

Evaluate Nurses' Environmental Consciousness as Leaders in Environmentally Sustainable Healthcare

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ABSTRACT

Background:

Climate change poses significant threats to human health and the quality of healthcare services, necessitating environmentally sustainable practices within healthcare systems. Nurses, often frontline healthcare workers, play a pivotal role in leading sustainability initiatives through programs such as Green Teams. Despite positive attitudes toward sustainability, many nurses lack sufficient knowledge and practical engagement in sustainable practices. This study examines nurses' environmental awareness, behaviors, and leadership roles in promoting ecologically sustainable healthcare.

Methods:

A sequential mixed-methods design was employed, comprising a cross-sectional survey using the Nurse's Environmental Awareness Tool (NEAT) and qualitative interviews with nurses involved in sustainability initiatives. Quantitative data were analyzed using descriptive and inferential statistics, while qualitative data were thematically analyzed. Participants included 314 nurses from public and private healthcare institutions, with additional interviews conducted with Green Team leaders and environmental coordinators.

Results:

The survey revealed moderate environmental awareness among nurses, with higher engagement in sustainable behaviors outside the workplace (PEB subscale) compared

to workplace behaviors (NPEB subscale). Factors such as age, work experience, and job role significantly influenced environmental behaviors. Nurses frequently cited challenges, including limited knowledge, skills, and institutional support for implementing sustainable practices at work. The qualitative findings emphasized the role of Green Teams in fostering awareness and addressing barriers, but also highlighted gaps in leadership, education, and practical guidance for sustainable practices.

Conclusion:

Nurses are essential to advancing sustainability in healthcare, yet significant barriers hinder their ability to implement sustainable practices in clinical settings. Enhancing nursing education, leadership, and institutional support for Green Teams can bridge these gaps. This study underscores the need for targeted interventions to empower nurses as leaders in ecologically sustainable healthcare systems.

Introduction

The impact of climate change on human society is a critical global concern, manifesting through issues such as microplastics, resource shortages, air pollution, droughts, and extreme weather events. These consequences directly and indirectly affect human health, leading to an increase in diseases and a decline in the quality of healthcare (1, 2). In response, various measures have been implemented globally to reduce environmental impacts and minimize ecological footprints (3). These initiatives are often framed as environmental regulations aligned with the Sustainable Development Goals (SDGs) (4–8).

The SDGs have been integrated into policies across multiple sectors, including healthcare, to foster a more sustainable transition. Strategic plans have been developed to mitigate climate change effects, focusing on enhancing the connection between health and the environment through innovative approaches. These strategies often involve evaluating the impact of healthcare activities using a set of environmental indicators (9–12).

One such focus is on the resources and support needed to implement sustainable practices, particularly for nurses, who are directly affected by environmental factors in their work (13, 14). Healthcare providers, including nurses, are integral to efforts aimed at reducing carbon footprints, building resilience to climate challenges, and taking on leadership roles in promoting sustainable healthcare practices (13–16). Education, training, and incentives are crucial for fostering sustainable behavior among healthcare workers, especially nurses (17, 18). Despite having positive attitudes toward sustainability, many nurses have limited knowledge and behavior in this area (19).

This gap contrasts with the role of nurses in leading initiatives like the “Green Team,” a concept introduced over a decade ago. Green Teams are interdisciplinary committees focused on implementing sustainability projects to reduce the environmental impact of healthcare operations. Members from various departments collaborate to identify opportunities, raise awareness, and encourage staff involvement in sustainability efforts (20, 21). Nurses, often leading these teams, play a crucial role in raising

awareness about the healthcare industry's environmental impact and developing strategies to address these challenges.

Green Teams, typically led by nursing professionals, are instrumental in driving sustainable change within healthcare systems (22). Nursing leaders on these teams guide efforts to implement sustainable practices, providing education, resources, and support to other healthcare professionals (23). These actions enhance nurses' knowledge, attitudes, and behaviors regarding sustainability and facilitate the promotion of environmentally friendly practices in healthcare settings (24–26). Understanding the barriers faced by nurses in adopting sustainable practices is essential to addressing these challenges effectively (24–26).

Measuring and identifying nurses' environmental awareness is critical to fostering sustainable hospitals (27, 28). Multidimensional indicators have been proposed to assess environmental awareness, often under the leadership of nurses in Green Teams (16). Nurses play a vital role in promoting sustainability within healthcare organizations, as highlighted by several studies focusing on nursing competencies and leadership in environmental sustainability (29, 30). Research has emphasized the importance of nursing leadership in fostering sustainable healthcare practices, especially during crises such as the COVID-19 pandemic (31, 32).

Effective leadership in Green Teams and healthcare organizations is vital for ensuring quality control and sustainable development (33). As environmental leaders, nurses contribute significantly to reducing hazardous waste and raising awareness about environmental issues in healthcare settings (34, 35).

Although nurses demonstrate some level of awareness and knowledge of sustainability, it is essential to evaluate their environmental competencies and identify areas for improvement within clinical management units (20, 33, 36). Education and training programs play a key role in promoting sustainable behavior among nurses, but addressing the barriers to implementing these practices is equally important (37). Therefore, this study aims to assess the environmental awareness and behaviors of nurses, particularly those in leadership roles, as members of Green Teams. The findings will help identify areas for improvement and inform strategies for creating a more sustainable healthcare environment.

Methods

This study examine nurses' environmental awareness and behaviors. The study was conducted in two phases. The first phase involved a cross-sectional, descriptive exploratory analysis using the Nurse's Environmental Awareness Tool (NEAT), which consisted of three subscales: the Nursing Awareness Scale (NAS), Environmental Behaviors Outside the Workplace (PEB), and Sustainable Behaviors in the Workplace (NPEB). The second phase incorporated qualitative interviews with nurses who had specific responsibilities related to environmental sustainability, supplemented by direct observations.

Participants

Participants were recruited from nursing staff in both public and private institutions affiliated with the national healthcare system. The sample included nurses who

completed the survey and met specific inclusion criteria. The target population consisted of nursing staff, auxiliary technicians, and students with relevant qualifications, as these individuals are closely involved in environmental management within healthcare facilities.

The study used a random sampling method to select a representative sample of nurses. The sample size was calculated to ensure a 95% confidence level and a $\pm 2\%$ margin of error, accommodating approximately 90% of the target population. Other healthcare and non-healthcare personnel were excluded.

In addition, environmental coordinators, often nursing supervisors, and Green Team members were invited to participate in interviews and observational activities. These interviews were conducted after sustainability-focused sessions, talks, or training events in clinical management units.

Data Collection

Data were collected over a defined period using an intentional sampling approach. Quantitative data were gathered through the NEAT survey, while qualitative data were obtained via interviews, participant observations, and field notes. The survey data focused on environmental awareness and behaviors among nurses, while the qualitative data explored themes such as leadership, barriers to sustainable practices, and areas for improvement.

Interviews included nursing leaders, registered nurses, and nursing students, with sample sizes refined until data saturation was reached. Before conducting the interviews, a pilot study was performed with a multidisciplinary team to test the interview questions. Observations took place during nurses' daily work routines, with the researcher acting as a non-intrusive observer.

The interviews, lasting between 20 minutes and an hour, were recorded, and observations were documented using field notebooks and mobile applications. The study focused on nursing supervisors responsible for promoting environmental awareness and registered nurses actively involved in Green Teams.

Data Analysis

Quantitative data were analyzed using descriptive statistics, including mean, standard deviation (SD), confidence intervals (CIs), and relative frequencies. Normalization tests, such as the Kolmogorov-Smirnov test with Lilliefors correction, were applied to evaluate the distribution of continuous variables. Comparisons between means were conducted using Student's t-test or analysis of variance, while the X^2 test with Yates' correction was used for categorical data. Correlations between variables were assessed using Pearson's correlation coefficients, and multiple linear regression was employed to study associations with the NPEB.

The qualitative data analysis followed a reflective ethnographic approach, supported by participant observation and triangulation among researchers. Transcripts were created from interview recordings, and field notes were incorporated to identify

themes and patterns. Key themes included Green Teams, sustainable practices, environmental awareness, leadership challenges, and areas for improvement.

Software tools such as SPSS and EPIDAT were used for statistical analysis, while ATLAS.ti and office applications supported the qualitative analysis, including keyword visualization based on the identified themes.

Results

The study included 314 nursing staff, primarily nurses, aged between 19 and 68 years, with an average age of 37.02 years (± 12.7 , 95% CI: 35.6–38.4). Women accounted for 76.4% of the participants, with over 20 years of work experience reported by 35.1%. The majority were registered nurses (70.4%), with 36% employed at local or regional hospitals, and 85.3% working for public institutions.

Regarding environmental awareness, the participants scored higher on the PEB subscale (31.83 ± 8.02 , CI 95%: 30.94–32.72 for frequency; 32.36 ± 7.15 , CI 95%: 31.57–33.15 for difficulty) compared to the NAS (26.13 ± 9.91 , CI 95%: 25.03–27.23 for knowledge; 47.39 ± 5.97 , CI 95%: 46.73–48.05 for impact) and NPEB subscales (23.82 ± 6.45 , CI 95%: 23.10–24.53 for frequency; 25.71 ± 6.31 , CI 95%: 25.01–26.41 for difficulty). These results suggested limited environmental knowledge (55.7%) but a high level of awareness of their potential environmental impact (70.4%). Nurses reported engaging more frequently in sustainable practices at home (57.3%) than at work, as domestic tasks were easier to implement (63.1%). Similarly, while recycling was perceived as relatively easy (57.6%), nurses reported performing such activities less often than desired (52.2%).

Key sociodemographic variables, including gender, work experience (median 10 years), job position, and region, significantly influenced the NEAT subscales. These variables affected environmental knowledge ($p < 0.01$), behaviors outside the workplace ($p < 0.01$), and workplace behaviors ($p < 0.01$).

The NPEB subscale revealed the lowest scores, reflecting poor engagement in workplace environmental activities. Specifically, 52.23% of nurses rarely performed sustainable activities at work, and 35.03% reported finding such tasks challenging. NPEB scores related to environmental behaviors were positively correlated with age ($r = 0.412$; $p < 0.001$), NAS knowledge ($r = 0.526$; $p < 0.001$), PEB frequency ($r = 0.57$; $p < 0.001$), PEB difficulty ($r = 0.329$; $p < 0.001$), and challenges in performing these behaviors ($r = 0.499$; $p < 0.001$). Similarly, the difficulty of engaging in adequate environmental behaviors was positively associated with age ($r = 0.149$; $p = 0.008$), NAS knowledge ($r = 0.249$; $p < 0.001$), PEB frequency ($r = 0.244$; $p < 0.001$), and PEB difficulty ($r = 0.442$; $p < 0.001$).

Using linear multiple regression, the initial model (square sum = 488.655; $p < 0.0001$) indicated that age, NAS impact, and PEB frequency outside the workplace were not significant predictors of workplace environmental behavior (NPEB) in terms of either frequency or difficulty ($p > 0.05$). However, the adjusted model revealed that NPEB was significantly influenced by PEB frequency and NAS knowledge ($p < 0.01$).

The findings highlight barriers to sustainable practices in the workplace, emphasizing the need to address challenges and improve environmental behaviors among nurses, particularly through targeted interventions and support mechanisms.

The qualitative study involved 10 participants, including nine women and one man, with a median age of 49 years and an interquartile range of 35–60. Participants had 20–30 years of work experience and primarily worked morning shifts (7 out of 10). Among them, nurses and nursing supervisors (5 out of 10) demonstrated higher levels of education (details in Supplementary File 2). The analysis identified several themes, including the relationship between nursing responsibilities and Green Teams (i), the promotion of sustainable environmental behaviors (ii), enhanced environmental awareness (iii), the role of leadership in sustainability (iv), barriers and limitations (v), and opportunities for improvement (vi).

(i) Nursing Responsibilities and Green Teams

Green Teams were recognized as essential committees comprising environmental leader nurses and other staff members. These teams aimed to increase hospital staff's knowledge and awareness of sustainability practices through meetings and training sessions. They also played a role in evaluating behaviors and knowledge. Nursing leaders emphasized the importance of proper waste disposal practices, as reflected in one nurse leader's question about specific bins for medical waste. These teams ensured staff adherence to best practices in sustainability, thereby contributing significantly to the hospital's environmental efforts.

(ii) Promotion of Sustainable Environmental Behaviors

The study highlighted resistance among nurses in clinical management units, often due to knowledge, skill, and attitude gaps. Participants noted challenges such as age differences, lack of awareness, and difficulty applying the principles of reduce, reuse, and recycle (the three Rs). Comments revealed uncertainty and limited understanding of sustainable initiatives, such as light packaging or waste separation, underscoring the need for practical guidance to overcome these barriers.

(iii) Environmental Awareness and Training

Nursing responsibilities fostered environmental awareness through training sessions and courses on sustainability. Participants acknowledged the importance of supplementing formal education with practical environmental practices. For instance, separating waste and considering water conservation were highlighted. Some participants also expressed concern about environmental issues like drought and emphasized the need for continuous education and integration of sustainability into healthcare practices.

(iv) Leadership in Sustainability

Leadership within Green Teams emerged as a critical factor in promoting environmental awareness and sustainability. Participants stressed the need for a supportive work environment where nurses could seek clarification without fear of criticism. Leadership's role included guiding nurses on incorporating sustainable

practices, such as including environmental recommendations in patient discharge reports. Feedback mechanisms and collaborative efforts were highlighted as pivotal for fostering a sustainable culture.

(v) Barriers and Limitations

Participants identified several barriers to environmental practices, including limited time, inadequate facilities (e.g., bins), and staff shortages. The COVID-19 pandemic exacerbated these challenges by increasing medical waste. Despite these difficulties, the pandemic also heightened awareness of sustainability issues. Comments highlighted the lack of resources, such as insufficient bins for COVID waste, and the struggle to balance patient care with sustainability efforts.

(vi) Opportunities for Improvement

Nurses noted they performed better in recycling at home than at work, pointing to a gap in translating knowledge into practical hospital actions. Time constraints and workload were major obstacles, limiting the integration of sustainability into daily routines. Participants expressed a desire to improve practices, such as including environmental considerations in documentation, but required additional support and guidance. Addressing these challenges and streamlining processes could enhance nurses' contributions to environmental sustainability.

By tackling these barriers and enhancing education, training, and leadership support, healthcare facilities can strengthen their commitment to environmental stewardship and create a more sustainable workplace.

Table 1. Sociodemographic characteristics of the sample

	Frequencies	
	N	%
Gender		
Female	240	76.4
Male	74	23.6
Nonbinary	0	0
Working experience		
More than 20 years	111	35.4
Between 11 and 20 years	56	17.8
Between 10 and 5 years	43	13.7
Less than 5 years	104	33.1
Position held		
Nursing Assistant	18	5.7
Student Nursing Assistant	1	0.3
Undergraduate Nurse	62	19.7
Registered Nurse	221	70.4
Student Nursing Specialist	12	3.9
Institution		
Local Hospital	113	36.0
Local Primary Health Care	56	17.8

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Regional Hospital	110	35
Regional Primary Health Care	12	3.8
Sociosanitary Institution (i.e., nursing home)	12	3.8
Other	11	3.6
Character		
Public	268	85.3
Private	20	6.4
Collaboration between public and private entities	26	8.3
Shift		
Only mornings	157	50.0
Only afternoons	14	4.5
Only nights	10	3.2
Rotating shift (switching among other shifts)	131	41.7
Other	2	0.6

Table 2. Differences between nurses' environmental behavior and knowledge

	Differences pertaining to environmental awareness (NAS)		Differences pertaining to environmental behavior outside the workplace (PEB)		Differences pertaining to environmental behavior in the workplace (NPEB)	
	Known ge	Impac t	Frequenc y	Difficult y	Frequenc y	Difficult y
Gender	0.158	0.004	0.278	0.774	0.031	0.867
Working experience	< 0.001	0.543	< 0.001	0.001	0.001	0.778
Position held	0.007	0.710	0.064	0.087	0.002	0.507
Institution	0.002	0.476	0.512	0.702	0.011	0.162
Character of the institution	0.272	0.557	0.488	0.903	0.485	0.949
Shift	0.218	0.914	0.121	0.237	0.839	0.277
Regions featuring nursing leaders	0.003	0.910	0.055	0.151	0.243	0.216

Discussion

This study underscores the critical role of nurses in promoting environmentally sustainable behaviors, both as members of Green Teams and as key leaders in their professional environments. The findings reveal that nurses generally demonstrate acceptable knowledge, attitudes, and behaviors concerning environmental sustainability in both their personal and professional lives. The qualitative analysis further reveals that these behaviors stem from nursing responsibilities, Green Team initiatives, and leadership efforts to identify obstacles and opportunities for improvement. The results emphasize that sustainable nursing behaviors within the workplace are strongly influenced by sustainable behaviors practiced outside of work. Barriers such as the COVID-19 pandemic and time limitations were identified as significant challenges in promoting sustainable practices. Importantly, while nurses' levels of knowledge are deemed acceptable, their attitudes, although not perfect, are showing positive progress.

Previous studies examining nurses' awareness of environmental sustainability have similarly reported moderate awareness levels and significant concern regarding the health impacts of climate change (37, 42, 43), findings that align with the NEAT-es results. Interestingly, participants were more consistent in practicing environmentally sustainable behaviors in their personal lives compared to professional settings, a trend consistent with earlier research involving registered nurses and nursing students (36, 41, 42). For example, research conducted in Sweden suggests that nurses are generally aware of environmental issues but may lack understanding of the healthcare sector's environmental impact (43). Similarly, Polivka Barbara J. et al. (2012) highlighted a disparity between nurses' sustainability knowledge and their workplace behaviors, emphasizing the need for targeted education and training to foster sustainable practices (44). A study in Taiwan also revealed that while nursing students exhibit positive attitudes toward sustainability, their knowledge and behaviors require improvement (45).

Through qualitative analysis, this research identified key barriers to sustainable practices among nurses, including time constraints, the COVID-19 pandemic, inadequate access to waste disposal facilities, and staffing shortages. These challenges are consistent with findings from other studies that reported limitations in resources, time, and support as ongoing obstacles to the adoption of sustainable workplace practices (29). Addressing these barriers through tailored interventions is critical to promoting sustainable behavior among nurses, a recommendation supported by this and similar research. These findings further underscore the importance of understanding nurses' perspectives on environmental sustainability in healthcare settings and the necessity for targeted support and resources (46). Leadership, including the role of Green Teams and environmental nursing leaders, was highlighted as essential in overcoming these challenges and fostering a greener healthcare system, aligning with previous recommendations for creating sustainable healthcare environments (21, 31). However, global qualitative studies have shown variation in nurses' views on environmental issues depending on the country. For instance, nurses in Sweden exhibited pro-sustainability attitudes even before the implementation of the 2030 Sustainable Development Goals (16). Integrating sustainability education into

nursing programs could better equip future nurses to address the challenges of climate change and promote sustainable healthcare outcomes (49).

Conclusion

In summary, while nurses demonstrate acceptable levels of knowledge, attitudes, and behaviors regarding environmental sustainability, a notable gap exists in the frequency of sustainable actions within professional settings. This underscores the need for greater alignment between nurses' personal and professional sustainability practices.

The qualitative analysis revealed significant barriers to adopting sustainable practices, including time constraints, disruptions from the COVID-19 pandemic, waste disposal challenges, and staffing issues. These findings align with previous research, highlighting persistent obstacles such as limited resources, time, and support. Addressing these challenges through targeted interventions is critical to fostering sustainable behavior among nurses. Both current research and qualitative insights emphasize the pivotal role of nursing leaders and Green Teams in overcoming these barriers and promoting sustainability within healthcare environments. Environmental nursing leaders, in particular, play a crucial role in cultivating a more environmentally conscious healthcare system, aligning with recommendations for greener healthcare practices.

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