)
	Afternoon/Night	56 (44,1%)	29 (46,8%)	16 (37,2%)	11 (50%)
	Rotating	6 (4,7%)	1 (1,6%)	2(4,7%)	3 (13,6%)
	Other	1 (0,8%)	0 (0%)	1 (2,3%)	0 (0%)
Working Schedule	**Full time**	107 (84,3%)	53 (85,5%)	36 (83,7%)	18 (81,8%)
	Part time	20 (15,7%)	9 (14,5%)	7 (16,3%)	4 (18,2%)
Training in Technologies used	**Sí**	91 (71,7%)	41 (66,1%)	31 (72,1%)	19 (86,4%)
	No	36 (28,3%)	21 (33,9%)	12 (27,9%)	3 (13,6%)

* The numerical results presented in the table refer to absolute and relative frequencies for all variables, except for age, which is expressed as mean and standard deviation.

The results obtained from the analysis of the different dimensions and subscales revealed elevated levels in the affective and cognitive dimensions, as shown in Table 4.

Table 4: Measurements of Technostress Dimensions.

Technostress	Subescales	Me	IQR	Level
Affective Dimension	Anxiety	2,5	1,5-3,25	Alto
	Fatigue	2,25	1-3,25	Alto
Attitudinal Dimension	Escepticismo	2,25	1-3	Medio alto
Cognitive Dimension	Ineficacia	1,75	1-2,5	Alto

*Me: Median; RIC: Interquartile Range

Table 5 provides a more detailed overview, breaking down the percentage distribution of participants by level. Most respondents were classified as having a very high level in the affective dimension.

Table 5: Levels of Technostress Dimensions in the Sample

Level	Anxiety		Fatigue		Skepticism		Ineffectiveness		Adicction	
	n	%	n	%	n	%	n	%	n	%
Very Low	4	3,15	7	5,51	12	9,45	10	7,88	1	0,79
Low	2	1,57	10	7,87	0	0	0	0	14	11,02
Moderately Low	13	10,24	18	14,17	23	18,11	15	11,81	30	23,62
Moderately High	12	9,4	28	22,05	55	43,31	9	7,09	40	31,50
High	47	37,01	31	24,41	25	19,6	52	40,94	30	23,62
Very High	49	38,58	33	25,99	12	9,45	41	32,28	12	9,45

*n: Absolute frequency

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The median technoaddiction score was 3, with an interquartile range of 2 to 3.83, indicating a moderately high level of technoaddiction among the study participants.

A total of 20.47% of the nursing staff surveyed met the criteria for a diagnosis of technostress.

Additionally, 37.79% of participants presented with signs of technoaddiction.

No statistically significant differences were found in overall technostress levels between men and women.

Despite the absence of statistically significant differences in overall technostress levels by gender, significant differences were observed in specific dimensions. Women showed higher levels of technology-related anxiety compared to men. This difference was statistically significant. Similarly, they also reported significantly higher levels of technological fatigue compared to their male counterparts (Table 6).

Table 6: Technostress Dimensions by Gender

Technostress Dimensions	Subescales	Score				Significance Value
		Men		Women		
		Me	IQR	Me	IQR	(Mann- Whitney U)
Affective Dimension	Anxiety	1,75	1-3	2,75	1,5-3,69	p= 0,032
	Fatigue	1,5	1-2,5	2,5	1,06 – 3,69	p=0,018
Attitudinal Dimension	Skepticism	2	1-2,75	2,25	1-3,19	p=0,263
Cognitive Dimension	Ineffectiveness	1,75	0,5-2,25	2	1,25 -2,75	p= 0,053

No statistically significant difference was found in technoaddiction between men and women (p = 0.375).

When analyzing the relationship between age groups and technostress, a significant correlation was identified (Table 7).

Table 7: Distribution of Technostress According to Age Group

Age Group/ Technostress	YES		NO		Significance Value (Chi-square)
	n	%	n	%	
<44	12	46,2	76	75,2	p=0,009
>=44	14	53,8	25	24,8	

Participants over 44 years of age showed higher levels of anxiety, as well as a negative attitude toward the use of technology (skepticism) and negative thoughts about their ability to manage ICT (ineffectiveness) (Table 8).

Table 8: Technostress Dimensions by Age Group

Technostress Dimensions	Subscales	Score				Significance Value (Mann- Whitney U)
		<44		>=44		
		Me	IQR	Me	IQR	
Affective Dimension	Anxiety	2	1,25-3	3	2,12 -3,88	p=0,007
	Fatigue	2	1 -3	2,5	1,5-3,38	p=0,202
Attitudinal Dimension	Skepticism	2	1-2,75	2,75	1,62 -3,75	p=0,028
Cognitive Dimension	Ineffectiveness	1,50	0,94-2,5	2,25	1,62-2,88	p=0,008

In contrast, participants under 44 years of age showed significantly higher levels of technoaddiction ($p = 0.05$).

Years of experience in the ICU did not significantly affect workers' susceptibility to technostress ($p = 0.131$). However, lower ICU experience was associated with higher levels of technoaddiction ($p = 0.016$).

No statistically significant associations were found between technostress and work shift ($p = 0.211$), contract type ($p = 0.161$), or working hours (full-time/part-time) ($p = 0.720$).

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Although prior training did not influence the overall presence of technostress (p = 0.361), it was associated with lower fatigue and greater perceived task confidence (i.e., lower levels of perceived ineffectiveness), as will be shown in Table 9.

Table 9. Technostress Dimensions Based on Prior Training.

Technostress Dimensions	Subscales	Yes		No		Significance Value
		Me	IQR	Me	IQR	Mann - Whitney U
Affective Dimension	Anxiety	2	1,25-3,12	2,75	1,94-3,56	p=0,125
	Fatigue	1,75	1-2,75	3	1,62-4	p=0,004
Attitudinal Dimension	Skepticism	2,25	1-3	2,12	1,25-2,81	p=0,836
Cognitive Dimension	Ineffectiveness	1,75	0,75 -2,5	2,25	1,5-2,75	p=0,017

No significant differences in technostress levels were observed between the participating hospitals.

The responses obtained from each item of the questionnaire are shown in Table 10.

This table highlights the items with the most extreme scores:

Most workers expressed a positive perception regarding the usefulness of ICT in the workplace (Item 4) and did not report significant exhaustion after using them (Item 7).

Workers, with a median score indicating "almost never," perceived that their colleagues considered them effective in handling technologies at their workplaces (Item 15).

The use of ICT outside the workplace by nursing staff was reported to be quite frequent (Item 18).

Moreover, it was common for workers to continue thinking about emails or using the internet after their workday had ended (Item 19).

Discussion

The results obtained in this study provide insight into this psychosocial phenomenon in a highly technologized and understudied environment, highlighting the importance of addressing the psychosocial impact of ICTs.

Several studies conducted in healthcare settings have evaluated technostress in different professional profiles, agreeing that levels usually range from moderate to high (1, 10, 21, 34-36, 39). However, most of them do not specify quantitative data that allow for direct comparison. A notable exception is the study by Keshavarz et al. (40), which revealed that approximately 41% of healthcare personnel experienced moderate levels of technostress, 36% high levels, and 23% low levels. These findings support the growing relevance of this phenomenon, especially in highly technologized services such as Intensive Care Units (ICUs).

Currently, there are no studies that specifically analyze techno-addiction in ICU nursing staff or in other healthcare groups, which limits the ability to make direct comparisons with our research.

It is noteworthy that technostress not only affects practicing staff but has also been identified in nursing students. A study conducted during the COVID-19 pandemic showed a high prevalence of technostress in this group: 86.4% had a medium-high level of technostress and 63.57% of techno-addiction. However, no statistically significant relationship was found with academic performance (Huanacuni Llanque, 2021). These results reflect early exposure to stressful technological factors, which could predispose to higher risk in professional stages if appropriate training and coping strategies are not implemented (41).

Although technostress is present in multiple occupational sectors, in the healthcare setting, it appears more intensely and with specific characteristics due to the high emotional burden and the responsibility inherent to clinically technology-mediated decisions. For example, a study conducted in the university teaching sector in Argentina showed very low values in both the affective dimension and the perception of inefficacy (37). In contrast, in our study, the affective dimension was the most affected, with a very high level, and

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inefficacy reached high levels. This difference could be explained by the very nature of work in ICUs, where the use of technology is associated with high-responsibility clinical decisions, increasing emotional and cognitive load.

When comparing our results with those obtained in administrative professionals, anxiety related to the use of technology is considerably higher in ICUs (median of 2.5 vs. 0.54). At the same time, fatigue is greater in the office setting (4.39 vs. 2.25) (29). This difference could indicate that, in critical hospital contexts, the use of technology generates greater emotional and physiological activation, linked to the immediacy and responsibility of clinical decisions. In contrast, in administrative environments, continuous, repetitive, and prolonged exposure to ICTs may be more related to cumulative wear and tear, mainly manifesting as fatigue.

In the healthcare sector, professionals working in acute care units have been found to exhibit higher levels of technostress compared to other hospital areas (34). Furthermore, performing a medical or nursing role has been associated with greater vulnerability to technostress (35). Along these lines, technostress has been identified as a relevant factor in the development of burnout among medical professionals (14).

Similarly, Kraft et al. (10) demonstrated a strong association between the perception of digital stress and emotional exhaustion among nurses in German hospitals, highlighting its negative impact on job satisfaction, performance, and productivity.

The analysis by dimensions according to gender showed that women presented significantly higher levels in the affective dimension of technostress, especially regarding anxiety, compared to men. This result is consistent with previous research indicating a greater predisposition of women to experience anxiety related to the use of technology in the workplace (3, 22, 27).

However, scientific literature reflects heterogeneous results. For example, Ragu-Nathan et al. (38), in their study with U.S. workers using ICTs in their professional environment, observed higher levels of technostress in men. These discrepancies highlight the complexity of the phenomenon and suggest that contextual, cultural, or methodological variables could significantly influence the results obtained in different populations.

Our study's findings are consistent with those of Llorens et al. (27), who identified a proportional relationship between age and the level of technostress. This association could be explained by the later incorporation of some professionals into the digital environment, making it more difficult for them to adapt to information and communication technologies (11).

However, this relationship is not conclusive. Kaihlanen et al. (12) observed that nurses with extensive professional experience reported similar levels of distress as newly graduated nurses, suggesting that chronological age alone does not determine technological adaptability and that other factors, such as training, work environment, or individual attitude, may play a relevant role.

In the case of younger generations, Díaz Sarmiento et al. (11) indicate that digital natives, having grown up in a highly technologized environment, show a greater tendency to develop technology dependency behaviors, consistent with the patterns observed in our study.

The relationship between professional experience and technostress should be analyzed with caution, as less time in the ICU does not necessarily imply a younger age. Some professionals, despite being older, have recently joined these units due to organizational reasons. This complexity makes it difficult to establish direct associations between experience, age, and ICT adaptation, suggesting that other factors, such as digital competencies or individual coping styles, may be more relevant than accumulated experience about technostress.

The fact that variables such as work shifts, contract type, or working hours were not significantly associated with technostress levels in this study suggests that this phenomenon may be more related to individual factors than to contractual or organizational work conditions. No previous studies specifically analyzing these variables about technostress in healthcare settings were found, limiting comparison and highlighting the need for further research in this area.

The relationship between training and technostress seems to depend not only on whether it is provided, but also on its quality, approach, and suitability to clinical needs. It

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has been noted that for nursing professionals, using technological tools without adequate training can lead to additional stress, reinforcing the importance of offering specific and well-structured training (42).

The literature agrees that well-designed training can foster technological adaptation, reduce stress, and increase the perception of competence (2, 16, 22). However, these benefits do not always translate into a global reduction of technostress if training does not include practical and emotional aspects.

In this regard, our study results could be influenced by variability in the training offerings between hospitals. Although training is offered, it may not be specifically adapted to the ICU staff profile. Low participation, lack of follow-up, and the use of unattractive or outdated methodologies could limit its real effectiveness and explain the lack of association with overall technostress.

The results of this study reveal notable homogeneity in technostress levels among the three hospitals analyzed. This uniformity suggests that the phenomenon is not necessarily conditioned by the organizational or technological particularities of each center but could respond to common factors in the intensive healthcare environment, such as high technological dependency, care demands, or institutional digital culture.

Despite these structural differences between centers, the professionals surveyed generally expressed a positive perception of the use of ICTs in their daily work. This could be explained by the functional benefits that technologies offer in clinical settings, such as process optimization, improved team communication, and quick access to clinical information (38).

However, frequent use of ICTs outside working hours was also evident, highlighting the need to set limits that promote digital disconnection. This regulation should not depend solely on individual responsibility but requires institutional support through policies that promote healthier and more sustainable use of technology in healthcare settings (6,7).

Overall, these findings reinforce the need to continue deepening the study of technostress and to design preventive strategies that consider both individual and organizational factors.

Limitations of the study

- As a cross-sectional study, it does not allow for the establishment of causal relationships, which limits the ability to affirm that certain factors are the cause of technostress.
- The study may present selection bias, as the response rate was 38.6%. This could limit the external validity of the results, since the professionals who participated may not adequately represent the entire target population.
- There is a possibility of response bias due to the subjective nature of the variables evaluated. This depends on participants' self-perception, which may lead to overestimation or underestimation of their level of technostress.

Future Lines of Research

- Analyze how technostress affects the quality of care in ICUs, given that its relationship with occupational burnout could negatively impact professional performance and patient safety.
- Explore whether personality plays a determining role in technostress.
- Study the effectiveness of specific interventions, such as training programs tailored to the needs of ICU staff, as this study showed that training was associated with lower fatigue and greater confidence in the use of ICT.
- Investigate whether organizational factors, such as workplace culture or team dynamics, influence the perception of technostress and the ability to adapt to technology.

Conclusions

- 20.47% of the participants met the criteria to be considered technostressed, while 37.79% showed signs of technoaddiction, highlighting the significant presence of this phenomenon in the ICUs studied.
- No statistically significant differences were found in overall technostress levels between men and women. However, women reported higher levels of anxiety and

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technological fatigue.

- Workers over the age of 44 showed higher levels of anxiety, skepticism, and perceived inefficacy in the use of ICTs, while those under 44 were more prone to technoaddiction.
- Length of service in the ICU did not significantly influence susceptibility to technostress. Nevertheless, lower experience was associated with higher levels of technoaddiction.
- Work shift was not found to influence the development of technostress, contradicting some theoretical expectations about the impact of work patterns on technology-related stress.
- No significant association was found between the type of work schedule and the presence of technostress.
- Although previous training was not directly associated with the presence of technostress, it was linked to lower fatigue and a greater sense of security in tasks involving ICTs, underlining the importance of staff training.
- No significant differences in technostress levels were detected among the three hospitals studied, suggesting a homogeneous experience of the phenomenon despite the specific characteristics of each institution.

Conflict of interest

The authors declare that there is no conflict of interest.

Founding

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